Analyzing Knowledge Management Capabilities of Software Development Companies in Sri Lanka

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This dissertation was submitted to the Department Computer Science & Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Masters in Business Administration in Information Technology.

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Abstract

Knowledge management (KM) has been the subject of much discussion over the past decade. Organisations have realized that they will not survive in the modern knowledge era unless they have a strategy for managing and leveraging value from their intellectual assets, and many KM lifecycles and strategies have been proposed. The term "Knowledge Management" has been applied to a very broad spectrum of activities designed to manage, exchange and create or enhance intellectual assets within an organisation.

Software development is a mental exercise. Software is produced by human thoughts that cannot be controlled, gathered or accumulated in the same ways as with physical goods. Knowledge work is fundamentally different in character from physical labor. The thoughts will make the knowledge, which is the main asset for any software development company. Hence the way it is managed is of crucial importance towards avoiding the repetition of mistakes and effective use of existing know-how in value addition process. The capability to do so by individual companies will decide their survival on the competitive market. As an emerging industry in Sri Lanka, software companies should focus on the knowledge management capability.

This dissertation tries to analyze the capability of knowledge management of software development companies in four different aspects. Those are *management focus, staff perception and attitude, internal process* and *available infrastructure*. We wish to analyze those aspects in Sri Lankan context and give guidelines on managing the knowledge asset. The capability index is derived, after gathering the importance of each aspect by questioning the industry people. Also the current level of capability is assessed, with the use of a derived scale; hence it gives an industry wide analysis.

Declaration

I certify that this thesis does not incorporate without acknowledgement to the material previously submitted for a degree or diploma in any university to the best of my knowledge and I belief it does not contain any material previously submitted for a written or orally communicated by other person except where due reference was made on this.

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To the best of my knowledge the above particulars are correct

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List of Abbreviations

ANOVA	Analysis of Variance
CBR	Case Based Reasoning
CMMI	Capability Maturity Model Integrated
CRM	Customer Relationship Management
DMS	Document Management System
ISO	International Standards Organization
J2EE	Java 2 Enterprise Edition
J2ME	Java 2 Mobile Edition
KM	Knowledge Management
KMC	Knowledge Management Capability
KMCI	Knowledge Management Capability Index
PM	Project Manager
QA	Quality Assurance
SEI	Software Engineering Institute
SLASI	Sri Lanka Association for the Software Industry
SQA	Software Quality Assurance
SVA	Software Vendors Association
TQM	Total Quality Management
WBS	Work Breakdown Structure

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1. Introduction

1.1. Background

Knowledge management (KM) was a buzzword in past decade and has a significant important for organizations that operate in very competitive market. An objective of mainstream knowledge management is to ensure that the right data and instructions are delivered to the right person at the right time, in order to take the most appropriate decision. That will eventually add value to the organization's products and services and generates the revenue in the most effective manner. In that sense, knowledge management is not only interested in collecting knowledge, but to relate knowledge and its usage. It has greater importance in software development, which totally depends on knowledge.

In software development, knowledge management is usually focused around developing processes and systems to help people in an organization to answer questions such as:

- Who in our organization knows something about 'Mobile Commerce'?
- Are we having a competitive edge against our competitor to get the next project on "Expert Systems"?
- Where can we use "Mobile Commerce"?
- How can I minimize the impact of an absence of a senior software engineer who works in a project for our most demanding client?
- How can I improve the knowledge sharing among software engineers?

Knowledge management focuses on leveraging an organization's collective knowledge and experience to improve performance; the focus is on processes such as strategic planning, problem solving, learning and decision-making. It also protects intellectual assets from decay, keeping the upto date knowledge; adds

the new and seasoned knowledge to organization's intelligence and provides increased productivity.

It should be emphasized that knowledge management is not about simply creating another database to hold collectable knowledge; it is about moving information from one person to another in reusable format. In academic jargon, knowledge management is the conversion of the tacit (the things we know and do – explained in detail under the literature review) to the explicit (physical manifestation of our knowledge) and presenting the result in such a way as to encourage reuses and generates new knowledge. This is the cycle of knowledge creation.

Globalization and the spread of multinational organizations are demanding the use of cross cultural management and working practices across several geographically separated regions. People belong to different countries, speak different languages and have diversity on their cultural values. Hence the perception and attitude of the people towards the key area will be different from one to another. The enabling factors also are varied from society to society. This leads to the question of whether knowledge management should be practiced in the same way across nations, which is the basis for this research.

This project aims to investigate the knowledge management capability of software development companies, by the use of a questionnaire based survey and informal interviews.

1.2. Importance of Knowledge Management to Software Development Companies

Software development companies heavily depend on their knowledge workers to provide their products and services. The human resource and their expertise are invaluable assets to the company. The correct utilization of the knowledge work force is the most important factor for high productivity. Knowledge management provides a model to acquire, create, store, transfer and utilize the knowledge. Why do we need knowledge management? The followings are some of the specific business factors.

- Software development or software outsourcing business becomes increasingly competitive and the rate of innovative is rising.
- The amount of time available to experience and acquire knowledge has diminished. There is no time for research and development as clients demand for quicker delivery of proven products and services.
- The high mobility of the staff in software development field leads to loss of knowledge to the organization. Also the new comers to the company have to be motivated, trained and got participated as quickly as possible in their jobs.
- There is a need to manage increasing complexity as small operating companies are trans-national sourcing the products and services.
- Highly expensive services such as those from technical architects, solution managers and consultants have to be effectively used and their knowledge has to be systematically absorbed by the company.
- Most of the work is knowledge based and the organization competes on the basis of knowledge.
- Software systems are increasingly complex, endowing them with a significant information component. Specialized tools and technologies are a must for the work involved. Hence the need for continuous learning by everyone in the organization cannot be avoided.

With the use of effective knowledge management strategy, companies can address the above issues and achieve the following additional advantages.

- Capabilities of employees, consultants and advisors of the organization will be centrally located and managed. This knowledge will serve as a pointer to people or institutes for specific capabilities required. For example, who knows object oriented analysis and design, who has worked with client-A before?

- All research and development activities will be documented. Hence no need to do the same activity again as it is already available in the knowledge base of the company. It enables the employees to be more innovative with new ideas.

- Expertise knowledge will be shared among individuals and hence the company can reduce its heavy risk of depending on key employees. Also the knowledge sources of the company will be identified and they will be made responsible to give their intellectual inputs to others.

- Lessons learned from typical reiterative or specific cases would be documented. The information of what worked in a similar earlier situation may serve to understand the current situations better. Past experience can thus be leveraged to assist future cases. This will give better means of developing and managing software systems.

1.3. Research Problem

Knowledge management is gradually taking hold in the business world as the key component for unlocking the enterprise's intellectual capital. Companies recognize, more than ever, that business is about value. Supporting, promoting, and valuing the intellectual and human capital that produce profitability are the primary business challenges of this decade. Especially the big players of the industry are trying to improve their processes of the software development. The standards such as CMMI and ISO will eventually increase the capability of organizations to manage their knowledge. As a manager of a technology company, all necessary steps should be taken to avoid undesirable dependability on individual knowledge workers for its core business activities. Most importantly, managers need to deal with their knowledge workforce in the most effective manner. For that, they will need to find answers for the following basic problems in Sri Lankan context.

- Is "Knowledge Management" a recognized strategy within the company?

- How does a manager know whether he follows the correct knowledge management strategy within his organization?
- What are the guidelines for having an effective knowledge management strategy in a Sri Lankan software development company?
- What are the key employee motivation factors towards having an effective knowledge management system?
- How to compare two companies on their knowledge management capabilities?

1.4. Research Objectives

The objectives of this research are listed below.

1. Identifying the key factors affecting the knowledge management capability in a software development company in Sri Lanka.
2. Suggesting guidelines for an effective knowledge management strategy for software development companies in Sri Lanka
3. Deriving a scale to rank Sri Lankan software development companies on their knowledge management capability. (KMC Index: Knowledge Management Capability Index)

1.5. Structure of the Dissertation

This dissertation is organized as follows. Chapter 2 deals with the literature on this topic and how they can be related to the research. In Chapter 3, the research methodology is described. This is followed in Chapter 4, on data collection and analysis. After that, limitations of the study are described in Chapter 5. The dissertation is concluded in Chapter 6.

This dissertation also has five appendixes. The Appendix-A shows the questionnaire distributed to collect the feedback from software development

professionals. The questionnaire collects data to measure the importance and current practice. The collected data in raw format for importance is shown in Appendix-B. The Appendix-C and D contain the summarized view of the data for importance and current practice respectively. Finally, the Appendix-E contains the instructions given for the respondents who participated in the questionnaire based survey.

2. Literature Review

2.1. General

The literature survey is very important for conducting a research as it lays the foundation of the research. It helps to understand the current body of knowledge-what already has been done, suggest paths to take, to improve the existing knowledge, and to lay down the plan for finding a solution for the research problem. We used the World Wide Web for finding much information about the knowledge management, especially those related to the objectives of this research. The following sections will explain the main findings on various thoughts of several gurus, their proposed models and systems in knowledge management. This literature review was done for fulfilling three objectives.

The first objective was to gather general introduction to the subject and give a background to the subject. This will be discussed and analyzed critically in order to show the extent of literature available on the subject. The first part of the literature review is basically on forming the definitions of key terms used in the research. The theoretical definitions of the main terms will be explained. As many terms and areas have different definitions from various researchers, the idea is not to stick to a specific definition but to get to know the broader view of each definition.

The second objective of the literature survey is to discuss the cultural, people and technological aspects of the knowledge management. This view will be important during formalizing the research model in the next chapter. The found literature also showed lot of arguments on various aspects of the knowledge management. Some say it is similar to the information management. This war of thoughts is discussed in a separate section of the literature review.

The third aim of the literature survey is to find the availability of a KM capability assessment model. Although there was no literature found in the local context about assessing the knowledge management capabilities in Sri Lankan software development companies, few related articles were found from researches done in other countries. Many of them describe the importance of managing the knowledge and effective ways to do it. They explain several

models to implement knowledge management within organizations in general. But literature on ways to measure the capability of managing knowledge in software development companies was difficult to find.

2.2. What is Knowledge?

2.2.1. General Meaning

The oxford dictionary definition states that knowledge is “facts, information, and skills acquired through experience or education” (Oxford, 2003). Davenport and Prusak have given a similar definition on knowledge with claim that knowledge is “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 and Prusak, 1998).

When we start learning about ‘knowledge’, it is found that the study of the nature and origin of knowledge is called epistemology, and goes back to the ancient Greek period (Stenmark, 2002). There are various definitions for knowledge. This can be readily seen when reading literature on knowledge. It seems that no two authors can agree on a definition. The data, information, experience, facts, know-how all are related terms of knowledge. Different authors have combined those terms in various manners to define the term ‘knowledge’. To demonstrate the ambiguity of knowledge, several definitions are presented below.

Knowledge management guru Nonaka has stated philosophical view on knowledge by giving knowledge as “a multifaceted concept with multi-layered meanings”. He also adopts the definition of knowledge as “justified true belief” (Nonaka, 1994).

Gill describes how knowledge has progressed during recent years. In the pre-industrial era, knowledge was the ‘skill’. In the industrial era it was changed to ‘knowledge of technology’. In the productions era it was considered as ‘knowledge of a production resource’. When the management revolution happened it transferred to ‘knowledge as an organizational resource’ (Gill, 2002).

To summarize the concept of knowledge, it is clear many authors have defined it in different forms. It is demonstrated from the variety of definitions

given above that are closely related. Hence we conclude that knowledge is a complex abstract word that can be interpreted in many different ways. Knowledge is often substituted for data and information. But most authors agree that knowledge has greater depth than information or data.

After having a general understanding on the definition of knowledge, it is interesting to find out two types of knowledge that are found from the literature. That categorization actually gives another important dimension to the knowledge. Two types of knowledge are tacit and explicit which are discussed below.

2.2.2. Tacit Knowledge

Tacit knowledge is a form of knowledge that cannot be expressed in formalized way. By definition, tacit knowledge is knowledge that people carry in their minds and is, therefore, difficult to access. Often, people are not aware of the knowledge they possess or how it can be valuable to others. Tacit knowledge is considered more valuable because it provides context for people, places, ideas, and experiences. Effective transfer of tacit knowledge generally requires extensive personal contact, communication and trust.

The famous researcher, Polanyi has used the term tacit knowledge in one of his books “The Tacit Dimension “ in 1966, and he justifies the phrase with the well cited quote “we know more than we can tell”. He has defined it as “what people know’ – which cannot be articulated, abstracted, codified, captured and stored” (Polanyi, 1966). This means that we cannot express what we know, and we will never be able to articulate what we hold internally. Tacit knowledge is therefore that which is difficult to formalize and articulate. It is personal, and specific to a context. This means that the same information or data can be formed to create different knowledge, when interpreted by two people. Hence it adds a human dependency to the knowledge; hence it becomes more and more complicated to manage.

Tacit knowledge consists often of habits and culture that we do not recognize. It refers to a knowledge which is only known by an individual and that is difficult to communicate to the rest of an organization. Hence the tacit aspects

of knowledge cannot be codified, but can only be transmitted via training or gained through personal experience. Since the tacit knowledge is personalized in nature, it will be interpreted by second person, based on his regional, organizational or social culture. Also it is difficult to share with people not embedded in that same culture.

Tacit knowledge has been described as "know-how". It is not the "know-what" [facts], "know-why" [science] or "know-who" [networking]. It involves learning and skill but not in a way that can be written down. Tacit knowledge has been found to be a crucial input to the innovation process. An organization's ability to innovate depends on its level of tacit knowledge of how to innovate. (Nonaka & Takeuchi, 1995) They say "Tacit knowledge may seem a simple idea but its implications are large and far reaching. If important knowledge is tacit, then it cannot be effectively spread through an organization. This means that useful knowledge will not be able to reach those who need it without direct, face-to-face contact."

It also means that training newcomers in an organization becomes more time consuming, because they must be given time to learn on their own while doing, which reduces overall efficiency. In order to collect and spread tacit knowledge, organizations must invest greatly in the human capital of its members.

2.2.3. Explicit Knowledge

Explicit knowledge is knowledge that can be formalized and expressed, through things such as formulae, training documents, instruction manuals, software systems etc. This form of knowledge is the opposite of the tacit knowledge. Nonaka and Takeuchi define explicit knowledge as "knowledge that is transmittable in a formal, systematic language" (Nonaka & Takeuchi, 1995). This means that as a result explicit knowledge is easier to store and share. But many authors consider it is not important as tacit knowledge.

2.3. What is Knowledge Management?

After gathering the facts about knowledge, then it is important to know what is meant by managing knowledge. From the literature it is clear that various forms of definitions again exist for knowledge management as well. It should be noted that different view points exist even to argue it is as a new label for information management; some say it is simply about keeping document repositories. Others take it more seriously by suggesting it is an essential function within an organization. Some others almost deny it actually exists. In this section different definitions of knowledge management will be given in order to demonstrate multiple views.

Malhotra takes a relatively strategic view of knowledge management (Malhotra 1997, 1998). He defines it in the following terms: "Knowledge Management caters to the critical issues of organizational adoption, survival and competence in the face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings."

Paul M. Hildreth and Chris Kimble have argued that some knowledge cannot be captured (Hildreth & Kimble, 2002). They say that knowledge management is essentially about people aspect of management. They focus on managing the less structured soft knowledge. They further describe knowledge management as an expansion of artificial intelligence, where “knowledge is viewed as information”. This shows that knowledge management extends to areas that relates to different academic domains.

Knowledge management is inherited from many related disciplines. Originally knowledge management draws from a wide range of disciplines and technologies such as cognitive science (The science of studying about mind and intelligence), organizational science, expert systems, knowledge base and artificial intelligence, library and information science, technical writing, relational and object databases, decision support systems and document .Most of the theories of knowledge management have been initially formulated in those disciplines. In last

decade many theorists have introduced their own findings to make knowledge management a vast area that spreads across many domains and disciplines.

Wigg says “Knowledge management is a conceptual framework that encompasses all activities and perspectives required for gaining an overview of creating, dealing with and benefiting from the company’s knowledge assets and their particular role in support of the company’s business and operations” (Wigg, 1995).

All above definitions of knowledge management suggest us that, it spreads across wide areas of fields; has managerial aspect for correct use; relates to human culture and attitude; can take technological aid for implementation. It definitely is a vital factor for organizations to survive in the ever changing competitive business context.

2.4. Knowledge versus Organizational Culture

What is organizational culture? Organizational culture is about the people and environment within an organization. It includes how people work together, team structures and their attitude and feelings of people on the various aspects of the organization. Many authors cite that it is absolutely essential to create a culture in an organization which is open to change, in order for effective knowledge management.

Kafantaris (Kafantaris, 2002) states that “an organization should promote an environment where people are rewarded and recognized for creating and sharing tacit knowledge through social interaction and continuous learning”.

A similar view is given by Ford and Chan (Ford and Chan, 2002). They claim that the success of knowledge management practice depends on the type of organizational culture.

Davenport and Prusak state that there are a set of fundamental principles for creating an organizational culture that is ideal for knowledge transfer, which include trust, common cultures, vocabularies and frames of reference, amongst others (Davenport and Prusak, 1998). Davenport and Grover

(Davenport and Grover, 2001) discuss the need to introduce knowledge management into people's everyday working lives. They emphasize that knowledge management should become an integrated function in the culture of an organization that every worker has a chance to contribute in their jobs.

Malhotra (Malhotra, 1998) discusses about knowledge workers in the organizations, and says "they need to be comfortable with self-control and self-learning. In other words, they would need to take higher degree of responsibility and authority, as well as capability and intelligence for handling both"

A study done by Anna Dening (Anna D, 2003), shows that there is a language dependency in knowledge management practice. She has surveyed English and French speaking communities separately to prove that language dependency in knowledge management is vital.

2.5. The Use of Technology in Knowledge Management

Malhotra (Malhotra, 1998) discusses how technology can aid knowledge management. He says that "the latest advances of information technology facilitate the processes such as gathering, analyzing, summarizing or distribution of information. That is the explicit knowledge can be managed with technology". He argues that the most important thing to consider is how this knowledge is translated into actionable knowledge that is mapped to the actual business context. Having the technologies doesn't necessarily ensure creativity and innovation that is necessary for organizational competence. He says "KM is not limited to collecting information from various domain experts and creating databases supported by organizational intranets. It is defined in terms of determining the individual knowledge needs of every employee and then satisfying that knowledge need".

Stenmark supports the use of technology in knowledge management, and says that "information technology environments such as intranets may be utilized to establish a virtual meeting place where communities of practice can engage in dialogue and collaboration. The intranets must be designed to support not only the informational aspects but also include people by making salient networks of users with similar interests and allow these to communicate and

collaborate" (Stenmark, 2002). He also emphasizes the 'people' aspect of the organization; even though how advance technology is used in the organization to mange the knowledge. This viewpoint clearly indicates the capability to manage knowledge will depend on to what extent the technology is used by the organization for effective communication among employees.

Davenport and Grover says that "technology can provide assistance in knowledge management, but its importance pales in comparison to developing knowledge-oriented cultures, motivating individuals to share and use knowledge, and encouraging workers to view their jobs in terms of effective knowledge management" (Davenport and Grover, 2001).

2.6. Critical Views on Knowledge Management

William (Wilson, 2002) says knowledge management is a useless exercise. He lists around 20 'management fashions' of the past 50 years, and claims that "knowledge management (whatever that is) and information management are likely to be the same. He listed many literatures such as Journal of Management Information Systems, Wirtschaftsinfomatik, European Journal of Information Systems, Praxis, Journal of Management Studies and IBM systems Journal and created view against the knowledge management. This implies that KM is purely a management fad, and that the author is very skeptical of knowledge management.

At the same time there are many writers and management gurus who firmly believe in knowledge management and its applications. This is why we get lot of literature on this subject, and it has grown to vast scale.

Davenport and Grover (Davenport and Grover, 2001) give a very optimistic view point stating that "It is increasingly clear that knowledge management is here to stay. It is a major part of the business". They further highlight the importance of the posts such as 'knowledge officer' in organizations.

2.7. Knowledge Management Frameworks

Derek Binney (Binney, 2001) provides a framework known as “KM Spectrum” to help organisations make sense of the large diversity of material appearing under the heading of KM, and to help them assess where they are in KM terms. His focus is on the KM activities that are being carried out, grouped into six categories:

1. *Transactional KM:* Knowledge is embedded in technology.

2. *Analytical KM:* Knowledge is derived from external data sources, typically focussing on customer-related information.

3. *Asset Management KM:* Explicit management of knowledge assets (often created as a by-product of the business) which can be reused in different ways.

4. *Process-based KM:* The codification and improvement of business practice and the sharing of these improved processes within the organisation.

5. *Developmental KM:* Building up the capabilities of the organisation's knowledge workers through training and staff development.

6. *Innovation/creation KM:* Fostering an environment which promotes the creation of new knowledge, for example through R and D and through forming teams of people from different disciplines.

For each of these categories of KM, Binney lists several examples of KM Systems or approaches that support them. By evaluating the each approach relevant to the organization, an overall assessment on knowledge management can be made. The approaches under each category are listed in the Table 2.1.

Table 2.1: KM Spectrum and Applications

Transactional	Case Based Reasoning (CBR) Help Desk Applications Customer Service Applications Order Entry Application Service Agent Support Applications
Analytical	Data Warehousing Data Mining Business Intelligence Management Information Systems Decision Support Systems Customer Relationship Management (CRM) Competitive Intelligence
Asset Management	Intellectual Property Document Management Knowledge Valuation Knowledge Repositories Content Management
Process	TQM Benchmarking Best Practices Quality Management Business Process (Re) Engineering Process Automation Lessons Learned Methodology SIE/CMM, ISO9xxx, Six Sigma
Developmental	Skills Development Staff Competencies Learning Teaching Training
Innovation and Creation	Communities Collaboration Discussion Forums Networking Virtual Teams Research and Development Multi-Disciplined Teams

Source: KM Spectrum - Understanding the KM landscape, Journal of Knowledge Management - Volume 5

2.8. Assessing the Knowledge Management

2.8.1. Knowledge Management Capability Check List

Jim McKeen and Michael Zack (Jim M. and Michael Z, 2003), offer the following checklist of 10 critical capabilities that need to be competitive in the new knowledge economy.

1. Does your organization explicitly recognize knowledge as a key element in its strategic planning exercises? “.
2. Does your organization benchmark its strategic knowledge against that of its competitors?
3. Has your organization developed a knowledge strategy that maps knowledge to value creation?
4. Is your organization able to identify internal sources of expertise?
5. Are your employees valued for what they know?
6. Does your organization look for opportunities to experiment and learn more about customers, products, technologies and internal operations?
7. Does your organization encourage and reward the sharing of knowledge?
8. Do you have effective internal procedures for transferring best practices throughout the organization?
9. Is the knowledge management group a recognized source of value creation within your organization?
10. Does your organization exploit external sources of knowledge effectively including customer knowledge?

2.8.2. Other Findings on Assessing the Knowledge Management

P. Jackson and J.E Klobas have given a model for knowledge transfer and creation in information technology companies. The model has been derived from the sociology of knowledge, in particular the work of Berger and Lukmann (Berger and Lukmann 1991). Berger and Lukmann had proposed a series of processes to describe how the 'inter-subjective' gap exists between people when the knowledge is shared can be overcome effectively.

Jackson and Klobas further detail their model, which has five main elements namely personal knowledge, externalization, objectivation, legitimating, internalization and knowledge creation. Their work is useful to get an idea of knowledge transfer but it does not define a way to measure the capability of knowledge management as whole (Jackson P, and Klobas J.E. 2003)

Johanna (Johanna R, 1999) explains several steps a manger should take within his organization to form a learning culture. She has stated the difference between great managers and lousy managers as the ability to create learning culture in their organizations. She further says, "the lousy managers repeated their mistakes on project after project; they claimed to want to solve problems but didn't' take the time to learn how to avoid repeating them".

Ravichandran S, Santham R, and Mohomed S (Ravichandran S, Santham R and Mohomed S, 2002) highlights their experience of implementing knowledge management tools in a company called SSI Technologies. They have quantified the benefits derived using a tool based process database for knowledge management.

New Zealand Institute of Management has developed NZIM Management Capability Index, which can be used to benchmark the management capabilities demonstrated in various business/organizational activities. Even though this is not relevant with the knowledge management capabilities, it can be used to get an idea of how to derive a knowledge management capability index in this research (Matheson, M. 2003).

2.9. Use of Literature Review

While conducting the literature review, it is found that there is a lot of literature on how to manage knowledge in organizations in general. Many researchers have come up with guidelines for implementing and assessing the knowledge management aspects of the organizations. Industry wise, very few analysis were found. There was no literature, describing the knowledge management aspects of the software development companies in Sri Lanka. But followings major facts were gathered from the literature review.

1. Knowledge has different forms to consider – tacit and explicit
2. Knowledge management acts something like a library in that it provides a repository for written information on a given subject, but it also tries to make available to the organization as a whole the knowledge that is in people's heads.
3. This knowledge is the most valuable of all because; it is used in decision making. Knowledge management helps to ensure prompt availability, accuracy and up to date knowledge
4. The cultural aspect of the knowledge management is important. Different people in different societies will have different attitudes towards knowledge management. The cultural values and their thoughts play a vital role. It is a crucial factor for capability of knowledge management of the organization.
5. The infrastructure and organizational business process is also an important aspect to be assessed. When it comes to the software development organizations, the software development process has to be considered.

3. RESEARCH METHODOLOGY

3.1. General

This chapter describes the research methodology that was adopted. First it describes the knowledge management capability model and why it was selected. Secondly the data collection methods, development of the questionnaire and interviews with the project management experts are described. Thirdly the pilot survey and the conduct of the main survey are discussed.

3.2. The Feedback From the Literature Survey

3.2.1. Knowledge Definition

During the literature review different definitions for knowledge was discussed. Knowledge is often spoken about in the same sentence as data and information, due to the fact that, as we have seen, they are closely related. But most authors agree that knowledge has greater depth than information or data. We found mainly two points; the difficulty of finding a unique definition and the definitions were not specific to the software development companies. Hence we propose the following definition for knowledge, simply because it gives concrete meaning to the research objectives.

The thoughts of software professionals, or processes in the company expressed in tacit or explicit form that contributes in any way to the software development activity is defined as knowledge.

3.2.2. Social-Cultural Aspects of Knowledge

From the literature we found that there is a social-cultural dimension for the knowledge, especially due to the tacit knowledge. Hence the capability of managing knowledge will depend on the culture being practiced among the software professionals. The attitude of them towards the knowledge activities need to be considered in the research model.

3.3. Research Model

The model shown in the Figure 3.1 will be used in this research to identify the knowledge management capability of a software development company.

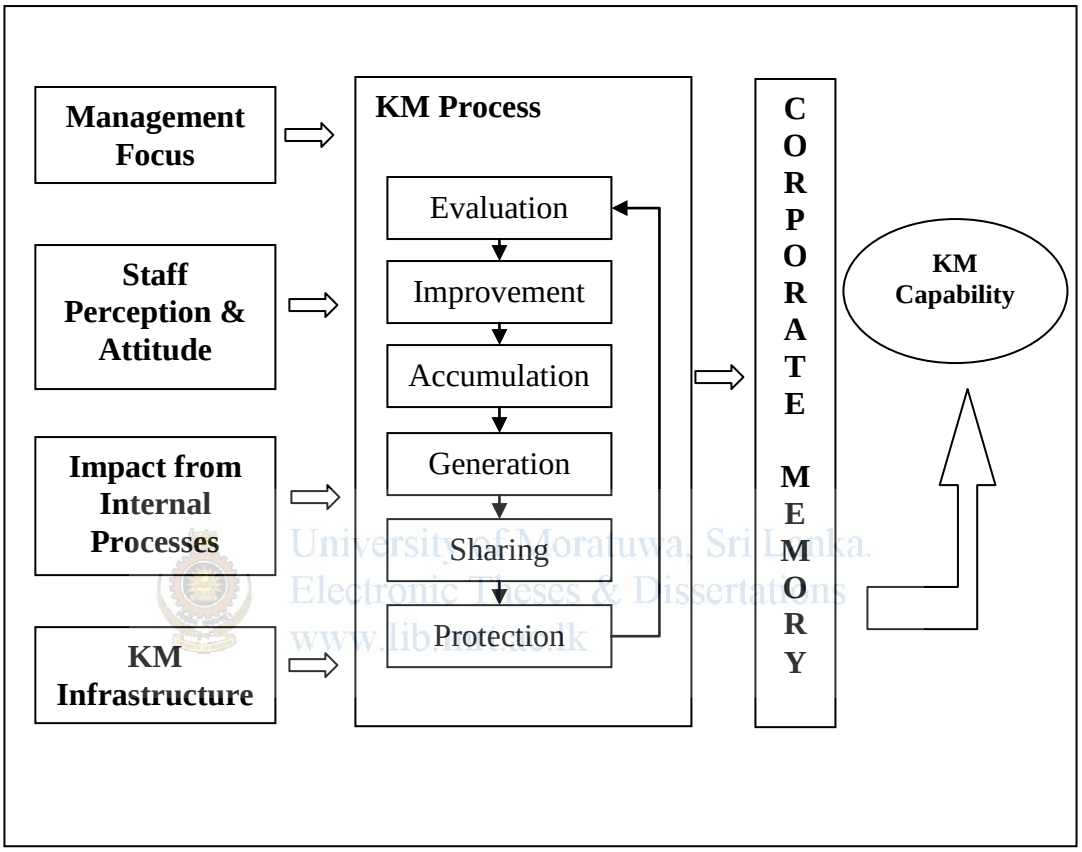

Figure 3.1: The Research Model

The model has three main parts as described below.

3.3.1. Four Pillars of Concepts

Four main concepts that will directly influence the knowledge management capability of an organization are identified. The foundation for these concepts was based on the findings from literature reviews. We wish to find the impact from each concept towards knowledge management capability. The four concepts are described in the following.

A. The Management Focus

The backbone of any organization is the management. The decisions taken by the management and its attitude towards each aspect of the organization will play a key role in any activity in the organization. Similarly, to have an effective knowledge management strategy in a software development company, we wish that the correct level of management focus is a must. Here the management includes the project managers and team leads who take middle level decisions in the software development process. If the top management has identified the knowledge as a key at the strategic level and if it is taken in to consideration during the long term decision making, that will further improve the management focus for effective knowledge management. The word 'focus' means the support and leadership given by managers of the organization to develop a knowledge based culture in the organization. Also they need to prioritize the knowledge management strategies aligned to their objectives.

B. The Staff Perception and Attitude

Here the attitude of all designated people is considered. The typical roles will be software engineers, designers, implementation consultants, team leads, tech leads, solution mangers, quality assurance (QA) engineers, client managers, and technical mangers and project managers.

The cultural diversity will play a key role in this concept as knowledge management aspects will affect each staff member individually. For example a software engineer will be reluctant to share his knowledge with his peers to keep his autonomy in the project. He may feel comfortable when keeping the knowledge to himself thinking that he will have more job security and recognition. Such an attitude of the staff will definitely affect the knowledge management capability of the whole software development company.

C. The Impact from Internal Processes

Each organization will have an internal process to deliver their products and services. It is assumed that the level of process maturity will have an impact towards the knowledge management capability. The software development companies having quality standards such as SEI-CMMI (Software Engineering Institute – Capability Maturity Model Integrated), ISO 9001(International Standards Organization), 5S, Six Sigma, Formal Work Practices may improve the organization's ability to manage knowledge well. When implementing those processes, some part of the knowledge management implementation will already be addressed. For example if a company follows CMMI, it is compulsory to collect various measurement on the software projects. Also keeping a skill set of the employee base is a must. Those procedures will certainly help to have better knowledge management in the company.

D. Knowledge Management Infrastructure

The third concept would be the infrastructure availability in the organization. For example the basic facilities such as telephone, email, chat, web conferences will decide the level of communication between teams located both locally and globally. The installed knowledge management tools and systems will have a positive impact if they are effectively used in the internal process of the organization.

This infrastructure includes all the software systems, hardware systems and office equipment which enable to have any kind of communication, information storing and retrieving, securing and making them promptly available.

The security of the information is also a vital factor in knowledge management. The correct information should be shared between correct people in the organization. The information can have different forms of external representation for various stakeholders of the organization. The infrastructure will also refer to any of the systems that enable the information management.

By measuring the above four concepts, we wish to analyze the knowledge management capability of the software development companies. The operationalization of the above four concepts will be discussed in section 3.4.

3.3.2. Knowledge Management Process

After the preliminary literature review the main steps of the knowledge management process were found. Several models have been proposed by various authors. The Choo's model has proposed six steps- evaluation, improvement, accumulation, generation, sharing and protection (Choo C. W. 1998). It is an iterative process, which will continue to evolve within the organization.

In this research above model is taken as basis and the factors affecting to the process is analyzed. The research model shown in Figure 3.1 will depend upon the four pillars of concepts explained previously. As various researchers have already defined the knowledge management process, this research will be mainly focused on to identify the factors affecting it in order to measure organization's capability. A set of guidelines for knowledge management will be proposed specially targeting the software development companies.

3.3.3. Corporate Memory and it's Usage

Final outcome of the effective knowledge management process is the corporate memory. It can be considered as a repository of organization's knowledge, and will be used in problem solving and decision-making process. The ability to use that memory to solve problems will be a good indicator of the capability of an organization to manage its knowledge.

3.3.4. Knowledge Management Capability

After collecting the data on the above four pillars of concepts, the *knowledge management capability index (KMC Index)* is derived. KMC Index should

consider the minimum level needed from each concept in a company towards an effective knowledge strategy. In the four variable model this will create a four dimensional surface with a lower boundary. But before that we need to test the four concepts, to see the significance of each concept towards the target capability index.

3.4. Operationalization of Variables

The Table 3.1 shows the independent and dependent variables that are used to operationalize the four concepts discussed in section 3.3.1.

Table 3.1: Independent and Dependent Variables

Type	Variable	Notation
Independent Variables	Degree of management focus towards knowledge management	X1
	Level of staff perception on knowledge management	X2
	Level of impact from internal processes	X3
	Degree of availability of knowledge management infrastructure	X4
Dependent Variable	Degree of knowledge management capability	Y1

3.4.1. Hypothesis Building

Hypothesis 1 (H1): There is a significant relationship between the independent variables (X1, X2, X3, X4) to the dependent variable (degree of knowledge management capability)

Null Hypothesis (H0): There is NO significant relationship between the independent variables (X1, X2, X3, X4) to the dependent variable (degree of knowledge management capability)

3.4.2. Deriving the Knowledge Management Capability Framework

A mathematical model to define the knowledge management capability is presented below. The dependent variable Y1 (KMC) is assumed to have linear relationship with the four independent variables (X1, X2, X3, and X4) and expressed in the following equation.

KMC = Function of (X1, X2, X3, X4) = $a_0 + a_1X1 + a_2X2 + a_3X3 + a_4X4$

In which $X1_{min}$, $X2_{min}$, $X3_{min}$, $X4_{min}$ are the lowest acceptable levels from X1, X2, X3 and X4 respectively.

The significance (a_1, a_2, a_3 and a_4) from each X1, X2, X3, and X4 will be found by statistical data analysis.

For a given company,

X1, X2, X3, and X4 will be known from the collected data, and

KMC Index (Un-Normalized) = Positive Square Root of SUM of

$$[X1]^2 + [X2]^2 + [X3]^2 + [X4]^2 +$$

$$[a_0 + a_1X1 + a_2X2 + a_3X3 + a_4X4]^2$$

Min KMC Index when all *X1, X2, X3 and X4* are minimum
Max KMC Index when all *X1, X2, X3 and X4* are maximum

KMC Index will be normalized to lie between zero and one, after finding the above Min KMC and Max KMC Index.

3.4.3. Defining the Indicators and Measures for Variables

In this section both dependent and independent variables will be further examined to identify the indicators that maps to the concepts discussed in the section 3.3. The Table 3.2 and Table 3.3 show the collected indicators. Then each indicator will be assigned a scale of measurement (in this case all are 5 point likert). Also for each indicator at least one question will be used to quantify it in the data collection process with the questionnaire. Questions numbers are noted for each indicator in the Table 3.2 and Table 3.3.

Table 3.2: Operationalization of Independent Variables

Concept	Variable	Indicator	Measure	Questions
Management focus towards knowledge management	Degree of management focus towards knowledge management (X1)	Latest knowledge	Very High to Very Low (5 Point Likert)	1.1.1
		Learning culture		1.1.2
		Knowledge asset		1.1.3
		Staff recognition		1.1.4
		Investment		1.1.5
		Flat structure		1.1.6
Staff perception on knowledge management	Level of staff perception on knowledge management (X2)	Willingness to learn	Very High to Very Low (5 Point Likert)	2.1.1
		Taking risk		2.1.2
		Sharing knowledge		2.1.3
		Trust others		2.1.4
		Looks for help		2.1.5
		Communication		2.1.6
		Looks for reward		2.1.7
		Satisfied with resources		2.1.8
Impact from internal processes	Level of impact from internal processes (X3)	Process oriented	Very High to Very Low (5 Point Likert)	3.1.1
		Quality focus		3.1.2
		Clear task allocation		3.1.3
Knowledge management infrastructure availability	Degree of availability of knowledge management infrastructure (X4)	Basic communication	Very High to Very Low (5 Point Likert)	4.1.1
		KM software		4.1.2
		DM software		4.1.3
		Usage of tools		4.1.4
		Information security		4.1.5

Table 3.3: Operationalization of Dependent Variable

Concept	**Variable**	**Indicator**	**Measure**	**Questions**
Knowledge Management Capability	Degree of knowledge management capability	Acquisition	Very High to Very Low (5 Point Likert)	5.1.1
		Creation		5.1.2
		Storage		5.1.3
		Transfer		5.1.4
		Utilization		5.1.5
		Capability	Very High to Very Low (4 Point Likert)	5.1.6

3.5. Questionnaire

3.5.1. Questionnaire Design

The developed questionnaire consists of six sections, including one for each identified variable conceptualized according to the research model. The section breakdown is shown in the Table 3.4.

Table 3.4: Section Breakdown in Questionnaire

Section	Collecting data on	No of Questions
1.1	Importance of management focus on KM	6
1.2	Level of current management focus	8
2.1	Importance of staff perception and attitude towards KM	8
2.2	Level of current staff perception and attitude	12
3.1	Importance of having internal processes for KM	3
3.2	Current level of having internal processes	5
4.1	Importance of KM infrastructure	5
4.2	Current level of infrastructure	4
5.1	KM capability	6
6.1	General Information of the respondent	3

The importance of each concept will be measured by getting the feedback for a set of questions belonging to each indicator. It allows respondent to select the importance for each questioned aspect. They can select very high, high, moderate, low, and very low for the importance (5 point likert). This is a judgement by respondents based on their experience. The feedback will be used to find the relative significance of each variable.

Each section (devoted to one concept) is accompanied by another set of questions to gather the current level of practice of the respondent's company. This is added to measure the organization's actual knowledge management capability aspects. Here the respondent is expected to give true facts of his company. He shouldn't give subjective answers with his own experience, but fill-in what level his company is performing according to his judgment. The derived

capability model will be applied to those respondent answers and find the exact capability index of the company.

There is a general information section in the questionnaire to collect respondent's details. It is placed at last because it can be sensitive to the respondent and normally sensitive questions are placed at the end of the questionnaire. Questionnaire is attached in Appendix-A.

Questionnaire was distributed in the form of soft copies via email. Instructions to fill questionnaire is attached with e-mail (Appendix-E). After a respondent finished answering, he must send it back by email. E-mail is the most convenient and efficient communication medium to deal with IT people because they normally spend a full working day in front of a computer.

The initial plan for publishing the questionnaire on the web didn't succeed due to time constraints. But that would have been a good solution, especially because filling an on-line form is easier and less time consuming than filling it in an email attachment as above approach.

3.5.2. Guidelines Adopted When Writing the Questionnaire

Based on the literature review, writing a questionnaire is an art. The presentation of the questions, their meaning, and clarity will improve the number of respondents and result in accurate feedback. The following guidelines were adopted when writing the questionnaire.

A. Avoiding misplaced questions

Questions placed out of order or out of context should be avoided. In general, a funnel approach is advised. Broad and general questions at the beginning of the questionnaire are recommended. The management focus section was added as the first section, because the most of the respondents will have something to say about the management. Then more specific questions were added. The sensitive questions were added at the end of the questionnaire.

B. Avoiding the use of confusing or unfamiliar words

Even though the target audience is highly educated people, the key terms used in the questionnaire were explained for user convenience. Then more accurate feedback was expected.

C. Forcing answers

Respondents may not want, or may not be able to provide the information requested. Privacy is an important issue to most people. Only the company name, designation and the number of employees in the company were asked.

3.6. Interviews

Next step of the research methodology, before sending out the questionnaire was to interview project management experts and validate the identified conceptual model. It is more appropriate to find out any other aspect that needs to be taken into account when analyzing the knowledge management capability. Their advice and comments are included because they are experts in this research domain (i.e. Sri Lankan software industry). Their opinion is very helpful, especially because most of the literature discusses cases and experiences outside Sri Lanka.

The initial questionnaire was fine tuned according to the input received from experts and was first distributed as a pilot survey. The feedback given by the participants in the pilot survey is important for further adjusting the questions to remove ambiguities. Also the average time it takes to fill the questionnaire was recorded to make sure that filling the questionnaire is not a time consuming tedious exercise for software professionals.

4. Data Collection and Analysis

4.1. General

This chapter describes how the sample was selected for the research and how data was collected. Then it discusses the steps of data summarization and how the data was quantified by giving weightings. The techniques used for statistical analysis is discussed later. Finally a discussion is presented on data analysis and the most significant factors that affect knowledge management capability will be selected.

4.2. Sampling

Sampling is the heart of data collection hence it should be done in unbiased manner. Software companies can vary from very small companies doing relatively simple solutions such as web site creation or graphic designing to companies who do large scale software development and have multiple blue-chip clients around the world.

The primary source for a list of companies operating in Sri Lanka in the software development business was the web. Namely two sites - Software Vendors Associations (SVA) and Sri Lanka Association for the Software Industry (SLASI). They have listed many of the companies and their contact details. The SLASI list had categorized the companies based on their servicing industry (such as apparel, finance banking, communication, education), technology specialization (such as Microsoft, J2EE, J2ME, Oracle, Graphics Design) and offered services and products (such as payrolls, reservation systems, real time systems, wireless and mobile solutions). Also some companies were found not listed on the sites as well.

As it is needed to have un-biased results on data, several types of companies have to be included in the data collection. The best way for this scenario is to go for stratified sampling, in which the population is divided in to sub categories and then taking random samples from each category.

Then the question was that what should be the basis of categorization. It was decided to use the ‘number of software professionals working in the

company' as the basis for categorization. The term 'professional' means any employee engaged in any form of software development activity. To find the number of employees, each company web site was searched. But in most cases, the personal contacts helped a lot to get the background information of companies. For some companies, it was difficult to find a way to communicate. Then those companies were removed from the list. After the initial findings, the short listed companies were divided into 3 categories – large, medium and small as shown in the Table 4.1 below.

Table 4.1: Sample Selection

Category	**Basis (Number of software professionals employed)**	**Selected No of Companies for survey**
Small	< 25	11
Medium	>25 and <100	22
Large	>100	06

4.3. Survey and Feedback

The questionnaire which was modified after the pilot survey was distributed among the above sample of companies. Total of 39 companies were selected for distribution. The number of large scale companies was limited in the industry, while most of them fit into medium scale. The same questionnaire was distributed twice within the last two years, due to the extended research time. Basic distribution mode was by email. Also the feedback was collected via e-mail. The feedback is in Microsoft Word file format and needed to be manually collected into a Microsoft Excel sheet. Out of 39 companies, we were able to collect feedback from 26 companies as shown in the Table 4.2. The raw data collected is attached in Appendix-B.

Table 4.2: Response Breakdown

Scale of company	No. of respondents from each company				Received responses	
	One	Two	Three	Four	No. of companies	Total responses
Small	2	5			**7**	**12 (19%)**
Medium	2	6	5		**13**	**29 (46%)**
Large			2	4	**6**	**22 (35%)**
Total	**4**	**11**	**7**	**4**	**26**	**63**

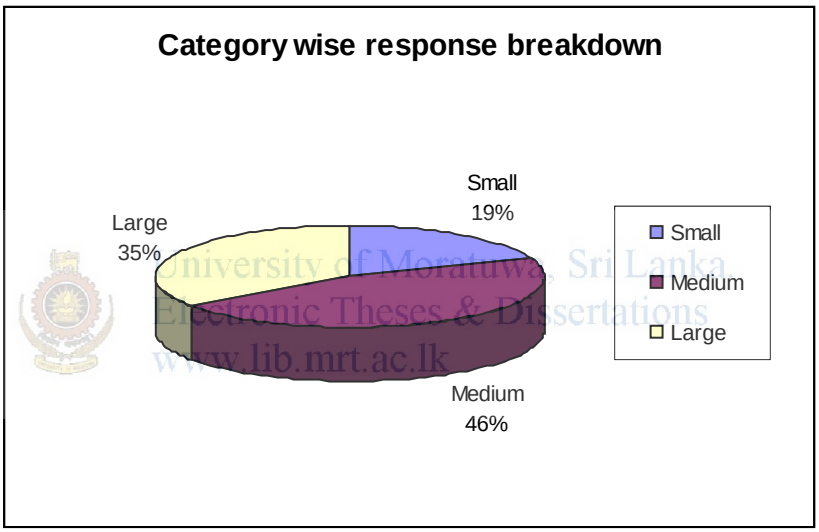

Figure 4.1: Category wise Response Breakdown

4.4. Statistical Analysis of Data

As described in the previous chapter, different independent variables have different number of questions. It was assumed that weights given to each question in a variable are equally split among them. All the questions used to check the importance of each aspect had a 5-point likert scale. The weight given for each level is shown below. The unanswered questions were not taken into calculation.

Table 4.3: Weighting the Answers

Importance	Very High	High	Moderate	Low	Very Low
Weight given	5	4	3	2	1

As given in the following equations, the value of each variable was calculated. The Appendix-C shows the summarized and weighted results collected from 63 responses.

Degree of management focus towards knowledge management (X1)

$$= \frac{\text{Total weight for all answered questions} * 100\ \%}{\text{Total maximum possible weight of all answered questions}}$$

Level of staff perception on knowledge management (X2)

$$= \frac{\text{Total weight for all answered questions} * 100\ \%}{\text{Total maximum possible weight of all answered questions}}$$

Level of impact from internal processes (X3)

$$= \frac{\text{Total weight for all answered questions} * 100\ \%}{\text{Total maximum possible weight of all answered questions}}$$

Degree of availability of knowledge management infrastructure (X4)

$$= \frac{\text{Total weight for all answered questions} * 100\ \%}{\text{Total maximum possible weight of all answered questions}}$$

Degree of knowledge management capability (Y1)

$$= \frac{\text{Weight of the answer} * 100\ \%}{\text{Maximum possible weight for the answer}}$$

4.4.1. Descriptive Statistics

Table 4.4: Descriptive Statistics

Variable	Mean	Median	Std. Deviation	Skew ness
X1	0.591	0.600	0.122	0.174
X2	0.595	0.575	0.099	0.120
X3	0.592	0.600	0.155	0.008
X4	0.583	0.560	0.126	0.102
Y1	0.729	0.720	0.078	0.106

The descriptive statistics derived from the collected data is shown in Table 4.4. Low standard deviations of each variable represent the accurate representation of the total population.

4.4.2. Linear Regression Analysis

Table 4.5: Linear Regress Result X1 –Y1

Regression Statistics	
Multiple R	0.465644
R Square	0.216824
Adjusted R Square	0.203985
Standard Error	0.069758
Observations	63

Table 4.5 shows the result of linear regression analysis for X1 and Y1. The correlation coefficient R = 0.465644 indicates that there is a considerable relationship between the degree of management focus towards knowledge management (X1) and degree of knowledge management capability (Y1).

The coefficient of determination R^2 = 20.40% indicates that only 20.40% of the movement in knowledge management capability is brought by the degree of management focus towards knowledge management which is a small influence indeed.

Table 4.6: Linear Regression Result X2 –Y1

Regression Statistics	
Multiple R	0.67184
R Square	0.451369
Adjusted R Square	0.442375
Standard Error	0.058386
Observations	63

Table 4.6 shows the result of linear regression analysis for X2 and Y1. The correlation coefficient R = 0.67184 indicates that there is a considerable relationship between the level of staff perception on knowledge management (X2) and degree of knowledge management capability (Y1).

The coefficient of determination R^2 = 44.24% indicates that only 44.24% of the movement in knowledge management capability is brought by the level staff perception on knowledge management which is a considerable influence indeed.

Table 4.7: Linear Regress Result X3 –Y1

Regression Statistics	
Multiple R	0.560095
R Square	0.313706
Adjusted R Square	0.302455
Standard Error	0.065301
Observations	63

Table 4.7 shows the result of linear regression analysis for X3 and Y1. The correlation coefficient R = 0.560095 indicates that there is a considerable relationship between the level of impact from internal processes (X3) and degree of knowledge management capability (Y1).

The coefficient of determination R^2 = 30.25% indicates that only 30.25% of the movement in knowledge management capability is brought by the level of impact from internal processes which is a considerable influence indeed.

Table 4.8: Linear Regress Result X4 –Y1

Regression Statistics	
Multiple R	0.262329
R Square	0.068816
Adjusted R Square	0.053551
Standard Error	0.076065
Observations	63

Table 4.8 shows the result of linear regression analysis for X4 and Y1. The correlation coefficient R = 0.262329 indicates that there is no strong relationship between the degree of knowledge management infrastructure availability (X4) and degree of knowledge management capability (Y1).

4.4.3. Multiple Regression Analysis

The Table 4.9 and Table 4.10 show the multiple regression result obtained including the analysis of variance result. The whole variable set was used in analysis.

Table 4.9: Multiple Regression Result – Full Set

	0	1	2	3	4
	Intercept	**X1**	**X2**	**X3**	**X4**
b	0.1374	0.2603	0.4439	0.1976	0.0971
S(b)	0.0380	0.0356	0.0449	0.0294	0.0357
t	3.6129	7.3073	9.8779	6.7114	2.7217
p-value	0.0006	0.0000	0.0000	0.0000	0.0086

Table 4.10: ANOVA - Full Set

Source	SS	df	MS	F	F critical	p-value
Regression.	0.3133	4	0.0783	69.1310	2.5307	0.0000
Error	0.0657	58	0.0011			
Total	0.3790	62				
S	0.0337					
R^2	0.8266					
Adjusted R^2	0.8147					

MS Excel was used to perform a multiple regression analysis with degree of knowledge management capability as the dependent variable and four variables X1, X2, X3, X4 as predictor variables.

According to the regression results $F_{(4,58)}$ = 69.1310 with p-value of "0.0000" in Table 4.10 indicates that there is strong evidence of a linear regression relationship. This is further confirmed by noting that the coefficient of determination is high (R^2 = 0.8266). Thus the combination of the four variables explains 82.66% of the variation in knowledge management capability. The adjusted coefficient of determination is a little smaller.

P-value of the variables X1, X2 and X3 is zero, but the p-value of the variable X4 is 0.0086. That indicates there is no relationship between degree of knowledge management infrastructure availability and knowledge management capability. It gives evidence to do further regression analysis after removing significance variables, in order to check any co-relation of X4 with other variable. Table 4.12 and Table 4.13 show the multiple regression result obtained when variable X3 was dropped from the analysis.

Table 4.11: Multiple Regression Result – Dropped X3

	0	1	2	3
	Intercept	**X1**	**X2**	**X4**
b	0.1777	0.2477	0.5223	0.1611
S(b)	0.0496	0.0470	0.0573	0.0454
t	3.5809	5.2694	9.1074	3.5483
p-value	0.0007	0.0000	0.0000	0.0008

Table 4.12: ANOVA – Dropped X3

Source	SS	df	MS	F	F critical	p-value
Regression.	0.2623	3	0.0874	44.1810	2.7608	0.0000
Error	0.1168	59	0.0020			
Total	0.3790	62				
S	0.0445					
R^2	0.6920					
Adjusted R^2	0.6763					

When variable X3 is dropped from the equation and the new regression analysis considers, the independent variable X4, which was not significant in the full regression equation, now becomes significant. (P-value of X4 ~ 0). The R^2 has dropped greatly with the removal of X3. That indicates that level of impact from internal processes (X3) and degree of knowledge management infrastructure availability (X4) are correlated with each other. Therefore, degree of knowledge management infrastructure availability is not significant when level of impact from internal processes is in the equation, but in the absence of level of impact from internal processes, degree of knowledge management infrastructure availability does have explanatory power. The analysis was continued with best-fit variables X1, X2 and, X3, to check the result further. The removal of X4 is meaningful even from the liner regression in Table 4.8, which showed that there is no significant relationship between X4 and knowledge management capability.

Table 4.13: Multiple Regression Result – Dropped X4

	0	1	2	4
	Intercept	**X1**	**X2**	**X3**
b	0.1836	0.2739	0.4264	0.2190
S(b)	0.0358	0.0371	0.0468	0.0299
t	5.1246	7.3779	9.1058	7.3337
p-value	0.0000	0.0000	0.0000	0.0000

Table 4.14: ANOVA – Dropped X4

Source	**SS**	**df**	**MS**	**F**	**F critical**	**p-value**
Regression.	0.3049	3	0.1016	80.9170	2.7608	0.0000
Error	0.0741	59	0.0013			
Total	0.3790	62				
S	0.0354					
R^2	0.8045					
Adjusted R^2	0.7945					

The result obtained after X4 is dropped from the equation and the new regression analysis done is shown in the Table 4.13 and Table 4.14. All three variables X1, X2 and X3 variables are significant. Table 4.14 indicates that R^2 in this regression is little smaller than R^2 with all four variables in the equation.

4.4.4. Hypothesis Testing

Hypothesis1 (H1): There is a significant relationship between the independent variables (X1, X2, X3, X4) and the dependent variable (Degree of Knowledge Management Capability)

Null Hypothesis (H0): There is NO significant relationship between the independent variables (X1, X2, X3, and X4) and the dependent variable (Degree of Knowledge Management Capability)

It can be concluded that the hypothesis (H1) is true, at a confidence interval 95%, and 82.66 % of the knowledge management capability is described by the four independent variables X1, X2, X3 and X4.

According to the further analysis done after removing variable X4, the following hypothesis becomes true against its null hypothesis. It can be said that 80.45% of the knowledge management capability is described by three independent variables X1, X2, X3 at a confidence interval of 95%.

Hypothesis 2 (H2): There is a significant relationship between the independent variables (X1, X2, X3) and the dependent variable (Degree of Knowledge Management Capability)

Null Hypothesis (H0): There is NO significant relationship between the independent variables (X1, X2, X3) and the dependent variable (Degree of Knowledge Management Capability)

4.4.5. Summary

From above analysis it is clear that the dependent variable Y1 (degree of knowledge management capability) has a strong relationship to the independent variables X1 (degree of management focus towards knowledge management), X2 (level of staff perception on knowledge management) and X3 (level of impact from internal processes). The analysis says, when X3 exists in the model, the X4 (degree of availability of knowledge management infrastructure) does not have considerable impact on the knowledge management capability. Hence the X3 and X4 are co-related. Hence we omit the X4 in further analysis and consider only X1, X2 and X3.

4.5. Deriving KMC Index Framework

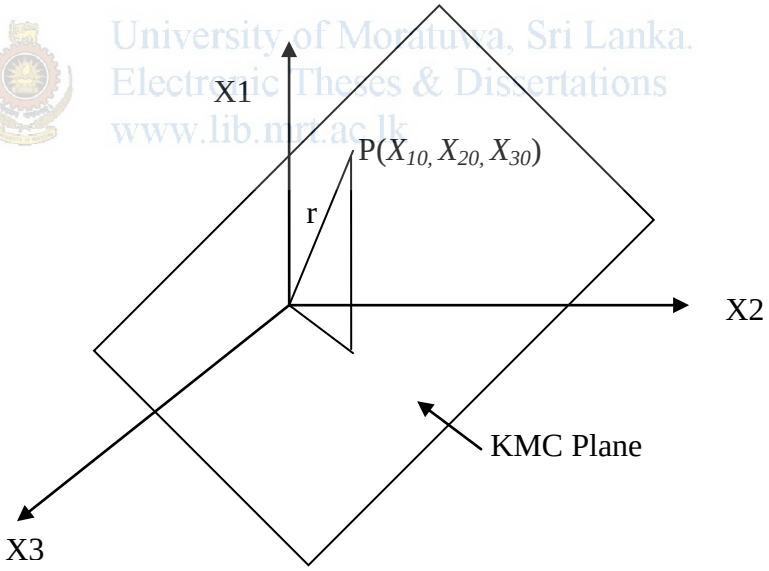

Figure 4.2: KMC Plane

The Figure 4.2 shows the diagrammatic representations of the variables X1, X2 and X3. Note that the plane is drawn only for the demonstration purposes, that actually lies in a fourth dimension. The plane KMC will be defined by the following model.

KMC = Function of (X1, X2, X3) = $a_0 + a_1X1 + a_2X2 + a_3X3$

Where $a_0 = 0.18359$, $a_1 = 0.27395$, $a_2 = 0.4264$, $a_3 = 0.21900$

Each company will have a corresponding point on the KMC plane. We define the KMC index as the distance from origin to the KMC plane. For a given company, we need to find the point P(X_{10}, X_{20}, *and X30*) to get the KMC index.

KMC Index (Un-Normalized) = Positive Square Root of SUM of

$$[X1]^2 + [X2]^2 + [X3]^2 + [a_0 + a_1X1 + a_2X2 + a_3X3]^2$$

4.5.1. Normalizing the KMC Index

As we wish to scale the KMC index to value between zero and one, we need to normalize the value obtained form above equation. To do that we will find the maximum and minimum values possible for KMC index. The maximum KMC Index possible from above equation is when X1, X2, X3 are taking their maximum values. Depending on the weights given in the questions (5 being the maximum and 1 being the minimum), the maximum value of any of X1, X2, X3 is 1.0, while the minimum being 0.2

Hence KMC Index maximum = 2.053

KMC Index minimum = 0.505

Then we calculate the normalized KMC Index as follows,

$$\text{KMC Index (Normalized)} = \frac{\text{KMC Index Un-Normalized - KMC Index minimum}}{\text{KMC Index maximum - KMC Index minimum}}$$

4.5.2. Acceptance Region

As we found considerable contribution from dependent variables X1, X2, X3 for the capability of knowledge management, it is obvious we need to define the acceptable minimum criteria for each. For example the independent variable X1, the level of management focus should have a minimum level for the company to have an effective capability. So we wish to find a minimum for each aspect. The resulted region is shown in following graph.

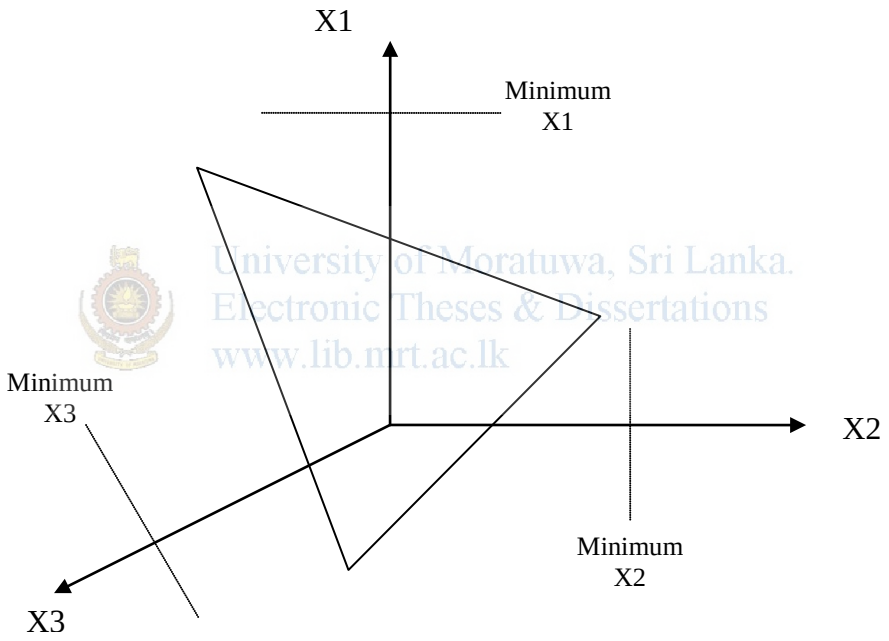

Figure 4.3: The Lowest Boundaries of X1 X2, and X3

By analyzing the current practice for each variable, we conclude that minimum acceptable level should be at least the average for each variable. The graphs below show the current practice for each independent variable and the average industry wise value. Hence the minimum values are in the Table below.

Table 4.15: The Lowest Boundaries of X1 X2, and X3

Variable	Concept	Minimum Accepted Level
X1	Degree of management focus towards knowledge management	0.4284
X2	Level of staff perception on knowledge management	0.4372
X3	Level of impact from internal processes	0.4427

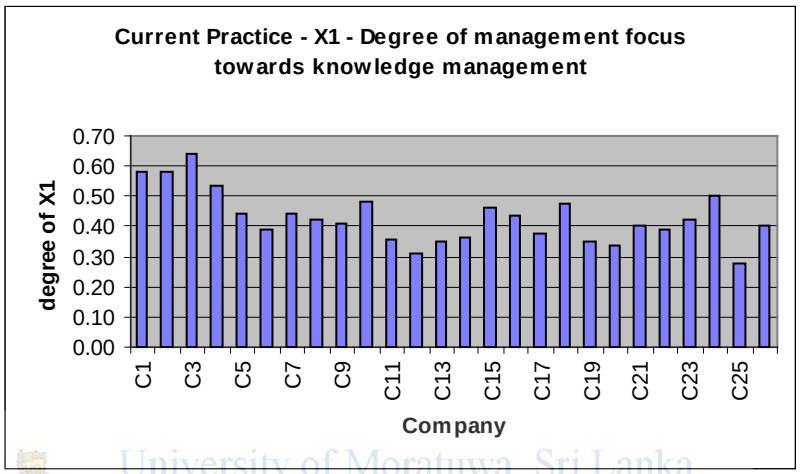

Figure 4.4: The Current Practice X1

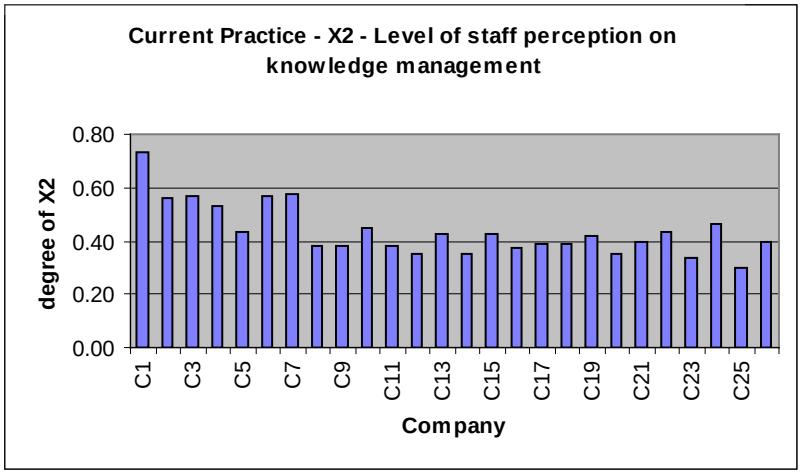

Figure 4.5: The Current Practice X2

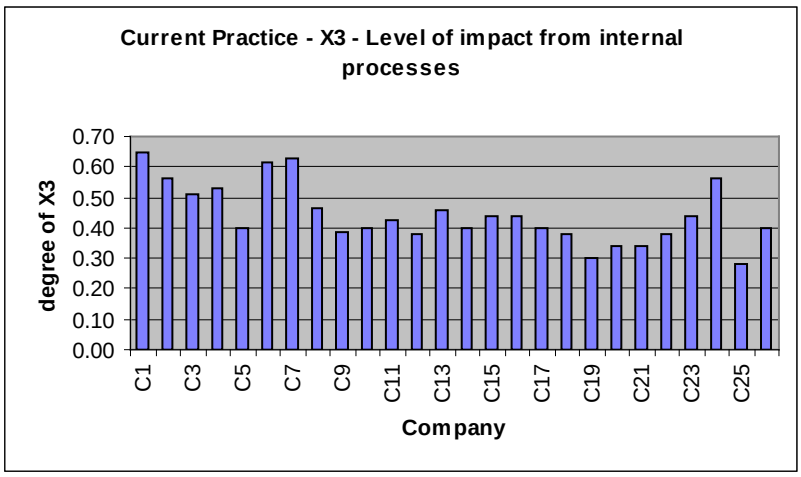

Figure 4.6: The Current Practice X3

4.6. Discussion

Based on the collected data for each company the KMC index was calculated. Then it is analyzed based on the scale of the company. The industry wise figure was calculated by averaging the KMC index for all companies.

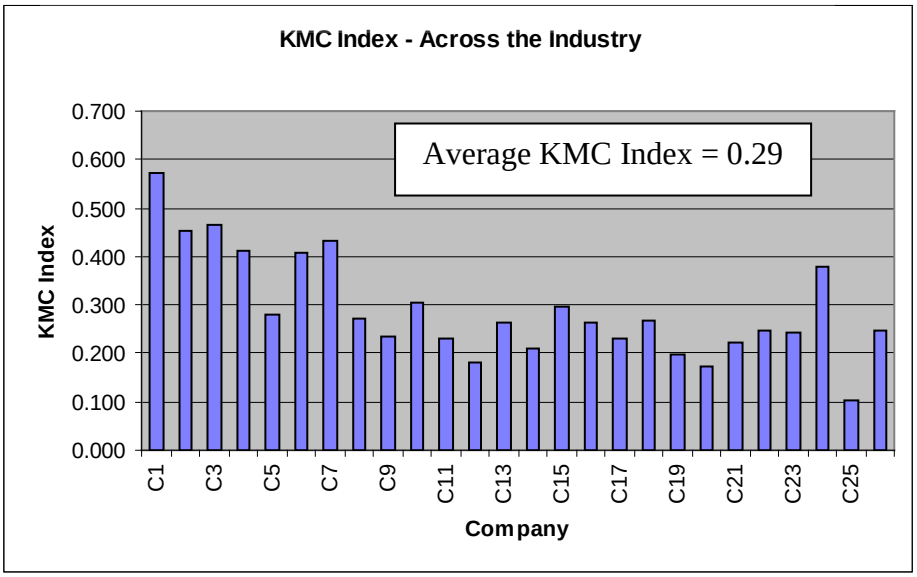

Figure 4.7: KMC Index

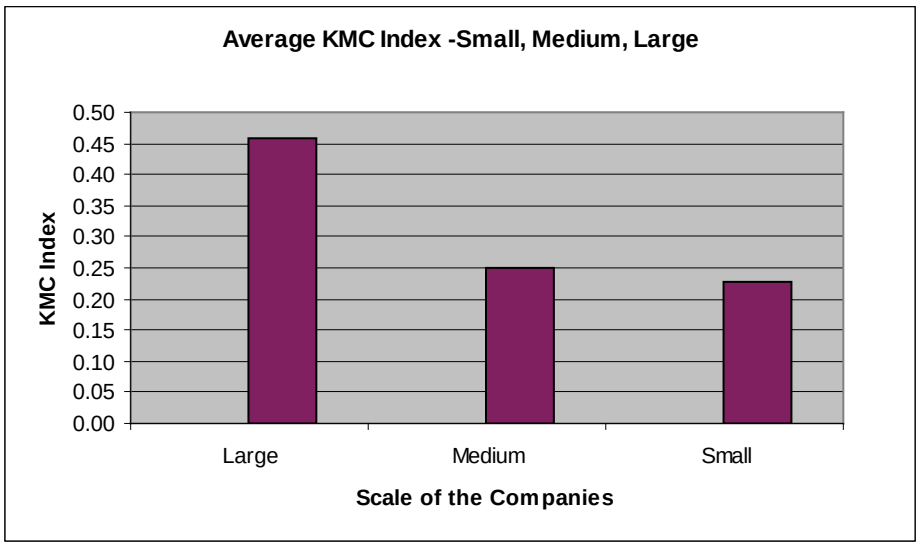

Figure 4.8: KMC Index Vs Scale of Companies

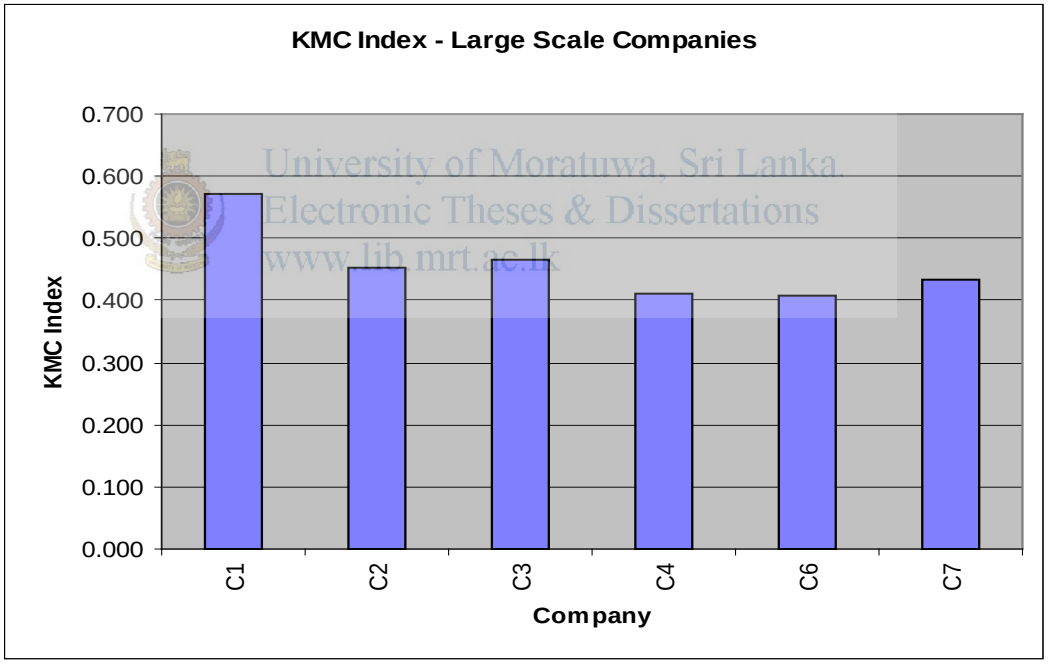

Figure 4.9: KMC Index in Large Scale Companies

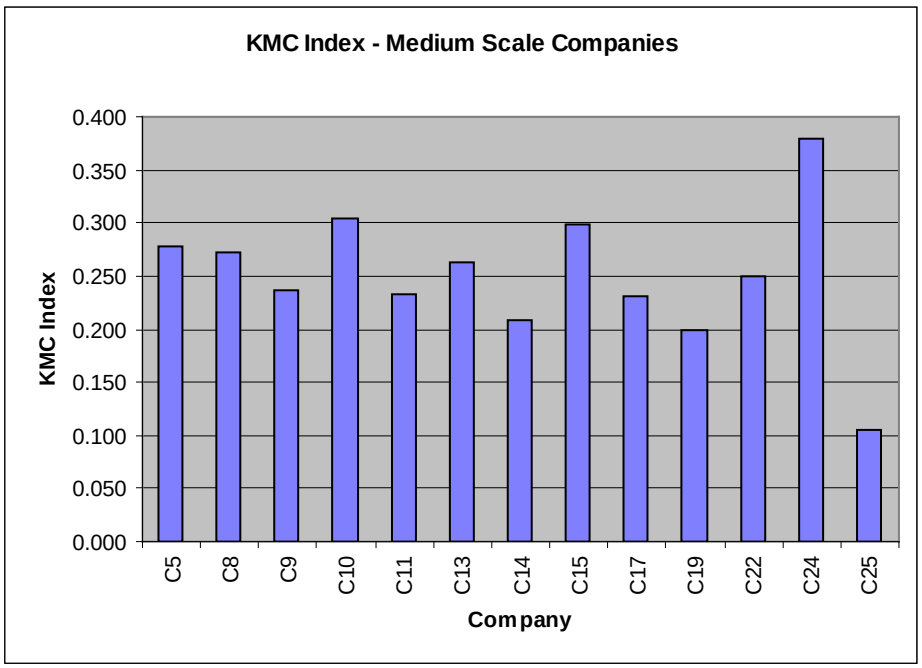

Figure 4.10: KMC Index in Medium Scale Companies

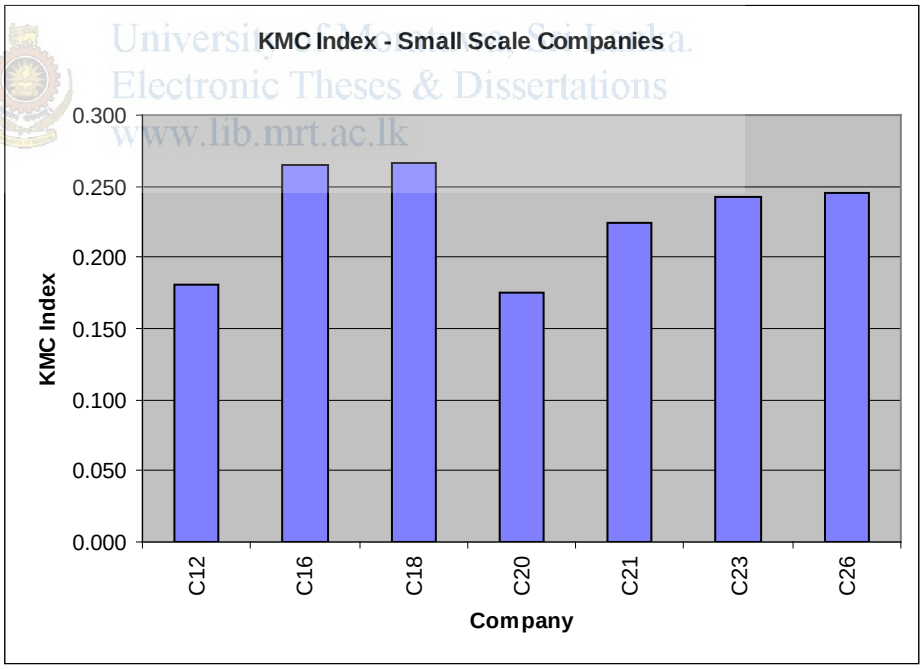

Figure 4.11: KMC Index in Small Scale Companies

5. LIMITATIONS OF THE STUDY

5.1. General

This chapter describes about the limitations of the study and difficulties faced during the research. Those will be useful for future researchers to take precautions and to improve the quality of the research.

5.1.1. Limited Time Period

Major limitation was that the research had to be completed within a short time period. Initially it was planned for about six month's. But it was delayed for several months. To overcome this, we would like to propose starting the research in middle semesters of the course in order to give more freedom for students to plan for the research activities. Also they will have more time on data collection which will result accurate, un-biased data collection in surveys.

5.1.2. Small Industry

Lack of big players in Sri Lankan software industry is another constraint. Most of the companies are not grown to the bigger level, many of them still in the entry level to the industry. The depth of software development work done locally by many companies is at the basic level.

5.1.3. Lack of Knowledge on the Subject

During the survey it was found that many of the stakeholders did not have sufficient knowledge to answer the questionnaire. The term knowledge management was new for some people. After the pilot survey this was addressed by adding a brief description to the questionnaire to describe the key terms used in the research.

5.1.4. Difficulty to Find Company Information

When searching for software development companies, there was no central database maintained by any authority to get the information of the companies. Some sites publish out dated lists even containing non operational companies.

5.2. Questionnaire Related Issues

Few of the respondents complained that the questionnaire is too lengthy because it had 5 sections to fill. Some said they had to think a lot when answering closely related questions. But it was difficult to consider those complaints because all sections were necessary for the questionnaire which was designed according to the research model. Also the nature of the subject doesn't permit to use very specific questions or words. Some complained about use of format used and preferred to use plain text.

The publishing of the questionnaire in the web, as a data collection form would have improved the response rate. Also it would have made data collection easier as the web page can be connected to a database to collect responses automatically.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

This chapter is focused on coming into a conclusion based on the studies carried out in the statistical analysis section. The last part of this chapter discusses about strategies that can be adopted for effective knowledge management process in a software development company and which type of companies need more attention on that regard.

6.2. Conclusion

The research has been carried out with the intention of analyzing the knowledge management capabilities of software development companies in Sri Lanka. Selected population for the study consists of all scales of the companies operating in the industry. They develop various types of software catering for different industries such as finance, education, apparel, banking, and insurance.

Based on the literature survey carried out, the limitations in local research in this context were found. Further, many researchers have pointed out the cultural, technological, people aspects of the knowledge management. Based on those findings, a conceptual research model was developed in order to analyze the knowledge management capability in four different aspects.

- Management focus towards knowledge management
- Staff perception on knowledge management
- Impact from internal processes
- Availability of knowledge management infrastructure.

Questionnaire-type field survey accompanied with few informal interviews with industry experts was used to gather information. The following conclusions were found after the statistical analysis of collected data.

- The above four aspects gives 82.66% contribution for describing the capability of knowledge management in a software development company in Sri Lanka. Based on the analysis it was revealed the impact from internal processes and availability of knowledge management infrastructure was co-related. Based on the further analysis, the infrastructure aspect was removed from the model. This is reasonable in practical sense, as in order to have effective internal processes, a good infrastructure is a pre-requisite.
- The remaining three aspects, gives 80.45% contribution towards describing the knowledge management capability with following individual contribution.
    - Staff perception on knowledge management (42.64 %)
    - Management focus towards knowledge management (27.39 %)
    - Impact from internal processes (21.90 %)

- The average value of the knowledge management capability index (KMCI) 0.29, gives us strong evidence of lack of attention and bad level of knowledge management practiced by software development companies in Sri Lanka.
- Different scales of companies show significance variance of knowledge management capability. This is evidenced by having relatively high KMCI of 0.45 (above the industry average) in large scale software development companies.
- The attitude and perception of software professionals in the company will play a key role in knowledge management.
- Process maturity also plays a key role in effective knowledge management.

6.3. Recommendations

6.3.1. For Industry

Based on the above conclusions and findings, we wish to give the following recommendations for better knowledge management capability in software development companies in Sri Lanka.

Knowledge management is a key to be competitive in the market. Hence the correct level of management focus is a must for better utilization of their intellectual assets in the company. Formal management reviews should be conducted across all projects to see how people share knowledge, to what extent the knowledge is being reused, how the research and development activities are documented, who are key resources that needs to be duplicated, what plans are derived to transfer their knowledge to others, how is second level of leadership is developed for each project and so on. The knowledge management should be an on-going activity. There is no end to it. With each project the acquired knowledge has to be re used in the next project where ever possible. The knowledge creation, in other words the innovation, is the key to the competitive edge.

The staff should be motivated, encouraged and rewarded by any means for sharing their expertise to have effective knowledge management. The high significance found in the research shows knowledge sharing has to be closely monitored. This is to be linked with the human resource management system in the company. The human resource department should not be isolated in the company. The correct feedback from the line level mangers should be taken in for people evaluation. The reward schemes should have a considerable portion for factors such as knowledge sharing, innovative ideas that improves the knowledge management capability.

The small and medium scale companies should put extra effort more (than big players in the industry), as they depend on a small set of people in their business. The heroic persons will deliver the goods only in the short run not in the long run. This is clearly indicated by the low values of the KMC index for small scale companies.

The process maturity is again a critical factor that needs to be considered. The lack of process orientation clearly diminishes the capability of knowledge utilization in a company. Such companies will need to invent the wheel, which results in heavy cost and over work. This may de-motivate the employees also. Hence all software development companies should pay attention on adhering to process standards such as CMMI or ISO. The limited number of certified companies in those standards in the country clearly results in the very low knowledge management capability index in the industry. The government subsidies on programs to start process consultant firms in the country would certainly improve the industry as a whole in better managing of knowledge.

6.3.2. For Future Work

- This research has to be generalized for more companies engaged in all aspects of the information technology.
- The number of responses can be increased by launching a web based questionnaire.
- A general invitation to the industry from an institute such as SLASI will have a positive impact on the number of participants.
- The same kind of study can be done in another country such as India, which has closely similar cultural orientation. This will give an international analysis of knowledge management capability. The result will give the KMC index for software industry in India which in turn enables to evaluate Sri Lanka's position.

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Appendix A: Questionnaire

Appendix B: Raw Data – Importance

Table B.1: Raw data – importance – independent variable

Response Index	Company Index	Independent Variable																					
		X1						X2								X3			X4				
		1	2	3	4	5	6	1	2	3	4	5	6	7	8	1	2	3	1	2	3	4	5
1	C1	4	5	4	3	4	4	3	1	1	5	4	5	3	3	1	3	3	2	5	2	4	1
2	C1	3	4	3	3	1	3	4	5	2	4	5	4	4	5	5	2	2	3	2	1	5	4
3	C1	3	2	5	4	4	1	2	2	1	3	2	2	1	1	2	1	3	1	4	2	1	5
4	C1	2	4	1	3	2	1	5	3	2	5	5	2	4	3	3	2	5	3	4	5	1	3
5	C2	2	3	1	3	1	2	3	4	5	3	3	3	3	4	4	3	1	3	2	1	2	2
6	C2	4	1	2	5	5	5	5	1	4	4	1	3	3	5	3	2	2	2	4	1	5	3
7	C2	4	1	4	5	1	3	2	3	4	3	4	3	3	1	4	4	1	5	3	4	2	1
8	C2	4	5	2	4	2	3	3	5	4	3	4	3	5	2	5	5	3	4	2	1	4	3
9	C3	5	2	1	4	5	2	2	5	2	1	3	3	2	1	1	1	1	5	1	3	1	4
10	C3	2	2	4	3	5	4	1	1	5	1	4	4	4	4	4	5	2	4	5	2	5	2
11	C3	1	2	5	1	4	4	5	3	4	5	3	2	2	5	4	5	5	2	5	1	4	2
12	C3	3	2	3	3	3	5	3	5	2	5	2	3	2	1	3	2	5	5	4	5	2	1
13	C4	5	5	4	3	2	1	4	2	3	3	2	3	5	1	5	5	1	1	2	5	4	2
14	C4	4	4	4	4	2	5	2	4	3	4	5	1	4	4	3	4	1	4	2	3	2	1
15	C4	2	3	3	1	2	2	2	3	3	5	5	1	5	4	5	1	5	3	5	4	5	1
16	C4	1	5	3	3	4	5	5	4	4	2	5	2	3	3	4	4	1	4	4	5	3	2
17	C5	2	1	3	3	5	4	1	1	2	5	5	1	1	3	1	2	2	2	4	3	1	1
18	C5	1	5	2	5	1	1	3	2	5	1	4	3	5	2	1	5	5	5	3	3	2	4
19	C5	5	4	3	3	4	4	3	3	1	5	5	5	5	4	5	2	2	5	1	5	1	1
20	C6	3	5	1	3	2	1	1	5	4	1	2	2	5	5	5	1	3	1	3	2	4	1
21	C6	4	5	3	3	1	5	5	3	4	5	2	2	4	5	2	2	5	5	4	3	1	3
22	C6	4	2	2	2	1	4	2	5	2	4	2	4	1	1	5	1	1	2	1	1	5	2
23	C7	1	3	5	4	1	2	5	3	2	5	3	3	1	4	3	2	4	3	5	3	1	1
24	C7	3	5	1	3	3	2	2	2	3	1	3	4	5	1	2	4	3	2	1	1	2	1
25	C7	3	3	3	3	5	5	3	4	1	5	5	2	3	3	5	5	3	1	3	3	5	1
26	C8	2	4	2	5	3	3	1	3	3	3	2	1	4	3	5	5	2	3	5	1	2	5
27	C8	4	3	5	2	3	4	4	4	4	4	2	4	2	5	4	5	1	3	3	3	3	2
28	C8	4	3	4	2	5	3	1	5	3	5	5	2	5	2	4	5	5	2	2	4	4	2
29	C9	2	3	2	2	2	2	2	2	3	3	5	3	2	2	5	2	5	4	3	5	2	5
30	C9	3	2	4	1	2	5	4	2	3	5	1	1	1	3	4	2	1	2	2	1	2	4
31	C9	5	3	3	3	2	2	2	1	5	5	3	2	3	4	3	4	4	2	3	2	2	1
32	C10	5	4	1	2	1	2	1	1	3	5	3	2	2	3	3	1	3	2	2	1	5	1
33	C10	3	1	1	5	3	1	5	4	4	2	3	1	2	2	4	5	1	5	3	3	1	2
34	C10	5	2	2	2	1	2	1	2	2	1	5	4	3	5	1	4	3	2	4	1	3	1
35	C11	5	2	4	5	3	1	1	1	2	5	1	5	1	4	1	5	3	5	1	3	1	3
36	C11	2	1	2	2	1	4	3	1	2	4	4	5	1	2	3	1	5	5	2	2	4	5
37	C11	4	2	2	1	2	1	2	2	2	4	2	4	2	4	5	2	1	3	5	5	2	3
38	C12	5	3	3	4	5	5	4	2	1	2	3	2	5	2	3	4	5	4	5	4	4	2
39	C12	2	1	4	3	4	4	5	2	4	2	3	3	3	3	1	2	4	1	4	1	1	4
40	C13	3	1	1	4	2	3	3	1	5	1	5	1	4	3	3	5	2	4	1	4	3	5
41	C13	4	5	1	4	4	5	1	3	1	4	5	2	4	4	2	1	1	2	4	5	3	4
42	C14	5	2	4	1	1	1	1	1	3	5	1	5	3	1	4	2	5	3	2	5	5	2
43	C14	4	4	2	2	4	3	1	5	2	3	4	1	3	2	3	5	3	3	2	1	3	1

Table B.1: Raw data – importance – independent variable (Continued)

Response Index	Company Index	Independent Variable																				
		X1						X2								X3			X4				
		1	2	3	4	5	6	1	2	3	4	5	6	7	8	1	2	3	1	2	3	4	5
44	C15	1	3	5	2	4	3	4	5	4	1	2	1	1	3	4	4	2	5	4	5	1	5
45	C15	3	1	2	5	3	3	2	2	3	2	5	3	2	5	5	3	1	3	2	3	1	3
46	C16	1	5	4	1	1	3	1	4	2	2	4	2	2	3	2	5	1	4	4	2	1	4
47	C16	1	4	5	1	2	3	4	3	2	1	2	1	1	5	2	4	3	3	2	4	5	1
48	C17	5	3	3	4	2	2	5	1	5	2	1	1	2	5	2	5	3	1	5	3	5	4
49	C17	2	1	3	1	3	4	3	4	5	5	5	2	4	5	1	1	5	1	4	2	4	2
50	C18	5	1	1	4	1	1	4	2	3	2	1	3	3	4	1	4	1	2	1	1	3	2
51	C18	1	4	4	2	5	3	1	1	1	4	4	4	1	2	2	3	1	3	2	4	5	2
52	C19	2	3	3	1	3	5	2	4	4	4	2	2	3	5	4	2	2	1	3	3	2	2
53	C19	2	5	5	1	5	2	1	1	2	4	1	1	2	3	4	2	1	5	1	4	2	5
54	C20	5	1	1	1	2	5	1	4	5	1	4	1	3	2	2	3	1	3	2	1	4	4
55	C20	5	5	5	4	5	3	1	5	2	1	3	4	5	5	2	2	2	4	3	5	4	2
56	C21	3	3	4	3	5	1	1	4	2	2	3	4	5	3	3	4	2	5	5	3	5	5
57	C21	2	5	5	3	4	3	2	4	2	2	5	3	2	5	2	2	5	2	4	5	2	1
58	C22	1	1	1	2	5	3	3	1	4	4	5	3	2	4	3	1	5	4	4	1	5	2
59	C22	1	1	1	3	1	3	2	1	5	2	4	4	4	5	1	3	3	3	5	2	1	1
60	C23	4	2	2	4	4	3	3	5	1	4	1	1	1	3	4	5	3	5	4	2	4	3
61	C24	4	3	5	5	1	5	3	4	5	4	3	1	4	4	1	4	1	3	4	1	2	2
62	C25	5	1	2	1	2	5	1	5	2	3	3	2	3	3	2	2	2	1	3	4	2	5
63	C26	4	3	1	4	4	1	2	5	5	2	2	1	3	2	3	5	2	5	4	4	5	2

Table B.2: Raw data – importance – dependent variable

Response Index	Company Index	Dependent Variable					
		Y1					
		1	2	3	4	5	6
1	C1	4	4	4	3	5	5
2	C1	5	5	3	4	4	
3	C1	3	2	4	1	5	3
4	C1	2	5	3	5	4	1
5	C2	5	5	2	1	5	1
6	C2	3	5	5	3	4	
7	C2	1	5	5	2	5	3
8	C2	5	4	3	5	5	2
9	C3	5	2	1	3	3	1
10	C3	5	3	3	4	5	5
11	C3	4	4	4	5	5	4
12	C3	4	3	2	5	5	4
13	C4	3	5	5	1	5	
14	C4	5	4	1	5	3	2
15	C4	4	3	5	5	2	1
16	C4	5	4	3	5	4	3
17	C5	1	4	3	5	3	1
18	C5	5	5	5	3	1	2
19	C5	5	3	1	5	5	4
20	C6	4	3	4	2	5	
21	C6	5	5	2	5	4	2
22	C6	5	1	5	1	4	3
23	C7	5	3	5	1	5	1
24	C7	4	3	1	5	2	
25	C7	4	5	5	3	5	5
26	C8	3	4	4	3	5	2
27	C8	5	3	1	5	4	3
28	C8	4	5	3	5	5	5
29	C9	2	3	4	4	5	4
30	C9	5	4	3	3	1	5
31	C9	5	5	1	1	4	2
32	C10	2	3	5	2	4	2
33	C10	5	4	4	1	4	3
34	C10	5	3	2	3	4	
35	C11	2	4	3	5	4	3
36	C11	2	5	4	1	4	5
37	C11	3	3	3	3	4	1
38	C12	4	3	5	5	4	5
39	C12	4	5	4	2	3	2
40	C13	3	5	1	4	5	3
41	C13	5	4	3	1	5	5
42	C14	5	1	5	1	5	5
43	C14	4	4	2	5	4	4

Table B.2: Raw data – importance – dependent variable (Continued)

Response Index	Company Index	Dependent Variable					
		Y1					
		1	2	3	4	5	6
44	C15	5	2	5	2	4	4
45	C15	5	2	5	3	3	3
46	C16	4	4	5	1	2	1
47	C16	5	2	4	4	2	2
48	C17	3	5	4	4	3	4
49	C17	5	1	4	5	5	2
50	C18	3	2	1	4	5	1
51	C18	3	4	4	2	3	4
52	C19	3	5	4	3	4	4
53	C19	4	2	1	5	4	5
54	C20	2	4	4	4	2	1
55	C20	5	5	2	4	5	5
56	C21	3	5	3	4	4	5
57	C21	5	4	5	3	3	4
58	C22	3	5	3	4	3	2
59	C22	4	4	5	1	3	2
60	C23	2	5	5	5	1	3
61	C24	4	5	4	5	2	5
62	C25	3	3	2	3	5	5
63	C26	4	5	4	4	1	4

Appendix C: Summarized Data – Importance

Table C.1: Summarized data – importance

Response Index	Company Index	Independent Variable				Dep't Variable
		X1	X2	X3	X4	Y1
1	C1	0.80	0.63	0.47	0.56	0.80
2	C1	0.57	0.83	0.60	0.60	0.84
3	C1	0.63	0.35	0.40	0.52	0.60
4	C1	0.43	0.73	0.67	0.64	0.76
5	C2	0.40	0.70	0.53	0.40	0.72
6	C2	0.73	0.65	0.47	0.60	0.80
7	C2	0.60	0.58	0.60	0.60	0.72
8	C2	0.67	0.73	0.87	0.56	0.88
9	C3	0.63	0.48	0.20	0.56	0.56
10	C3	0.67	0.60	0.73	0.72	0.80
11	C3	0.57	0.73	0.93	0.56	0.88
12	C3	0.63	0.58	0.67	0.68	0.76
13	C4	0.67	0.58	0.73	0.56	0.76
14	C4	0.77	0.68	0.53	0.48	0.72
15	C4	0.43	0.70	0.73	0.72	0.76
16	C4	0.70	0.70	0.60	0.72	0.84
17	C5	0.60	0.48	0.33	0.44	0.64
18	C5	0.50	0.63	0.73	0.68	0.76
19	C5	0.77	0.78	0.60	0.52	0.76
20	C6	0.50	0.63	0.60	0.44	0.72
21	C6	0.70	0.75	0.60	0.64	0.84
22	C6	0.50	0.53	0.47	0.44	0.64
23	C7	0.53	0.65	0.60	0.52	0.76
24	C7	0.57	0.53	0.60	0.28	0.60
25	C7	0.73	0.65	0.87	0.52	0.88
26	C8	0.63	0.50	0.80	0.64	0.76
27	C8	0.70	0.73	0.67	0.56	0.72
28	C8	0.70	0.70	0.93	0.56	0.88
29	C9	0.43	0.55	0.80	0.76	0.72
30	C9	0.57	0.50	0.47	0.44	0.64
31	C9	0.60	0.63	0.73	0.40	0.64
32	C10	0.50	0.50	0.47	0.44	0.64
33	C10	0.47	0.58	0.67	0.56	0.72
34	C10	0.47	0.58	0.53	0.44	0.68
35	C11	0.67	0.50	0.60	0.52	0.72
36	C11	0.40	0.55	0.60	0.72	0.64
37	C11	0.40	0.55	0.53	0.72	0.64
38	C12	0.83	0.53	0.80	0.76	0.84
39	C12	0.60	0.63	0.47	0.44	0.72
40	C13	0.47	0.58	0.67	0.68	0.72
41	C13	0.77	0.60	0.27	0.72	0.72
42	C14	0.47	0.50	0.73	0.68	0.68
43	C14	0.63	0.53	0.73	0.40	0.76
44	C15	0.60	0.53	0.67	0.80	0.72
45	C15	0.57	0.60	0.60	0.48	0.72

Table C.1: Summarized data – importance (Continued)

Response Index	Company Index	Independent Variable				Dep't Variable
		X1	X2	X3	X4	Y1
46	C16	0.50	0.50	0.53	0.60	0.64
47	C16	0.53	0.48	0.60	0.60	0.68
48	C17	0.63	0.55	0.67	0.72	0.76
49	C17	0.47	0.83	0.47	0.52	0.80
50	C18	0.43	0.55	0.40	0.36	0.60
51	C18	0.63	0.45	0.40	0.64	0.64
52	C19	0.57	0.65	0.53	0.44	0.76
53	C19	0.67	0.38	0.47	0.68	0.64
54	C20	0.50	0.53	0.40	0.56	0.64
55	C20	0.90	0.65	0.40	0.72	0.84
56	C21	0.63	0.60	0.60	0.92	0.76
57	C21	0.73	0.63	0.60	0.56	0.80
58	C22	0.43	0.65	0.60	0.64	0.72
59	C22	0.33	0.68	0.47	0.48	0.68
60	C23	0.63	0.48	0.80	0.72	0.72
61	C24	0.77	0.70	0.40	0.48	0.80
62	C25	0.53	0.55	0.40	0.60	0.64
63	C26	0.57	0.55	0.67	0.80	0.72

Appendix D: Summarized Data – Current Practice

Table D.1: Summarized data – current practice

Response Index	Company Index	Independent Variable			
		X1	X2	X3	X4
1	C1	0.80	0.63	0.47	0.56
2	C1	0.57	0.83	0.60	0.60
3	C1	0.63	0.35	0.40	0.52
4	C1	0.43	0.73	0.67	0.64
5	C2	0.40	0.70	0.53	0.40
6	C2	0.73	0.65	0.47	0.60
7	C2	0.60	0.58	0.60	0.60
8	C2	0.67	0.73	0.87	0.56
9	C3	0.63	0.48	0.20	0.56
10	C3	0.67	0.60	0.73	0.72
11	C3	0.57	0.73	0.93	0.56
12	C3	0.63	0.58	0.67	0.68
13	C4	0.67	0.58	0.73	0.56
14	C4	0.77	0.68	0.53	0.48
15	C4	0.43	0.70	0.73	0.72
16	C4	0.70	0.70	0.60	0.72
17	C5	0.60	0.48	0.33	0.44
18	C5	0.50	0.63	0.73	0.68
19	C5	0.77	0.78	0.60	0.52
20	C6	0.50	0.63	0.60	0.44
21	C6	0.70	0.75	0.60	0.64
22	C6	0.50	0.53	0.47	0.44
23	C7	0.53	0.65	0.60	0.52
24	C7	0.57	0.53	0.60	0.28
25	C7	0.73	0.65	0.87	0.52
26	C8	0.63	0.50	0.80	0.64
27	C8	0.70	0.73	0.67	0.56
28	C8	0.70	0.70	0.93	0.56
29	C9	0.43	0.55	0.80	0.76
30	C9	0.57	0.50	0.47	0.44
31	C9	0.60	0.63	0.73	0.40
32	C10	0.50	0.50	0.47	0.44
33	C10	0.47	0.58	0.67	0.56
34	C10	0.47	0.58	0.53	0.44
35	C11	0.67	0.50	0.60	0.52
36	C11	0.40	0.55	0.60	0.72
37	C11	0.40	0.55	0.53	0.72
38	C12	0.83	0.53	0.80	0.76
39	C12	0.60	0.63	0.47	0.44
40	C13	0.47	0.58	0.67	0.68
41	C13	0.77	0.60	0.27	0.72
42	C14	0.47	0.50	0.73	0.68
43	C14	0.63	0.53	0.73	0.40

Table D.1: Summarized data – current practice (Continued)

Response Index	Company Index	Independent Variable			
		X1	X2	X3	X4
44	C15	0.60	0.53	0.67	0.80
45	C15	0.57	0.60	0.60	0.48
46	C16	0.50	0.50	0.53	0.60
47	C16	0.53	0.48	0.60	0.60
48	C17	0.63	0.55	0.67	0.72
49	C17	0.47	0.83	0.47	0.52
50	C18	0.43	0.55	0.40	0.36
51	C18	0.63	0.45	0.40	0.64
52	C19	0.57	0.65	0.53	0.44
53	C19	0.67	0.38	0.47	0.68
54	C20	0.50	0.53	0.40	0.56
55	C20	0.90	0.65	0.40	0.72
56	C21	0.63	0.60	0.60	0.92
57	C21	0.73	0.63	0.60	0.56
58	C22	0.43	0.65	0.60	0.64
59	C22	0.33	0.68	0.47	0.48
60	C23	0.63	0.48	0.80	0.72
61	C24	0.77	0.70	0.40	0.48
62	C25	0.53	0.55	0.40	0.60
63	C26	0.57	0.55	0.67	0.80

Appendix E: Instructions to Responders

Introduction:

This questionnaire has been prepared to analyze the knowledge management capabilities of software development companies in Sri Lanka. The questions are of general nature and are divided into 5 sections. The definitions of key terms used in the questionnaire are given separately for your convenience.

You are kindly requested to answer all relevant questions. This survey is carried out for an academic purpose and information given will be kept confidential. Therefore, your cooperation is highly appreciated to make it success.

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Key Term 1: Knowledge

Knowledge is "facts, information, and skills (know-how) acquired through experience or education".

Key Term 2: Knowledge Management (KM)

Knowledge management is a key business activity with two primary aspects.
Treating the knowledge as an important part of organization's strategy, policy and practice
Making a direct connection between an organization's intellectual assets (human capital) and business goals

- Following are integrated components of KM.
- Generating new knowledge
- Accessing valuable knowledge from outside sources
- Using accessible knowledge in decision making
- Embedding knowledge in processes, products and services
- Representing knowledge in documents, databases and software
- Facilitating knowledge growth through culture and incentives
- Transferring existing knowledge into other parts of the organization
- Measuring the value of intellectual assets