Integrating Enterprise Risk Management (ERM) with Knowledge Management (KM) through HSE UTP Lessons Learned System

by

Nurul Izzah Binti Samin

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

SEPTEMBER 2012

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

**Integrating Enterprise Risk Management (ERM) with Knowledge Management
(KM) through HSE UTP Lessons Learned System**

by

Nurul Izzah Binti Samin

A project dissertation submitted to the

Business Information System Programme

Universiti Teknologi PETRONAS

in partial fulfilment of the requirement for the

BACHELOR OF TECHNOLOGY (Hons)

(BUSINESS INFORMATION SYSTEM)

Approved by,

…………………….

(Mr Khairul Shafee Kalid)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

SEPTEMBER 2012

CERTIFICATION OF ORIGINALITY

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

_____

NURUL IZZAH BINTI SAMIN

ABSTRACT

The complexity of the enterprise risk management is identifying and coordinating risk processes actions across organization. Moreover, risk failures is not being widely disseminated in order to improve practices and tighten policies. The merging of the two disciplines of Knowledge Management (KM) and Enterprise Risk Management (ERM) is foreseen to bring greater value in evaluating and assessing risk. Health Safety and Environment Lessons Learned System (HSELLS) is a project that aims to develop an online, document management application in communicating the risk throughout organization. This paper seeks to contribute to the emergence of research on Enterprise Risk Management by applying KM tool to support risk monitoring and review process. The paper will demonstrates the use of Lessons Learned System as part of KM technology via a case study of HSE UTP, to reduce time, improve decision making, and increase productivity and reliability. A system development life cycle is used to develop HSELLS. At the end of the project, a working prototype is developed to create a platform for user to share and disseminate risk throughout the organization.

Keywords: Knowledge Management, Enterprise Risk Management, Monitoring and Review Process, Lessons Learned System, Health Safety and Environment, Health Safety and Environment Lessons Learned System

ACKNOWLEDGEMENT

First and foremost, I would like to express my greatest gratitude to the Almighty, Allah s.w.t for bestowing upon me endurance and persistence to complete this Final Year Project. Alhamdulillah, praise be to Allah S.W.T, the most gracious and most merciful for giving me the strength and wisdom throughout the entire process.

Secondly, I would like to say thank you to my Final Year Project (FYP) supervisor, Mr Khairul Shafee Kalid for the support by accepting my proposed topic and also for giving me the motivation and guideline throughout completion of my final year project. Thank you for all the feedbacks given in ensuring the success of this project. Your kindness, constructive feedback and guidance are only God who can repay.

Special thanks to Mr Suhaidi Mustafa, manager for Health Safety and Environment (HSE) UTP for willingly to spend some time in providing feedback and information needed to develop this project. Last but not least, I would like to thank my family and friends for their supports and understandings. Endless thanks to my close friends, Hafsah Syakirah and Fatin Ghazi who has help me through thick and thin and those who have helped me out directly and indirectly until this project reached its end.

May all good deeds be repaid handsomely by Allah SWT and thank you very much.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Enterprise risk management (ERM) is a process, evolving various people including board of directors, management and other staff, which deals with uncertainty, associated risk and opportunity (COSO, 2004). ERM should be applied across the enterprise, with the purpose to identify potential events that may adversely affect the entity. ERM involve planning or day-to-day decision-making and considered as part of an organization's culture. Through ERM, uncertainty, associated risk and opportunity are effectively handled thus enhancing the capability to build value. Nevertheless, inappropriate or ineffective Risk Management ultimately can prevent value creation especially when we manage risk separately from knowledge management.

Previous researchers are trying to connect KM theory into ERM, but fail to establish which part of KM technology can solve the issue of lack of integration, communication and no dissemination of risk. Organizations have come to realize the importance of managing all risks and their interaction, especially on integrating Knowledge Management (KM) with ERM. The contribution of this paper is to address the problem and mainly focusing on risk monitoring process.

Risk management itself is frequently not a problem of lack of information, but rather lack of knowledge with which interprets its meaning. This project will use KM technology of Lessons Learned System to address the issue of inefficient way in handling in ERM while focusing on risk monitoring and review processes. By adding

knowledge management techniques and principles in this project, the expected outcome from the proposed system is to achieve an effective monitoring and review process of ERM, while ensuring all lessons learned document are properly communicated and disseminated throughout the organization.

Besides, this project is intended to establish relationship on how KM processes of creation, storage retrieval, transfer and application can be used in managing risk associated to HSE department in UTP. The similarities and connection between both frameworks is illustrated in Figure 1 where both process will align people, processes and technology for better performance.
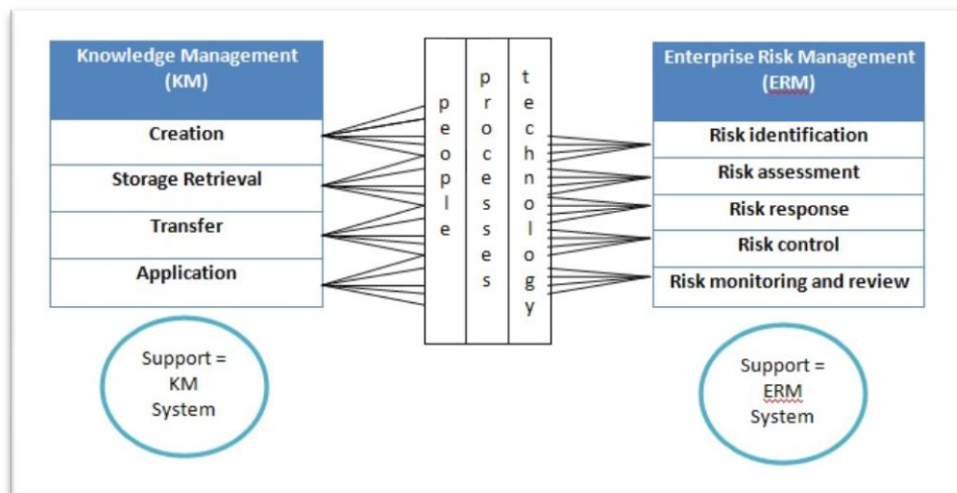
FIGURE 1: Similarities between KM process and ERM process. Adapted from "Before and After Modelling: Risk Knowledge Management is required" by Rodriguez E, John S. Edwards, 2008

By doing a case study in HSE UTP department, this project is intended to solve the problem of difficulty in sharing the risk that is currently adopted by the Health Safety and Environment (HSE) Department in UTP. As for now, all lessons learned captured by HSE department were disseminated through email and all lessons learned document were kept in a form of hard copy. The project is about development of KM technology called Lessons Learned System that allowed sharing and reusing knowledge gained through experience. This system will also allow the users to add, and update the document of lessons learned and store it in the lessons

learned repository. The expected impact from the finished system is all lessons learned should be reused and understood on which task they apply, and this should be integrated in organization's decision-making process. In addition, the system was intended to improve risk monitoring and review process by having an up-to-date system where all lessons learned stored should be validate and updated from time to time.

1.2   Problem Statement

Enterprise risk management (ERM) plays a crucial business role in enabling management to effectively deal with uncertainty and associated risk and opportunity (COSO, 2004). In the long run, a successful implementation of ERM is able to provide an optimal balance between growth and return associated with related risks. When risks is treated independently without knowledge, the problem arise when risk are not properly communicated thus causing information about risk failures is not being disseminated throughout the organisation. Risk failures then were let reside in the repository without the awareness of the staff to communicate the risk and prevent the same mistakes. As a result, this will certainly prevent value creation of ERM when all lessons learned document has not being implemented in decision making process and people will not learn from the mistakes.

Besides, there were no platform for the risk analyst to share, and disseminate risk which in turn, all lessons learned gained has not been reused for decisions making process. This will cause the same type of risk to occur again in the future. In HSE UTP itself, all lessons learned document were kept in hard copy, thus causing difficulties in sharing the document to others in the organization. Having realized a need for this, this research intends to come up with a lessons learned system that allow user and HSE personnel in retrieving database, uploading and updating the new risk in a form of lessons learned document. People in the organization can benefit from the lessons learned stored in repository as when experts become unavailable, other employees who encounter conditions that closely match some lessons' context may benefit from applying it. An effective lessons learned system

will prevent us from repeating the same type of mistakes and allow us to repeat our successes. At the end of the project, the system will help in managing the risk effectively and helps in communicating the risk among organizations.

1.2.1   Significance of the project

This project are intended to develop a fully functional working prototype using Content Management System, Microsoft SharePoint Foundation 2010 to create a platform for all users in sharing their lessons learn document in a more properly mannered system. The system will provide an enhance user experience where users can easily upload document in a simple step, and edit the properties easily. The filter function can also enhance capability in finding the desired document more effectively. Additionally, user can now share any risk or lessons learned experience in discussion forum and attached picture to it. This system will be used by HSE admin that includes HSE staff and steering committee, and all staff in UTP.

1.3   Aims and Objectives

The project is aim to establish the relationship between KM and ERM by developing a KM solution of "HSE Lessons Learned System (HSELLS)" while focusing on risk monitoring and review process. The objectives of the projects are as follows:

1. To conduct preliminary investigation and gathering of user requirement for Lessons Learned System

2. To analyse the current existing implementation on how lessons learned are stored and shared in organization

3. To design KM solution of "HSE Lessons Learned System" in accordance to selected KM technology

4. To develop a functional working prototype of Health Safety and Environment Lessons Learned System (HSELLS)

In the first category, preliminary investigation with HSE experts in UTP is important to gather user requirement on how to improve the process flow in documenting lessons learned. The second category in analyzing the current existing implementation will point out the weakness of current adopted implementation and enable us to identify improvement area for the proposed system. The third category in designing KM solution of HSE Lessons Learned System will follow the Knowledge Management process of capturing, store, share, and apply to improve inefficient way of handling risk. Finally, a functional working prototype of HSELLS is proposed to resolve the issues address by HSE UTP, applying KM principle and techniques in the system thus allowing the users to share and disseminate risk across the organization.

1.4   Scope of Study

In order to resolve the issue of independent treatment of risk, several scope of study has been identified.

1. The study will use monitoring and review process of ERM

2. The study will involve with KM technology of Lessons Learned System in addressing the issue of communicating the risk throughout the organization.

3. The case study will uses Health, Safety and Environment (HSE) in UTP representing Enterprise Risk Management

1.5   The Relevancy of the Project

The development of HSELLS is relevant to the future uses of HSE department as it is aim to improve user experience while managing lessons learned document in a more interactive and simple to use. This would be able to help users to fully utilize the platform created in sharing and storing all lessons learned document, and eventually allow users to repeat success and prevent failures As a result, the proposed system will improve decision-making process in managing risk in UTP. For the time being,

the author will use the core functionality of document management, and discussion forum to address the issues.

1.6　　Feasibility of the Project within the Scope and Time Frame

The development of HSELLS shall be completed on time as the author has 2 semesters to complete the whole project. The time span of two semesters is divided into two parts, the report, and implementation. The time frame provided is adequate for author to analyse, design and implement the system throughout the semester. During the first semester, the author focuses more towards the research in establishing connection between ERM and KM, while during the second semester; it is the time for the project design and implementation. This is very crucial moment where the author needs to be able to come out with a working application based on the user requirements. Since the scope of the project will focus on HSE UTP, and focuses on monitoring and review process, this project is feasible to monitor all lessons learned document captured is review and updated from time to time, thus providing value in managing risk of ERM.

CHAPTER 2

LITERATURE REVIEW

2.1   Definition of Knowledge

Many experts in management have their own definition of knowledge. Nonaka and Takeuchi (in Kubo et al., 2001), both define knowledge as clear job-related information and the skills and experience required to carry out tasks.   Furthermore, Gammelgaard and Ritter (in Al-Alawi et al., 2007) have concluded that knowledge is a combination of life experiences, which can evaluate and contribute new ideas. Davenport and Prusak define knowledge as "a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, process, practices, and norms." This has been supported by Al-Alawi et al., (2007) which suggest that knowledge is not limited to paper or databases, but it is also exists in people's minds and is expressed by their behaviours.

As quoted by Shaari, knowledge is different from information in the sense that it is restricted to context, is more subjective and is connected to behaviour (Shaari, 2009). This has been justified by Nonaka saying that information becomes knowledge when it is interpreted by individuals and given a context in the beliefs and commitments of individuals" (Nonaka et al., 2000).

2.2   Enterprise Risk Management Theory

According to the Committee of Sponsoring Organizations (COSO), 2004,

> *ERM is defined as a process, affected by the entity's board of directors, management, and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within the risk appetite, to provide reasonable assurance regarding the achievement of objectives. (COSO, 2004).*

The Casualty Actuarial Society (CAS) has different view in defining ERM where ERM has been define as the discipline by which organization in any industry assesses, controls, exploits, finances, and monitors risks from all sources for increasing the organization's short and long-term value to its stakeholders. Enterprise risk management will enables management to effectively deal with uncertainty and associated risk and opportunity, striking an optimal balance between growth and return goals and related risks (Steinberg, 2004).

COSO points out that ERM is an ongoing process, which applied in strategy setting and across the enterprise and is designed to identify events that, if they occur, will affect the entity and to manage risk within its risk appetite. James,W argues that the implementation process of ERM does not occur overnight and, is not easy to accomplish. James, W added that ERM is an ongoing process, and a journey in which these steps are a starting point. (James,W. 2005). Researchers explain that ERM require the need to design and implement a set of actions that can be continuously and iteratively applied throughout the enterprise. (Beasley, 2009) Rather, a practical approach to risk management include processes and activities that must be integrated within an organization's core activities so that risk management is performed on an ongoing, consistent basis by employees throughout an organization. That way, risk management becomes an integrated core activity that is applied continuously as the enterprise conducts its business and executes its strategy. (Beasley, 2009).

2.3   Enterprise Risk Management Processes

The ERM framework is often depicted as a cube illustrated in Figure 2 . As illustrated in the figure, ERM processes start with the organization must create an (1) **internal environment** that fosters a commitment to competence, provides discipline, and articulates governance structures within the risk culture of the firm. (COSO,2004). Secondly, ERM proceed with the second process of objective setting (2) while ensuring ERM linked and support the strategic objectives of the enterprise. COSO adds the process of **risk identification** in which management must undertake an (3) event identification phase to develop or update a list of specific events that, if they occur, could influence business process performance.

FIGURE 2: ERM Framework. Adapted from "Enterprise Risk Management, Understanding and Communicating Risk" by Rittenberg L, Martens.F, 2012

After risk is identified, management must performs a (4) **risk assessment** by evaluating the likelihood that the event will occur and estimating the probability of the event if it does occur. Then, management must select and implement an appropriate (5) **risk response** for all events, based on the risk appetite of the firm and the cost/benefit relationships for the various response options, and establish (6) **control** activities to help ensure that those risk responses are properly executed.

To manage this network of processes, COSO stress out that the organization must establish channels for (7) **information and communication** that enable personnel to carry out their responsibilities and that provide management with feedback about the extent to which the organization is achieving its objectives. This important steps is

crucial to ensure that risk are properly communicated throughout the organization, Finally, to govern the risk management process, the organization must establish a program for (8) **monitoring** how well each component is functioning and for tracking performance over time. The last process is important in ensuring the effectiveness of the risk process wether it has give impact to the organization.

2.4   Knowledge Management Theory and Process

Davenport (1994) offered the widely quoted definition "Knowledge management is the process of capturing, distributing, and effectively using knowledge." According to Duhon, (1998):

> *"Knowledge management is a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers."*

Both definitions share a very organizational, a very corporate orientation. KM, historically at least, is primarily about managing the knowledge of and in organizations.

Becerra-Fernandez and Sabherwal identify that knowledge management relied on four main kinds of knowledge management processes as follows: discovery, capture, sharing, and application. The relations of the processes are shown in Figure 3. Knowledge Discovery is defined as the development of new tacit or explicit knowledge from data and information or from the synthesis of prior knowledge. Knowledge Capture is defined as the process of retrieving either explicit or tacit knowledge that resides within people, artifacts, or organizational entities. Knowledge Sharing is the process through which knowledge is communicated to other individuals. Knowledge Application depends on the availability of knowledge.
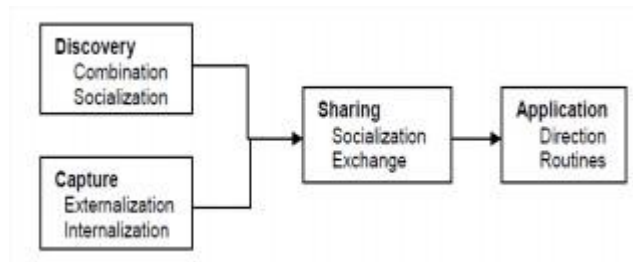
FIGURE 3: Knowledge Management Process

While ERM processes is an ongoing process, so do Knowledge Management process. Knowledge management is more than just an application of technology. In term of similarities, both ERM and KM involves cultural changes in the way employees perceive the knowledge they develop. (Dataware Tech, 1998). Nonaka and Takeuchi (1995) described the knowledge creation of explicit and tacit knowledge in the SECI model of socialization, externalization, combination and internalization. In managing ERM, it requires capturing both tacit and explicit knowledge of the risk itself. Stephanie (2011) explains knowledge management mainly involves people, processes and technology as key to success in adressing each of the eight phases of the knowledge management process, all in the context of aligning business and IT. The similaritites between both KM and ERM is Enterprise Risk Management also aligns strategy, people, processes, technology and knowledge. (James.W, 2005)

2.5   Knowledge Management and Enterprise Risk Management

While it is true that KM can enhance innovation, knowledge sharing, and performance in business, its greatest value may lie elsewhere – in risk management. (McElroy, 2003). Researchers argue that knowledge is the pillars to comprehend and manage the risk, as without knowledge, risk cannot be managed properly. Previous ERM and KM research has proven two main themes. First, researchers evaluate how knowledge can reduce leading to better risk management. Examples of this research include De Zoysa and Russell (2003) who examined how knowledge can assist risk identification, risk quantification, and risk response; and Verhaegen (2005) and Otterson (2005) who consider how knowledge informs decision makers. Second,

researchers examine how the process of knowledge management can improve enterprise risk management.

Researchers also explain that knowledge is necessary to comprehend and manage risk. Researchers have recently proposed that in Managing Corporate Reputation and Risk, Neef pointed out saying "a company can't manage its risk today without managing its knowledge." (Neef, 2005). In the point of view of McElroy (2003), knowledge management and risk management are inseparable. Some researchers try to explain the similarities between ERM and KM; such as the need for employee insight, the importance of action, the value of lessons learned, and conclude that risk management is knowledge management (Neef, 2005). These researchers propose common KM techniques such as knowledge mapping, communities of practice, ''hard tagging'' experts as the basis of a new KRM approach.

Rodriguez & Edwards (2008b) examine the weakness of ERM implementation based on the two conceptual pillars: "Risk Management is frequently not a problem of a lack of information, but rather a lack of knowledge with which to interpret its meaning". Knowledge management (KM) constructs to differentiate risks. Researchers explains that knowledge makes risk 'learnable' by moving decision makers from the unknown to the known; while knowledge management mobilizes the knowledge and expertise of employees (Neef, 2005), by transferring knowledge to decision makers, improving knowledge accessibility, embedding knowledge in controls and processes, and generating new knowledge (Marshall et al., 1996).

To the best of your knowledge, has your organisation or business unit suffered from one or more significant risk or compliance failures during the past three years?
(% respondents)

No	59
Yes	35
Don't know	6

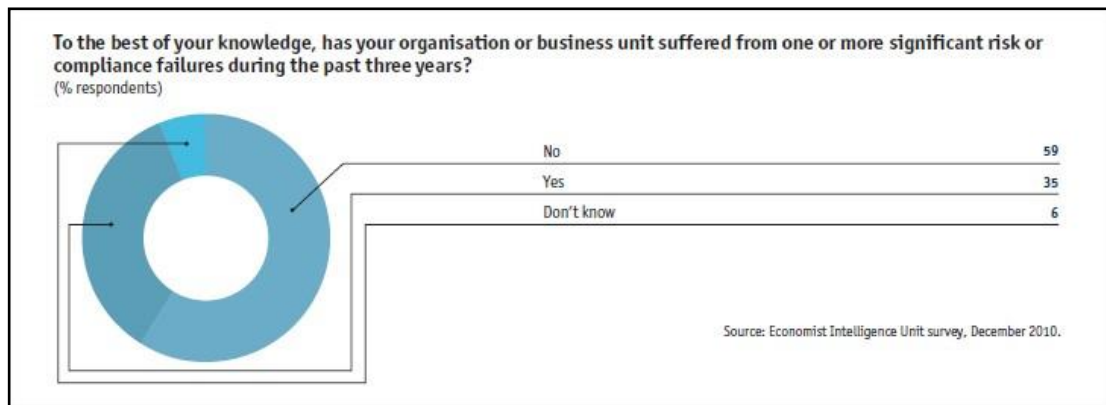Source: Economist Intelligence Unit survey, December 2010.

Figure 4: Questionnaires Adapted from "Ascending the Maturity Curve Effective Management of Enterprise and Compliance," by Rob Mitchell, Economist Intelligent Unit, March 2011

"To the best of your knowledge, has your organisation or business unit suffered from one or more significant risk or compliance failures during the past three years?"

The Economist Intelligent Unit (2011) explains that companies may be underestimating the extent of risk and compliance failures in their organisation as the knowledge about risk failures is not being widely disseminated in order to improve practices and tighten policies. This has been prove from the survey done by Economist Intelligent Unit and illustrated in Figure 4. At first glance, the fact that only one-third of respondents have experienced a risk or compliance failure might seem like a comforting finding. But respondents are most likely underestimating the scale and frequency of such events. This suggests that information about risk failures is not being disseminated throughout the organisation. (Economist Intelligent Unit , 2011)

Researchers also agree that one key deficiency in existing risk management practice is due to the lack of integration and communication. (Harner & Michelle M. 2010) The traditional segregated approach to risk management prevented many firms from understanding their true exposure if various identified risks converged and from communication those risk efficiently to senior executives and directors. The contribution of knowledge management in this perspective is through communication that can be used to build an internal KM culture by breaking down reluctance to

share information, share access and accept a new way of presenting the information. (Stephanie, 2011).

2.6 Risk monitoring and Review Process

One of the final steps in implementing ERM is risk monitoring and review process. Researchers explains that risk cannot be set once and then left alone for extended periods. Rather, it should be reviewed and incorporated into decisions about how the organization operates. This is especially important if the organization's business model begins to change. (Rittenberg, L and Martens, F, 2010). According to The Public Risk Management Association, monitoring and review ensures that the organisation monitors risk performance and learns from experience. It is frequently the case that risk assessments were recorded in a risk register. The scope of activities covered by monitoring and measuring also includes monitoring of risk improvement recommendations and evaluation of the embedding of risk management activities in the organisation, as well as routine monitoring of risk performance indicators. In terms of connection between monitoring and review process with lessons learned system, this clearly indicates that risk monitoring processes can be efficiently handled using a lessons learned system where all recorded risk will be stored in risk repository. A lessons learned system also ensures that every accidents/incidents or successes should be recorded and shared with peoples in organisation. In lessons learned itself, improvement and recommendations is included so that people can react to it if the same situation occur. An updated and review of lessons learned will be done yearly in ensuring the recorded lessons learned followed the act of compliances.

2.7 Lessons Learned Definition, Process and Successful Implementation

NASA defines "lessons learned" as knowledge or understanding gained by experience. NASA also explains that this experience may be positive, as in a successful test or mission, or negative, as in a mishap or failure. Sharing lessons learned thus provides value in reducing risk, improve efficiency, promote validated processes, and improve performance in ongoing and future NASA projects. (NASA, 2001)

According to Weber, R et.al (2000), a Lessons Learned (LL) Processes are knowledge management (KM) solutions for sharing and reusing knowledge gained through experience. Weber et.al explains that it involves five main processes of collecting, validating, storing, disseminating, and reuse as illustrated in Figure 5. CDC Unified Process, 2011 has a different view of lessons learned processes. CDC Unified Process explains that lessons learned start with identification, documentation, validation, and dissemination of lessons learned. In detail, CDC Unified Process incorporate of those processes by identification of applicable lessons learned, documenation of lessons learned, archiving lessons learned, distributuion to appropriate personal, and follow-up to ensure that appropriate actions were taken.

collect → validate → store → disseminate → reuse

FIGURE 5: Lessons Learned Process

An effective Lessons Learned process should prevent us from repeating our mistakes and allow us to repeat our successes. It should be an instrumental part of any organization's overall "continuous improvement" process. There has been major successful implementation of lessons learned system by some organization. For example, NASA has their own "Lessons Learned Information System (LLIS)" where they kept all data about individuals, directorates, programs, projects, and any supporting organizations and personnel across NASA, including engineering, technical, science, operations, administrative, procurement, management, safety, maintenance, training, flight and ground-based systems, facilities, medical, and other activities.(Martin, P.K, 2012). NASA's policy on lessons learned codification allows them to monitor their risk effectively and enable them to reuse the lessons learned for future benefit.

LLSs is the Center for Army Lessons Learned (CALL) at Fort Leavenworth, KS, established in 1985 for the purpose of collecting lessons learned during simulated combat training exercises (U.S. Army, 1997). Over the years, CALL's mission has expanded to encompass lessons from actual combat and other military operations. CALL also employs dedicated expert observer teams to collect lessons from selected high-priority operations. CALL is staff with resources necessary to accomplish a variety of lessons-learned functions, including collection; analysis; processing; dissemination; archiving; and research. CALL's lessons learned system is another example of successful implementation of lessons learned system.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This section describes how the projects were planned out in order to fulfil its objectives and aims of the project. The coverage of this methodology section will involve methodology used from the preliminary works done starting from the initial stage of the project until the development stage of the project. The overall scheduled planned for this project can be referred to the Gantts Chart provided in this section.

3.2 System Development Methodology

In developing HSE UTP Lessons Learned System (HSELLS), typical system development life cycles (SDLC) were used throughout the entire project. The SDLC aims to produce high quality systems that meets or exceeds customer expectations, reaches completion within time and cost estimates, works effectively and efficiently in the current and planned information technology infrastructure, and is inexpensive to maintain and cost-effective to enhance. Within the time frame constraints given to develop this project, SDLC is most suitable methodology that enables creation of system to the testing part, while ensuring the system run smoothly. The prototypes being developed were further refined bases on the users' feedback. The diagram in Figure 6 summarizes the SDLC techniques used in this project:
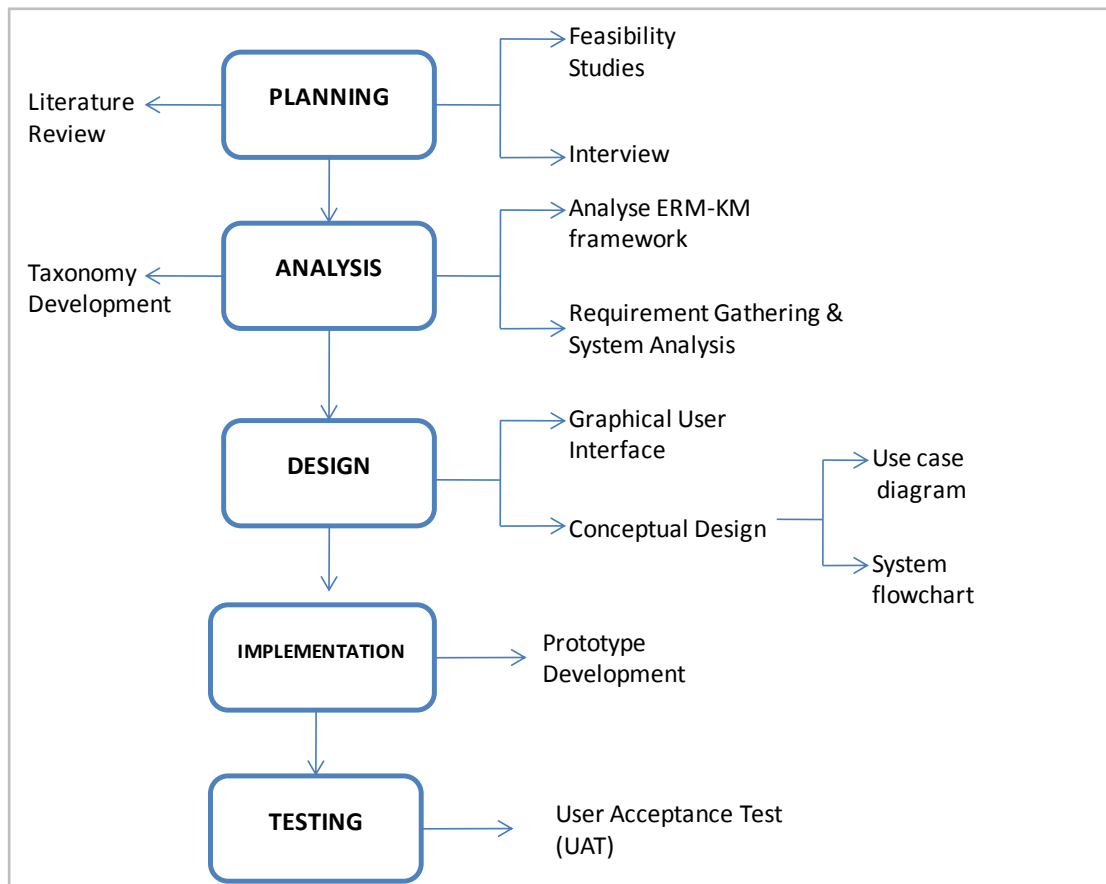
FIGURE 6: System Development Life Cycle (SDLC) for HSELLS

3.3 Planning

3.3.1 Literature Review

In the project planning phase, methodologies are being refined by conducting systematic surveys of existing literature that implements Enterprise Risk Management alone. A thorough research on two elements focusing ERM and KM were made in finding the relationship of how KM can resolve the issue of ineffective treatment of ERM. Reviews from journal, research paper, and current industry applying ERM were identified in order to strengthen the knowledge about the research element of this project. Based on a few research material and journal on the research area, a critical review on the literature helps identify the key areas of improvement to be implemented on the proposed system. A proper analysis on the KM technology is made ensuring the right technology were used to address the issue of recording the lessons learned in HSE UTP. The main resources of journals and

research papers come from ACM provided by UTP Information Resource Centre (IRC) ,IEEE website www.IEEE.org, emeraldinsight, and sciencedirect.com.

3.3.2   Feasibility Studies

For feasibility study, the subject matter expert (SME) has been contacted and author has managed to talk with HSE experts, Mr Suhaidi Bin Mustafa. A meeting and discussion has been made in understanding what is the main problem faced by the organization and why risk awareness is not being practiced throughout the organization. HSE did kept the lessons learned document but it may be stored in a form of hardcopy, causing difficulty for other users in UTP retrieving the document. The feasibility study were focusing on technology and system feasibility involving system requirement in terms of input, processes, output and procedures in storing all HSE lessons learned document. In terms of operational feasibility, the proposed system should allowed the HSE staff to maintain the system by itself without having the need of technical capabilities.

3.4   Analysis

3.4.1   Analysing ERM-KM framework

For design phase, findings from the analysis phase were translated into detailed graphic form. This step integrates work from all preceding steps so that it culminates in a strategically oriented KM system design. Developing the key layers of the KM architecture is being done to meet the ERM's requirements. The similarities between both processes were analysed to determine the interaction and connection on how KM can support ERM. Throughout this processes, an established KM-ERM framework has been proposed to study as stated in Figure 7.
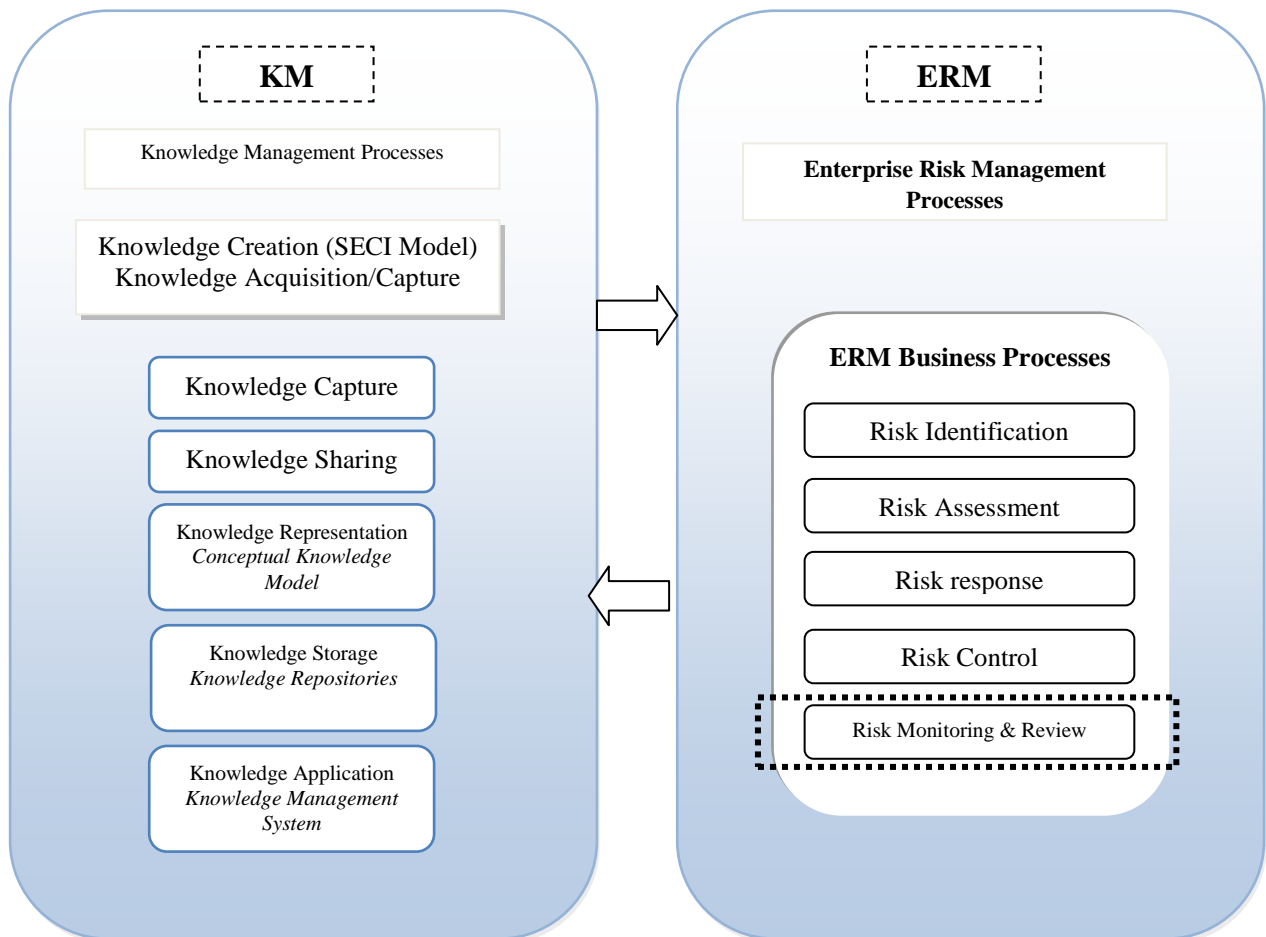
FIGURE 7: ERM and KM framework

While analysing the ERM-KM framework in figure 7, and relate to development of lessons learned system, knowledge is capture by documenting lessons learned from their insights and experiences in handling the incidents happen. This captured document will certainly help ERM process of risk identification by avoiding such similar incidents and also at the same time allowing users to repeat success. In term of knowledge sharing, the captured document will be shared in the repository of lessons learned system while allowing user to view and download document. The system will help HSE department in monitoring and review risk from the updated lessons learned document by validating submitted lessons learned document that fullfilled their format and procedures. KM will use Knowledge Application of Content Management System (CMS) to improve monitoring and review process when the users were able to update any changes made from the previous document to the updated document.

3.4.2   Requirement Gathering and System Analysis

The process of requirement gathering was started by initial evaluation on the current process used by HSE department in storing and sharing lessons learned in UTP. In addition, other requirement gathering methods were also implemented to define some expected functionalities required in the new systems. The requirement gathering methods initially adopted were as the following:

1. Interview with Head of Department and Executives of Health Safety and Environment UTP.
2. Document analysis

The interviews and the document analysis methods were used in understanding the current implementation method and to clarify the process flow used to identify and collect risks in UTP. The interview is aimed to increase understanding on how the actual person deals with all type of risk and hazards happen in UTP as part of their job routines. The aim of the interviews and document analysis was to understand how knowledge on the risk is being collected, how they resolve accidents and incident, to be processed and reported in the department. Besides, document analysis helped to discover on what type of metadata should be included for user to upload the document, such as title, document no, and date of document. The summary of the interview is aimed to discover the following objectives:

1. The current way of recording lessons learned and risk incidents on how they were managed and handled
2. The platform used by HSE UTP department in disseminated lessons learned in UTP
3. To understand who are the people involved in recording and reporting the risk to the HSE department

The findings of the interview were discussed on chapter 4, results and discussion.

3.4.3   Taxonomy Development

After planning activities and interviewing have been done, a taxonomy development was made according to the findings from the interview. Firstly, in defining the scope, the taxonomy development should be able to fulfilled three business context of purpose, usability, and input sources for taxonomy design. In addressing the first business context, the purpose of taxonomy should be in breaking down the available risk in UTP according to its type, such as fire hazards, lost of containments, or road accidents. This will help user in finding the lessons learned document according to its type of risk. In terms of usability, the taxonomy will be used in finding desired document more easily by navigating through type of risk available, and search by title or categories.

In content scope, the taxonomy was build within UTP organization, while the content source of the taxonomy will be build upon risk in HSE UTP only. This will involve on the lessons learned document categorized by its incident and accidents. In terms of user, the person who will be using the taxonomy range from all engineering department and computer information science department. Basically, the user involve with all employees in UTP, who are bounded by the Act of Occupational Safety and Health Administration (OSHA).

3.5   Design

The design phase requires the author to put what has been planned into graphical user interface (GUI). The design is made from the result of user requirement gain from the interview with HSE manager and document analysis. This is vital because the design has to be valid according to what HSE department prefer and the nature of the scope. In design phase, user requirement and feedback from HSE UTP has been seriously considered while developing the graphical user interface. This phase is important in ensuring the core functionality and additional features were included in the proposed system.

3.5.1 Graphical User Interface

Graphical User interface is the core of the application where it will portray on how the system will look like; it has to be simple and easy to use. The design prototype in the form of GUI has been produced on a rough scetch. The HSE admin had specify on what are the basic functionalities should be included in the system. HSE admin had also responded and commented towards the state of the proposed interface while providing feedback and analysis to improve the application.

The development of the pages started parallel with the development of the system. The priority of pages creations were given based on its functions and for the time being, only pages that contain critical forms are created in order to ensure all the basic functions related to the system can be connected smoothly. After core functionality of the system is created, any additional features proposed by HSE admin has been drawn and included in the scetch of the GUI.

3.5.2 Conceptual Design

In the design phase, conceptual design here were used to creates logic of the application flow by using UML diagram which consisted of package diagram and flowcharts. The UML diagram used were swimlane, process flow analysis and use case diagram. Package diagram contains use cases to illustrate the functionality of the software system while the flowcharts shows logic of the application and to enable to tract process flow of the system. A use case diagram were able to portray different type of user in proposed HSE Lessons Learned System (HSELLS) and the various ways that they interact with the system. Most importantly, drawing Use Case diagram will gather requirements of a system including external and internal influences and its functionalities has been identified. In this conceptual design, Microsoft Powerpoint 2007 were used to illustrated the functionality and the component of the system.

3.6   Implementation

3.6.1   Prototype development

In this stage of prototype development, the author undergoes the process of preparing a system that demonstrates the feasibility of a solution to a problem. The purpose of prototype development was to determine as best as possible whether the development satisfies the system requirements and meets its aims and objectives to integrate ERM with KM using HSE Lessons Learned System. The end user will interact directly with the system and gives feedback from the prototype developed. Functional requirements usually focus on the key input and output data. When developing the protoytpe of HSELLS, the development will take into account of the end-user input and commitment to the prototype development to review the prototype. The prototype created for the system will be continued to evolve throughout the project life cycle until all user requirements and its core functionality has been satisfied.

3.7   Testing

3.7.1   User Acceptance Test (UAT)

User Acceptance Test (UAT) is often at the final step before rolling out the system. The main purpose of this testing is to validate the end to end business flow, system transactions and user access, confirms the system or application is functionally fit for use and behaves as expected. The main focus is on the functionality and the usability of the application rather than the technical aspects. The end users who will be using the proposed HSELLS test the application before 'accepting' the application. In this project, the end users included were HSE personel and other lab technician. The testing is intended to gives the end users the confidence that the application being delivered to them meets their requirements. When testing prototype deployments, there are possibilities in discovering problems with the deployment design. This testing were also aimed to discover any nail bugs related to usability of the application. UAT will identifies areas where user needs are not included in the system or the needs are incorrectly specified or interpreted in the system. In case of any problems with the testing of HSELLS, author will iterate back to earlier phases

in the solution life cycle to address the problems issued by the users and resolve the issue while developing the second prototype.

In UAT, User Acceptance Test Plan is executed to verify and ensure HSELLS meets its requirement guided by HSE department. UAT Test Plan will outlines on entry and exit criteria while ensuring the system testing of HSELLS runs perfectly on uploading and updating document libraries functions. The second test were creating test case for HSELLS by providing different scenarios for different functions. After test case were done, authors had documented the defects found during UAT to the HSE admin and resolve the issue on bug from the system. The last step of UAT were to sign off the system once the HSE admin has "Accept" the system delivered.

3.8 Gantt Chart

PROJECT ACTIVITIES		WEEK														
		1	2	3	4	5	6	7		8	9	10	11	12	13	14
Planning	Preliminary Research Work	■	■	■	■											
	Prepare/edit Gantt Chart	■	■	■	■											
	Feasibility studies of current system used by HSE department		■	■	■											
Analysis	Analyse ERM-KM framework		■	■												
	Requirement gathering and system analysis by reviewing the interview		■	■												
	Taxonomy development on risk				■	■	■	■								
Design	Draft the system flow			■	■											
	Design system components			■	■											
	Design system prototype using Microsoft SharePoint					■	■	■		■	■	■				
	System testing					■	■	■								
Implement	Evaluate the system							■								
	User Review and testing									■	■	■	■			
	System Delivery											■	■			
Important Dates	Submission of Progress Report				■											
	Pre-EDX									■						
	Dissertation												■			
	VIVA													■		
	Final Dissertation															■

(Mid-Semester Break between weeks 7 and 8)

26

3.9 Tools Required

3.9.1 Software

- *Microsoft SharePoint Foundation 2010*

The most suitable software to develop HSE Lessons Learned System is Microsoft Sharepoint Foundation 2010, a free basic function software from Microsoft Corporation. Microsoft SharePoint Foundation 2010 is the low-cost entry level or pilot solution for organizations and departments looking for secure, Web-based collaboration and suitable for intranet uses. Since the development for HSELLS is for pilot phases, SharePoint Foundation 2010 has the ability to deliver and coordinate schedules, organize documents, and participate in discussions through team sites, blogs, and document libraries. This extra features provided by Sharepoint can be benefit for the purposes of developing HSELLS. Its features of document management and discussion forum allow users to benefit from it and ensure knowledge about risk is communicated throughout the department.

Besides, since HSE Lessons Learned System is mean for internal use only, Microsoft Sharepoint Foundation 2010 is the perfect tool to develop the system. People can access collaboration capabilities through a familiar, Web-based interface and everyday tools including the Microsoft Office system of productivity programs. The familiar and intuitive look of SharePoint Foundation 2010 means it can be deployed rapidly with less disruption to current work practices and with less demand for training and support. This means that HSE admin can manage their own site without the need of technical skills as Sharepoint Foundation is easy to use. HSE admin can monitor and update the content of HSELLS while ensuring all documents uploaded were verified.

- *Microsoft Sharepoint Designer2010*

Microsoft SharePoint Designer 2010 is a Web and application design program used to build and customize HSELLS SharePoint sites and applications. SharePoint Designer 2010 provides a single environment where author will work HSELLS site, its lists and libraries, pages, data sources, workflows, permissions, and more. By using Sharepoint Designer, author can see all key ingredients of HSELLS site in one place, and see the relationships between these objects.

Configuring or designing components of HSELLS site does not need any writing of code. The redesigned user interface, easy connectivity to external systems, improved views and forms, and enhanced workflow design capabilities allow author to respond more rapidly to the business needs. Deploy Safe Customizations with Confidence provides control over where and how all people involved in record use throughout all levels of HSELLS SharePoint deployment. Besides, this tool will preserve a consistent brand and layout across a site collection or web application by controlling customization throughout entire site. This is to ensure all page developed will have the same features, feels, background, and functionality of the proposed Lessons Learned System.

- *Adobe Photoshop*

Adobe Photoshop, a powerful image editor tools is used while developing the system. Adobe Photoshop will be used in creating banner on the landing page of HSE Lessons Learned System. Additional image like logo will require the need of Photoshop as photoshop will produce high quality image photo without distortion.

CHAPTER 4

RESULTS AND DISCUSSION

4.1   System Requirement

4.1.1   Interview and Document Analysis

The results from the interviews and the document analysis activities has found that the HSE executives and two staff were responsible in performing the main administrative processes involving storing incidents and accidents happen in UTP. The current processes in recording leessons learned is in the form of hardcopy. In case of any mishap happen in the lab causing fire, the person in charge of the lab will write a report to be submitted to HSE department.

Additionally, HSE department used i-HSE website by PETRONAS to report log time injury or lost of containment. I-HSE is not user friendly especially when users entered wrong information, thus causing difficulty for HSE admin in storing through the system. Besides, T-drive platform were used to store lessons learned, but it not user interactive when compared to a fully functional system. The disadvantages of the T-drive is user cannot search the desired document according to its title or name, but instead they have to look into folder one by one. The current system has a lot of drawbacks in term of sustainability and this will cause more difficulty when the experts leave the organization.

4.2   System Analysis and Design

4.2.1   Use Case Diagram

The preliminary design efforts for the development of this system are within understanding that this system will play its main role in providing a better platform in disseminating risk through lessons learned system in HSE, UTP. Based on the results of the current system analysis activities, a use case diagrams are used to further refine the functions and features that the Lessons Learned System should entail. While gathering the system functionalities of Lessons Learned System, the actors identified were users across UTP organization, and HSE admin that will monitor and update the system. The use case diagram drawn will show the interaction between the user and HSE admin as illustrated in Figure 8.
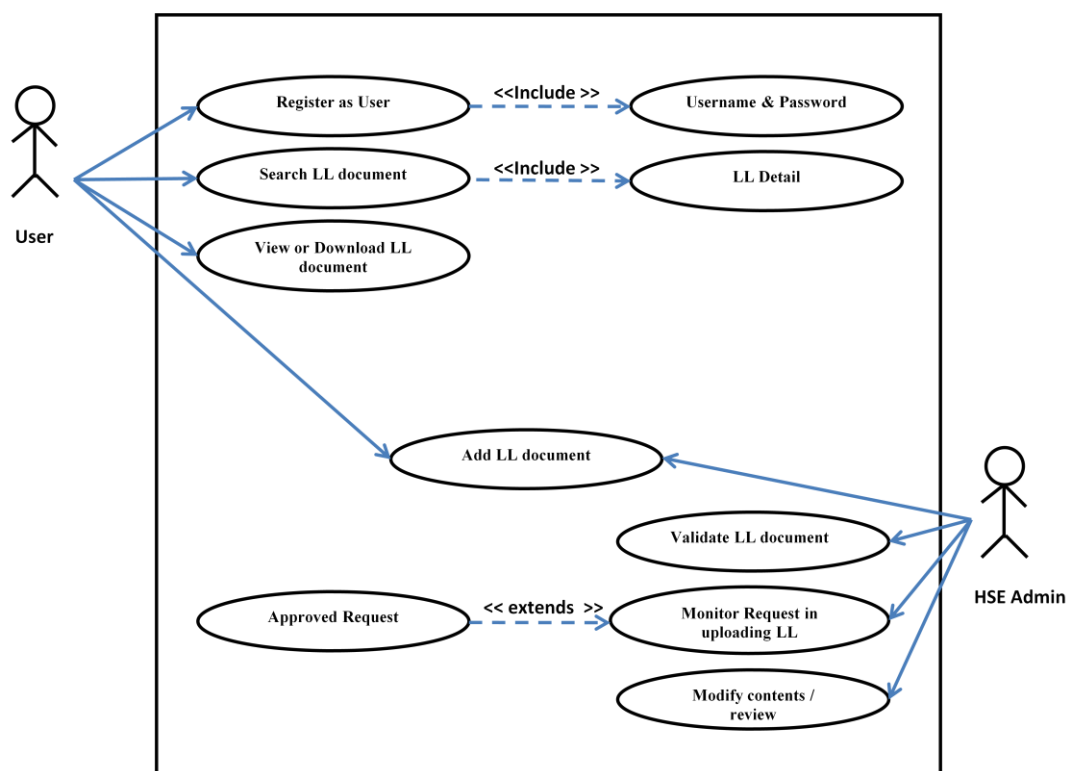
FIGURE 8: Use Case Diagram for HSE Lessons Learned System

The system is beyond proposed caters two types of people, which are the User, and HSE admin.

- **i) User**
  - Role   : Register as User
  - Activity   :
    - The user need to provide username and password and other personal information to be submitted manually to HSE department UTP so that they can view all the content in the lessons learned system
    - After providing all the details, the user can now login when HSE admin has given temporary username and password to retrieve the site.
    - The user can view and download the document and use it in any processes related to it
    - The user can also add any new lessons learned document and send for approval to the HSE admin

- **ii) HSE Admin**
  - **Role   :** Act as admin that will monitor all request in uploading new lessons learned document and validate the document
  - **Activity   :**
    - The HSE admin will monitor the request of the user who want to submit lessons learned document
    - HSE admin will then validate the lessons learned document on whether the document follow the format and procedures by the HSE department
    - After validating the document, the approved document will be inserted in the repository together with the metadata information and its knowledge attributes
    - The HSE admin have the right to modify and review the current content and he will be in charge in ensuring all document were updated from time to time

4.2.2 System Flowchart
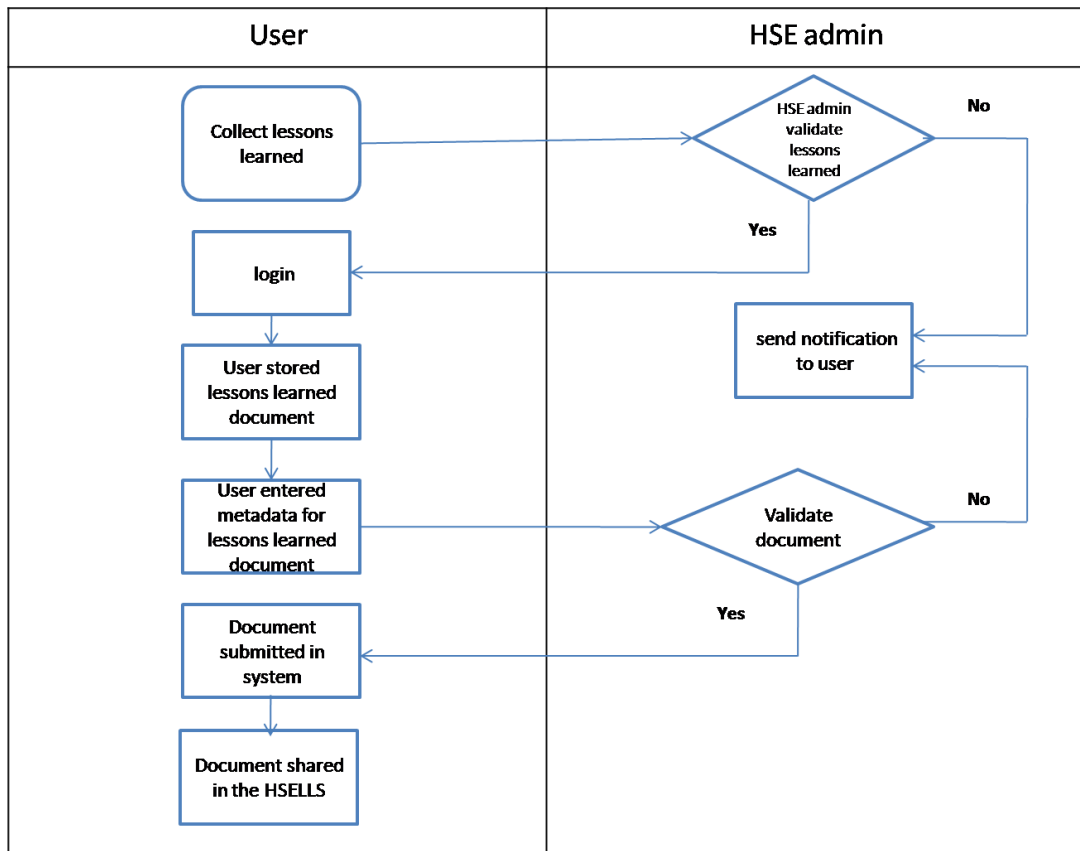
FIGURE 9: System Flowchart for HSELLS

The diagram starts when user collect lessons learned and send to HSE admin to validate the lessons learned. User will then submits application to access HSELLS site, which includes email address and staff ID. This request will be forwarded to HSE admin and HSE admin is in charge in providing temporary username and password to access the site. This is done manually and not directly to the system for safety purposed and the system is intended for intranet and within organisation only. After the admin had verified the staff ID, user can now login their details by entering temporary username and password and start viewing HSELLS sites. They can now change the temporary password. User will now stored the document by uploading lessons learned document into the system. After uploading the lessons learned document, user must enter metadata and knowledge attributes for the desired document and this require the action of HSE admin to validate the document before allowing it to reside in the repository. After HSE admin has approved the lessons learned document, it will now submitted in the system and shared in the HSELLS

4.2.3 System Architecture
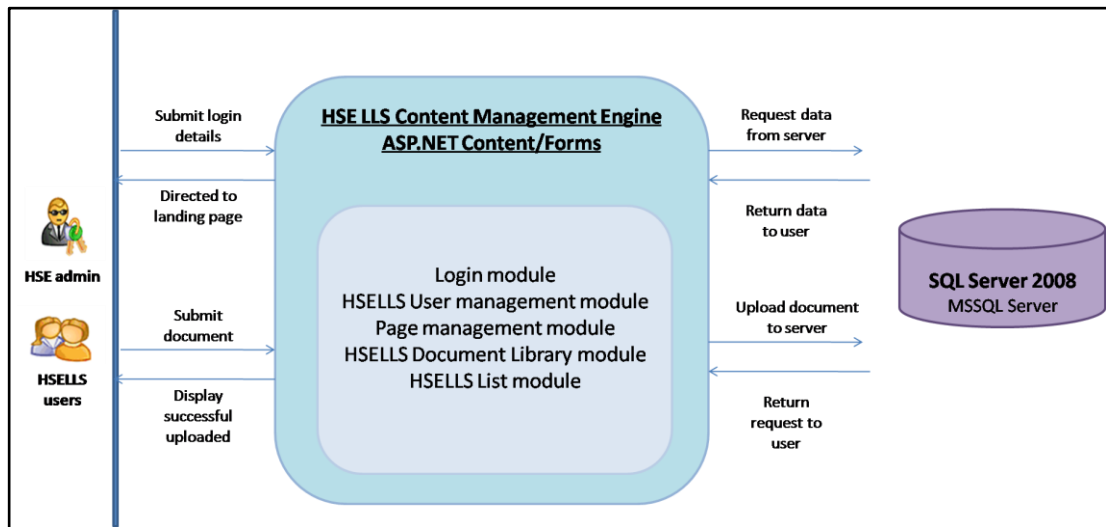
FIGURE 10: System Architecture for HSELLS UTP

According to the system architecture in Figure 10, the Content Management Engine (CME) of Microsoft SharePoint Foundation 2010 was using ASP.NET Content/Forms. The CME of the HSELLS were using Login module where HSE admin and HSELLS users need to login before accessing HSELLS. This is because HSELLS is intended for internal uses only thus protecting intellectual property of HSE UTP. Only authorized users were allowed to view HSELLS sites, and users need to grant access from HSE UTP for username and password. The CME will request data from SQL server (MSSQL database) by validating username and password and return data to user by allowing them to be directed to the landing page.

HSELLS page management module enables author to add and delete an unlimited amount of pages within HSELLS website. Besides, it also allows author to create a linking structure and navigate from one page to another page. When users submitted lessons learned document, HSELLS document library module will send request to SQL server (MSSQL database) for residing document in the HSELLS system. The server will send approved request to users and display successful uploaded. HSELLS list module allow user to report any unsafe act and unsafe condition in the system. Additionally, all modification of the document library, list, discussion forum can be

edited in Microsoft Sharepoint Designer 2010 and the changes made in Sharepoint Designer will be reflected in HSELLS website.

HSELLS user management module allows different type of users to have different type of roles in managing the content of the system. The HSE administrator has super admin control in editing the page content, for allowing access control, and has the right to change the role of the HSELLS users from visitors to contributors. The content editors have the right to add, delete, or modify document but has no access to modify the content of the pages. HSELLS web site visitors have the right to view the content only, and downloading document is impermissible. The developer will be the one who has the capability to change any page setting including the design, banner, workflow and others.

All pages and any content modified will be save in local host of SQL Server 2008, MSSQL Database. CMS Sharepoint has the ability to interact with Microsoft Office 2007/2010 which includes Microsoft Word and Excel. Sharepoint 2010 is more stable when using Internet Explorer to view the content. Microsoft Sharepoint Foundation 2010 is built entirely on ASP.NET, using the NET Framework and ASP.NET class libraries, and the development tools. By using Micosoft Net Framework Security features on HSELLS websites, and the underlying ASP.NET 2.0 and .NET Framework 3.0, Net Framework certainly help give protection from unauthorized changes to the data available in the system, thus help ensure that sensitive information is available only to those authorized to see it.

4.2.4   Sample of Graphical User Interface

A basic design on the HSE Lessons Learned System is drawn as illustrated in the Figure 11. Firstly, user need to login first to view the document and content of the system. While uploading the document, a list of metadata is needed to be filled by user and submitted to HSE admin. The left side panel is a quick launch which

includes type of risk in UTP. The top bottom has a drop down function, which also links to the home page and risk types in UTP. The middle part is document library view.
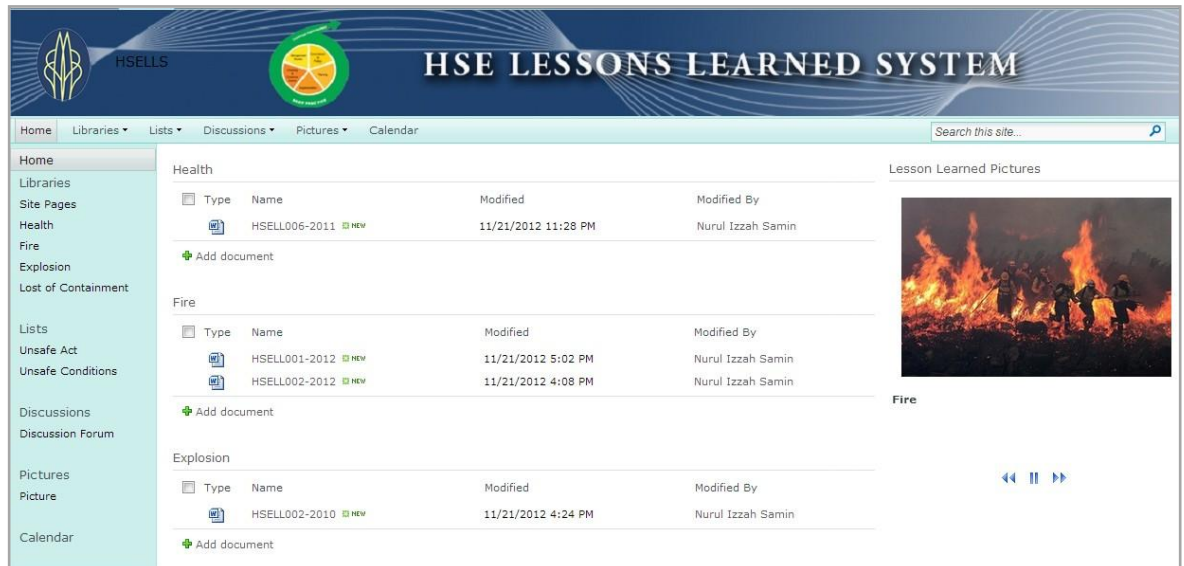

FIGURE 11: sample of HSELLS GUI

4.3   Prototype Development

During the course of this project, HSELLS prototypes were able to be developed within the given timeframe. This prototypes illustrates the iteratives nature in the development of the system according to the SDLC methodology as discussed in Chapter 3. In this section, the core functionality and added value will be discussed on the following subsections.

4.3.1   Login Page

Before entering HSE Lessons Learned System on the url of http://eceos-pc/HSELLS, user will need to login using username and password. This username and password were given to user from HSE admin, in which user need to apply request to access the page manually to HSE admin. This is done to ensure security by verifying staff ID and email. When HSE admin receive the request for username and password, they

will give users temporary username and password that have been verified as UTP staff. The screenshot of the login page is illustrated in Figure 12.

FIGURE 12: Login Page of HSELLS UTP

4.3.2 Landing Page

After user has submitted username and password to login, user will be directed to the landing page in which they can view all document uploaded in the Libraries. In section 1 in Figure 13, user can navigate to document libraries on the left side panel classified according type of risk. There are five types of risk classified in document library, which are Health, Fire, Explosion, Lost of Containment and Biological Hazards.

In section 2 from the figure 13, this is additional functionality requested by HSE manager, where a list of Unsafe Act and Unsafe Condition is included in the proposed system. This list has its main purposes for the users to report any condition of unsafe act that happen around UTP campus.

In section 3 from figure 13, a discussion forum is added as additional features where all users in UTP can communicate and discuss any issue related to Health Safety and Environment. For section 4, all types of document uploaded in different types of risk will appear here and classified according to its risk types.

FIGURE 13: Landing page of HSELLS

4.3.3 Navigating through document libraries

4.3.3.1 Classification of risk - Health

For the document libraries features, the prototype was developed to manage different types of risk, which includes Health, Fire, Explosion, Lost of Containment, and Biological. The following screenshots in Figure 14 illustrates Health risk types. User can view all document submitted through the system and its metadata and knowledge attributes can be seen in this pages. This metadata included were document no, date of incident/incident, location, root cause, recurrence, recommendations and technical authority. Metadata is important for document management purposes because it helps to facilitate and improve the retrieval of information. These metadata has help to describe the content of the document without the need for user to open the document and read all pages.
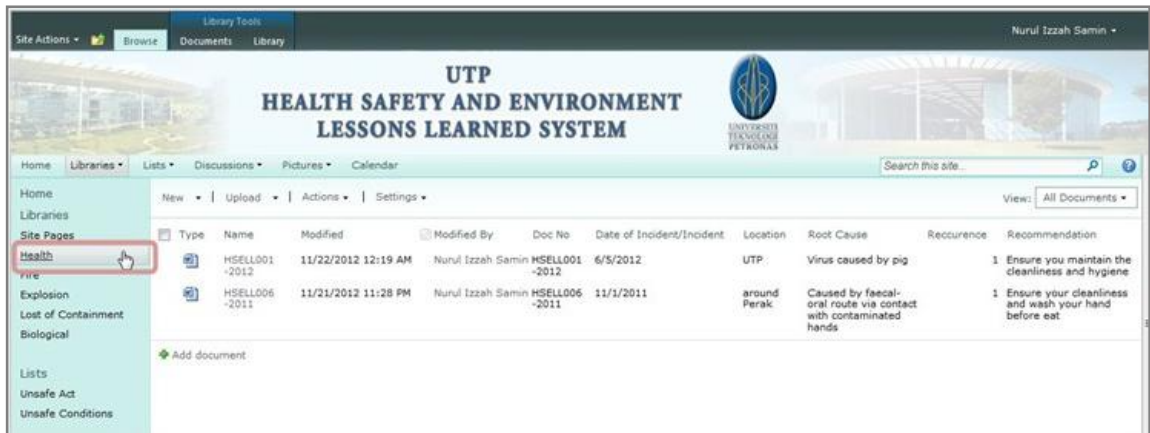
FIGURE 14: Navigating Health Document Libraries

4.3.3.2 Filter Column from Document Libraries

Microsoft Sharepoint allow user to filter column according to its types. This features will certainly help user in finding the right document faster in an efficient way. The following screenshots in Figure 15 illustrates that the date type is filtered to 11/1/2011 and only one document appeared instead of two.

FIGURE 15: Filter column in document libraries

4.3.3.3 Upload document in document libraries

To upload document in the document libraries, there are a few methods that user can use. User can navigate through the upload column function or directly to "add document" function as illustrated in Figure 16. Both methods will link to new window for uploading document.

FIGURE 16: Method of uploading

Upon clicking "upload" or "add document", a new window appear and user can now directly upload document through the system by browsing through the desired document and press OK button. This process is illustrated on Figure 17.
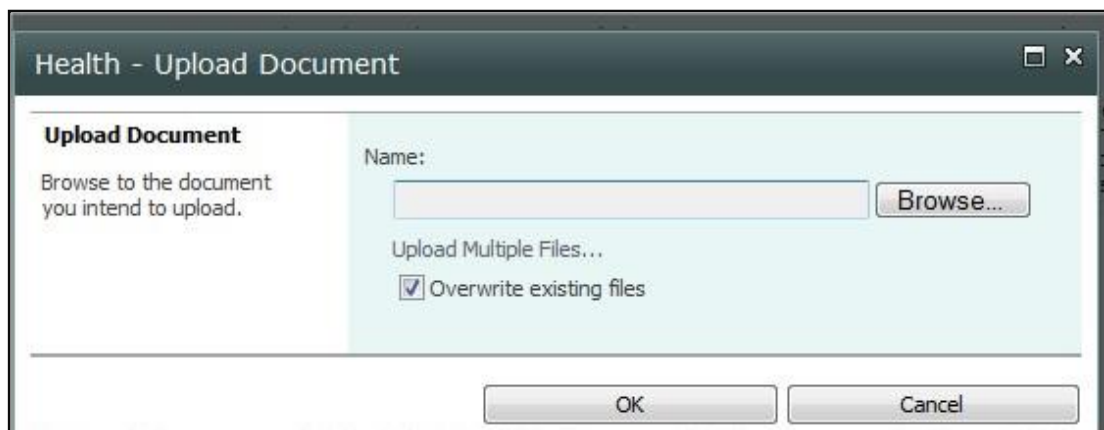
FIGURE 17: Upload document to Health document libraries

After selecting the desired document, a new window appeared asking user to enter the metadata and knowledge attribute to be inserted in the system as illustrated in Figure 18. The compulsory item were name, document no, health types and technical authority. This information is crucial upon uploading document, as this metadata will provide meaning to document while knowledge attributes will enable better matching of contexts and more effective application of the knowledge.

FIGURE 18: Metadata and knowledge attributes for uploaded document

After user has successfully filled all the information, the documents are now
uploaded in the system. From the screenshot in the Figure 19, the new document
uploaded will be label with "New" and this will certainly help other users to notify
the new document uploaded in the document library.

FIGURE 19: New document successfully uploaded in Health

4.3.4 Add details in List for Unsafe Act and Unsafe Condition

Unsafe act and unsafe conditions list is aimed to allow any users in reporting any unsafe conditions and acts around UTP. This added functionality in Figure 18 is aimed to reduce number of accidents and accidents happen in UTP thus preventing any fatality or mishap. This function also allow user to include peoples in the action column to notify the person in charge for the unsafe conditions. The person will be notified by the email and the person can take action quickly.

FIGURE 20: Unsafe Conditions List

When the user add new item in the list, a new window appeared as in Figure 21. The metadata information needed to report is the title, report No, description, location and most important is the person who need to take action as illustrated in Figure 21. User need to select the person from the list provided and this function allows notification to be sent directly to the person. As a result, the person responsible will take action quickly.

FIGURE 21: Unsafe conditions metadata

4.3.5 Discussion forum

A discussion forum is another added functionality, which allow user to exchange opinion and discuss any topics related to their interest. Besides, in this discussion forum, all users can discuss any lessons learned gained from their experiences. Different types of user will respond and share their experiences, insights and solution to the problem. This platform thus allows users to communicate the risk throughout entire organization and benefit from exchanging opinion. Users were also allowed to attach pictures as pictures can describe a whole overview of accidents/ incidents. The sample of discussion forum was illustrated in Figure 22.

FIGURE 22: Discussion forum in HSELLS

By pressing the reply button, user can comment any feedbacks and review on the current post as illustrated in Figure 23. This will certainly allow users to use their tacit knowledge in handling similar type of accident and share their experiences with others. Thus, discussion forum will certainly help reducing risk in UTP.
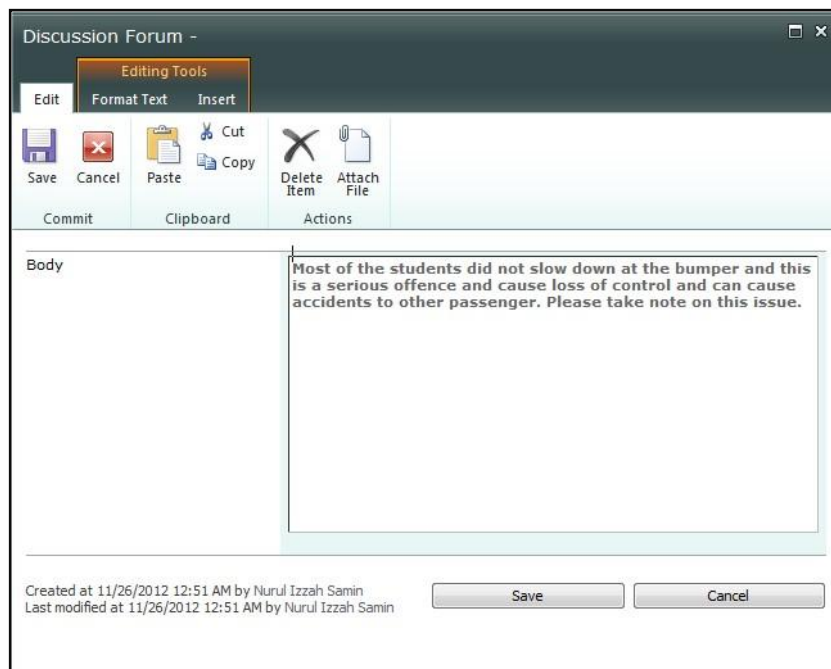

FIGURE 23: Replying for discussion forum

43

4.4   User Acceptance Testing (UAT)

After deliverables of the HSELLS prototypes were made, a user acceptance testing were scheduled with HSE manager, Mr Suhaidi Mustafa. This formal testing were done to identified user needs, requirements, and business processes conducted satisfies the acceptance criteria and thus enabling HSE manager to determine whether or not to accept the system. The steps taken for User Acceptance Testing typically involve one or more of the following:

4.4.1   User Acceptance Test (UAT) Test Plan

In the first step of developing test plan for HSELLS, the test plan in intended to verify and ensure HSELLS meets its requirements guided by HSE department, UTP. The UAT Test Plan outlines the User Acceptance Testing Strategy and describes the key focus areas, entry and exit criteria. In User Acceptance Testing Stategy, functional testing ensures that the system correctly performs its intended function for uploading and updating document libraries for lessons learned document. This functionality will be tested against use cases, the actor of HSE admin and the user of HSELLS, Primary & Alternate Flow for uploading document, and business rule should be validated in testing to ensure that the functionality satisfies the use case diagram set in Figure 6. For entry criteria, it allows the testers the plan the testing activities and this activities includes:

- integration testing signed off should be received.
- Business requirements and functional requirements have been met by HSE department
- UAT test cases are ready for execution.
- UAT testing environment should be ready.
- Necessary access for testing should be obtained.
- No critical bugs should be present in Sharepoint Foundation
- All the modules committed for testing should be tested and test report should be handed over to client.

The exit criteria for HSELLS UAT were no critical defects found or minimum outstanding medium priority defects should be found, business process is workings satisfactorily and UAT sign off meeting with all stakeholders.

4.4.2 Designing User Acceptance Test Case

The User Acceptance Test Cases help the author to test the application thoroughly starting from the login process until user successfully uploaded document and logout through the system . This also helps ensure that the UA testing provides sufficient coverage of all the UAT scenarios. The test case is described in the table

TABLE 1: User Acceptance Test Case for HSELLS

User Role	Test Description (Intention)	How to Test	Result (User Feedback)
Administrators	Uploading document to the Health Document Library	1. From a page, in the quick launch, navigate to the **Health on the left side panel**. 2. On the page, click "Upload" or "Add Document" to add document in Health document libraries 	Users are able to navigate between Health document library and user have successfully uploaded document in the system.

3. A windows will appear, asking user to upload document, click **Browse** to choose desired document and click **OK.**
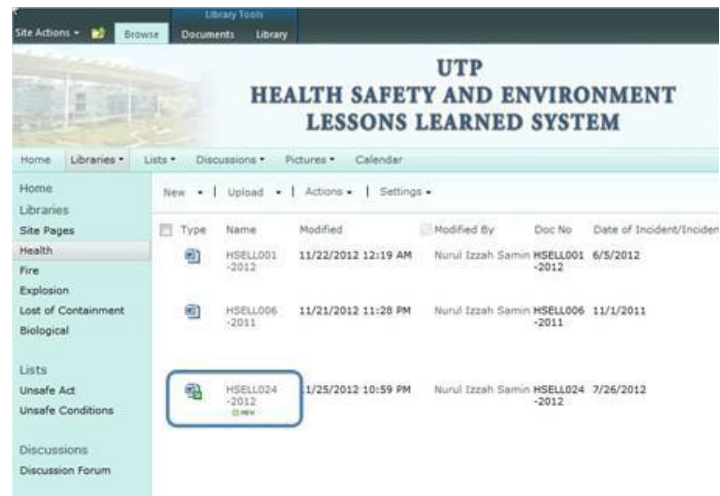

4. Another window will appear, prompt user to enter metadata and knowledge attributes to the document.
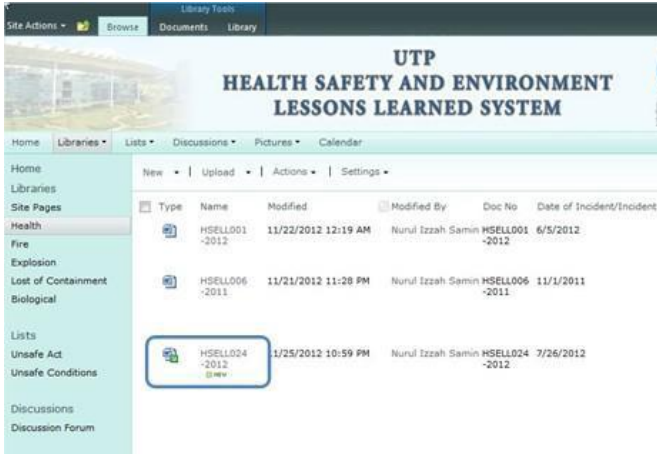
5. When you have finished filling the information including compulsory fields label with *, click **Save**
6. New document is successfully uploaded into the system and label "NEW.

Administrator	Filter document	1. To filter document according to the **DATE OF INCIDENT/ACCIDENT,** click on the row of date "**Date of Incident/Accident**" and choose 11/01/201	Users are able to filter document according to its date.
Administrator	View document	1. To view document, click on the "HSELL024-2012", user will be navigate directly through Microsoft Word.	The bugs identified when user try to view document directly from the system, but errors occurred saying that "unable to view document".

4.4.3 Documenting the Defects found During UAT and Resolving the Issue/Bug Fixing

The bug found during user testing with HSE manager, Mr Suhaidi were recorded for resolving issue purposes. The defects found in viewing document were caused by "Versioning" features added to the document. The "Version" features is intended to track any changes made to the document. Due to this bug, author has to remove this function to allow users to view document. If version features not removed, user can still download a copy of the lessons learned document by viewing the property and download a copy to the system instead of view the document directly to the system.

4.4.4 Sign Off

Upon successful completion of the User Acceptance Testing and resolution of the issues, the sign off generally indicates the acceptance of HSE Lessons Learned System. Once the HSE Admin has "Accept" the System delivered, this indicate that the software meets their requirements. Additional feedback on the added functionality were point out from HSE admin. This includes allowing user to search document according to the titles, or description provided in the metadata. This will certainly help users to find their desired lessons learned document more faster and efficient. This point were taken and considered for future planning of development of HSELLS.

4.5 Chapter Summary

In the result and discussion chapter, it highlights the overall actual system development process being carried out in this project based on the guidelines laid out in the System Development Life Cycle (SDLC) methodology. This project has successfully completed the initial requirements gathering stage in which all system features has been successfully included into the prototype. The initial requirements were gathered using different toolds of interviewing and document analysis. Upon the completion of initial prototype, ongoing engangement session with users were

made in order to obtain feedbacks for further refinery process on the initial prototype. In general, the core functionality of the prototype has been successfully developed while additional features and functionalities provide added value to the prototype. The discussion forum and reporting of unsafe risk and condition has provide greater value in disseminating risk and lessons learned in UTP. Overall, the prototypes developed had successfully fulfill the most crucial functionalities in managing and recording Lessons Learned document alhtough the comprehensive system as an expected solution would require more time beyond the given time constraints.

CHAPTER 5

CONCLUSIONS

5.1   Relevancy to the Objectives

The emergence of knowledge management with enterprise risk management provides greatest value in managing risk across organization. Many researchers agree that a company cannot manage its risk today without managing its knowledge. The findings obtained from preliminary investigation being conducted in HSE UTP, revealed similar issue, inefficiencies of the current process in recording risk as lessons learned. Thus, there is a need for a system to assist HSE UTP in making their risk learnable by avoiding mistakes and repeating success from lessons learned document. The development of this project is hoped to contribute to that purpose while ensuring risks are communicated throughout the organization.

A preliminary investigation and gathering of user requirement were done by interviewing HSE expert, while identifying the weakness of the current implementation. The current implementation for recording lessons learned documents were done manually in hard copy and there were no platform for users to share the document. This project is intended to improve the current process in monitoring and reviewing the risk, to become a platform for user in retrieving, downloading, and response to the risk from the lessons learned document. At the end of this project, a proposed HSE UTP Lessons Learned System has been successfully developed in addressing the issue of weak communication of risk throughout the organization. A functional working prototype that has the capabilities in managing document together with added features of discussion forum and reporting unsafe act and condition has been proved to provide value in managing risk.

5.2   Future Work

In light of turning the system implementation into reality, this project will be continued its development stage by including several functionalities such as search function. This search function allow user to find desired document according to its taxonomies. A proper workflow is proposed to allow the document to be reviewed and comment from HSE admin before submit the document to the system. It is hoped from the system delivery, should it be continued in becoming a system that could assist in decision making processes in HSE department and throughout the organization.

5.3   Final Remark

The importance of managing risk with knowledge management is effective ways for ensuring risk were being disseminated throughout the organization. The completion of this project is hoped to contribute to that purpose with added value of knowing that UTP do has the capability to produce such system that will also contributes in corporate sustainability of its organization. This project has significantly give significant impact to the author for much had been learnt in dept on how to develop a system in accordance to user's requirement.

REFERENCES

Al-Alawi, A.I, Nayla Y.Al-M & Yasmeen F.M. (2007). Organizational Culture and Knowledge Sharing; Critical Success Factors, Journal of Knowledge Management, 11(2), 22-42.

Beasley et. al (2009) Strengthening Enterprise Risk Management for Strategic Advantages

Becerra-Fernandez, I. and Sabherwal, R., "Knowledge Management: Systems and Processes", M.E. Sharpe, Inc., 2008.

Ben S Bernanke (2009) Chairman, Fed. Reserve, Adress at the Federal Reserve Bank of Chicago's Annual Conference on Bank Structure and Competition (May 7,2009) (transcript   retrieved   from http://www.federalreserve.gov/newsevents/speech/bernanke20090507a.htm)

Chan, J. 2009 "Integrating Knowledge Management and Relationship Management in an Enterprise Environment", Vol 9, Issue 4, pp 26-5

Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2004. Enterprise risk management anizations of the Trea American Institute of Certified Public Accountants, Jersey City, NJ (2004)

Dataware Technologies (1998) *Seven Steps to Implementing Knowledge Management in Your Organization*. pp 4-32

Davenport, Thomas H. (1994), Saving IT's Soul: Human Centered Information Management. Harvard Business Review, March-April, 72 (2)pp. 119-131. Duhon, Bryant (1998), It's All in our Heads. Inform, September, 12 (8).

Davenport, Thomas H., and Lawrence Prusak. 1998. *Working Knowledge: How Organizations Manage What They Know*. Cambridge, MA: Harvard Business School Press.

Dickinson, G. 2001. "Enterprise Risk Management: Its Origins and Conceptual Foundation." The Geneva Papers on Risk and Insurance 26(3): 360–366.

Ganesh D. Bhatt, (2001),"Knowledge management in organizations: examining the interaction between technologies, techniques, and people", Journal of Knowledge Management, Vol. 5 Iss: 1 pp. 68 – 75

Harner, Michelle M., Barriers to Effective Risk Management (2010). Seton Hall Law Review, Vol. 40, p.1323,2010; U of Maryland Legal Studies Research Paper No. 2010-25.

James,W. (2005) Enterprise Risk Management: Practical Implementation Ideas

Lili Wang, Hailiang Wang, & Keyi Wang. (2010). The investigation analysis on knowledge-sharing barriers and incentives of university scientific research and innovation teams. *Management and Service Science (MASS), 2010 International Conference on,* pp. 1-4.

Marakas, G.M. (1999), Decision Support Systems in theTwenty-first Century, Prentice-Hall, Englewood Cliffs, NJ.

Marshall, C., Prusak, L. and Shpilberg, D. (1996), ''Financial risk and the need for superior knowledge management'', California Management Review, Vol. 38 No. 3, pp. 77-102.

Martin, P.K (2012) Office of Audits. Review of NASA Lessons Learned System

McElroy, M.W. (2003), The New Knowledge Management: Complexity, Learning and Sustainable Innovation, KCMI Press, Amsterdam.

Mischen, P.A. and Jackson, S.K. (2008), ''Connecting the dots: applying complexity theory, knowledge management and social network analysis to policy implementation'', Public Administration Quarterly, Vol. 32 No. 3, pp. 314-39.

NASA, 6 Aug 2008 < http://www.gao.gov/new.items/d011015r.pdf>

Neef, D. (2005), ''Managing corporate risk through better knowledge management'', The Learning Organization, Vol. 12 No. 2, pp. 112-24.

Nonaka, I, Toyama, R., & Konno, N. (2000). SECI, Ba and Leadership: A Unified Model of Dynamic Knowledge Creation. Long Range Planning, 33(1), 5-34.

Peter Massingham, (2010) "Knowledge risk management: a framework", Journal of Knowledge Management, Vol. 14 Iss: 3, pp.464 – 485

Rittenberg,L & Martens,F (2012). Enterprise Risk Management : Understanding and Communicating Risk Appetide.

Rob Mitchell (2011) Ascending the Maturity Curve Effective Management of Enterprise and Compliance, Economist Intelligent Unit, March 2011.

Rodriguez, E. (2008a) A bottom-up strategy for a KM implementation at EDC Export Development Canada. Chapter 10 in Making Cents Out of Knowledge Management

Shaari, R. (2009). Human Resource Development and Knowledge Sharing Practices Among Academicians In Malaysian Public Universities. Unpublished PhD, Universiti Teknologi Malaysia, Johor Bharu.

Steinberg.et al (2004) Enterprise Risk Management - Integrated Framework Suhaidi Mustafa, Manager of Health Safety and Environment, UTP. Personal Interview, April 20, 2012

Sanjaya De Zoysa, Alan D. Russell. (2003) Knowledge based risk identification in infrastructure projects[J]. Can.J.Civ, Eng,30(3): 511-522.

Stephanie (2011). Aligning People, Processes and Technology in Knowledge Management. *2011 Ark Conferences on,* pp. 1-4

Tah, J. H. M., & Carr, V. (2001). Towards a framework for project risk knowledge management in the construction supply chain. *Advances in Engineering Software, 32*(10–11), 835-846.

The Public Risk Management Association & The Association of Insurance and Risk Manager. " a Structured Approach to Enterprise Risk Management (ERM) and the requirement of ISO 31000

U.S. Army. (1997). *Center for Army lessons learned handbook, 97-13.* Fort Leavenworth, KS: Author.

Verhaegen, T. (2005), ''Knowledge makes risks manageable'', Business Insurance: Industry Focus, Vol. 3, pp. 16-17.

Weber, R., Aha, D.W., & Becerra-Fernandez, I. (2000b). *Intelligent lessons learned systems.* To appear in *International Journal of Expert Systems Research & Applications.*

Xu Hui, & Wan Yi-qian. (2009). Risk identification and measure based on data analysis ——take internationalization risk as an example. Management Science and Engineering, 2009. ICMSE 2009. International Conference on, pp. 134-140.