Development of Student Centred Knowledge Management System Based in a Higher Education Institution

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Development of Student Centred Knowledge Management System Based in a Higher Education Institution

Chong Liu

A dissertation submitted in partial fulfilment of the requirements of
Dublin Institute of Technology for the degree of
M.Sc. in Computing (Knowledge Management)

June 2012
I certify that this dissertation which I now submit for examination for the award of MSc in Computing (Knowledge Management), is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Dublin Institute of Technology and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institute’s guidelines for ethics in research.

Signed: ____________________________

Date: 11 June 2012
ABSTRACT

With the emergence of a knowledge society and of information technology, knowledge has become a key resource to develop a sustained economy. It is a vital word in the Knowledge Management area (Awad & Ghaziri, 2004). Knowledge Management has also become vital to help knowledge organizations seek a competitive advantage. It also encourages members of organization to share knowledge and improve the organization’s efficiency, performance, and competitiveness (Shin, 2004). Therefore, an increasing number of organizations have realized the necessity of knowledge management. Especially, the Higher Education Institute (HEI) as the extraordinary “business” will be suitable for implementing knowledge management approaches and activities to have a competitive advantage in the “education market”.

The head of HEI realizes the challenges that knowledge organization brings. The challenges include: the intensive knowledge needed to manage; activities involved in knowledge creation, dissemination, and learning; preferred activities of students. Knowledge Management System (KMS) is a platform to support the KM processes to provide better services for students, staff, and faculties. It is established through information technology and mechanisms. The KM processes consist of knowledge discovery, capture, sharing, and application. Knowledge discovery and capture can convert between tacit and explicit knowledge; then the knowledge is stored in the repositories; after that, knowledge sharing occurs between partners, departments, and individuals; the knowledge application can provide better applications to support decisions.

MSc in computing is one of programmes in School of Computing within DIT. This research will attempt to develop and evaluate a KM system that will help HEIs be a ‘knowledge organization’. Due to the timescale required for implementation, it will be for a small group of students on the same programme in the same HEI. While the findings will be analyzed and reviewed in the wider research context, they will be restricted by this timescale.
Key words: Knowledge, Knowledge Management, Knowledge Management System, Higher Education Institute, knowledge organization
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# TABLE OF CONTENTS

ABSTRACT .................................................................................................................. II

TABLE OF FIGURES .................................................................................................. VIII

TABLE OF TABLES ................................................................................................... XIII

1. INTRODUCTION ....................................................................................................... 1

1.1 PROJECT INTRODUCTION .................................................................................. 1
1.2 BACKGROUND ..................................................................................................... 2
1.3 RESEARCH PROBLEM ....................................................................................... 3
1.4 INTELLECTUAL CHALLENGE ............................................................................ 4
1.5 RESEARCH OBJECTIVES .................................................................................... 4
1.6 RESEARCH METHODOLOGY ............................................................................. 5
1.7 RESOURCES ........................................................................................................ 5
1.8 SCOPE AND LIMITATIONS .............................................................................. 6
1.9 ORGANISATION OF THE DISSERTATION ....................................................... 6

2 KNOWLEDGE MANAGEMENT ........................................................................... 8

2.1 INTRODUCTION ..................................................................................................... 8
2.2 KNOWLEDGE ....................................................................................................... 8
2.3 TYPES OF KNOWLEDGE .................................................................................... 11

2.3.1 Tacit Knowledge & Explicit Knowledge ......................................................... 11
2.3.2 The Spiral of Knowledge ............................................................................... 14
2.3.3 Declarative Knowledge VS Procedural Knowledge ...................................... 15
2.3.4 General Knowledge VS Specific Knowledge ............................................... 15
2.3.5 Combination of Knowledge .......................................................................... 16

2.4 KNOWLEDGE MANAGEMENT ........................................................................ 18

2.4.1 Knowledge Management Definition ............................................................. 18
2.4.2 Benefits of KM ............................................................................................. 21
2.4.3 The Role of Technology in Knowledge Management ..................................... 22

2.5 KNOWLEDGE MANAGEMENT SYSTEMS .................................................... 25

2.5.1 Introduction ................................................................................................... 25
2.5.2 The Four Sub-Systems of KMS .................................................................... 26
5.3.4 Timetable ................................................................. 113
5.3.5 Forum ........................................................................ 114
5.3.6 Learning Journal ......................................................... 115
5.3.7 Reuse .......................................................................... 116
5.4 CONCLUSION .................................................................. 117

6 EXPERIMENTATION & EVALUATION ................................ 118
6.1 INTRODUCTION ................................................................ 118
6.2 EXPERIMENTATION ............................................................. 118
6.3 USER EVALUATION .............................................................. 118
6.3.1 Basic Information ............................................................ 119
6.3.2 Facilities ........................................................................ 119
6.3.3 Interface ......................................................................... 125
6.3.4 Preferences .................................................................... 126
6.4 KEY FINDINGS FROM EVALUATION ................................ 127
6.5 CONCLUSION .................................................................... 128

7 CONCLUSION ..................................................................... 129
7.1 INTRODUCTION ................................................................. 129
7.2 RESEARCH DEFINITION & RESEARCH OVERVIEW ............ 129
7.3 CONTRIBUTIONS TO THE BODY OF KNOWLEDGE ............. 130
7.4 EXPERIMENTATION, EVALUATION AND LIMITATION ......... 131
7.5 FUTURE WORK & RESEARCH ............................................. 131
7.6 CONCLUSION .................................................................... 131

BIBLIOGRAPHY ..................................................................... 133

APPENDIX A — KNOWLEDGE MANAGEMENT SYSTEM PRE-SURVEY 141

APPENDIX B — KNOWLEDGE MANAGEMENT SYSTEM EVALUATION
FORM ..................................................................................... 145
### TABLE OF FIGURES

**FIGURE 2.1** Knowledge Pyramid (Awad & Ghaziri, 2004) ........................................... 10

**FIGURE 2.2** The Pyramid (IFRCRCS, 2005) ................................................................. 11

**FIGURE 2.3** Tacit and Explicit Knowledge (Kidwell, Vander Linde & Johnson, 2000) ......................................................................................................................... 13

**FIGURE 2.4** The Spiral of Knowledge (Nonaka & Takeuchi, 1995) ......................... 14

**FIGURE 2.5** Diagram of Different Types of Knowledge (Milton, 2007) ................. 16

**FIGURE 2.6** Knowledge Management Processes (Becerra-Fernandez & Sabherwal, 2010) .................................................................................................................. 20

**FIGURE 2.7** Knowledge Management .................................................................... 23

**FIGURE 2.8** Knowledge Management Scope (Colman, 2011) ........................... 23

**FIGURE 2.9** The Visible & Invisible Knowledge ....................................................... 24

**FIGURE 2.10** An Overview of Knowledge Management Solutions (Becerra- Fernandez, Gonzalez & Sabherwal, 2004) ................................................................. 26

**FIGURE 2.11** Knowledge Codifications in the KM System Life Cycle (Awad & Ghaziri, 2004) ................................................................................................................. 29

**FIGURE 2.12** Techniques for Capturing Different Types of Knowledge (Milton, 2007) ....................................................................................................................... 32

**FIGURE 2.13** Knowledge Sharing in KM System Building Life Cycle (Awad & Ghaziri, 2004) .............................................................................................................. 35

**FIGURE 2.14** Differences between CBR and Rule-Based Reasoning (Awad & Ghaziri, 2004) ............................................................................................................... 37

**FIGURE 3.1** Conceptual Portal Framework (Mansourvar, M. & Mohd Yasin, N., 2010) .......................................................................................................................... 50

**FIGURE 4.1** Questions related to Explicit & Tacit Knowledge ......................... 57

**FIGURE 4.2** Questions related to General and Specific Knowledge ............... 58

**FIGURE 4.3** Questions related to Declarative & Procedural Knowledge ...... 58

**FIGURE 4.4** Questions related to Explicit & Declarative Knowledge Overlapping ................................................................................................................................. 59
FIGURE 4.5 QUESTIONS RELATED TO TACIT & DECLARATIVE KNOWLEDGE OVERLAPPING........................................................................................................... 59

FIGURE 4.6 QUESTIONS RELATED TO TACIT & PROCEDURAL KNOWLEDGE OVERLAPPING........................................................................................................... 60

FIGURE 4.7 QUESTIONS RELATED TO EXPLICIT, GENERAL & DECLARATIVE KNOWLEDGE OVERLAPPING........................................................................................................... 60

FIGURE 4.8 QUESTIONS RELATED TO TACIT, GENERAL & DECLARATIVE KNOWLEDGE OVERLAPPING........................................................................................................... 61

FIGURE 4.9 QUESTIONS RELATED TO TACIT, SPECIFIC & PROCEDURAL KNOWLEDGE OVERLAPPING........................................................................................................... 61

FIGURE 4.10 Q1 RESULTS...................................................................................... 63

FIGURE 4.11 Q2 RESULTS...................................................................................... 63

FIGURE 4.12 Q3 RESULTS...................................................................................... 64

FIGURE 4.13 Q4 RESULTS...................................................................................... 64

FIGURE 4.14 Q5 RESULTS...................................................................................... 65

FIGURE 4.15 Q6-1 RESULTS.................................................................................... 66

FIGURE 4.16 Q6-2 RESULTS.................................................................................... 66

FIGURE 4.17 Q6-3 RESULTS.................................................................................... 67

FIGURE 4.18 Q6-4 RESULTS.................................................................................... 67

FIGURE 4.19 Q6-5 RESULTS.................................................................................... 68

FIGURE 4.20 Q6-6 RESULTS.................................................................................... 68

FIGURE 4.21 Q6-7 RESULTS.................................................................................... 69

FIGURE 4.22 Q6-8 RESULTS.................................................................................... 69

FIGURE 4.23 Q6-9 RESULTS.................................................................................... 70

FIGURE 4.24 Q6-10 RESULTS................................................................................ 70

FIGURE 4.25 Q6-11 RESULTS................................................................................ 71

FIGURE 4.26 Q6-12 RESULTS................................................................................ 71

FIGURE 4.27 Q6-13 RESULTS................................................................................ 72

FIGURE 4.28 Q6-14 RESULTS................................................................................ 72

FIGURE 4.29 Q6-15 RESULTS................................................................................ 73

FIGURE 4.30 Q6-16 RESULTS................................................................................ 73

FIGURE 4.31 Q6-17 RESULTS................................................................................ 74

FIGURE 4.32 Q6-18 RESULTS................................................................................ 74

FIGURE 4.33 Q6-19 RESULTS................................................................................ 75
TABLE OF TABLES

TABLE 2.1 Combination of three different types of knowledge (Becerra-Fernandez, Gonzalez & Sabherwal, 2004) ................................................................. 18
TABLE 2.2 Knowledge Acquisition Activities (Gaines, 2001) ........................................ 33
TABLE 2.3 CoPs Connect to Spiral of Knowledge ............................................................. 36
TABLE 3.1 The steps describing the four phases (Tiwana, 2002) ................................. 40
TABLE 3.2 Comparison between Web Site and Web Portal (Azarbarzin, 2008) 48
TABLE 4.1 The summary of student’s requirements, solutions & description. 99
1. INTRODUCTION

1.1 Project Introduction

In the 21st century, high speed development of information technology (IT), knowledge has become more and more important. Global economies and Ireland in particular, are currently engaged in a knowledge revolution evolving from a manufacturing to a service base fuelled by technological advances\(^1\). As expressed by Drucker (1993), knowledge is the only meaningful resource today; the traditional ‘factors of production’ have not disappeared, but they have become secondary. Generally, it is classified by tacit and explicit knowledge. The tacit knowledge is difficult to share. *Tacit knowledge represents what we know but cannot express in its full form* (William & Amin, 2006).

The intensive knowledge exists in different kinds of organizations. In the competitive society, delivering valuable services has become more critical in the organizations. Also, knowledge management (KM) can help organizations to gain competitive advantage through knowledge sharing. *KM is the acquisition, sharing and use of knowledge within organizations, including learning processes and management information systems* (Civi, 2000). The activities of KM in the organization include: discover new knowledge, capture existing knowledge, share knowledge and reuse knowledge.

The focus of this project is to develop a knowledge management system (KMS) based on Higher Education Institutions (HEI) opinion. HEI, as the intensive knowledge organization and the knowledge coming from multiple resources, should have their own system to explore, manage and share knowledge in order to provide better services for users. HEI should continue to improve their existing operating models and

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should understand the appropriate procedures of searching, storage, duplication, and application in order to gather necessary knowledge (Richard, 2001). A KMS is the collector of knowledge capture, knowledge sharing, knowledge learning and knowledge creation which are a number of KM tasks. Therefore, the KMS will play a key role to make better services in HEI.

1.2 Background

In the ‘knowledge society’, KMS has become a necessary part of ‘knowledge organization’. As the expressed by Maier (2002), KMS is an information and communication technology (ICT) system in sense of an application system or an ICT platform that combines and integrates functions for the contextualized handing of both, explicit and tacit knowledge, throughout the organization or that part of the organization that is targeted by a KM initiative. It is different from traditional ICT system. As the described by Maier (2002), the KMS has its own characters:

- **Contextualized combination and integration of functionality**
  
  *KMS will combine and integrate existing functions. E.g.: For the publication, organization, visualization, distribution, search and retrieval of both explicit and tacit knowledge. KMS functions provide the link between explicit and tacit knowledge.*

- **Integration of intelligent functions**
  
  *KMS will integrate intelligent functions, such as analysis, mining of texts, intelligent search agents and so on.*

- **Matching with KM initiatives**
  
  *In order to motivate an effective and efficient use of the KMS, the KM initiatives have to embed the KM system. Therefore, KMS are designed “with KM in mind”.*

HEI is a special “business”, and it has a unique culture which is intensive knowledge from multiple resources in HEI. Due to this unique culture, the knowledge management has become more and more important, and the knowledge management approaches and activities are also suitable for implementing in HEIs. Rowley (2000) expressed higher education institutions are in the knowledge business, since they are involved in knowledge creation, dissemination, and learning. HEIs generate the
extraordinary quantity of knowledge, but they try to keep pace with digital revolution and seek competitive advantage in “educational market”. Also HEIs need to enhance the services and support to do “business” — students want to use the IT facilities to search, learn, and share knowledge through internet; Faculty wants to assess learning outcomes; staff wants to create their own web pages to manage the knowledge and share it with other learners. The knowledge management systems (KMS) as a platform is to explore, manage and share knowledge in order to provide better services for students, faculty, staff, and other partners. Nowadays, many HEIs are using web portal as a type of KMS to provide best practices and services for users who want to use information technology.

This project is focusing on develop a KM system for a specific programme in DIT. Dublin Institute of Technology is one of the famous and proud historic institutions; it has been recognized as a pioneer in the technological higher education. DIT is also authorized to confer its own awards. It is one hundred and twenty year old. Until 2012, there are more than 10 thousand students including part-time, full-time and remote learning in DIT. However, there is no real knowledge management system (KMS). This research project seeks to examine the case study how the KMS worked in Open University and to build a KMS to meet the requirements of users in Master of Science in Computing. To perform this research, the KM techniques will play the key role.

1.3 Research problem

The aims of this project are to investigate the requirements for KMS in a HEI, and to identify the benefits to introducing a KMS into a HEI, and to test findings through the development of KMS for a single programme in a single HEI.

Dublin Institute of Technology (DIT) is one of HEIs in Ireland; it is one of the famous and proud historic institutions; and it has been recognized as a pioneer in the technological higher education. DIT is also authorized to confer its own awards. It is one hundred and twenty year old. Until 2012, there are more than 10 thousand students including part-time, full-time and remote learning in DIT. These students are distributed in four mainly colleges. Therefore the kinds of digital online systems are
also standing in these four colleges. However, there is no real knowledge management system (KMS) in DIT.

The first part of research is to establish the management of knowledge within HEI. This research will identify:

- Types of Knowledge managed in HEI
- Types of KMS/Tools used to manage knowledge in HEI
- Extent to which KMS are currently used and have been used

From this a requirements derivation will be designed to support the development of a KMS within the MSc in Computing in DIT School of Computing from a student perspective. To design an effective KMS requires that the user of the system be central to the derivation. The requirements derivation will involve the knowledge capture approach: questionnaire.

### 1.4 Intellectual challenge

The development of KM system in this project will be implemented. Based on the following intellectual challenges:

- Understanding what a KM is
- Understanding what a KM system is
- Researching KM system case studies in open university
- Understanding how KM system works
- Analyzing the critical feedback from lectures and students
- Exploring and learning how to develop a website by a free host
- Understanding how to use the research instruments such as interviews & questionnaires

Critically analyzing the experiment results in order to draw scientifically valid conclusions

### 1.5 Research objectives

The following objectives have been achieved throughout the dissertation and contributed to the overall outcome:
• Identify the types of knowledge students needed and when they needed
• Identify the best practice in the area of student oriented KMS in HEIs
• Identify the benefits to introducing KMS in a HEI
• Derive a set of requirements for a student to design KMS
• Build a KM system for Master of Science in Computing
• Evaluate the KM system by deploying for use by a small student group

1.6 Research methodology

For the purposes of this research project, primary and secondary research was conducted in this project.

Secondary research includes a literature review to identify case studies of the implementation knowledge management tools and systems within HEIs.

From an analysis of the output of this review, the types of knowledge managed, type of tools and systems used and barriers and enablers to the introduction of KMS in HEIs identified. This forms the foundation of the primary research conducted.

A series of surveys was created which were used to find out the requirements of students and to understand what type of things the KMS can deal with, and to make sure what knowledge it should manage for this group of users. Critical analysis of the results from these surveys that that were used to develop a design to fit the user needs.

After building a KM system, the system was deployed for use and online evaluations conducted to evaluate the accessibility, flexibility and robustness of KM system.

1.7 Resources

The following resources were used to complete this research project:

- Project Supervisor Guidance: Weekly meeting and regular discussions. Help of the project supervisor was the most important and it was the key element to complete project successfully.
- DIT Master of Science in computing group: Master of Science in computing group was the critical interviewees to complete the research.
Research on KM systems case studies of Open University via website

DIT library services support – Access to IEEEXplore library (E-tutor) to look for useful academic journals in order to complete the research. Also the book borrowing and print services were used.

Google Scholar was used to search useful and latest literature

Survey software: the online survey tool was necessary to evaluate the KM system that was built for Master of Science in Computing. The survey tool was Google docs.

Microsoft office was used to complete the dissertation, particular in Microsoft word and Microsoft excel. The former was to conduct the document. The later was to perform the analysis.

1.8 Scope and limitations

The research will attempt to develop and evaluate a KM system that will help HEIs be a ‘knowledge organization’. Due to the timescale the implementation will be for a small group of students on the same programme in the same HEI. While the findings will be analyzed and reviewed in the wider research context, they will be bounded by this scope.

The main limitation for this project is the time. All the works involved surveys, design, build and evaluate KM system should be implemented within three months. Some skills and knowledge gaps needed to be bridged. The difficulty of looking for existing KM systems in Higher Education is that the systems needed to register. Also the online survey would happen in the evaluation part, and the key point was if the feedbacks could be gathered immediately.

1.9 Organisation of the dissertation

The dissertation was divided into seven chapters, and each chapter gave a brief description as follows:

CHAPTER TWO

This chapter will introduce the concept of knowledge, knowledge management, the different types of knowledge that exist in the HEI, both tacit knowledge and explicit knowledge, and highlighting the benefits that the organizations use them.
Finally, the knowledge management system will be introduced as four sub-systems.

CHAPTER THREE
This chapter will introduce the concept of ten-step road map. Describe the HEI environment and the KMS can bring to the HEI. List three case studies to identify what to do on developing KMS in this project.

CHAPTER FOUR
This chapter is about the design and analysis of survey. The design of survey is based on the case studies in chapter 3. Then it will analyze the gathered data. The results can bring to generate the blueprint that is for design KMS in chapter 5.

CHAPTER FIVE
This chapter is to design and build the KM system based on the analysis of case studies and survey findings that are reflecting the literature reviews of chapter 3 and 4.

CHAPTER SIX
This chapter is about the evaluation of the KM system that has set. It also conducts the online survey to make sure if the KM system can meet the requirements in chapter 4.

CHAPTER SEVEN
The conclusions of the research project will be presented. It includes objectives that the project achieves, the limitation and future work.
2 KNOWLEDGE MANAGEMENT

2.1 Introduction

Knowing ignorance is strength
Ignoring knowledge is sickness
—LAO TSU (Awad & Ghaziri, 2004)

In today’s competitive business environment, knowledge is the key resource for competitive advantage of many organizations. It helps them confront the challenges, and makes the better decision or solutions for their business. Drucker (1994) expressed: “Knowledge has become the key resource, for a nation’s military strength as well as for its economic strength.” The real issue is how to manage knowledge. During the processes of management, most organizations are trying to manage knowledge through computer; it is the transformation from file management to electronic management. Knowledge management has become more systematic and effective.

Firstly, this chapter introduces the concept of knowledge management and the benefits of knowledge management and addresses the issue of the role of technology in knowledge management. Then, it explains in detail what the knowledge is, and distinguishes knowledge from data and information. It also describes the normal way to classify the tacit and explicit knowledge. Finally, knowledge acquisition will be introduced, and some techniques of knowledge acquisition are discussed.

2.2 Knowledge

Awad & Ghaziri (2004) indicated that knowledge is the most vital word in the Knowledge Management (KM) area. So what is knowledge? Why is it quite distinct from data and information? What are the types of knowledge? Lots of research work will be displayed followed by.

There are many definitions of knowledge as well as KM. The list of some will be displayed as follow:
“Information, understanding and skills that you have gained through learning or experience”


Awad & Ghaziri (2004) defined knowledge as “understanding gained through experience or study”.

Liebeskind (1996) offered the definition “information whose validity has been established through tests of proof”.

Different meanings of knowledge were generated by the understanding in different domain. It should have own value. Obviously, it was distinct from data and information. “Knowledge, unlike information, is about beliefs and commitment (Nonaka & Takeuchi, 1995)”.

The following definitions were from Davenport & Prusak (2000):

Data — A discrete, objective fact about events

Information — Data that makes a difference

Knowledge — a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.

Awad & Ghaziri (2004) offered the knowledge pyramid. It was shown by Figure 2.1.
The information, knowledge and wisdom are all from data that is fundamental. It might be a raw number, or a fact. For example, Tom is forty years old. This is data; it does not have any meaning. However, if says, Tom is forty years old, he is older than his brother. This becomes information. In the real world data exists everywhere, and especially there are thousand millions of data in the organizations. So the organizations must transform data into information.

The top one is wisdom. It is not only the highest level of knowledge pyramid, but also it represents the action with vision, foresight and ability to see beyond the horizon (Awad & Ghaziri, 2004).

Based on hierarchical classification provided by IFRCRCS (2005), the pyramid also indicated the four levels (Figure 2.2):

- Data are basic facts and statistics with little ontological relationship.
- Information involves the description of physical and social situations by combining and interpreting quantities of data.
- Knowledge refers to the understanding of how things function.
- Wisdom is the ability of make decisions on the basis of principles, experience and knowledge.
In this dissertation, knowledge relates to everything that students need to know and use when they study in higher education. The challenge issues may include identifying knowledge, classifying it, and displaying it in a better way. The significant challenges around the institute as follow:

- College students don’t know what they all know
- College students don’t know what their classmates know
- Even if they do know, it is not easy to share with others.
- Even if they can share, it does not mean that others may learn from it or use the similar methods.
- College students don’t know where they can get the information they needed.
- Even if they do know, it is not easy to find out in a straight way.

2.3 Types of Knowledge

2.3.1 Tacit Knowledge & Explicit Knowledge

Knowledge can be classified into a variety of types. Here the common classification of knowledge named tacit and explicit knowledge will be discussed. Nonaka and
Takeuchi (1995) first defined categories of knowledge as tacit and explicit knowledge. These are as follows (Becerra-Fernandez, Gonzalez & Sabherwal, 2004):

- Generally speaking, tacit knowledge is the knowledge embedded within the mind of people. It is difficult to capture and share. As William & Amin (2006) indicated, tacit knowledge represented what we knew but could not express in its full form. For example, in the higher education institution, a lecture works for over 15 years and gets rich experience in his domain. That can help him teach students in the excellent manner. Such knowledge would be tacit; unless the lecture diffused it in the form of the document that others can use and learn from it. The tacit knowledge is not ready to be transmitted in any systematic or logical manner. The trust is the vital element for employees to transfer tacit knowledge effectively. Trust supports the KM process by giving employees clear impressions that free exchange (Awad & Ghaziri, 2004). Once the tacit knowledge is shared, it becomes more flexible to reuse. For example, three students in Dublin Institute of Technology (DIT) discuss the specific topic about knowledge management. After that, they write the discussion results and form it into PowerPoint. Next, they make a presentation on their topic with PowerPoint. This is the knowledge sharing process that is tacit—explicit—tacit. The audiences can use the knowledge that is generated by three students in DIT again.

Many organizations encourage employees, customers, partners to share tacit knowledge using best practices. For instance, e-mail, meetings (face to face, remote), etc. 3M (Minnesota Mining and Manufacturing) corporation used the stories as part of its business planning to resolve the problems that faced in his business.

- In contrast, the explicit knowledge is knowledge that has been expressed into words and numbers. It may be formed in many structures. For example, the most common form of presenting explicit knowledge are in the form of data, documents, specifications, manuals, products, procedures (computer programs). The next level form of explicit knowledge may be drawings, audio and video tapes. Such knowledge can be shared formally and systematically. Obviously it is easily to be diffused and retrieved than tacit knowledge. In
modern organizations, the explicit knowledge is normally stored in data warehouse with high quality, reliable information systems. It is shared to others such as learners, partners, and colleagues, in order to improve the efficient working and avoid wasting the resources. Knowledge sharing means *effective transfer*, so that the recipient of knowledge can understand it well enough to act on it. Thus, it may take place among individuals as well as groups, departments, or organizations (Jensen & Meckling, 1996; Alavi & Leidner, 2001). Sharing knowledge is an important process in enhancing organizational innovativeness and performance.

Figure 2.3 shows the relationships, characteristics between explicit and tacit knowledge based on Kidwell, Vander Linde & Johnson (2000). The explicit knowledge exists in the organizations such as policies, products, strategies, processes, but the tacit knowledge exists like skills, experiences, relationships within and outside the organization. The two definitely different types of knowledge are all embedded in the work processes, as well as core systems and infrastructure. They are converting in the work processes, and help to guide actions and decisions. The conversion between tacit and explicit knowledge will be discussed in next section.

![Figure 2.3 Tacit and Explicit Knowledge (Kidwell, Vander Linde & Johnson, 2000)](image-url)
2.3.2 The Spiral of Knowledge

There is a challenge issue that how to convert between tacit knowledge and explicit knowledge. In the literature of “Spiral of Knowledge”, Nonaka & Takeuchi (1995) offered four integrated processes in knowledge creation: externalization, internalization, combination, and socialization. Figure 2.4 is shown that.

![The Spiral of Knowledge](image)

**Figure 2.4 the Spiral of Knowledge (Nonaka & Takeuchi, 1995)**

In the research of Becerra-Fernandez & Sabherwal (2010), the externalization, internalization processes occur in knowledge capture, and the combination, socialization processes occur in knowledge discover.

**Tacit to tacit — the Socialization Process**
In the socialization process, tacit knowledge is acquired and shared without being made explicit. In other words, the process is not capturing knowledge but sharing or discovering without forming documentation. For example, meetings, talking during coffee time, etc.

**Tacit to explicit — the Externalization Process**
In the externalization process tacit knowledge is transformed into explicit knowledge. That means the knowledge must be recording and codifying in papers, books, etc.
Explicit to Explicit — the Combination Process

This process is easy to implement. It is the process to produce new explicit knowledge through combine and reconfigure multiple sources of knowledge.

Explicit to tacit — the Internalization Process

This process is a part of knowledge capture processes. It is the process of learning by repetitively doing a task that absorbs the internal existing information (principles and procedures), and makes it to form newly knowledge which can lead to action.

2.3.3 Declarative Knowledge VS Procedural Knowledge

Based on literature Singley & Anderson (1989) and Kogut & Zander (1992), the first distinction for examination is between declarative knowledge and procedural knowledge. These are as follows (Becerra-Fernandez, Gonzalez & Sabherwal, 2004):

- Declarative knowledge focuses on beliefs about relationships among variables. For example, all other things being equal, greater price charged for a product would cause some reduction in its number of sales. Then it can be stated in the form of propositions, expected correlations, or formulas relating concepts represented as variables. And also it about ways in which things (concepts) are related to each other and their properties.

- Procedural knowledge focuses on beliefs relating sequences of steps or actions to desired (or undesired) outcomes. For example, the set of justified beliefs about the procedure that should be followed in a government organization in deciding on whom to award the contract for a particular area. Thus, procedural knowledge can be processes, tasks, activities and conditions under which tasks are performed.

- Generally speaking, declarative knowledge may be characterized as “know what”; in contrast, procedural knowledge may be viewed as “know how”.

2.3.4 General Knowledge VS Specific Knowledge

The final classification of knowledge that will talk about focuses on whether the knowledge is possessed widely or narrowly. These are as follows (Becerra_Fernandez, Gonzalez & Sabherwal, 2004):

- General knowledge is possessed by a large number of individuals and can be
transferred easily across individuals. For instance, knowledge about the rules of rugby in Ireland can be considered general, especially amongst fans of the game. It is found everywhere because the knowledge is relating to a basic understanding of rugby. Almost young people know rugby in Ireland, because it is the national game.

As Hayek (1945), Jensen and Meckling (1996) expressed, specific knowledge is possessed by a very limited number of individuals, and is expensive to transfer. There is a good example of distinction between a coach and typical fan watching a rugby game. The coach can filter the information from the game, and get the useful knowledge to help players win the game. Just few fans may have this knowledge. It can be classified by two types: technically specific knowledge and contextually specific knowledge. The former is deep knowledge about a specific area. It relates to knowledge that uses tools and techniques to confront the problems in the domain. Normally, some formal training needs this kind of knowledge. The latter refers to knowledge of particular circumstances of time and place in which work is to be performed (Hayek, 1945; O’Reilly & Pondy, 1979). It pertains to the organization and the organizational subunit within which tasks are performed.

2.3.5 Combination of Knowledge

![Diagram of different types of knowledge](Milton, 2007)
Although the previous classifications of knowledge are independent, they could be a whole in the complex reality. It seems to be easy to combine two types of knowledge (Explicit & Tacit, Declarative & Procedural) (Figure 2.5). These two pairs are outlined in previous section. Declarative knowledge could be explicit or tacit as well as procedural knowledge. If combining one more pair of knowledge (General and Specific), it would become more complicated. The table 2.1 indicated the combination of three different types of knowledge (Becerra-Fernandez, Gonzalez & Sabherwal, 2004). The declarative knowledge also could be explicit or tacit, and general or specific as well as procedural knowledge.
Table 2.1 Combination of three different types of knowledge (Becerra-Fernandez, Gonzalez & Sabherwal, 2004)

2.4 Knowledge Management

2.4.1 Knowledge Management Definition

Drucker was the first to suggest that the U.S. economy had shifted from production to knowledge (Drucker, 1969). KM has become main issue around the world in knowledge economic age with many researchers focusing on the area of Knowledge
Management (KM) in the latter half of the 20th century and into the 21st. KM is increasingly seen as a set of vital practices that are knowledge discovery, knowledge mapping, knowledge database, database mining, etc. It all related to keeping knowledge using tools or methodologies in a better way. KM can help the organizations obtain the recognition of customers, further to gain the competitive advantage over opponents. It also encourages an organization’s members to share knowledge and improves the organization’s efficiency, performance, and competitiveness (Shin, 2004).

Many definitions of Knowledge Management are used in research currently, three which are useful to the project discussed in this dissertation are:

Becerra-Fernandez & Sabherwal (2010, p. 40) gave a more detailed definition of KM that “defines as performing the activities involved in discovering, capturing, sharing, and applying knowledge so as to enhance, in a cost-effective fashion, the impact of knowledge on the unit’s goal achievement”.

Duffy (2000) defines Knowledge Management as “a set of business practices and technologies used to assist an organization to obtain maximum advantage from one of its most important assets — knowledge”.

Barclay and Murray (2012) indicate that “knowledge management often encompasses identifying and mapping intellectual assets within the organization, generating new knowledge for competitive advantage within the organization, making vast amounts of corporate information accessible, sharing of best practices, and technology…”

Despite the researchers have given different versions about definitions of KM, there are some integral parts:

- Processes/Activities
- Intellectual Components
- Knowledge as an asset
These definitions are listed because the researchers were talking about the KM as an active process using words activities, processes, technologies, etc. And the researchers mentioned that knowledge as an asset is the most important to the organizations.

Figure 2.6 shows KM processes (Becerra-Fernandez & Sabherwal, 2010) that consist of discovery, capture, sharing and application. Each process is supported by a set of subprocesses, such as combination, socialization, externalization, internalization, exchange, direction and routines. The definitions of four processes as below (Becerra-Fernandez & Sabherwal, 2010):

- **Knowledge Discovery**: to develop the tacit or explicit knowledge from data and information or from the prior knowledge.
- **Knowledge Capture**: to retrieve tacit or explicit knowledge that existing in people, artifacts or organizational entities.
- **Knowledge Sharing**: to communicate to other individuals about tacit or explicit knowledge. As the spread of internet technologies, knowledge sharing may occur between business partners, departments and personnel.
- **Knowledge Application**: to establish effective application in making-decision and task performance depends on the better processes of knowledge discovery, capture and sharing.

![Knowledge Management Processes](image)

**Figure 2.6 Knowledge Management Processes (Becerra_Fernandez & Sabherwal, 2010)**

These four KM processes can be implemented in the KM system which is a platform to provide better services for users. During this process, knowledge discovery and capture can convert between tacit and explicit knowledge; then the knowledge is stored in the
repositories e.g. databases, documentations, etc; after that, knowledge sharing occurs between partners, departments, and individuals through exchange and socialization; In addition, knowledge application can provide better applications to the decision support. Also they are the knowledge management activities.

2.4.2 Benefits of KM

KM activities or processes may include knowledge capture, sharing and business practices. Intellectual components may include knowledge (explicit and tacit), information and data. Achievement stands for improvement of competitive advantage within organization.

Bradley (1997, p. 54) expressed that “Today, knowledge is accumulating at an ever-increasing rate. It is estimated that knowledge is currently doubling every 18 months and, of course, the pace is increasing”. However, intensive disorganized knowledge can lead organizations or personnel to be far away from their achievement. Therefore, knowledge management can bring more benefits; especially for organizations. Becerra-Fernandez & Sabherwa (2010, p. 4) expressed based on Davenport and Prusak (1998) that “These benefits may include leveraging core business competencies, accelerating innovation and ... building sustainable competitive advantage”.

The benefits of introducing KM are many and varied and debated in research. Awad and Ghaziri (2004) that KM will achieve the following in the organizations:

- Make visible organizational knowledge
- Provides access to an organization’s collective expertise anywhere in the organization
- Retains the organizational knowledge in times of change
- Exploits knowledge as an organizational asset
- Do the ‘right’ thing rather than do something right
- Make sure knowledge is up to date and relevant
- Enables the survival of the organization
- Embeds knowledge in organization’s processes
However, the bad decisions can also lead in the organizations. Fahey & Prusak (1998) indicated the eleven deadliest sins of KM practices of organizations which lead to failed KM initiatives:

- Not developing a working definition of knowledge;
- Emphasizing knowledge stock to the detriment of knowledge flow;
- Viewing knowledge as existing predominantly outside the heads of individuals;
- Not understanding that a fundamental intermediate purpose of managing knowledge is to create a shared context;
- Paying little heed to the role and importance of tacit knowledge;
- Disentangling knowledge from its uses;
- Downplaying thinking and reasoning;
- Focusing on the past and the present and not the future;
- Failing to recognize the importance of experimentation;
- Substituting technological contact for human interface;
- Seeking to develop direct measures of knowledge;

2.4.3 The Role of Technology in Knowledge Management

Grant (2000) indicated the value of digital technology from a productivity perspective. The knowledge has not only been held by people, but also has been held by digital technology. The technology may provide the possibilities of knowledge replication. Grant suggests that “explicit knowledge offers greater potential for value creation because of its replicable potential.” And codification of turning tacit knowledge to explicit knowledge can also support the rapid rates of economic growth through replication technology. Moreover, it will accelerate as the new arrival of technology (Grant, 2000).

However, it is not enough to having the technology. People, who have knowledge and use new technology, play the vital role in KM. Normally it refers to employees in the organizations. Applying technology aims to help employees do an efficient job, further to improve organization’s innovations and competitiveness. As Awad and Ghaziri (2004, p. 22) said, “Over 80 percent of all technology-centred KM efforts have been known to fail because of a lack of attention to people (Whiting 1999).” And also the 70% component of KM is people, 20% is process, and 10% is technology.
KM involves people, technology and process in overlapping parts as follows (Figure 2.7):

![Knowledge Management](image)

**Figure 2.7 Knowledge Management**

Knowledge Management scope in the organization related to objectives of KM (Awad & Ghaziri, 2004) (Figure 2.8). Business, people and technology are the knowledge management scope. The objectives of KM include

a) Exploit organizational knowledge to be an asset.

b) Provide a system platform to make knowledge visible and accessible.

c) Establish a culture that makes employees share knowledge and trust each other.

![Knowledge management scope](image)

**Figure 2.8 Knowledge Management Scope (Colman, 2011)**
Sometimes, the KM processes do not only happen in individuals work, but also many take place in collective situations of social interaction. As Elkjaer (2003) observed, the individual and the organization are bound together by power relations, such that there is no distinction between solitary and collective knowledge. General speaking, the organizational knowledge consists of visible and invisible knowledge in the organization (Figure 2.9). Visible knowledge may encompass documents, products, productive processes, customers, partners and etc. Invisible knowledge may encompass ideas, experience, expertise and all the things contained in the mind of an expert and a knowledge worker. Davenport and Prusak (1998, p.5) expressed that in organizations, knowledge often becomes embedded not only in documents or repositories but also organizational routines, processes, practices, and norms.

![Figure 2.9 the Visible & Invisible Knowledge](image)

In the above three objectives, the organizational culture is the most important. Firstly, the organizational culture could be a belief, and could reflect the work attitude of employees. Next, to modify organizational culture can address the biggest challenge that KM vendor faces (Awad & Ghaziri, 2004). Last but not the least, the trust among employees has been not only a precedent condition for the organizational behaviours, but also it is the basis of organizational culture.
2.5 Knowledge Management Systems

2.5.1 Introduction

According to Becerra-Fernandez, Gonzalez & Sabherwal (2004), Knowledge Management Systems (KMS) are the integration of technologies and mechanisms that are developed to support the four KM processes, which are the broad processes that help in discovering, capturing, sharing and applying knowledge. It aims to help organizations manage knowledge, share and communicate knowledge more easily and accurately, such as ideas, photos, etc. KM Systems are more vital for organizations to seek competitive advantage. It also provides the platform to implement the knowledge management activities. Alavi and Leidner (2001) leaded three main objectives of KMS: firstly, to construct a knowledge infrastructure; secondly, to proactively search and present knowledge; finally, to make knowledge visible and show the position and function of knowledge in organizations. Davenport et al. (1998) expressed four broad types of KM Systems objectives in practice:

- Create a knowledge repository;
- Improve knowledge assets;
- Enhance the knowledge environment;
- Manage knowledge as an asset;

“KM system is simply a way of allowing employees to access the information they need instantly” (Sasson & Douglas, 2006). However, KM System is not simply to display the knowledge, but also is an active entity to meet the requirements of organizations/users. KM mechanisms are classified by short term and long term. Short term may include learning by doing and observation, or face to face meeting. Long term may include cooperative projects across departments, organizational policies, standards, the hiring of a chief knowledge officer, employ rotation across departments. KM technologies are the key component of KM system. It includes artificial intelligence (AI) technologies that used for knowledge acquisition and case-based reasoning systems, electronic discussion groups, computer-based simulations, decision support systems, enterprise resource planning systems, expert systems, information management systems, and knowledge management systems.
KMS is also one of the four broad levels in Knowledge Management (KM) solutions. Figure 2.10 shows the overview of knowledge management solutions. KM mechanisms and technologies support the KM systems and get benefit from the KM infrastructure.

![Diagram showing the overview of knowledge management solutions](image)

**Figure 2.10 An Overview of Knowledge Management Solutions (Becerra-Fernandez, Gonzalez & Sabherwal, 2004)**

### 2.5.2 The Four Sub-Systems of KMS

Go back the discussion about KM processes in chapter 2, the KM processes consists of knowledge discovery, knowledge capture, knowledge sharing and knowledge application. Based on these four KM processes supported, KM systems can be divided into four kinds of subsystems: knowledge discovery systems, knowledge capture systems, knowledge sharing systems and knowledge application systems (Becerra-Fernandez, Gonzalez & Sabherwal, 2004).

- Knowledge Discovery Systems provide the platform for developing the tacit or explicit knowledge from data and information or from the prior knowledge. In knowledge discovery systems, two integrated processes are given support:
combination (produces new explicit knowledge through combine and reconfigures multiple sources of knowledge) and socialization (produces new tacit knowledge without being made explicit). In other words, the process of knowledge discovery systems aims to discover and share the new tacit and explicit knowledge from multiple resources.

The mechanism of knowledge discovery system is to using socialization to create new tacit knowledge (Becerra-Fernandez, Gonzalez & Sabherwal, 2004). It is a common practice in many organizations. For example, Honda, which is one of the most famous companies in Japan, applied socialization to resolve the problems by “brain-storming” when they faced in research and development (R&D) (Nonaka & Takeuchi, 1995). Normally, the informal communication and meetings can also discover new tacit knowledge. For instance, simple discussions over lunch time among colleagues, classmates or friends, the topic might be daily problems, TV shows, and interesting stories and so on.

The technology of knowledge discovery system is to using data mining to create new explicit knowledge (Becerra-Fernandez, Gonzalez & Sabherwal, 2004). Data mining and knowledge discovery in databases have been attracting a significant amount of research, industry, and media attention of late (Fayyad, Piatetsky-Shapiro & Smyth, 1996). Data mining applies in many kinds of industries, such as marketing, retail, banking, and insurance, telecommunications, and operations management. For example, the main applications of data mining in banking are risk management, fraud detection, customer relationship management. The banking used data mining techniques to find useful information from intensive data. Bank of America wants to retain its best customers to identify opportunities to sell them additional services. The bank uses data mining technology to analysis the customer data and measure existing customers, in order to predict the trend of business strategies in the future. The Canadian Imperial bank of commerce (CIBC) has used data mining to manage it mortgage portfolio. They used models, data analysis and prediction to review late payers for their mortgage product. They wanted to forecast the warning of the possibility of bankrupt the late payer would be. In south eastern France, CELDA is one of the largest of France's 31 savings banks that uses data mining techniques and its data warehouse to answer many questions such as:
precisely who are our customers, what do they want and what are their buying patterns?

- Knowledge capture systems provide the platform to retrieve tacit or explicit knowledge that existing in people, artifacts or organizational entities. The following question is that what knowledge capture is. Awad & Ghaziri (2004) reviewed a list of literature and revealed as many definitions of knowledge capture. They defined knowledge capture as a process by which the expert’s thoughts and experiences are captured. Generally speaking, explicit knowledge may capture from databases, books, documentations and some ways that can make records. However, tacit knowledge may capture from experts, discussion over lunch time between colleagues/friends. Because tacit knowledge represents what we know but cannot express in its full form (William & Amin, 2006). The most difficult is to capture knowledge from expert. The methods to capture knowledge can be implemented in many ways. One of them got from Awad & Ghaziri (2004) was: (a) Using an appropriate tool to elicit information from the expert. (b) Interpreting the information and inferring the expert’s underlying knowledge and reasoning process. (c) Using the interpretation to build the rules that represent the expert’s thought processes or solutions. The capturing knowledge is the first step which the knowledge developers are addressed when they start the building process (Figure 2.11).
The main challenge in knowledge capture is to capture tacit knowledge. Converting tacit knowledge into explicit knowledge is the externalization process. According to Awad & Ghaziri (2004), there are three technologies to capture tacit knowledge. Firstly, use tangible form to capture tacit knowledge, such as experiences, best practices, insights and meetings. For example, the experiences about how to handle suppliers/partners, how new business was won; the best practices about handling customer queries/needs, improve the manufacturing processes; existing or enhanced knowledge that is made explicit in meetings; and insights about customers buy products as lifestyle statements. Next, the interview is being used commonly in the early stages as a tool capturing tacit knowledge.
There are four primary advantages of interview as a tacit knowledge capture (Awad & Ghaziri 2004): a) Its flexibility makes it a superior tool for exploring area about which not much is known concerning what questions to ask or how to formulate questions; b) It offers a better opportunity than any other tool for evaluating the validity of information acquired; c) It is an effective technique for eliciting information about complex subject and for probing an individual’s sentiments underlying expressed opinions; d) Many people enjoy being interviewed, regardless of the subject. They usually cooperate when all they have to do is talk. Generally speaking, the interviewees are experts and users. The experts are asked to express the scenario of the domain, because experts have vast amounts of knowledge that is in the heads. However, the experts are very busy and each expert does not know everything. The users are asked to express the requirements. In this case, the knowledge developer should get ready for interview as logically as programming: structured or semi-structured interview. Several steps may include: setting the stage and establishing rapport; phrasing questions; listening closely and avoiding arguments; evaluating session outcomes (Awad & Ghaziri 2004). In addition, recording or videoing can record interviews with internal and external experts.

The mechanism of knowledge capture system is to use stories for capturing organizational knowledge. The organizational stories are defined as a detailed narrative of past management actions, employee interactions, or other intra- or extra-organizational events that are communicated informally within organizations (Swap et al., 2001). For example, 3M Corporation used the stories to fix out the business problems from set the stage to generate excitement from all the members of organizations. “At 3M, the power of stories is recognized as a means to see ourselves and our business operations in complex, multidimensional forms — that we are able to discover opportunities for strategic change. Stories give us ways to form ideas about winning” (Swap et al., 2001). This is the short time proponent of storytelling. For the long time proponent of storytelling at IBM Corporation, Snowden (2000) indicated a set of guidelines for organizational storytelling:

- Stimulate the natural telling and writing of stories.
- Stories must be rooted in anecdotal material reflective of the community
in question.

- Stories should not represent idealized behavior.
- An organizational program to support storytelling should not depend on external experts for its sustenance.
- Organizational stories are about achieving a purpose, not entertainment.
- Be cautious of overgeneralization and forgetting the particulars. What has worked in one organization may not necessarily work in others.
- Adhere to the highest ethical standards and rules.

Other important considerations in the design of an organizational storytelling program include (Post, 2002):

- For storytelling to be effective, people must agree with the idea that this could be an effective means of capturing and transferring tacit organizational knowledge.
- Identify people in the organization willing to share how they learned from others about how to do their jobs.
- Metaphors are a way to confront difficult organizational issues.
- Stories can only transfer knowledge if the listener is interested in learning from them.

Knowledge Acquisition (KA) is the area of Knowledge Management aimed at capturing knowledge in a particular domain. It is something that must be addressed in any KM project. The term *acquisition* is easier to define in terms of the transfer of property rights (Barzel 1997), but it is not easy to implement. KA is collaborative and evolutionary process. The three essential aspects of acquisition are:

- Knowledge Capture: to acquire and elicit knowledge (tacit and explicit) from knowledge worker and other resources by appropriate techniques.
- Knowledge Analysis: to identify the knowledge needed to establish the knowledge based system.
- Knowledge Modeling: to create the different ways of viewing.
The KA techniques aim to implement knowledge capture, knowledge analysis and knowledge modelling. According to Milton (2007), it used interesting map to show the KA techniques for capturing different types of knowledge (Figure 2.12).

![Figure 2.12 Techniques for capturing different types of knowledge (Milton, 2007)](image)

There are three important steps that knowledge developer converts expertise into a coded program (Awad & Ghaziri, 2004):

1) To elicit knowledge from experts by an appropriate technique
2) To analyze the knowledge that get from experts
3) To build the rules that represent experts’ thought through analysis result

Card or Concept sorting
Card sorting (also known as Concept Sorting) is a KA techniques used to find out how an expert compares and orders concepts. In a typical Card Sorting exercise, the participant can reveal knowledge about class, properties and relations. It means the participant may re-arrange the cards into different groups based on class, properties or relations between cards. It is used to capture concept knowledge and tacit knowledge.
**Interview**

The interview is also a common and effective way to use for collecting general information in a particular domain. It is classified into structured, semi-structured, unstructured interview. Unstructured interview is used in early stages of acquisition, but it is not good at doing deep research. Structured interview can simply be filling in a questionnaire at the interview, but it is not flexible. Normally semi-structured is used frequently.

**20 Questions**

This exercise aims to extract the attributes and values (or new concepts) from the questions asked. The expert should be in the exercise. In a typical 20 questions exercise, a participant will think of an object/concept in the domain. Then the expert asks questions to confirm what object/concept is. Next, the participant can only answer yes or no. Normally there are not too many questions to ask. Finally, the questions will be collected.

Gaines (2001) offered some knowledge acquisition activities (Table 2.2). Several of these methods are applicable to the KMS work in HEI, such as gathering advice from consultants, customers, or suppliers; acquiring other organizations; gathering advice from professional literature and so on.

<table>
<thead>
<tr>
<th>Recruiting people with expertise</th>
<th>Training employees</th>
<th>Employees participating in communities of practice</th>
<th>Process improvement through experience in use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gathering advice from consultants, customers, or suppliers</td>
<td>Gathering advice from professional literature</td>
<td>Developing new products and processes</td>
<td>Process improvement through process analysis</td>
</tr>
<tr>
<td>Forming joint ventures with other organizations</td>
<td>Licensing patents and processes</td>
<td>Contracting with other organizations</td>
<td>Process improvement through purchase of technology</td>
</tr>
</tbody>
</table>

**Table 2.2 Knowledge Acquisition Activities (Gaines, 2001)**
Knowledge sharing systems provide the platform to enable members to acquire tacit and explicit knowledge from other individuals. According to Awad & Ghaziri (2004), the goal of knowledge sharing is to narrow the gap between what members know and what members do. In learning organizations, knowledge sharing system may support the sharing and reuse organizational knowledge and existing systems. Figure 2.13 shows the knowledge sharing play the key role in KM System building life cycle. Knowledge sharing is a requirement for knowledge transfer for competitive advantage, performance, and profitability after knowledge is captured, codified, tested, and deployed. It makes visible what is now known. The knowledge sharing systems might be attracted by knowledge seekers and knowledge owners. Knowledge owners may (Dignum, 2002):

- Want to share knowledge with trusted group;
- Decide when to share;
- A fair exchange, or reward, for sharing knowledge;

As the same as knowledge seekers (Dignum, 2002):

- Not be aware of all the possibilities for sharing, thus the knowledge repository typically helping them through searching and ranking;
- Decide when to acquire knowledge;
- Some feedback for sharing knowledge;
Knowledge sharing systems support the process to share tacit or explicit knowledge with other individuals. In Chapter 2, we discuss the process of sharing tacit knowledge is named socialization, and the process of sharing explicit knowledge is named exchange. Normally, the tacit knowledge stores in head of experts. The following question is how to share it. Meetings and Community of Practices (CoPs) can support the knowledge sharing. Wasko & Faraj (2000) describe three kinds of knowledge: “knowledge as object”, “knowledge embedded within individuals”, and “knowledge embedded in a community”. CoPs have become associated with sharing knowledge as well as making explicit “expertise”. Then, members of CoPs have tacit knowledge; they want to share with others by kinds of ways such as meetings, email, and so on. Moreover, knowledge sharing...
systems provide the process to share knowledge with collaborative environment. Table 2.3 shows the CoPs connects to spiral of knowledge. Awad & Ghaziri (2004) expressed, collaborative environment includes email, electronic meeting systems such as discussion forums, and chat, workflow and videoconferencing communication technologies.

<table>
<thead>
<tr>
<th>Tacit to Tacit</th>
<th>Knowledge Yellow</th>
<th>Community of Practice</th>
<th>Knowledge Repository</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tacit to Explicit</td>
<td>Telephone conversation</td>
<td>CoP seminar</td>
<td></td>
</tr>
<tr>
<td>Explicit to Explicit</td>
<td>Answer to email query</td>
<td>Documented explanation</td>
<td>Combination of knowledge content</td>
</tr>
<tr>
<td>Explicit to Tacit</td>
<td>Internalisation of email response</td>
<td>Internalisation of explanation</td>
<td>Internalisation of content</td>
</tr>
</tbody>
</table>

Table 2.3 CoPs Connect to Spiral of Knowledge

The benefits of CoPs may include:
- Knowledge on tap
- Inputs from many different perspectives can lead to more rounded and deeper understanding (and potentially unique insights)
- Eases the learning curve for people new to the relevant knowledge area
- Tapping into knowledge and experience reduces reinvention and supports more effective decision making.

Knowledge application systems provide the platform to establish effective application in making-decision and task performance depends on the better processes of knowledge discovery, capture and sharing (Becerra-Fernandez & Sabherwal, 2010). The mechanisms and technologies, which are in the processes of knowledge discovery, capture and sharing, can support knowledge application systems by routines and direction. Awad & Ghaziri (2004) described knowledge application mechanisms facilitate direction such as hierarchical relationships, help desks, and support centers; and routines such as organizational policies, work practices and standards. On the other hand, expert systems, decision support, advisor systems, and fault diagnosis systems are the examples of knowledge
application systems to be technology supporting.

Based on Awad & Ghaziri (2004) discussions, the main technologies for knowledge application systems are Case-Based Reasoning and Rule-Based Reasoning. They are applying into different domain based their characteristics (Figure 2.14). Aamodt & Plaza (1994) and Leake (1996) indicated different variations of CBR:

- **Exemplar-based reasoning:** these systems seek to the solutions to solve problems through classification, which is to find the right class for the unclassified exemplar. And the set of classes, which of the most similar past case may become the solution of the classification problem, are the possible solutions to the problem (Kibler & Aha, 1987).

- **Instance-based reasoning:** a large number of typically simple instances (or cases), which are defined by a small set of attribute vectors, are required by these systems. The major characteristic of these systems is automated learning, requiring no user involvement (Aha et al., 1991).

- **Analogy-based reasoning:** these systems are used to solve the problems based on past cases from a different domain (Aamodt & plaza, 1994; Veloso & Carbonnell, 1993). And these systems aim to find a way to map the solution of the analogue case to present the problem by focusing on reusing case.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Domain Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule-based systems</td>
<td>Applicable when the domain knowledge can be defined by a manageable set of rules or heuristics</td>
</tr>
<tr>
<td>Case-based reasoning</td>
<td>Applicable in weak-theory domains, that is, where an expert either does not exist, or does not fully understand the domain. Also applicable if the experience base spans an entire organization, instead of a single individual.</td>
</tr>
</tbody>
</table>

Figure 2.14 Differences between CBR and Rule-Based Reasoning (Awad & Ghaziri, 2004)
2.6 Summary

This chapter began by defining knowledge and highlighting the difference between data, information and knowledge. Knowledge is the most vital word in the Knowledge Management area. It is definitely distinct from data and information, but it is based on data and information. Next, the types of knowledge were introduced: tacit and explicit knowledge, declarative and procedural knowledge, general and specific knowledge. Focusing on transfer between tacit and explicit knowledge, the spiral of knowledge model (Nonaka & Takeuchi, 1995) was used to indicate knowledge discovery and capture. In addition, combining these types of knowledge was important to help understand the complicated knowledge in today's high speed development of information technology. Then identifying the definition of the KM and describing the area of KM that includes KM components (people, process and technology), KM processes (Knowledge Discovery, Knowledge Capture, Knowledge Sharing and Knowledge Application), and explaining the reason for trying to manage knowledge. KM, as a vital part embedded in organizations, has become more and more important for enhancing organizational innovativeness and performance. In addition, KMS has four sub-systems to support the KM processes. Knowledge acquisition plays a key role in the process to capture knowledge. It is the necessary step for capturing information. The techniques included card sorting, interview, 20 questions and the list goes on. It is important to apply the right techniques to gather different types of knowledge.
3 KNOWLEDGE MANAGEMENT SYSTEM IN HIGHER EDUCATION INSTITUTION

3.1 Introduction

There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one

―MACHIAVELLI, 1513 (Awad & Ghaziri, 2004)

Higher education institutions are in the knowledge business, since they are involved in knowledge creation and dissemination and learning. For intensive knowledge in higher education institute, knowledge management is more important. It aims to improve the use efficiency of knowledge. During the process of managing knowledge, the knowledge management system, as a platform which is used to implement knowledge management activities, will play a key role in the higher education. It helps HEIs to seek competitive advantage in modern society.

This chapter will introduce the ten-step road map which aims to identify the processes of development KM strategy and KM systems into the organizations. Then the Higher Education Institution (HEI) environment will be introduced, and analyzed the HEI perspective. Next, the benefit that KMS brings to HEI will be discussed. Finally, Open University, which is one of three case studies, will be examined to identify the best practices which this project can learn from and implement some of them.

3.2 The Ten-Step Road Map

KM Systems are vital for organizations to seek a competitive advantage. It also provides the platform to implement the knowledge management activities. In 2002, Amrit Tiwana wrote the Knowledge Management Toolkit: Orchestrating IT, Strategy,
and Knowledge Platforms. It provides to implement knowledge management (KM) in
the organizations. In his book, Tiwana proposed a ten-step KM Road Map to seek
competitive advantage, because the best way cannot be easily copied from the
competitor. The steps are describing the four phases in Table 3.1:

<table>
<thead>
<tr>
<th>Phase 1: Infrastructural Evaluation</th>
<th>1</th>
<th>Analyse the Existing Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Align Knowledge Management and Business Strategy</td>
</tr>
<tr>
<td>Phase 2: KM system analysis, design and development</td>
<td>3</td>
<td>Design the Knowledge Management Infrastructure</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Audit Existing Knowledge Assets and Systems</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Design the Knowledge Management Team</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Create the Knowledge Management Blueprint</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Develop the Knowledge Management System</td>
</tr>
<tr>
<td>Phase 3: Deployment</td>
<td>8</td>
<td>Deploy, using the Results-Driven Incremental Methodology</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Manage Change, Culture and Reward Structures</td>
</tr>
<tr>
<td>Phase 4: Evaluation</td>
<td>10</td>
<td>Evaluate Performance, Measure ROI, and Incrementally Refine the Knowledge Management System</td>
</tr>
</tbody>
</table>

Table 3.1 the Steps Describing the Four Phases (Tiwana, 2002)

These four phases are described as follows:

Phase 1: Infrastructural Evaluation

Step 1: Analysis of Existing Infrastructure — by analyzing and accounting for what is already in place in your company, you can identify critical gaps in the existing infrastructure. Consequently, it stands a better chance of generating stronger management support for the KM project because the “old” existing investment are not abandoning.

Step 2: Aligning Knowledge Management and Business Strategy — Developing system is always at a low level that is used specifications and
features without abstractions or visions, while business strategy is usually at a high level that is used by abstractions and visions. And this step aims to make the connection between KM platform design and business strategy. Then, apply the strategy into the system design.

Phase 2: Knowledge Management System Analysis, Design, and Development

Step 3: KM Architecture and Design — an understanding of KM System architecture that is consist of the infrastructural components are selected. These components can help create the KM system model requires thinking in terms of an *infostructure*, rather than an infrastructure. Therefore, the first big choice is the collaborative platform, which helps decide whether the organization will use the Web or a proprietary platform correctly.

Step 4: Knowledge Audit and Analysis — in this step, a knowledge audit should be done firstly. Then, assemble an audit team to identify knowledge in both critical and weak through performing the assessment of knowledge assets within an organization. In advanced, a KM project must begin with what the organization already knows.

Step 5: Designing the Knowledge Management Team — In order to design an effective KM team, the advices as follows:
- Identifying key stakeholders both within and outside the organization.
- Identifying sources of expertise needed to design, build and deploy the system successfully while balancing the technical and managerial requirements.

Step 6: Creating the Knowledge Management System Blueprint — the blueprint is the foundation for building and incrementally improving a KM system. Before working towards designing KM architecture, make an understanding of the seven-layer architecture. Then determining how each of these can be optimized for performance and scalability, as well as high levels of interoperability. The blueprint will also make sure the scope of KM system which gets better ROI (Return on Investment). Finally, the blueprint will establish ways to *future-proof* the KM system with the introduction of the next
wave of new technology.

Step 7: Developing the Knowledge Management System — Depends on the creation of blueprint in step 6, start to put the system together while confront the issues of integrating a system across different layers. It aims to build a flexible and stable KM platform.

Phase 3: Deployment
Step 8: Pilot Testing and Deployment Using Results Driven Incremental (RDI) Methodology — in this step, the typical KM system must meet the actual needs of users. Although a cross-functional KM team can help uncover many of these needs, a pilot deployment is the ultimate reality check. In order to carry out these, the suggestions as follows:

✧ Make a decision how to select the cumulative releases with give the highest pay-offs.
✧ Make an evaluation on need for pilot project.
✧ Make an evaluation on RDI methodology to deploy the system.

➢ Step 9: Leadership and Reward Structures — The KM system, as the most erroneous assumption that is made by many organizations is that the intrinsic value of an innovation, will lead to its enthusiastic adoption and use. Because the knowledge sharing cannot be mandated, the employees are like volunteers. It has to encourage the employees to use, or require a new reward structures to motivate employees to use the KM system. In addition, it contributes to their enthusiastic adoption.

Phase 4: Metrics for Evaluation
Step 10: Real-Options Analysis for Knowledge Management — measuring return on investment (ROI) must be met for both financial and competitive impacts of KM in the organizations. The purposes of measuring returns might be: prove the impact of effective KM by being used hard data and monetary figures, and refine the KM design through subsequent iterations.

All in all, the 10-Step Road Map aims to find the most suitable way to implement the KM and KM platform (system) for seeking competitive advantage. It is the process
from developing system (low level) to business strategy (high level). Tiwana (2002) indicated the road map would help build a KM strategy and KM system that could be tailored to any organization.

### 3.3 The Environment of Higher Education Institute

Higher Education Institute (HEI) can stand for society for research into higher education. It is a typical industry that has a unique culture. There is intensive knowledge in HEI, this is the main characteristic. Due to this natural culture, the HEIs are the most suitable for introducing knowledge management approaches and activities. Rowley (2000) expressed higher education institutions are in the knowledge business, since they are involved in knowledge creation and dissemination and learning. According to discussion of Chapter 2, knowledge can be categorized into many pairs: tacit and explicit knowledge; declarative (know what) and procedural (know how) knowledge; general and specific knowledge, and etc. Davenport & Prusak indicated that most people consider knowledge to be broader deeper and richer than data or information and offer the following definition of knowledge: “...A fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information...”(Davenport & Prusak, 2000). The knowledge resources of HEI mainly get from novel degree programmes and interdisciplinary programmes. And it might merge two fields together in unique and interesting ways. Somewhere disciplinary knowledge is increasing exponentially (Clark, 1996).

As the increasing growth of “educational market”, the heads of HEIs are more and more interested in any method which could gain competitive advantages during the specific business. Dorothy & John (2007) noted that the competitive environment might include the growth in corporate and for-profit institutions, a buyers-market for students. For intensive knowledge in HEI, the biggest challenge is how to manage kinds of knowledge. Knowledge management system seems to be one of recent leading tools in this direction. For example, in the early 1990s, a university was assumed to improve its ranking would look to an all-encompassing, integrated knowledge management system to achieve its goals, whereby Southwest University was the case. Given the initial enthusiasm and high expectations that a new knowledge
management system would solve all of the HEI’s data access, manipulation, storage, and integration problems, it is surprising that Southwest did not complete the project reasonable close to its initial two-year timeline (Hakken, 2003). KPMG 2000 survey displayed that the 16% organizations had a specially KM system. And the survey also found that the reason why KMS often do not support effective KM was a lack of understanding of users’ requirements from the KMS (KPMG, 2000). It shows KMS is more important for HEI, and the way to develop KMS is also vital as well.

The teaching and research are the vital activities in HEI. The stakeholders in these two activities may include lectures, students, or other partners. In research intensive institutions the most obvious knowledge resource is output of its research activities. As the external environment increased pressure upon institutions of higher education to become more productive and business-like, it is not surprising that business management techniques are promoted as the best vehicles for change (Ewell, 1999). Knowledge about the effectiveness of key management processes such as discovery, capture, sharing, and application could also be considered key resources. In HEI, the student is a customer group. They will learn knowledge from lectures, books, other facilities in HEI. Facing the intensive knowledge, the students sometimes are confused. For example, the students did not know where the knowledge is located; they did not know how to get it. After they got it, the students wanted to share it with others, but they did not know what others knew. After they knew that, they did not know how to share the knowledge. The KM processes can address those problems with students. And knowledge management system is developed to support the KM processes.

In most of HEIs, web-based tools were used in common. Bostock (2002) and Wickert (2001) indicated that the greatest potential for the practice of KM lies with the internet and the web. Email is the best practice of web-based tools. It allows people to work with their own paces.

3.4 The Benefits of KMS Bring to HEI

In part 2.5, the Knowledge Management System provides the platform to implement the KM approaches and activities and to seek competitive advantage. It aims to support the four KM processes, which are the broad processes that help in discovering,
capturing, sharing and applying knowledge. And KM system is also one of the four broad levels in Knowledge Management (KM) solutions. Bixler (2002) noted that ten technologies underpin KM solutions as follows:

- Capture and store
- Search and retrieve
- Send critical information to individuals or groups
- Structure and navigate
- Share and collaborate
- Synthesize
- Profile and personalize
- Solve or recommend
- Integrate with business applications
- Maintenance

KM system consists of knowledge discovery system, knowledge capture system, knowledge sharing system and knowledge application system.

- Knowledge discovery system will produce new explicit knowledge through combine and reconfigures multiple sources of knowledge, and produce new tacit knowledge without being made explicit. It is the foundation of knowledge management system life cycle. In the HEIs, intensive data and information does not exist loosely. Students are difficult to find the information they needed correctly. The portal web is not enough useful. The knowledge discovery system can collect these data and information, and produce the explicit and tacit knowledge. Normally, the explicit knowledge is stored in the database. The mechanism of knowledge discovery system is to using socialization to create new tacit knowledge (Becerra-Fernandez, Gonzalez & Sabherwal, 2004). It is a common practice in many organizations. Data mining is the technology of knowledge system discovery to create new explicit knowledge.

- Knowledge capture systems retrieve tacit or explicit knowledge that existing in people, artifacts or organizational entities. For HEIs, explicit knowledge may capture from databases, books, documentations and some ways that can make records. However, tacit knowledge may capture from experts, discussion over
lunch time between colleagues/classmates. Because tacit knowledge represents what we know but cannot express in its full form (William & Amin, 2006). The most difficult is to capture knowledge from internal and external experts. In other words, capture tacit knowledge is the main challenge. The capturing knowledge is the first step which the knowledge developers are addressed when they start the building process.

There are three technologies to capture tacit knowledge. Firstly, use tangible form to capture tacit knowledge, such as experiences, best practices, insights and meetings. For example, the experiences about how to handle suppliers/partners, how new business was won; the best practices about handling customer queries/needs, improve the manufacturing processes; existing or enhanced knowledge that is made explicit in meetings; and insights about customers buy products as lifestyle statements. Next, the interview is being used commonly in the early stages as a tool capturing tacit knowledge. There are four primary advantages of interview as a tacit knowledge capture (Awad & Ghaziri 2004): a) Its flexibility makes it a superior tool for exploring area about which not much is known concerning what questions to ask or how to formulate questions; b) It offers a better opportunity than any other tool for evaluating the validity of information acquired; c) It is an effective technique for eliciting information about complex subject and for probing an individual’s sentiments underlying expressed opinions; d) Many people enjoy being interviewed, regardless of the subject. They usually cooperate when all they have to do is talk. Generally speaking, the interviewees are experts and users. The experts are asked to express the scenario of the domain, because experts have vast amounts of knowledge that is in the heads. However, the experts are very busy and each expert does not know everything. The users are asked to express the requirements. In this case, the knowledge developer should get ready for interview as logically as programming: structured or semi-structured interview. Several steps may include: setting the stage and establishing rapport; phrasing questions; listening closely and avoiding arguments; evaluating session outcomes (Awad & Ghaziri 2004). In addition, recording or videoing can record interviews with internal and external experts.

- Knowledge sharing system is the vital element in KMS. It enables members to
acquire tacit and explicit knowledge from other individuals. According to Awad & Ghaziri (2004), the goal of knowledge sharing is to narrow the gap between what members know and what members do. In learning organizations, knowledge sharing system may support the sharing and reuse organizational knowledge and existing systems. The main purpose of KM system is to share knowledge. “KM is the combination of people, processes, and technology that come together to promote a robust system of information sharing, while guiding organizations toward ongoing reflexivity and learning” (Metcalfe, 2006). Knowledge sharing is a requirement for knowledge transfer for competitive advantage after knowledge is captured, codified, tested, and deployed. It makes visible what is now known. In HEIs, there are many ways to share knowledge with individuals by IT support. For example, lectures upload the notes or past exam papers on their own website, then students download it. Students can ask to help with lectures by email. Students can communicate and ask to solve problems by blog or forum. Dignum (2002) identified the possibilities situation of share knowledge between owners and seekers.

Knowledge application system provide the platform to establish effective application in making-decision and task performance depends on the better processes of knowledge discovery, capture and sharing (Becerra-Fernandez & Sabherwal, 2010). Awad & Ghaziri (2004) described knowledge application mechanisms facilitate direction such as hierarchical relationships, help desks, and support centres; and routines such as organizational policies, work practices and standards. On the other hand, expert systems, decision support, advisor systems, and fault diagnosis systems are the examples of knowledge application systems to be technology supporting. In HEIs, the rule-based reasoning normally is used when developing the system.

3.5 Case studies

The real case studies can be used to review the knowledge management system as a platform applied in higher education institute to seek the competitive advantages.
3.5.1 Case Study 1: Web Portal (Mansourvar, M. & Mohd Yasin, N., 2010)

This study aims to discover the university needs to the web portal as an essential tool for students to help them get the information they needed. Web portal is also a type of knowledge management system, which is established to collect, integrate, and disseminate knowledge. Powell (2003) indicated that a portal is a network service that collects information from different resources into a personalized and single point of access using searching technology such as cross searching, harvesting and alerting to help users. For example, Yahoo is a general portal; a HEI website homepage is a specialized portal. Azarbarzin (2008) highlighted the differences between the website and web portal (Table 3.2):

<table>
<thead>
<tr>
<th></th>
<th>Web Site</th>
<th>Web Portal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Website is owned by an organization or center.</td>
<td>Portal is user-centric, which means that a user can organize and offer information and data.</td>
</tr>
<tr>
<td>2</td>
<td>The user cannot interact with a website.</td>
<td>The user and portal can have two-way communication or interaction.</td>
</tr>
<tr>
<td>3</td>
<td>Website is not an essential knowledge domain.</td>
<td>Portal is the gateway to specific or special knowledge domain.</td>
</tr>
<tr>
<td>4</td>
<td>The information and sources on a website are rarely updated.</td>
<td>The information sources on a web portal are updated, regularly by the owner.</td>
</tr>
</tbody>
</table>

Table 3.2 Comparison between Web Site and Web Portal (Azarbarzin, 2008)

The portal services can be classified based on the following two criteria (Mansourvar, 2010):

- *The progression and maintenance of different services need different methods, therefore this gives rise to different cost structures.*
- *Members use different utilities for the different services, hence the presence of distinct usage models*
Ang et al. (2005) divided web portal services into three types:

- **Search**: The main function of web portal is to find the essential information about a certain topic or subject. The different types of strategies were used to satisfy the members’ requirements in the web portal, such as homegrown solution or outside solutions.

- **Information**: Users can look for kind types of information in web portals without any username and password, such as news, sports, weather reports, etc.

- **Personal Service**: Some services in web portals need to register, such as emails, chat rooms, personalized home pages. When a user opens his home pages, the information which this user is interested will be displayed on the page. Allan et al. (2003) listed some services available on the web portals as follows:
  - **Online shopping**
  - **Query: based resource discovery**
  - **Query: based application selection**
  - **Resource scheduling**
  - **Deployment service**
  - **Lifecycle management**

The Faculty of Computer Science and Information Technology (FCSIT), University of Malaya (UM) used a survey questionnaire to capture students’ problems with the current portal in the faculty. The survey aims to find the problems that students are lack of information and resources in the faculty, and to find the student’s requirements for building new portal.

The main reasoning for using the portals is efficiency. The web portal is not only ease of use, but also it is ease of development, easily customized interface, rich functionalities, and pluggable architecture. Allan et al. (2003) illustrated standard features to consider when selecting a portal framework:

- **Integration with the existing functionality**
- **Easy to develop new functionality**
- **Programming language independence**
- **Standards to access content**
- **Standards for interoperability and portability**
Figure 3.1 presents the conceptual framework with the basic knowledge management system that includes components of a portal administration, decision support, document management, web management, content communication, and programs.

In 1998, SHEFC1 built an online interface for students to access electronic information sources. That included students used computers to access and retrieve training materials, databases, financial data, etc. Normally, a university portals can be viewed as a single point, which provides access to information on programmes, courses, data search tools, library resources, communication tools, etc. As the progress of internet technology, the web portal has become more powerful. Most universities use the web portal to achieve educational goals such as monitoring knowledge, controlling educational processes, etc. Goodman et al. (2002) indicated that universities consider three aspects pertaining to use of the portals:

- **Systems Integration**: Universities can integrate more and more IT systems within their campuses. It helps efficiently knowledge convert and offers more services for students.
• Utilization of e-business technology: Universities and other HEIs use the internet to offer better and more efficient services to students and staff.

• Provide wider use of data and services of existing systems

This case study aims to identify the web portal as a type of knowledge management system play a key role in the universities. The web portal is used to fulfil student’s need to access the required information online. Web portals are difference from web site, because it is user-centric and the information sources are updated regularly. The main characteristics of web portals are ease of use, integration of existing functions. The web portal that is used in university aims to achieve educational goals. The three aspects of using portals in universities are system integration, utilization of e-business technology, and provide wider services of existing systems. So web portal is vital for the universities to support students to access the required resources and information in order to implement knowledge sharing.

3.5.2 Case Study 2: Kuali Knowledge Management System (Aikman, 2012)

This study aims to develop a new Knowledge Management System (KMS) to implement best practices in delivering excellent knowledge-centred support for students, faculty, and staff. The KMS utilizes the Knowledge Base (KB) of Indiana University (IU) as a foundation and extends the new features to enable other institutions of higher education to share code and content. This project will generate a next-generation knowledge management system to provide the superior services for all the users who use information technology and can benefit all Kuali partners as a platform for developing, managing, and sharing support content for all existing and future Kuali software. Kuali is a growing community of universities, colleges and commercial firms’ partner to build and sustain open-source software for higher education, by higher education; and the member of Kuali Community can participate in the design and use of the open source software.

In order to achieve the ultimate goal of the KMS and the measure of success, the higher education organizations should:

• Identify, collect, and maintain the critical information student, faculty, and staff need.
• *Make that information accessible to them when and where they need it.*

The challenges of academic environment are information capture and delivery management. The KMS can be addressed the challenges through allowing organizations to implement best practices, but the solution is not itself. Especially for the academic environment, due to its innate culture of sharing, the KMS is more suitable for such an endeavour.

For the organization’s support mission, such a KMS must:

• *Allow for knowledge capture during support problem-solving*
• *Enable and enhance collaboration among information providers, information managers, and consumers*
• *Provide for flexible management of content through a logical lifecycle from creation through archival*
• *Serve as a repository for rich, modular content that can be reused and delivered via many interfaces*
• *Deliver insight into how the content is being consumed and used, continually informing its management*
• *Provide the potential for meeting the best practice needs of knowledge management (e.g., security, access, revising control)*

And the KMS allows individual users to:

• *Search for information quickly and effectively*
• *Understand information’s relevance and authority*
• *Contribute content, ranging from text to rich media*

Finally, the new KMS will take many advantages over the current system:

• *The new system will support multiple document markup languages, including the Darwin Information Typing Architecture (DITA), an industry standard.*
• *The new system will support many “Enterprise 2.0” features, such as a rating system for documents, threaded user comments, tagging, and expanded content delivery abilities.*
• *Users will have the option of logging in for enhanced features, such as a “favorite documents” list and saved searches.*
• The new system will support an API for integration into other support tools used for walk-in, telephone, chat, email, and on-site support.

• Based on Kuali Rice, the system will expose a rich web services interface, allowing other enterprise systems to use the KB as a repository for context-sensitive help to users of that application.

• It will be able to host KB systems at other institutions, while using the same backend as IU.

• Expanded reporting metrics will be loaded into institution’s data warehouse for analysis.

This case study indicated the university and HEIs are most suitable for implementing KMS to meet the needs of students, faculty, and staff. The challenges of academic environment are information capture and delivery management. The KMS will integrate the best practices that are from existing systems and expand the new features to overcome the challenges. Additionally, in order to achieve the ultimate goal of KMS, the higher education organizations should identify what information the students, faculty and staff need, and when they need it. Finally, the individual users can search for information quickly and effectively, understand information’s relevance and authority, and contribute content, ranging from text to rich media through the KMS.

3.5.3 Case Study 3: Open University in UK (www.open.ac.uk)

The Open University (OU) in UK is a part-time higher education, supported distance and open learning for both undergraduate and postgraduate qualifications. The main tool for learning and communicating is web-based system. Here the OU community is examined. This is the place to find out where the OU is participating online, and what to play with and what cool stuff to give away. The OU has been working with external partners to create spaces for users to experience what to offer. It wants everyone to reach their own conclusions so it has made thousands of hours of content freely available to users via YouTube, iTunes U and OpenLearn. It wants users to reuse the content in ways that benefit them. As the students increasingly coming online, the OU consider that they can get information they need from each other rather than from organizations. There are a couple of options available if students want to set up an informal group for their fellow students: personal tools (available on StudentHome) and current social networking spaces.
Some interesting learning tools are available in OU learningSpace. The tools are described as follows:

- **Cohere** is an experimental knowledge mapping tool that runs on the web, connecting users and their ideas, to other learners with common interests.
- **FlashVlog** is a tool, allowing users to create video diaries online almost instantly.
- **FM** is a video conferencing tool. It allows a group of people to meet online from anywhere in the world. Video conferencing allows users to foster good problem solving skills, to communicate with people with common interests, to have a discussion about a unit users have uploaded to OpenLearn, and to work together on a challenge posed by material users have encountered online.
- **The forums on OpenLearn** are a place to meet, discuss and share ideas. Think of the forum as an online message board where users can post messages and read those from other learners.
- **A Learning Club** can be set up by anyone who wants to meet other learners to discuss a subject of shared interest. Check the list of clubs to see if there is already a club available for your subject area. It allows users to set up, or join a learning club that can help them find people to study with. The users may already be in a group of students who want somewhere to meet online to chat and share information. They might share and store resources in their club forum.
- **Learning Journal** allows students to keep their own personal notes and reflections on the material they are studying or on their general study experiences. Students can choose to keep the notes to themselves, or to share their entries with other learners. All their notes will be stored on the OpenLearn site and are always available for them to review, edit or delete.

(These introductions of tools are from the UK Open University’s website.)

This case study aims to find the best practices (learning journal and learning club) and tools (Cohere knowledge mapping tool, FlashVlog, FM video conference tool) which might be used in development of KMS for MSc in Computing.
3.6 Summary

This chapter began with the description of the ten-step guide which aims to guideline the development of knowledge management systems in the organizations. Firstly, analyzing the situation of organization and the alignment between KM and business strategy; next, auditing the knowledge asset and systems, creating the blueprint, and developing the KM system; after that, using RDI methodology to deploy the KM system; finally, evaluate whether the KM system can meet the requirements that are found in the knowledge audit process.

Then, this chapter reviewed the general background of higher education environment, which can help understand the main challenge within today’s competitive trend. The KMS played the important role in this environment. Finally, the three case studies were examined to find the key factors to develop KMS. It included in the web portal as a type of knowledge management system are used frequently in universities today; universities and HEIs are most suitable for implementing KMS, which integrates multiple best practices from existing systems and adds new features into KMS, to provide better services for students, faculties, staff, and other partners. To identify and collect the information they need, and when they needed. The final case study aims to investigate the interesting and best practices/tools which were used in UK Open University. These case studies can help develop KMS for MSc in Computing.
4 DESIGN AND ANALYSIS OF THE SURVEY

4.1 Introduction

This chapter aims to set up a design of the survey. It examines the current knowledge the students needed and describes the published tools used. The analysis then has been discussed and the requirements of students were identified. The survey design is based on the objectives of this project which is proposed by DIT MSc in computing. The results of analysis provided the information needed to implement the KM system.

4.2 Design of the Survey

According to the research problems and research objectives, the research of the project will identify types of knowledge managed in HEI and types of KMS/tools used to manage knowledge in HEI, and the best practice in the area of student oriented KMS in HEI. Before the survey was designed, the following should be considered:

- What knowledge do students need?
- When do students need it?
- Join DIT:
  - Programme information, apply and register course, student funding, school information, living expenses
- Start of semester:
  - Module information, timetable, login system, change password, register modules, lecture information
- During semester:
  - Download notes, assignment information, discussion group, library services (borrow books, printer, computer, meeting room), Webcourses, online class
- End of semester (exam time):
  - Exam information (exam rules, exam timetable, exam location, exam results, exam recheck/remark/repeat), job news/opportunities
- How do students currently get it?
- What do students think of the tools available to them?
• What do students use them for?
• What other types of tool would students prefer?
• What tools for what type of knowledge?
• Other experiences students found useful.

Those questions can help design the survey. Based on those questions, the main survey questions are showed as follows:
• Identify the time when the programme information is most useful to you.
• Rate the existing system/webpages in terms of their usefulness to you in providing information about your programme.
• How often do you use the existing tools to find information about your programme?
• How often do you use in Webcourses?
• Which of the functions do you use in the library system?
• For tools made available by DIT, identify the characteristics would be important to you.
• Comments, suggestions & best practice

And these questions can be related to analyzing the types of knowledge through building the diagrams as follows:

![Diagram showing Explicit Knowledge and Tacit Knowledge with questions]

Figure 4.1 Questions related to Explicit & Tacit Knowledge
Figure 4.2 Questions related to General and Specific Knowledge

Figure 4.3 Questions related to Declarative & Procedural Knowledge
Figure 4.4 Questions related to Explicit & Declarative Knowledge Overlapping

Figure 4.5 Questions related to Tacit & Declarative Knowledge Overlapping
Figure 4.6 Questions related to Tacit & Procedural Knowledge Overlapping

Figure 4.7 Questions related to Explicit, General & Declarative Knowledge Overlapping
Figure 4.8 Questions related to Tacit, General & Declarative Knowledge
Overlapping

Figure 4.9 Questions related to Tacit, Specific & Procedural Knowledge
Overlapping
The survey was made by Google docs. It creates and shares the work online and it is free. The characteristics of Google docs are:

- Create, edit and upload quickly
  Import the existing documents, spreadsheets and presentations, or create new ones from scratch.
- Access and edit from anywhere
  All the users’ need is a Web browser. The documents, spreadsheets and presentations are shored securely online.
- Share changes in real-time
  Invite people to owner’s documents and make changes together, at the same time.

4.3 Analysis of the Survey

This section will demonstrate the analysis of the data gathered through the survey. The survey was post for one week, and the total responses were 15 as well. The questionnaire was designed and formed through Google Docs. It was published on the ditmsc.blogspot.com.

These questions are implemented in the survey. Question from 1 to 5 is related to background information about participants. Question 6 and 7 is related to knowledge needed. Question 8 is related to sources of knowledge. Question from 9 to 12 is related to tools used. Question from 13 to 15 is related to preferences. The details illustrated as follows:

4.3.1 Background Information

The first five questions are related to the basic demographic details of each respondent. These questions are relating to explicit knowledge. They are age, nationality, are you registered on a (part-time/full-time programme), which programmes you are registered (totally five programmes within MSc in Computing), and the year of programme. The results are given in Figure from 4.10 to 4.14.
Figure 4.10 Q1 Results

Question 1 and 2 provide the personal background of the respondents. Different age groups and culture may decide their views. In the survey, 53% respondents were in group 25-35, 20% respondents were in group 18-25, 13% were in group 35-45, and 13% were in group over 45.

The results indicated nearly half respondents were under 35 years old. The project would be considered more about the respondents who were under 35 years old. They might accept new technology more motivate. 87% respondents are EU students. The other 13% is Non EU.

Figure 4.11 Q2 Results
Question 3 provides the various programmes. Normally, the full-time respondents should have more modules each semester than part-time. 53% respondents are registered on a part-time programme. The other 47% is registered on a full-time programme.

Figure 4.13 Q4 Results

Question 4 lists the programmes of MSc in Computing. Six respondents are registered Data Analytics, 4 respondents are registered Advanced Software Development, 4 respondents are registered Knowledge Management, and 1 respondent is registered Information Technology.
The fifth question is the year of programme. It is to investigate the total number of years for currently studying this programme in DIT. It is divided into the categories: 1st year, 2nd year, 3rd year and 4th year. 67% respondents are fresh. 33% respondents are 2\textsuperscript{nd} year.

The basic information was collected to identify the background of the respondents, such as age group, nationality, the programme the students attend and the grade they are in.

4.3.2 Knowledge Needed

The question six (This question investigates the knowledge students need and when they need it) aims to identify when the respondents needed the information about programme. This question is relating to tacit and declarative knowledge. This is the vital question for classifying the information in a fresh classification as the information diffusely exists in DIT website. The period of time that respondents needed information was separated into start of academic year, start of each semester, during semester, end of semester (Exam Time) and throughout academic year.

For each of the following, please indicate the time when this programme information is most useful to you?
In Q6-1, 87% respondents approved that the information about fees and funding displays at start of academic year, 7% respondents approved at start of each semester, and 7% respondents approved throughout academic year.

In Q6-2, 47% respondents approved that the academic calendar displays at start of academic year, 27% respondents approved at the start of each semester, and 27% respondents approved throughout academic year.
Figure 4.17 Q6-3 Results

In Q6-3, 47% respondents approved that the details on modules display at start of academic year, 47% respondents approved at the start of each semester, and 7% respondents approved during semester.

Figure 4.18 Q6-4 Results

In Q6-4, 40% respondents approved that the programme rules and regulations display at the start of academic year, 20% respondents approved at the start of each semester, 27% approved throughout academic year, and 13% approved during semester.
In Q6-5, 27% respondents approved that the programme timetable displays at the start of academic year, 40% approved at the start of each semester, 13% approved during semester, and 20% approved throughout academic year.

In Q6-6, 53% respondents approved that the registration processes and deadlines display at the start of academic year, 40% approved at the start of each semester, and 7% approved throughout academic year.
In Q6-7, 20% respondents approved that the programme mentor/chair display at the start of academic year, 33% approved at the start of each semester, 7% approved during semester, and 40% approved throughout academic year.

In Q6-8, it identified when the study skill was most useful to students. 20% respondents approved that the study skills display at the start of academic year, 7% approved at the start of each semester, 27% approved during semester, 7% approved at the end of semester, and 40% approved throughout academic year.
In Q6-9, 33% respondents approved that the student support services display at the start of academic year, 13% approved during semester, 7% approved at the end of semester, and 47% approved throughout academic year.

In Q6-10, 20% respondents approved that the library services display at the start of academic year, 7% approved at the start of each semester, 20% approved during semester, 53% approved throughout academic year.
In Q6-11, 40% respondents approved that the living Dublin information displays at the start of academic year, 7% approved at the start of each semester, 13% approved during semester, and 40% approved throughout academic year.

In Q6-12, 73% respondents approved that the DIT news items display throughout academic year, 20% approved during semester, and 7% approved at the start of academic semester.
In Q6-13, 73% respondents approved that the programme news items display throughout academic year, 20% approved during semester, and 7% approved at the start of academic semester.

In Q6-14, 73% respondents approved that the seminar/conferences/fairs related to programme area display throughout academic year, 20% approved during semester, and 7% approved at the start of academic semester.
In Q6-15, 73% respondents approved that the job news/opportunities display throughout academic year, 13% approved during semester, and 13% approved at the end of semester.

**Figure 4.29 Q6-15 Results**

In Q6-16, 53% respondents approved that the DIT location map displays at the start of academic year, 7% approved during semester, 7% approved at the end of semester, and 33% approved throughout academic year.

**Figure 4.30 Q6-16 Results**
In Q6-17, 13% respondents approved that the exam timetable displays at the start of each semester, 13% approved during semester, 53% approved at the end of semester, and 20% approved throughout academic year.

In Q6-18, 20% respondents approved that the exam results display throughout academic year, 60% approved at the end of semester, 7% approved during semester, 7% approved at the start of each semester, and 7% approved at the start of academic year.
In Q6-19, 20% respondents approved that the exam recheck/remark/appeal displays throughout academic year, 53% approved at the end of semester, 20% approved at the start of each semester, and 7% approved at the start of academic year.

In Q6-20, 20% respondents approved that the supplemental exam displays throughout academic year, 47% approved at the end of semester, 7% approved during semester, 20% approved at the start of each semester, and 7% approved at the start of academic year.
In Q6-21, 27% respondents approved that the system logins display at the start of academic year, 27% approved at the start of each semester, 7% approved at the end of semester, and 40% approved throughout academic year.

In Q6-22, 80% respondents approved that the technical support displays throughout academic year, 13% approved during semester, and 7% approved at the start of each semester.

The question seven (This question supplement the gaps that do not mention in question 6.) If you noted use of other sources in Question 6, please provide some details: The respondents mentioned the information related to international students.
The seventh question is not mandatory. It asks respondents to give other sources which are omitted during the design of the questionnaire. This question may fill the gap of sixth question.

4.3.3 Sources of Knowledge

The question eight (This question aims to ascertain students’ satisfaction of current tools/systems in providing information about their programmes.) Please rate each of the following in terms of their usefulness to you in providing information about your programme (1 star=low, 4 stars=high). 1 or 2 stars represent useless; 3 or 4 starts represent useful.

![Figure 4.37 Q8-1 Results](image1)

In Q8-1, 33% respondents rated the usefulness of MyDIT as three stars, 27% respondents rated it as four stars, 27% rated as 1 star while 13% rated as 2 stars.

![Figure 4.38 Q8-2 Results](image2)
In Q8-2, 40% respondents rated the usefulness of Webcourses as 2 stars, and 27% rated as 1 star. 20% rated as 3 stars, and 13% respondents rated as 4 stars.

Figure 4.39 Q8-3 Results

In Q8-3, 20% and 7% respondents rated the usefulness of Webtimetables as 4 stars and 3 stars. However, 60% respondents rated the usefulness of Webtimetables as 2 stars, and 13% respondents rated it as 1 star.

Figure 4.40 Q8-4 Results

In Q8-4, 33% respondents never used Mypassword. 7% and 20% respondents rated the usefulness of Mypassword as 1 and 2 stars. 27% respondents rated it as 3 stars, 13% as 4 stars.
In Q8-5, 20% respondents never used it. 33% respondents rated the usefulness of library service system as 3 stars, 27% as 4 stars, 7% as 1 star and 13% as 2 stars.

In Q8-6, 47% respondents rated usefulness of student self-service system as 3 stars, 33% as 4 stars and 20% as 2 stars.
In Q8-7, 40% respondents rated the usefulness of DIT website as 3 stars, 20% as 4 stars, 20% as 2 stars and 13% as 1 star. Another 7% respondents never used it.

In Q8-8, 67% respondents rated the usefulness of class blog as 4 stars, 27% as 3 stars and 7% as 1 star.
In Q8-9, 73% respondents rated the usefulness of information about classmates as 4 stars, 20% as 3 stars and 7% as 2 stars.

In Q8-10, 67% respondents rated the usefulness of lecture web pages as 4 stars, 20% as 3 stars, 7% as 1 star and 7% never used it.
In Q8-11, 60% respondents never used it. 27% respondents rated the usefulness of school facebook page as 1 star, 13% as 2 stars.

The eighth question is mandatory. It aims to investigate the students’ satisfaction of existing main systems/tools/functions used to providing information about the programme within DIT. This question is relating to tacit knowledge. Knowing what systems/tools/functions student would like to use is deemed to be very useful information for the view of designing new KMS.

The question nine (This question is to identify the frequency that student used tools/systems to find information about their programme.) How often do you use the following to find information about your programme?
In Q9-1, 73% respondents used class blog frequently, and 27% respondents were occasional.

Figure 4.49 Q9-2 Results

In Q9-2, 40% respondents never used class discussion group blog, 40% respondents were occasional, and 20% respondents were frequent.

Figure 4.50 Q9-3 Results

In Q9-3, 13% respondents never used Webcourses, 53% respondents were occasional, and 33% were frequent.
In Q9-4, 7% respondents never used lecture websites, 27% respondents were occasional, and 67% respondents were frequent.

In Q9-5, 33% respondents never used DIT websites, 47% respondents were occasional, and 20% respondents were frequent.

In Q9-6, 33% respondents never used Google Search, 50% respondents were occasional, and 17% respondents were frequent.
In Q9-6, 20% respondents never used Google search, 47% respondents were occasional, and 33% respondents were frequent.

**Figure 4.54 Q9-7 Results**

In Q9-7, 13% respondents never used email lectures, 67% respondents were occasional, and 20% respondents were frequent.

**Figure 4.55 Q9-8 Results**

In Q9-8, 73% respondents used consult classmates frequently, and 27% respondents were occasional.

The ninth question is mandatory. It ascertains the frequency of using the existing resources to find information about the programme. This style of question is quantitative assessment.
The question ten (This question was obligatory and the participants were asked to choose one of the following: Strongly Disagree, Disagree, Agree, Strongly Agree or N/A). This question was obligatory. The participants were asked to rate these question.

![Question 10 - I know which resources/systems to use for all queries I have.](image)

**Figure 4.56 Q10-1 Results**

This sentence aims to investigate if the students knew which resources/systems to use for all queries they had. In Q10-1, 40% respondents agreed that they knew which resources/systems to use for all queries they had, 20% strongly agreed, 20% disagreed, while 20% strongly disagreed.

![Question 10 - I can access lecture notes and other material needed easily.](image)

**Figure 4.57 Q10-2 Results**

This sentence aims to identify whether students can get the lecture notes and other material needed easily. In Q10-2, 7% respondents disagreed that they can access lecture notes and other material needed easily, 53% agreed while 40% strongly agreed.
This sentence aims to investigate students can get technical support easily for all systems in DIT. In Q10-3, 20% respondents disagreed that they can access technical support easily for all systems, 20% strongly disagreed, 40% agreed, 7% strongly agreed, while 13% were no answer.

This sentence aims to identify the students can contact lecturing staff by email when they need to. In Q10-4, 40% respondents agreed that they can contact lecturing staff by email when they need to, 60% strongly agreed.
This sentence aims to identify whether the students would like a single system through which they could interact with all aspects of participating in a programme. In Q10-5, 33% respondents agreed that they would like to a single system through which they could interact with all aspects of participating in a programme, 53% strongly agreed, while 13% were no answer.

This sentence identifies whether the students would like to share knowledge with other learners through online tools. In Q10-6, 67% respondents agreed that they would like to share knowledge with other learners through online tools, 20% strongly agreed, 7% disagreed while 7% strongly disagreed.
This sentence identified whether the students would like to be able to control when knowledge is presented to them. In Q10-7, 7% respondents disagreed that they would like to be able to control when knowledge is presented to them, 20% were no answer, 47% agreed while 27% strongly agreed.

This sentence investigates the students can contact other learners on their programmes easily. In Q10-8, 40% respondents agreed that they can contact other learners on their programme easily, 40% strongly agreed, 13% disagreed while 7% strongly disagreed.

The question eleven (This question is to identify the useful functions/tools are in Webcourses). Which of following have you used in Webcourses? The question eleven was obligatory. This question aimed to identify the frequency of using functions by
respondents in Webcourses system. According to question eight, 40% respondents rated the usefulness of Webcourses as 2 stars, and 27% rated as 1 star. It showed that the Webcourses system was not enough useful for respondents in providing information about their programme. 53% respondents used Webcourses to download lecture notes and submit assignment frequently.

![Question 11 - Download Lecture Notes](image)

**Figure 4.64 Q11-1 Results**

In Q11-1, 20% respondents never downloaded lecture notes by Webcourses, 27% respondents were occasional, and 53% were frequent.

![Question 11 - Submit Assignments](image)

**Figure 4.65 Q11-2 Results**

In Q11-2, 53% respondent submitted assignment frequently by Webcourses, and 47% respondents were occasional.
In Q11-3, 80% respondents never participated in discussion with other students by Webcourses, and 20% respondents were occasional.

In Q11-4, 93% respondents never uploaded ideas for comment and feedback by Webcourses, and 7% respondents were occasional.
In Q11-5, 87% respondents never set and viewed calendar events by Webcourses, and 13% respondents were occasional.

![Figure 4.69 Q11-6 Results](image)

In Q11-6, 87% respondents never sent email by Webcourses, and 13% respondents were occasional.

![Figure 4.70 Q11-7 Results](image)

In Q11-7, No respondents chat online by Webcourses.

![Figure 4.71 Q11-8 Results](image)
In Q11-8, 73% respondents never got grade by Webcourses, and 27% respondents were occasional.

Figure 4.72 Q11-9 Results

In Q11-9, No respondents discussed issues with lectures by Webcourses.

The question twelve (This question aims to identify the functions/tools that students used in the library system.) The question twelve was obligatory. According to question 8, 20% respondents never used it. 33% respondents rated the usefulness of library service system as 3 stars, 27% as 4 stars, 7% as 1 star and 13% as 2 stars. Which of following do you use in the library system?

Figure 4.73 Q12 Results
67% respondents used computing electronic resources in library service system. 60% respondents used E-journal in library service system. 60% respondents used search and renew books in library service system. 47% respondents used find exam paper in library service system. 27% respondents used opening hours and other in library service system. 13% respondents used change password in library service system. Notice: People may select more than one checkbox, so percentages may add up to more than 100%.

4.3.4 Preferences

The question thirteen (This question identifies the characteristics of tools that students prefer to.) For tools made available by DIT, which of the following characteristics would be important to you

![Question 13](image)

Figure 4.74 Q13 Results

This is the multiple choice question. Reliability was chosen as the top characteristic would important to respondents (15 respondents highlighted this); followed by systems contains up to date information (13 respondents highlighted this); next in turn was single point of access (11 respondents highlighted this); after that was represents an authoritative source of information (8 respondents highlighted this); last but not least was allows collaboration with other learner.
The question fourteen (This question is a free form text that aims at looking for good examples of tools DIT could learn from. This question is to broaden the mind.)

If you have examples of tools DIT could learn from please note below (include links if possible):

• Possible consider using Moodle - it’s a bit better than Webcourse Online lectures - lectures could be recorded and streamed online. This would be good for students who work or have to travel to attend lectures

• Downloadable version of blackboard in use in UCD automatically downloads all notes onto local system

• discussion forum

• Google+ might be better than all the blogs and emails. Google Calendar for timetables.

• Moodle

The question fifteen (The good comments will improve the work’s quality.) Please enter any additional comments:

• Be consistent - last semester was predominately webcourses, this year it is back to lecturer websites. I’m following 4 blogs even though I’m only doing 2 subjects. There needs to be an element of control.

• In question 6 a number of the questions were N/A for me, however this is not an option - so I defaulted the answer to the first button, as I had to choose one.

• Blogs are useless way for students to communicate with each other for that purpose forms are the best, it is badly needed.

• Overall Knowledge Management is very poor and inconsistent in the school. Email lists seem to be inaccurate.

4.4 Key Findings from Survey

Based on the responses of surveys, the following concludes the analyzed results:

• Identified the knowledge needed by students. This knowledge is grouped around a timeline — start of semester, mid of semester, end of semester and all year.
  ➢ Start of Semester: DIT map, Fees and Funding, Registration and Deadline
- Mid of Semester: Calendar, Programme Timetable, Student Rules & Regulations
- End of Semester: Exam Consultant, Exam Timetable, Exam Results, Supplemental Exams
- All Year: Current Vacancies, DIT News & Events, International Office, Living in Dublin, Programme Mentor & Chair, Programme News, Seminars/Conferences/Fairs related to programme area, Study Skill, Support Office, Technical Support

- Reusing the existing systems in DIT, such as MyDIT, Library Services System, Student Self-Service System, DIT website, Class blog, and Lecture webpages.
- The characteristics of system/tools should be reliability, up to date information, and single point of access.
- Discussion forum should be contained in the system.

The Table 4.1 describes the summary of students’ requirements, solutions and details.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Solution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students want to find the most useful information</td>
<td>Classify the information based on the period</td>
<td>There is lots of information in DIT Websites. Students can access the part of the KMS without registration. The period identified information is included. In order to help students find the information needed immediately, the system gives a pop-up window to advice them when students login.</td>
</tr>
<tr>
<td>when they needed.</td>
<td>period identified: Start of Semester,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>During Semester, End of Semester and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Throughout Academic Year.</td>
<td></td>
</tr>
<tr>
<td>Students do not want to access multiple websites</td>
<td>Reuse and centre the multiple existing</td>
<td>The quick link function can centre the existing systems. It is on the top of the website. These are the</td>
</tr>
<tr>
<td>by login different DIT systems.</td>
<td>systems in the KMS.</td>
<td></td>
</tr>
</tbody>
</table>

96
Students just use some existing DIT systems frequently. | Display the existing DIT systems which students use frequently in the apparent positions. | When students login the KMS, the existing systems which students use frequently are displayed in the right sidebar below the student information. These are the links of systems. After students click the one link of system, and they want to go back to KMS, they can click the back key besides the left of the website.

Students would like a single system through which they could interact with all aspects of participating in a programme. | The KMS consists of information about programmes/modules/lectures details, centre existing DIT systems, and develop new functions/tools to share the knowledge with other learners. | The KMS can satisfy the needs that students can find the most useful information about programmes when they needed, and KMS can provide a platform for students to share knowledge with other learners. The learning club will be carried out.

Students would like to | The learning club/forum and | The students can use
<table>
<thead>
<tr>
<th>Share knowledge with other learners through online tools. And they would like a discussion forum.</th>
<th>Generates in KMS.</th>
<th>Learning club/forum after they register. The learning club can be set up by anyone who wants to meet other learners to discuss a subject of shared interest.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students would like to be able to control when knowledge is presented.</td>
<td>The learning journal generates in KMS.</td>
<td>The students can use learning journal after they register. Learning journal allows the learners to keep themselves personal notes and reflections on the material they are studying or on their general study experiences.</td>
</tr>
<tr>
<td>Students prefer tools with characteristics which are reliability, systems contains up to date information, single point of access, and represents an authoritative source of information.</td>
<td>The development tool of KMS is Drupal, and the KMS gets the support of MSc in Computing programme chairperson.</td>
<td>Firstly, the development tool of new system is Drupal which is an open source content management platform powering millions of websites and applications. It’s built, used, and supported by an active and diverse community of people around the world. All the development is basic on the Drupal 7. And the new system contains all the information which is from DIT website. So it is</td>
</tr>
</tbody>
</table>
reliability. Next, the system admin will up to date information/news which is from DIT every day. The administrator may be the head of Master of Science in Computing. In addition, because the administrator could be the head of Master of Science in Computing, the published information should be an authoritative source. Finally, the new system is to centre the information and reuse the existing DIT system, so it just provides some best practices to represent and share users’ knowledge. For example, learning club can be set up by anyone who wants to meet other learners to discuss a subject of shared interest.

<table>
<thead>
<tr>
<th>Students would like Google+</th>
<th>Add the Drupal plug-in with Google+</th>
<th>Processing</th>
</tr>
</thead>
</table>

Table 4.1 The summary of student's requirements, solutions & description
4.5 Conclusion

To summarise, this chapter is to analyze the feedbacks from students through an online survey, and get the results which contribute to the build of KM system. Based on the findings of this section, the students have the willingness to establish a system for knowledge capturing, sharing and applying it to DIT MSc in computing. Until now, there is intensive information around the DIT websites, the students have to retrieve the information they needed; this can be both time-consuming and inconvenient; and access multiple systems by login different websites. Therefore it is proposed for this project not only to gather information from the existing DIT systems and classify the information so as to encourage communication between students, but also to reuse and centre the useful existing systems for students. Finally, the findings were summarized from the analysis of the survey and supported redesign of the KMS for MSc in computing programme.
5 KNOWLEDGE MANAGEMENT SYSTEM

5.1 Introduction

The focus of this chapter is the design and implementation a Knowledge Management System for MSc in computing students based on the outcome of the literature review in chapter 2 and chapter 3, as well as the analysis of survey results in chapter 4. The KMS aims to establish a student centred knowledge platform in order to support student activities when engaging with a Higher Education Institute.

5.2 KMS Design

The introduction in previous chapter, the ten-step road map describes the processes to develop a KMS in the organization. In the part of designing KMS, the blueprint should be implemented. The figure 5.1 shows the overview of the KMS for MSc in computing. This is based on the requirements in chapter 4.
It describes how the KMS is focusing on students who are in DIT MSc in computing. The main function of KMS is to identify the knowledge student needed and this knowledge is grouped around a timeline: start of semester, during semester, end of semester and throughout academic year. It reuses the existing systems in DIT, such as MyDIT, timetable, library system; and it also creates new forum and learning journal which has proved valuable on other systems such as those used by the Open University (www.open.ac.uk).

Key features of the system are:

- Single point of access is one of the KMS characteristics, it depends on DIT technical infrastructure. Each student and member of staff will have access via a unique ID. Although not implemented for this trial version, this should be linked.
to existing DIT username and passwords to ensure consistency and holistic sense the KMS aims to provide.

- Inclusion of existing DIT systems: A range of DIT systems are already in place which successfully achieve a number of student requirements. Rather than redeveloping these, this system incorporates access to them from within.
- Up to date information: Information in the KMS is sourced from the programme management who will have facilities to keep it updated.
- Time relevant knowledge: The system is designed so that the knowledge students need is associated with the time they need it so that the system can deliver the knowledge students need when they most need it e.g. information registrations will be automatically made available in a highly visible manner when this is most relevant to the student.
- Reliability: Both the information and the implementation should be reliable. Drupal 7 has been chosen as it is a highly regarded solution with a strong reputation in this area (Purrer, 2010). As the core information is kept updated by the programme management it can be considered reliable also.

5.2.1 System Calendar

The system calendar is a core part of the system allowing knowledge to be linked to relevant time periods to improve knowledge delivery to students. The periods identified are: start of semester, during semester and end of semester (Figure 5.2). Based on the investigation when students needed identified information, these periods will overlap such as students will need information about registration at the start of semester 1 and also need access to knowledge that is largely allocated to during the semester.

The academic calendar operates as follows: each semester is 15 weeks in duration, 12 weeks teaching plus 3 for examination. Holidays are not counted within the 15 weeks. Take the semester 1 as an example as follows:

Semester 1

1. Registrations starts from Week1 September and must be completed by week 4 of October.
2. Programme induction starts Week 2 or week 3 of September
3. Teaching starts week 3 of September, Teaching finishes week 3 of December

4. Examinations start week 2 of January

5. Exam results are generally available Semester 2

Overlaps:
Step 1, 2 and 3 will overlap until probably week 5 of Semester 1 e.g. while students are registering etc they need to be able to access details of timetables etc. However while the majority of students will register in the first weeks there may be some who are delayed and will still need to be informed of this requirement.

Step 3 and 4 will overlap: exam timetables and procedures will be issued during teaching and students focus will switch to exams only when exams have actually started.

Step 4, 5 will overlap: students will require information about when results will be available during exams.
5.2.2 Use Case Diagram

Figure 5.3 shows a use case diagram for students in KMS, and Figure 5.4 shows a use case diagram for staff in KMS.

The main actors are students who can search and publish articles; they can check information about programme such as timetables, modules, lectures, past exam papers and notes; they also can write comments and experience, and upload personal ideas, photos, etc. All of these can be stored in the database and retrieved within the system as needed.
Figure 5.3 Use Case for Students in KMS
5.2.3 Types of Knowledge Available

In KMS, there are four types of actors: students, system admin, system, and course team. These four actors can do some actions with three types of knowledge which identified in chapter 4 (Figure 5.5). For example, students can access direct explicit declarative knowledge such as dynamic and static web content (Figure 5.6 and 5.7). They can also generate the tacit declarative knowledge, and they can comment to tacit procedural knowledge.

Figure 5.4 Use Case for Staff in KMS
Dynamic web content can deliver explicit declarative knowledge, such as announcement board, programme news, and so on. It is updated by system admin. According to different ID, the system may display different content.

Static web content can also deliver explicit declarative knowledge, such as the information student needed by timeline, modules, timetables, and so on. It updates infrequently, accesses on demand and keeps pace with times.
5.3 Prototype Student Centred Knowledge Management System

Based on the design of KMS in 5.2 this chapter, the KM system was implemented by using Drupal\(^2\) to develop the online prototype with Blue Hosting\(^3\). The blue hosting is the formal proposed hosting by Drupal. The website is using administrator role to build the system. The website is: www.dannykms.com/drupal.

The project is a web based application, which is running under Linux system. The database system used is MySQL. The application is controlled by Tomcat Apache server. This server is responsible for displaying user interface and logic. All logic is done using PHP that serve dynamically generated pages based on HTML. The application is using MySQL driver in order to retrieve data from database. Database is stored on MySQL server. All data is gathered using SQL statements.

The following diagram describes the architecture of this application. Please note that in case of this application controller and model connects together.

The MVC architecture is an efficient pattern to separate model layer, view layer and controller layer (Figure 5.8). In regard of technical, program can easily manage and maintain system in the future. Considering system to be replaced by company business expansion, it is important to enable system collaborating with legacy system in term of

\(^2\)http://drupal.org/
\(^3\)https://my.bluehost.com/cgi/account?logout=1
the principle of software engineering. Since the system works as independent component, it will allow existing part of system re-engineering. Parallel development methodology also gets benefit from MVC. Single team member will play an important role in development phase. That is the reason why it was chosen.

The main components of the system are as follows:

- Quick Link
- Announcement board
- My Modules
- Timetable
- Forum
- Learning Journal
- School News
- Reuse
  - Library system
  - MyDIT
  - Student Union

5.3.1 Main Page

The Figure 5.9 illustrates the interface of KMS homepage. The theme is made by Kiwi Themes, which is a company focused entirely on providing high-quality themes for Drupal content management system. Students can have a look at the Quick Link and School News without login, but they cannot make a comment when they browse the School News. The Quick Link contains identified knowledge students needed which is
grouped around a timeline: start of semester, during semester, end of semester, and all year (Figure 5.10).

![KMS Homepage](image)

**Figure 5.9 KMS Homepage**

![KMS Quick Link](image)

**Figure 5.10 KMS Quick Link**

### 5.3.2 Announcement Board

Figure 5.11 shows the interface when students login. The announcement board is at the top right corner of website. It related to the system calendar. For example, it displays lectures information at start of year, study tips during year, revision notes at end of year. And it is uploaded by course team.
The student information contains student’s name, course name and type of course. After student registered, it was stored in database. When student login, it is displayed at the right side of website.

5.3.3 My Modules

My Modules is located at the right side of website. It contains all the description of modules students attended, lectures’ information, course description, and past exam papers. All the modules exam papers are included. Students do not need to download it from different websites, and they can come to understand modules and lectures circumstances in advance. Figure 5.12 shows the details of My Modules.
### KMS My Modules

<table>
<thead>
<tr>
<th>Modules</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Methods and Proposal Writing</td>
<td>Damian Gordon</td>
</tr>
<tr>
<td>Universal Design</td>
<td>John Gilligan</td>
</tr>
<tr>
<td>IT Security and Forensics</td>
<td>Fred Japhet Mtenzi &amp; Said Jafari Kavula</td>
</tr>
<tr>
<td>Problem Solving, Communications and Innovation</td>
<td>Damian Gordon</td>
</tr>
<tr>
<td>Research Writing and Scientific Literature</td>
<td>Deirdre Lawless</td>
</tr>
<tr>
<td>Systems Architectures</td>
<td>Ronan Bradley</td>
</tr>
<tr>
<td>Visualisation</td>
<td>Colman Mcmahon</td>
</tr>
<tr>
<td>Knowledge Management Tools and Techniques</td>
<td>Colman Mcmahon</td>
</tr>
<tr>
<td>User Centred Design</td>
<td>Robert Ross</td>
</tr>
<tr>
<td>Data Mining</td>
<td>Brendan Tierney</td>
</tr>
<tr>
<td>IT Security and Forensics</td>
<td>Fred Japhet Mtenzi &amp; Said Jafari Kavula</td>
</tr>
<tr>
<td>Software Project Management</td>
<td>Colm O'Sullivanibhain</td>
</tr>
<tr>
<td>Knowledge Acquisition and Model</td>
<td>Deirdre Lawless</td>
</tr>
<tr>
<td>Data Management</td>
<td>Robert Ross</td>
</tr>
<tr>
<td>Man and Machine</td>
<td>Andrea Curley</td>
</tr>
<tr>
<td>Software Design</td>
<td>Richard Lawlor</td>
</tr>
<tr>
<td>Case Studies in Knowledge Management</td>
<td>Robert Ross</td>
</tr>
</tbody>
</table>

**Figure 5.12 KMS My Modules**

#### 5.3.4 Timetable

The Figure 5.13 shows that timetable is located at the right side of website. Students can download the timetable when they click it. The course team uploaded the timetable when it was generated.
5.3.5 Forum

The uses of Forum within the website are:

- It provides a platform to express the opinions/ideas about something interesting for students.
- The course team can read the content of forum, in order to understand what the students need, and when they needed.
- All the records will be stored in database. The system admin can track it.

Figure 5.14 shows the interface of forum page.
5.3.6 Learning Journal

A Learning Journal allows you to keep your own personal notes and reflections on the material you’re studying or on your general study experiences. You can choose to keep the notes to yourself, or to share your entries with other people. All your notes will be stored on the website and are always available for you to add or review.
5.3.7 **Reuse**

The reusing is decided by integrating analysis of survey in chapter 4 and real needs of development in KMS. The DIT webmail and library resources are reused through the links. Also student union is necessary for students to get the essential and kinds of information when they study in DIT. Figure 5.16 shows the reuse existing systems and student union webpage in KMS.
5.4 Conclusion

This chapter aims to utilise the findings of the survey as well as the literature reviews to design and build a knowledge management system for MSc in commuting programme. The system is web based application. It used Drupal 7 as a development tool with Blue Hosting. The refined road map to build KMS firstly identifies the requirements of users; then design the KMS (create the blueprint); after that, build the KMS based on the design; finally, evaluate the KMS to meet the users’ requirements. The evaluation part will be addressed in the next chapter.
6 EXPERIMENTATION & EVALUATION

6.1 Introduction

This chapter illustrates the evaluation of knowledge management system for MSc in computing programme. It aims to evaluate the system to meet the requirements which are found in chapter 4. The knowledge management system that was designed and built in chapter 5 will be used by students. Then students will fill in the online evaluation form by Google docs.

6.2 Experimentation

Evaluation form was released from 17th April. The notice was published on MSc in computing discussion group blog. In addition, Damian Gordon was introduced the system in his Problem Solving, Communication and Innovation class. Each participant registered and accessed the system through www.dannykms.com/drupal. The suggestion was that the participants filled the evaluation form after they used the system a few times. The evaluation form was also made by Google docs, and published through http://tinyurl.com/dannykmsproject. Also the students could use the public account to access the system: username (test), password (test).

6.3 User Evaluation

This evaluation aims to test the best practices can meet the requirements previous found. For each participant, it is free to fill the evaluation form and give the comments on improving KMS. The ultimate goal of KMS is to provide better services for MSc in computing students through identifying and collecting information they needed and when they needed. In order to achieve this goal, the following questions should be mentioned:

1. Is this system easy to navigate?
2. Did you find the Quick Link at the top left corner? Are you happy with the classification of information in Quick Link?
3. Did you find the useful information you needed in Quick Link?
4. What else information do you think should be added in Quick Link?
5. Rate some sentences to meet the previous survey Questions ten in chapter 4.

6. Would you like the style of announcement board at the top right corner?

7. How many times have you accessed the system?

8. What functions have you used?

9. What would you add to the system to improve it?

10. Comments

Here the each participant was asked to answer those questions above to identify the KMS to meet the requirements that were found in previous chapter.

6.3.1 Basic Information

Question seven was asked the respondents to indicate the frequency of the respondent used. It was designed to highlight the content of evaluation form which was answered by the respondents was convincing. Totally eight respondents filled this question, five of them accessed the system three or more than three times, two of them accessed twice, and another one accessed once. It illustrates more than 60% respondents made a clear understanding with the system. The results of evaluation form are truly and reliable.

6.3.2 Facilities

Question from 2 to 4 was related to identify whether Quick Link function can meet the students’ requirements what knowledge they need and when they needed.

Question two was asked the respondents to indicate whether the student is happy with the classification of information in Quick Link. This question is designed to highlight how satisfaction of students for the classification of information in Quick Link. Totally eight respondents chose option “Yes” (Figure 6.1). It illustrates the classification of information, which is grouped based on the period identified previously, is a better way to bright the students’ eyes.
Figure 6.1 Q2 Results

Question three was asked the respondents to identify whether the student can find the useful information in Quick Link. This question is designed to investigate the information is useful for student in Quick Link. Totally eight participants chose option “yes” (Figure 6.2). It indicates the Quick Link function can meet the students’ requirements that students can find the useful information when they needed.

Figure 6.2 Q3 Results

Question four was a free form text aimed at getting an individual’s view on what they considered other information should be added in Quick Link. This question is designed to supplement the information which did not mention in Quick Link. Totally eight respondents wrote “No”. It illustrated the students can find the most useful information they needed in Quick Link.

Question five was asked the respondents to rate these sentences.
Q5-1 was designed to identify the awareness held by respondents that the information is most helpful in Quick Link. Totally eight respondents answered this question, six of them strongly agreed that information included in the Quick Link is most helpful, and two of them agreed (Figure 6.3).

![Figure 6.3 Q5-1 Results](image)

Q5-2 was designed to identify the awareness held by respondents that the information is most helpful in noticeboard. Totally eight respondents answered this question, seven of them agreed that they can get the most helpful information on the noticeboard when they login the KM system, and one of them strongly agreed (Figure 6.4).

![Figure 6.4 Q5-2 Results](image)

Q5-3 was designed to identify the knowledge is presented in the system can satisfy the students needs. Totally eight respondents answered this question, five of them agreed that they can get the knowledge they needed in the system (Figure 6.5). However, three of them disagreed that. It illustrates the knowledge is presented in the system can
meet more than 60% respondents needs, nearly 40% cannot meet. This is uncompleted system, so it needs more effort to improve.

5. Rate these sentences - I can get the knowledge I needed in the system.

![Bar chart showing responses to the knowledge needed question.]

**Figure 6.5 Q5-3 Results**

Q5-4 aims to investigate the applying situation of integration of DIT existing system. Totally eight respondents answered this question, four of them disagreed that they can access any DIT existing system/website through KM system, three of them agreed, and one of them strongly agreed (Figure 6.6). Based on design of system, not all the DIT existing system used in the system, such as webcourses, student self-services and DIT website.

![Bar chart showing responses to the access to DIT system question.]

**Figure 6.6 Q5-4 Results**

Q5-6 aims to identify the respondents can get the materials easily in KM system. Totally eight respondents answered this question, four of them agreed that they can get the materials easily in the system, but the other four disagreed that (Figure 6.7).
Q5-7 was designed to identify the material the respondents got included relevant and up to date. This is a continuation of the previous question (Q5-6). Also eight respondents answered this question, four of them agreed that they can get the materials which included relevant and up to date, but the other four respondents did not agree that (Figure 6.8). The initial version of system was released on 19th April, so it needed more time to improve it.

Question six was asked the respondents to identify the their satisfactions of style of noticeboard at the top right corner. This question was designed to investigate the other style of noticeboard may be more suitable for the system. Totally eight respondents answered this question, seven of them liked the style of noticeboard, only one dislike it (Figure 6.9). So the announcement board is successful to develop.
Question eight was asked the respondents to investigate what functions they used in the system. This question was designed to identify the functions developed could be useful for students. It helps the developer change the functions to a better position. This question was a multiple choices which were permitted for one or more options. Totally eight respondents answered this question, eight respondents used Quick Link, seven respondents used Timetable, four respondents used My Modules, one used Learning Journal and Webmail (Figure 6.10).

Figure 6.9 Q6 Results

Figure 6.10 Q8 Results
The Quick Link is the main function to carry out the requirement of students who want to find the most useful information when they needed. The results indicated each respondent accessed this function. So Quick Link is successful to achieve the goal.

My Modules was generated to keep the knowledge about the modules, such as module introduction, lecture information, notes, past exam papers and programme description. Those can help students gain the explicit knowledge which is useful for student to keep the pace with study. The results indicated nearly 50% respondents accessed this function. So My Modules is successful to let students enjoy their studying life.

Timetable was important element for students when semester started. This timetable is for all academic year. It helps students make a right pace with study, and balance their life. Although it was the end of semester, it was about 85% respondents accessed this function.

Question nine was asked the respondents to identify the awareness of improving the system through adding some new functions or tools. This question aims to highlight a better way to improve the system and open the developer’s mind. The respondents gave some suggestions as follow:

- It would be better if added some useful links, such as discussion group, blog...
- The moodle is better than webcourses.
- Webcourses is not included in the system.
- Maybe link to other college websites, UCD, Trinity...
- Google+ may be suitable for the system.
- Links to DIT website, discuss blog
- Webcourses is not available.
- Discussion blog might be added.

6.3.3 Interface

Question one was asked the respondents to identify whether the system is easy to navigate. Totally eight respondents agreed the system is easy to navigate (Figure 6.11). It illustrates the respondents are used to access the system.
Question ten was asked the respondents to identify their satisfactions of layout of KM system. This question was designed to improve the interface of system. Totally eight respondents noticed this question. Just one said that the classification of Quick Link is a good idea for identifying the knowledge he needs. Others all liked the layout of system, but did not write the reason.

6.3.4 Preferences

Q5-5 aims to identify the respondents’ awareness of using the KM system during their study life in DIT. Totally eight respondents answered this question, four of them agreed that they would like to use the system during study in DIT, two of them strongly agreed, and only one of them did not know (Figure 6.12).
Question eleven was a free text aimed at getting an individual’s view on what the respondents considered to improve the system. This question is designed to let the respondents talk anything interesting about the system. It is the best way to supplement the gap out of the developer’s mind. Just two respondents gave the comments as follow:

- It’s better to add Google calendar into system stead of timetable.
- The announcement board could be a bright style.

6.4 key Findings from Evaluation

Based on the analysis of evaluation form, the key findings as follow:

- Generally, the proposed KM system is fine. Most of respondents will utilize the system during the study life in DIT.
- The classification of information based on the period identified (start of semester, during semester, end of semester and all year) can meet the requirements of students. And information is presented in the system can also meet students needs.
- The system just centered existing system in DIT, it was not real integration. So the system just linked to the website of other systems. And not all the existing systems were reused in KMS. It just reused webmail, library system, and student union.
- The top frequently functions/tools the respondents used were Quick Link, My Modules and Timetable. The more and more functions/tools will be released in the future work.
- The noticeboard is the important element in the system. It aims to display the most essential information the students needed, and it changes the content with the timeline: start of semester, during semester, and end of semester. And it may change to bright style.
- The up-to-date of information and material is also more vital. The project is not a team development, so some material is not latest such as the past exam papers.
- The more useful links should be added into the system. For instance, DIT website, discussion blog, and other college websites.
• The discussion forum function did not reflect the value in the evaluation form. The reason might be just few respondents utilized the system; they are busy in the end of semester.

6.5 Conclusion

To summarise, this chapter aimed to evaluate the KMS developed for MSc in computing programme. To achieve this, the evaluation questions were generated. It presented the description of the experiment, designed questions on the requirements found in the previous chapter. The released tool was also Google docs; and was evaluated by students who study MSc in computing programme and they filled in the evaluation form after they used system.

The results of evaluation form were discussed and summarized. Many of the responses were reliable and convincing, because the respondents wanted to utilize the system in the future. The key findings would help future work to improve the system.
7 CONCLUSION

7.1 Introduction

The final chapter of this dissertation describes some conclusions and suggestions from performing this research project. The aim of this research was to develop a knowledge management system for MSc in computing programme in DIT. Before the KMS was built, the four tasks had to be implemented: firstly, to conduct an online survey, which aims to identify the requirements of MSc in computing students. Secondly, based on the findings of the online survey results and previous literature review, it generated a blueprint in order to design the KMS. Thirdly, according to the design plan, to build the KMS by using Drupal with Blue Hosting which is a free online platform; and the last, by using the web based KMS; create an experiment for evaluation by the MSc in computing students in DIT. The questions on the evaluation form were generated to reflect the requirements of students which were found in previous chapter. By performing these four tasks, it was hoped to reflect the knowledge needed by students who study MSc in computing programme and recognize the benefits the knowledge management system has offered.

This chapter presents a summary of the research in terms of the initial aims and objectives, and indicates what was achieved during the period of research. In addition, this chapter discusses the contribution to the body of knowledge and the potential areas for future work.

7.2 Research Definition & Research Overview

With the high speed development of information technology and business competition, knowledge has become more and more important to sustained economic development and seeking competitive advantage. Therefore, knowledge management approaches and activities are better way to implement to achieve success in the organizations. The challenges of knowledge management are knowledge capture and sharing. Higher Education Institutions, as special “business”, have intensive knowledge. This is the reason why HEIs are the most suitable for implementing KMS which is a platform to
support the knowledge management processes: knowledge discovery, knowledge capture, knowledge sharing, and knowledge application. School of Computing has recognized the change should be occurred, proposing a KMS is to manage knowledge and make it efficiently. This project developed a KMS within MSc in computing.

This KM system aims to establish a student centred knowledge platform in order to support student activities when engaging with a higher education institute. The chapter 2 reviewed the concepts of knowledge, knowledge management, and knowledge management system. Next, the guide to develop KMS, higher education environment, and KMS bring benefits to HEI were reviewed in chapter 3. In addition, the online survey was generated to identify the requirements of MSc in computing students in chapter 4. After that, the prototype KMS was built in chapter 5. Finally, the evaluation form was released to test the KMS can meet the requirements of students in chapter 6.

### 7.3 Contributions to the Body of Knowledge

This project is to develop a knowledge management system for MSc in computing students in DIT. The research introduced the ten-step road map to implement knowledge management activities and systems. The main considerations of design survey were what knowledge students needed, when they needed, what types of tools students preferred, etc. which was concluded the student’s requirements. In addition, the three case studies were introduced. The first case study illustrated web portals as a type of knowledge management system were used in universities in common today. Next case study indicated HEIs were most suitable for implementing KMS, which integrated multiple best practices from existing systems and added new features into KMS, to provide better services for students. The final one was to investigate the best practices and tools which were used in UK Open University. The previous reviews and case studies can help develop a KMS for MSc in computing students.

The online surveys were generated and released to identify the student’s requirements and how KMS could meet the requirements. Also the questions in survey were related to different types of knowledge. Although the scope of project was small, the findings could be suitable for a huge group. The key findings from surveys added to the body of knowledge and could be applied to any HEIs for that matter. The prototype KMS was
developed based on the key findings from survey, previous literature review, and case studies.

7.4 **Experimentation, Evaluation and Limitation**

The experimentation in this project was to investigate the findings of survey, and develop a knowledge management system based on the key findings. The respondents involved were MSc in computing students in DIT.

The evaluation was generated and released through online survey to evaluate KMS could meet the requirements of students. The feedback was analyzed for future work.

7.5 **Future Work & Research**

Several areas for potential future work and research will be illustrated:

- Deep detailed research of the developed knowledge management system within HEI.
- Lectures and course team will be involved as actors in the KMS.
- More functions and tools will be implemented into KMS. It can provide the more and better services for students, Lectures, course team.
- The leading information technology will be researched in the future work.
- The security problems will be considered in the future.
- The KMS will be implemented into a school.
- After implementing KMS, future research may be how it can actually bring benefits into a programme or school.

7.6 **Conclusion**

This project aims to develop a knowledge management system for MSc in computing programme. The higher education institute was the most suitable for implementing knowledge management system, because there was intensive knowledge in HEI. During the research processes, the main road map was vital to develop KMS; the key findings from survey helped identify the knowledge students needed and this knowledge was grouped as a timeline, and the requirements were generated; moreover, the development of KMS was conducted based on the key findings and literature
review; and finally a student centred KMS was evaluated by students who study MSc in computing programme to meet the requirements previously found.
BIBLIOGRAPHY


Azarbarzin, Y., 2008, a Framework of Knowledge Portal for Malaysian, *Public Consultation*

Barclay, R.O. & Murray, P.C., 2012, What is Knowledge Management, Available at: http://www.imamu.edu.sa/Scientific_selections/abstracts/Abstract%20%
20IT%20%203/What%20Is%20Knowledge%20Management.pdf [Accessed date: 02 March 2012].


Civi, E., 2000, Knowledge management as a competitive asset: a review, Journal of Marketing Intelligence and Planning, Vol. 18 No. 4, pp. 166-174


Coakes, E., 2003, Knowledge Management: Current Issues and Challenges, IRM Press, pp. 92-103
Colman, M., 2011, Lecture: What is Knowledge Management?


Dorothy, L., & John, M., 2007, Strategic: Higher Education Environment, Available at: https://docs.google.com/viewer?a=v&q=cache:jCV11UvL8BQJ:hermes.aascu.org/media/public_purpose/sep-oct07strategic.pdf+higher+education+environment&hl=en&pid=bl&srcid=ADGEESi6ry7v4BRRB-RMGEVU7iWZM43vy2J8FRCDMAHDb7qw9Cp66Wd4nmS0oXtKMGFSBdLW9qMddh8CRiixpJ8So4cCbqFICMPu4dAZC2HWDpVRDLzGFwVRDoXeHo6uEgTeNFRZOh&sig=AHIEtbTHJjJeFRQcKpXB8onrCBBS1B4dxQ [Accessed date: 11 Feb 2012]


Drucker, P., 1994, the Age of Social Transformation, *Atlantic Monthly*, 274(5), 53-70

Duffy, J., 2000, Knowledge Management: To Be or Not To Be?

Elkjaer, B., 2003, Organizational learning: the third way, *Organizational Learning and Knowledge: 5th International Conference*, Lancaster, UK, pp.18


Fayyad, U., Piatetsky-Shapiro, G. & Smyth, P., 1996, From Data Mining to Knowledge Discovery in Databases, *AI Magazine*


Hakken, D., 2003, the Knowledge Landscapes of Cyberspace, *Routledge*, London, UK

Hayek, F.A., 1945, the use of knowledge in society, American Economic Review (XXXV: 4), September, 519-530


KPMG, 2000, Knowledge Management Research Report, KPMG Consulting


Maier, R., 2002, Knowledge Management Systems: Information and Communication Technologies for Knowledge Management, Berlin

Mansourvar, M. & Mohd Yasin, N., 2010, Web portal As a Knowledge Management System in the Universities, World Academy of Science, Engineering and Technology


Pavitt, K., 1984, Sectoral patterns of technical change: Towards taxonomy and a theory, Research Policy, 13, pp. 343-373.


Purrer, C., 2010, Drupal: the content management system for handling multimedia files


Whiting, R., 1999, Myths and Realities, *Information Week*, p.42ff

Wickert, A. & Herschel, R., 2001, Knowledge Management Issues for Smaller Business

APPENDIX A — KNOWLEDGE MANAGEMENT SYSTEM PRE-SURVEY

Knowledge Management System Pre-Survey

Dear,
I am a student in School of Computing, DT, working towards my MSc in Computing degree. I am conducting research for my thesis, pertaining to the development of a Knowledge Management System to support Third Level Students.

Disclaimer: Your participation in this survey is completely voluntary and your responses will remain anonymous. Survey results will be aggregated and summarized for use in the research project. Thank you for your participation.

Regards,
Chand Su, MSc in Computing Student

* Required

Question 1 *
Age
18-25

Question 2 *
Nationality
○ EU
○ Non-EU

Question 3 *
Are you registered on a
○ Full-time programme
○ Part-time programme

Question 4 *
Please select the programme on which you are registered
○ MSc in Computing (Assistive Technology)
○ MSc in Computing (Universal Design and Assistive Technology)
○ MSc in Computing (Advanced Software Development)
○ MSc in Computing (Data Analytics)
○ MSc in Computing (Information Technology)
○ MSc in Computing (Information and Knowledge Management)
○ MSc in Computing (Knowledge Management)

Question 5 *
Year of programme
1st year
Question 6

For each of the following, please indicate the time when this programme information is most useful to you:

<table>
<thead>
<tr>
<th>Information category</th>
<th>Start of Academic Year</th>
<th>Start of Each Semester</th>
<th>During Semester</th>
<th>End of Semester (Exam/Time)</th>
<th>Throughout Academic Year</th>
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</thead>
<tbody>
<tr>
<td>Information on Fees/Funding</td>
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<td>Details on Modules</td>
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<td>Programme Rules and Regulations</td>
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<td>Programme Timetable</td>
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<td>Registration Processes and Deadlines</td>
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<td>Programme Mentor/Chair</td>
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<td>Study Skills</td>
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<td>Student Support Services (Counselling, Disability, International, Students Union etc.)</td>
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<td>Library Services (Books, Electronic Resources, Printers, Meeting Rooms etc.)</td>
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<td>DIT News Items</td>
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<td>Programme News Items</td>
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<td>Seminars/Conferences/Fairs related to programme area</td>
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<td>Job News/Opportunities</td>
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<td>DIT Location Map</td>
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<td>Exam Timetable (Including location, times)</td>
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<tr>
<td>Exam Results</td>
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<td>Exam Recheck/Remark/Appeal</td>
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<td>Supplemental Exams</td>
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<td>System Logs</td>
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<td>Technical Support</td>
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</tbody>
</table>

Question 7

If you noted use of other sources in Question 6, please provide some details:

Question 8

Please rate each of the following in terms of their usefulness to you in providing information about your programme (1 star=low, 4 stars=high):

<table>
<thead>
<tr>
<th>Source</th>
<th>1 star</th>
<th>2 stars</th>
<th>3 stars</th>
<th>4 stars</th>
<th>Never used</th>
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<td>Library service system</td>
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<td>Student self-service system (check exam results)</td>
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<td>DIT Website</td>
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<td>Class Blog</td>
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<td>Information from Classmates</td>
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<td>School Facebook Page</td>
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</table>
### Question 7
How often do you use the following to find information about your programme?

<table>
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<th></th>
<th>Frequently</th>
<th>Occasionally</th>
<th>Never</th>
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</thead>
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</tr>
<tr>
<td>Lecturers Websites</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DIT Website</td>
<td></td>
<td></td>
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<tr>
<td>Google Search</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Email lecturers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consult classmates</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Question 8
Please rate the following sentences.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know which resources/systems to use for all queries I have.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I can access lecture notes and other material needed easily.</td>
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<tr>
<td>I can access technical support easily for all systems.</td>
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<tr>
<td>I can contact lecturing staff by email, when I need to.</td>
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<tr>
<td>I would like a single system through which I could interact with all aspects of participating in a programme.</td>
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<tr>
<td>I would like to share knowledge with other learners through online tools.</td>
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<tr>
<td>I would like to be able to control when knowledge is presented to me.</td>
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<tr>
<td>I can contact other learners on my programme easily.</td>
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</tbody>
</table>

### Question 9
How often do you use in Webcourses?

<table>
<thead>
<tr>
<th></th>
<th>Frequently</th>
<th>Occasionally</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Download Lecture Notes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit Assignments</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Participate in Discussion with Other Students</td>
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<td></td>
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<tr>
<td>Upload Ideas for Comment and Feedback</td>
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<tr>
<td>Set and View Calendar Events</td>
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<tr>
<td>Send email</td>
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<td></td>
<td></td>
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<tr>
<td>Chat online</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Get Grades</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discuss issues with lecturers</td>
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</tbody>
</table>
Question 12
Which of following do you use in the library system?
- Search books
- Renew books
- Change password
- E-tutor
- E-Journal
- Opening hours
- Find exam papers
- Computing Electronic Resources (ACM, IEEE etc)
- Other: 

Question 13
For tools made available by DIT, which of the following characteristics would be important to you?
- Systems contains up to date information
- Repurposed an authoritative source of information
- Reliability
- Allows collaboration with other learners
- Single point of access
- Other: 

Question 14
If you have examples of tools DIT could learn from please note below (include links if possible):

Question 15
Please enter any additional comments:

Submit
APPENDIX B — KNOWLEDGE MANAGEMENT SYSTEM EVALUATION FORM

1. Is the system easy to navigate? *
   - Yes
   - No

2. Did you use the Quick Link at the top left corner? Are you happy with the classification of information in Quick Link? *
   - Yes
   - No
   - Other: __________

3. Did you find the useful information you needed in Quick Link? *
   - Yes
   - No
   - Other: __________

4. What else information do you think should be added in Quick Link? *


5. Rate these sentences *

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>I consider that information included in the Quick Links is most helpful.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I can get the most helpful information on the noticeboard when login the KM system.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I can get the knowledge I needed in the system.</td>
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<td></td>
</tr>
<tr>
<td>I can access any DIT existing system/website through KM System.</td>
<td></td>
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</tr>
<tr>
<td>I would like to use the KM System during my study life in DIT.</td>
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</tr>
<tr>
<td>I can get the materials easily in KM System.</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>I can get the materials that included relevant and up to date.</td>
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</tbody>
</table>
6. Would you like the style of announcement board at the top right corner? *
   - Yes
   - No
   - Other: [ ]

7. How many times have you accessed the system? *
   - Once
   - Twice
   - Three or more than three times
   - Never

8. What functions have you used? *
   - Quick Link
   - My Moodle
   - Timetable
   - Learning Journal
   - Forum
   - Other: [ ]

9. What would you add to the system to improve it? *

10. Would you like the layout of KM system? *
    If yes, please write which part do you like. If no, please write some suggestions.

11. Comment, Suggestions & Recommendations