Knowledge Management Practices in Small-Scaled Project-Based Software Engineering Organisations – The Case of Enverian Ltd.

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This work is solely the work of author and submitted in partial fulfilment of the requirements for the degree of Masters in Project Management.
“Knowledge has become the key economic resource and the dominant
– and perhaps even the only – source of competitive advantage.”

– Peter Drucker
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ABSTRACT

Large portion of the key research in the Knowledge Management field has been conducted in the large organisational setting. In contrast, this thesis focuses on Knowledge Management practices utilised by small-scaled project-based Irish software development organisation Enverian, headquartered in Dublin. It is intended that the results of this work will uncover Knowledge Management areas within Enverian, which require improvement, and at the same time contribute to the better understanding and appreciation of knowledge management in small-scaled software project-based organisations.

The research strategy chosen for this thesis was survey research. The main research activity was the conducting of structured interviews with two company directors, and a distribution of Knowledge Management Assessment Tool (KMAT) questionnaire to the employees and management in Enverian. It allowed for better understanding of the company’s culture, current practices and attitudes towards Knowledge Management, and uncovered the areas of Knowledge Management that require improvement. The interview format and data analysis was informed by a detailed review of literature on the Knowledge Management in small to medium-sized organisations and software engineering environments.

Knowledge Management appears in Enverian to get its form especially at an operational and tactical levels, however lacks formal structure and executive management drive on a strategic level. A set of recommendations for improved Knowledge Management practices within Enverian was formulated after careful analysis of the research findings.

Keywords: Knowledge Management, Knowledge Management Strategy, Project Management, Small-Scaled Software Development Organisation, Software Development
EXECUTIVE SUMMARY

Knowledge Management is becoming one of the most talked topics in today’s business environment. However, large portion of the key research in the Knowledge Management field has been conducted in the large organisational setting. The focus of this thesis is on Knowledge Management practices utilised by small-scaled project-based Irish software development organisation Enverian. The company was established in 2011 and has been in operation for two years only. Enverian operates in a knowledge-intensive environment, and therefore management of knowledge should play an important role in the company’s strategy. The Board of Directors in Enverian recognized the need for an improved Knowledge Management practices within the company and wish to take a more structured approach to the management of organizational knowledge going forward.

The main focus of this thesis was to look at where the value of Knowledge Management in Enverian should be, to what extent is Enverian achieving this value and where does the organisation fall down in terms of maximising this value. The thesis also focused on what Enverian should do to enhance and improve current Knowledge Management practices.

The research strategy for the purpose of this research was survey research. Before undertaking the survey research, a comprehensive literature review focused on Knowledge Management in small-scaled organisations and software engineering environment was carried out. Knowledge Management can benefit companies like Enverian in that it can serve as a risk mitigation and prevention technique for risks that are often ignored by companies, such as key person dependency and loss of knowledge due to various reasons. It can also serve as a source of competitive advantage over competitors. Effective Knowledge Management can accelerate learning, and save time and cost by eliminating the need for rework.

The main research activity was the conducting of structured interviews with two company directors. It allowed for better understanding of the Enverian’s strategy, structure, culture and systems in relation to Knowledge Management. For the purpose of this research a Knowledge Management Assessment Tool (KMAT) questionnaire was also distributed to seven participants, both employees and management of Enverian, in order to assess the Enverian’s current Knowledge Management maturity level.

The KMAT findings revealed that Enverian occupies Level 2: *Initiation Level* position, which suggests that the organisation is beginning to recognise the need to manage knowledge or
may already be initiating a pilot Knowledge Management project. The level of maturity is understandable, as the company has been in operation for two years only. The findings from KMAT also revealed Enverian’s strengths and weaknesses in relation to current Knowledge Management practices. The Knowledge Management Measurement, as well as Leadership proved to be the weakest, whereas Knowledge Management Culture together with Technology scored the highest.

The findings from structured interviews revealed that Enverian’s organisational culture and structure are very supportive of Knowledge Management. On the other hand, the company lacks a formal and strategic approach to its management of knowledge. Enverian has no systematic Knowledge Management policy on the strategic level and management of knowledge lacks management drive and leadership. This results in Knowledge Management not being central to the organisational strategy. Revenue-generating potential of Knowledge Management has not been realised, as the organisation has not developed a way to measure the value of Knowledge Management as of yet.

Based on the findings from both KMAT and structured interview, it can be concluded that Knowledge management in Enverian operates at a very informal level. In order to maximise the value that Knowledge Management can create for Enverian, the company is in need to develop a formal Knowledge Management strategy. The strategy will formalise the process of organisational Knowledge Management and maximise the value potential of knowledge within Enverian. Formulation of Knowledge Management strategy must be driven by senior executives, as they have a direct influence on the organisational culture, structure and systems within Enverian. The author believes that the most appropriate strategy, and one that Enverian would benefit the most from, would be a combination of Codification and Personalisation. Enverian should also consider hiring/nominating a “knowledge manager”, who would assist with formalising and putting structure around management of knowledge within Enverian in place.

Enverian operates in a knowledge-intensive software engineering environment, hence Knowledge Management should be central to their organisational strategy. The author believes that this work will inform the company and help them to realise the value Knowledge Management can bring to an organisation like Enverian.
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CHAPTER 1: INTRODUCTION

1.1 The Research Project

This thesis addresses the subject of Knowledge Management practices in small, project-based software development organisation - Enverian. Software engineering is considered to be one of the most “knowledge-intensive” lines of work (Bjørnson & Dingsøyr 2008, Aurum et al. 2008b, Boden & Avram 2009, Desouza et al. 2006, Dingsøyr & Røyrvik 2003, Edwards 2003). For that reason, companies, both small and large-scaled, need to understand the importance of knowledge management and benefits it brings to the organisation. The aim of this study is therefore to devise a set of recommendations for a small-scaled Irish based software development company Enverian, in order to enhance and improve their management of knowledge. Current Knowledge Management practices within Enverian will be closely examined and a set of recommendations will be formulated.

1.2 The Research Objectives

- In Enverian, where the value of Knowledge Management should be?
- To what extent is Enverian achieving this value and where does the organisation fall down in terms of maximising this value?
- What should Enverian do to enhance and improve current Knowledge Management practices and maximise the value of Knowledge Management within Enverian?

1.3 Structure of the Thesis

In Chapter 2 the literature review on Knowledge Management and relevant concepts, perspectives and issues on the subject matter are explored. Research methodology is described in Chapter 3. Here, the research method and mechanisms will be explained in detail. Research findings, analysis and commentary on the research findings are presented in Chapter 4. Discussion of Findings is presented in Chapter 5. Finally in Chapter 6, author deals with the conclusions that are drawn from the research. Recommendations, limitations and suggestions for further research are also presented in this chapter.
1.4 Scope of the Thesis

The thesis describes the findings from research into the utilisation of Knowledge Management practices in small-scaled, project-based software development organisation – Enverian. It is the author's opinion that the findings will enhance and improve management of knowledge within Enverian.

1.5 Enverian – Organisation within Which the Research is Carried Out

Enverian is a small-scaled, Irish owned, software engineering company headquartered in Dublin. The company employs seven people including software developers, testers, business analysts and management staff. Enverian Ltd. was established in 2011 to provide complex and flexible software products and solutions focused on the renewable energy sector. Enverian Ltd. is a company founded on the expertise of Renewable Energy Experts to meet the needs of the global Renewable Energy Sector. The company has created a solution that allows energy companies to maximize their investment by capturing real-time project progress and demonstrates where the company is creating most value.
The company is led by a Board of former CIO's of Blue-chip companies and a Senior Management team with extensive experience of delivering key strategic and business initiatives in Renewable Energy, Biotechnology, Financial, Utilities and IT environments. Drawing on the expertise and skillsets of the founders, this is a familiar market in which they have all succeeded previously.

Enverian has now deployed its award winning solution to clients in Ireland, the United Kingdom and United States and is managing over 21GW of renewable energy projects across the globe through the innovative cloud based application. The combination of a ground breaking software solution and an expert consultancy team sets them apart in a competitive and growing renewable energy sector.

The company operates in a knowledge-intensive environment and therefore management of knowledge should play an important role in the company's strategy. The Board of Directors collectively recognized the need for an improved Knowledge Management within the company. They believe that the research will benefit the organization and uncover the areas of Knowledge Management that require improvement.

Figure 2 Enverian- Organisational Chart
CHAPTER 2: LITERATURE REVIEW

Before undertaking the survey research, a comprehensive literature review focused on three themes relevant to research question will be carried out. The first section of the literature review introduces the concept of Knowledge. The second section is focused on Knowledge Management, its principles and its utilisation in small and medium sized organisations. The third section of the literature review focuses on Knowledge Management in Software Engineering Organisations, its benefits and consequences of ineffective Knowledge Management.

2.1 Knowledge

Davenport and Prusak (2000) assert 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. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms”. Alavi and Leidner (1999) supports this view under the postulation that “knowledge is a justified personal belief that increases an individual’s capacity to take effective action” hence increases the success rate of the decision making process.

Nonaka (1994) distinguishes between two types of knowledge – “tacit” and “explicit”. Tacit knowledge resides in within individuals mind in the form of memory, know-how, skills, expertise, education and creativity, and can be acquired through imitation and practices (Aurum et al. 2008, Adenfelt & Lagerström 2006, Alavi & Tiwana 2002). Tacit knowledge is hard to codify. In contrast, explicit knowledge is stored in textbooks, documents, and often expressed in codified form of organisational routines, guidelines and practices (Aurum et al. 2008, Adenfelt & Lagerström 2006, Alavi & Tiwana 2002).

Aurum et al. (2008) highlight the existence of third type of knowledge called “implicit knowledge”. Some tacit knowledge can be codified and converted into explicit knowledge (Aurum et al., 2008b), and this type of knowledge is what they refer to as “implicit knowledge”. Aurum et al. (2008) highlight that the value of implicit knowledge is acknowledged by in the upper levels of organisations’ management and it is perceived as critical in assisting and enabling employees to fulfil their roles (Aurum et al., 2008b).
Knowledge can be used “to make wiser decisions about strategy, competitors, customers, distribution channels, and product and service life cycles” (Davenport & Prusak, 2000), hence serve as a source of competitive advantage for organisations. Without a sustainable competitive advantage companies would not be able to withstand the competitive and ever changing nature of today’s global markets. Nonaka (1994) aptly supports this reality, highlighting that any organisation that operates in and deals with dynamically changing environment should not only “process information efficiently but also create information and knowledge”. Therefore management of knowledge should be embedded into organisational culture and become an essential part of everything organisation does (Davenport & Prusak, 2000).

Snyder (1996) suggests that organisational knowledge comprise of skills, cognitions, and systems. Organisational skills category includes the technical, professional and social skills of its employees, both behavioural and intellective (Snyder, 1996). Snyder (1996) defines cognitions as “the information, ideas, values, and attitudes shared by members” and organisational systems as “the structures, procedures, and policies related to performing tasks, coordinating resources, and managing external relationships.” The organisational knowledge components - skills, cognitions and systems, are interconnected and need to be managed. Knowledge management offers formal structures and procedures for management of the organisational knowledge to their best potential, and allows organisations to gain a sustainable competitive advantage through their knowledge base.

2.2 Knowledge Management

Knowledge Management, its benefits and utilisation is becoming one of the most talked and discussed topics in today’s business environment. The purpose of Knowledge Management is to “transfer implicit knowledge to explicit knowledge, as well as to transfer explicit knowledge from individuals to groups within the organisation” (Aurum et al., 2008b).

In accordance with King (2009), “the goals of KM are the leveraging and improvement of the organization’s knowledge assets to effectuate better knowledge practices, improved organizational behaviours, better decisions and improved organizational performance.” Hence, Knowledge Management is the process of identifying, creating, capturing, preserving

Kasvi et al. (2003) suggests that Knowledge Management comprises of the following four activities:

1. **Knowledge Creation**
2. **Knowledge Administration**
3. **Knowledge Dissemination**
4. **Knowledge Utilisation and Productisation**

Knowledge creation involves activities such as knowledge gathering, grouping and arrangement and “collection, combination and modification and refinement (Kasvi et al., 2003) Knowledge administration is concerned with knowledge storage, arrangement and structuring, and retrieval (Kasvi et al., 2003). Knowledge dissemination is related to knowledge distribution within and outside the project, as well as between the projects (Kasvi et al., 2003). Knowledge utilisation and productisation involves the embodiment of knowledge into products, services and decisions, and its utilisation in other projects (Kasvi et al., 2003).

Beijerse (2000) postulates that there are four crucial means with which one can organise – “achieve certain goals using certain means”:

1. **Strategy** – helps to define the medium and short term goals in relation to the factor knowledge
2. **Structure** – is there to assist people to make their knowledge, their information, their capacities and their attitudes, useful, productive and creative
3. **Culture** – knowledge sharing culture within organisation positively impacts motivation of people to make their knowledge productive and to use the systems available within the organisation
4. **Systems** - the systems are aimed at the management of the operational mechanisms that is targeted at “making the information, the capacities and the attitude within the organisation, productive” (Beijerse, 2000)

Hence, Knowledge Management can be defined as the “management of knowledge (information, the capacities and the attitude within an organisation) by steering the strategy, structure, culture and systems and the capabilities and attitudes of people with regard to their knowledge” (Beijerse, 2000).
2.2.1 Knowledge Management and SMEs

Large portion of the key research in the Knowledge Management field has been conducted in the large organisational setting, whereas small and medium-sized companies get very little or no attention in this research, suggests (Beijerse 2000, Evangelista et al. 2010, Durst & Edvardson 2012). Knowledge is now considered one of the critical driving forces for gaining competitive advantage and business success (Nonaka 1991, Davenport & Prusak 2000, Birkinshaw 2001, Wong 2005, Wong & Aspinwall 2005, Yeh et al. 2006, Migdadi 2009).

Small and medium-sized enterprises (SMEs) have a flat structure, organic free-floating management style with owners taking on central position, suggest Durst & Edvardson (2012). Centrality, in conjunction with limited financial resources and expertise can often have a negative impact on knowledge-management in SMEs, as most of the knowledge becomes stored in the minds of the owner and some key employees rather than codified and physically stored or shared within the organisation.(Durst & Edvardson, 2012).

Beijerse (2000) analysed Knowledge Management processes in 12 small to medium-sized innovative companies from the industrial and business sector. The companies' knowledge management processes were analysed and looked at from the four different perspectives –
Strategy (strategic level), Structure and Culture (Tactical Level) and Systems (Operational Level). Beijerse (2000) found out that there was:

- “hardly any systematic Knowledge Management policy on strategic level in small and medium-sized companies”,
- “hardly any systematic Knowledge Management policy on tactical level in small and medium-sized companies”
- “79 different instruments with regard to knowledge management on operational level in small and medium-sized companies”

Her view is supported by a very recent work of Durst & Edvardson (2012), who suggest that “most SMEs have no explicit policy targeted at strategic Knowledge Management, and they tend to treat Knowledge Management on an operational level – at the level of systems and instruments.”

On a positive side, Desouza & Awazu (2006) postulate that common knowledge possessed by all members of the SMEs is very deep and broad. This common knowledge makes the organisation of work easier by easing issues of knowledge transfer, sense making, and application, argues Desouza & Awazu (2006).

SMEs have very often limited resources (Desouza & Awazu 2006, Durst & Edvardson 2012), hence their knowledge need to be utilised in the most effective and efficient ways. “SMEs compete on their know-how and hence have to use knowledge to their advantage, even more so than traditional resources”(Desouza & Awazu, 2006).

### 2.2.2 Critical Success Factors (CSFs) for Implementing KM in SMEs

The work of Wong (2005), Wong & Aspinwall (2005), and Migdadi (2009) focused on the study of enablers and critical success factors for implementing Knowledge Management in small and medium enterprises. Wong (2005) proposed 11 critical success factors suitable and specifically tailored to the needs of small and medium businesses. His study was supported by the work of Wong & Aspinwall (2005) who conducted a survey in SMEs based in UK, on CSFs for adopting Knowledge Management in small and medium-sized enterprises. The following are the CSFs for implementing KM in the SME sector outlined in order of importance by Wong & Aspinwall (2005):

1. Management Leadership and Support
2. Culture
3. Strategy and Purpose
4. Resources
5. Process and Activities
6. Training and Education
7. HRM
8. IT
9. Motivational Aids
10. Organisational Infrastructure
11. Measurement

Based on the findings by Wong & Aspinwall (2005), the top three factors for successful implementation of knowledge management in SMEs are management leadership and support, organisational culture and organisational strategy and purpose. According to Migdadi (2009), Knowledge Management practices must be actively and aggressively driven and supported by senior executives, as they have a direct influence on the organisational culture and approach to Knowledge Management. His view is supported by King (2009) in that it is the managers, who are responsible for creating the environment and achieving the Knowledge Management goals by motivating the individuals and creating social processes that will facilitate Knowledge Management success. Hence, executives need to be driving the Knowledge Management process within Enverian. Knowledge sharing and collaborative culture is also essential for an effective implementation of KM. “Organizational culture not just defines the value of knowledge and explains the advantage that knowledge creates for the organization, it also influences the efforts that the employee is willing to share and put into the organization” (Migdadi, 2009). Strategy steers the company towards becoming knowledge based as well as provides a rationale for pursuing KM, suggests Wong (2005).

2.3 Knowledge Management in Software Engineering

The importance of leveraging knowledge for gaining competitive advantage within organisations has been widely accepted in Knowledge Management literature and amongst academics (Zack 1998a, Zack 1998b, Adenfelt & Lagerström 2006a, Adenfelt & Lagerström 2006b, Bresnen et al. 2003).

Software engineering is considered to be one of the most "knowledge-intensive" lines of work (Bjørnson & Dingsøyr 2008, Aurum et al. 2008b, Boden & Avram 2009, Desouza et al.)
2006, Dingsøyr & Røyrvik 2003, Edwards 2003), that requires “the handling of complex and context specific knowledge to be successful”, suggest Boden & Avram (2009). Hence the need for “software” knowledge management is clearly evident.

Software engineering is defined as “an engineering discipline that is concerned with all aspects of software production from the early stages of system specification through to maintaining the system after it has gone into use”(Sommerville, 2011). Software is developed through projects (Cooke-Davies & Arzymanow, 2003), henceforth software engineering is managed and governed by project management principles.

In today’s dynamic market place, many organisations implement projects in order to reach the specific goals or achieve a desired outcome. Companies employ project management practices to consistently deliver business results as they are looking for a way to stand out of the pack in today’s competitive and chaotic global economy. (PMI White Paper, 2010) “Executives discovered that adhering to project management methods and strategies reduced risks, cut costs and improved success rates—all vital to surviving the economic crisis.” (PMI White Paper, 2010)

Software engineering provides a systematic approach to cost, schedule, and dependability issues in relation to software production, and also addresses the needs of software customers and producers, highlights Sommerville (2011). The systematic approach in software engineering can also be referred to as a software process consisting of sequential activities that result in the creation and invention of software products (Sommerville 2011).

In most cases, all software processes involve four fundamental activities/phases, to include “Software Specification”, “Software Development”, “Software Validation” and “Software Evolution” (Sommerville, 2011). The specification phase involves requirements definition, user expectations and definition of system constraints. Software Development phase involves establishment of overall system architecture, programming and code writing. Software is tested and checked, to make sure that it meets customer requirements and that it is aligned with the business case, in the Software Validation phase. All the modifications, to reflect customer and market changes, are performed in the final Software Evolution phase.

Software development process, as well as software systems itself, are becoming more complex and sophisticated with the evolving technology and information age phenomenon. Hence software developers need to handle an increasing amount of software knowledge,
both explicit and tacit, in shorter time frames. “In businesses such as the software industry, which uses knowledge as a resource, activities are knowledge intensive, requiring constant adoption of new technologies and practices” (Neves, Da Silva, Salomon, Da Silva, & Sotomonte, 2013). Ward & Aurum (2004) support this reality under the postulation that software developers are under constant pressure to keep up with the evolving technology. For that reason, developers need to develop the knowledge in order to understand these emerging technologies.

Software development environment is very complex and challenging (Dingsøyr & Conradi 2002, Ward & Aurum 2004). According to Standish Group’s 2011 CHAOS Report (as cited in Anon 2012), 63% of software projects carried out between 2002-2010 were either described as complete failures or challenged. Only 37% was considered successful, as they delivered all the requested functionality, within the expected timeframe and within the planned budget.

Ward & Aurum (2004) believe, that knowledge management can be a way of providing organisations with the opportunities to appreciate these difficulties and complications, and offer solutions to the problems. “The management of knowledge and experience are key means by which systematic software development and process improvement occur” (Ward & Aurum, 2004). The software improvement would not be possible without improved management of knowledge. (Dingsøyr & Røyrvik, 2003).

2.3.1 Knowledge Management Strategy and Software Engineering

“The most important context for guiding Knowledge Management is the firm’s strategy” (Zack, 1998a). Based on a study of 25 different business organizations in consulting, healthcare and technology sector, Hansen et al. (1999) refer to two main Knowledge Management strategies, well known and widely used in the software engineering industry – Codification and Personalization (Bjørnson & Dingsøyr 2008, Dingsøyr & Røyrvik 2003).

Codification, also known as “People-to-Documents” strategy is based on extracting knowledge from the person who developed it, codified, stored, made available and reused by other members of the organisation for various purposes (Hansen et al., 1999) Personalisation, on the other hand, is based on the “Person-to-Person” principle, where instead of storing knowledge in databases and documenting it, knowledge is transferred in brainstorming sessions and one-to-one conversations (Hansen et al., 1999). According to
Edwards (2003), codification is best suited to the more technical activities within software engineering such as programming issues, method documentation and problem tracking and resolution. On the other hand, personalisation are a better option for managerial and organisational activities, argues Edwards (2003).

Knowledge Management strategy should be driven by company’s competitive strategy (Hansen et al., 1999). Before making any choice in relation to Knowledge Management strategy, executives must be able to justify why customers buy a company’s products or services rather than those of its competitors, suggests Hansen et al. (1999) Both company and its customers will suffer if executives fail to select the Knowledge Management strategy that supports a clear competitive strategy, asserts Hansen et al. (1999). Once the competitive strategy is clear, managers should explore the following questions in order to develop the most suitable Knowledge Management strategy (Hansen et al., 1999):

- Does the organisation offer standardized or customized products/services?
- Does the organisation have mature or innovative product?
- Do people in the organisation rely on explicit or tacit knowledge to solve the problems?

In their work, Hansen et al. (1999) suggest the strategy that best fits the organisational conditions as per the table below (see Figure 4 Knowledge Management Strategy Fit):

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>ANSWER</th>
<th>STRATEGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the organisation offer standardized or</td>
<td>Standardized</td>
<td>CODIFICATION</td>
</tr>
<tr>
<td>customized products/services?</td>
<td>Customised</td>
<td>PERSONALISATION</td>
</tr>
<tr>
<td>Does the organisation have mature or</td>
<td>Mature</td>
<td>CODIFICATION</td>
</tr>
<tr>
<td>innovative product?</td>
<td>Innovative</td>
<td>PERSONALISATION</td>
</tr>
<tr>
<td>Do people in the organisation rely on explicit</td>
<td>Explicit</td>
<td>CODIFICATION</td>
</tr>
<tr>
<td>or tacit knowledge to solve the problems?</td>
<td>Tacit</td>
<td>PERSONALISATION</td>
</tr>
</tbody>
</table>

**Figure 4 Knowledge Management Strategy Fit**
Source: Adapted from (Hansen et al., 1999)
**Codification Strategy** is the best fit for the organisation under the following conditions (Hansen et al., 1999):

- Product/Service that organisation offers is **STANDARDIZED**
- The Products/Services that organisation offers are **MATURE**
- People in the organisation rely on **EXPLICIT** knowledge when solving the problems

**Personalisation Strategy** is the best fit for the organisation under the following conditions (Hansen et al., 1999):

- Product/Service that organisation offers is **CUSTOMISED**
- The Products/Services that organisation offers are **INNOVATIVE**
- People in the organisation rely on **TACIT** knowledge when solving the problems

“A company's Knowledge Management strategy should reflect its competitive strategy: how it creates value for customers, how that value supports an economic model, and how the company's people deliver on the value and the economics” (Hansen et al., 1999). Failure to do so can result in poor organisational performance and financial returns.

### 2.3.2 Benefits of Knowledge Management

Knowledge is viewed by many academics as a source of sustainable competitive advantage (Nonaka 1991, Davenport & Prusak 2000, Birkinshaw 2001, Wong 2005, Wong & Aspinwall 2005, Yeh et al. 2006, Migdadi 2009). “In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. When markets shift, technologies proliferate, competitors multiply, and products become obsolete almost overnight, successful companies are those that consistently create new knowledge, disseminate it widely through the organization, and quickly embody it in new technologies and products.” (Nonaka, 1991) His view is supported by Davenport and Prusak (2000) who aptly supports this reality, highlighting that “in a global economy, knowledge may be a company’s greatest competitive advantage” and Birkinshaw (2001) who suggests that “a firm’s only enduring source of advantage is its knowledge – the knowledge of its employees’.

The benefits of implementing a Knowledge Management Systems (KMS) in an organisation today include improved workforce morale, greater corporate consistency and coherence, as well as richer organisational knowledge base (Davenport & Prusak, 2000). According to Nicholl (2012), other benefits include the avoidance of repeating the mistakes made on past
projects, utilising the maximum potential and experience of the individuals and teams within the organisation, as well as taking advantage of existing internal expertise and experience.

According to Rus & Lindvall (2002), KM can be viewed as a risk prevention and mitigation strategy, as it openly addresses risks that are often ignored by organisations. Such risks in their opinion include repetition of mistakes and need for rework as a result of people forgetting what they learned from previous projects, loss of or unavailability of individuals who own key knowledge, loss of knowledge due to attrition, as well as “lack of knowledge and an overly long time to acquire it due to steep learning curves.” (Rus & Lindvall, 2002) Their view is supported by the work of Wiewiora et al. (2009) who suggest that reinvention of ideas and systems, in addition to the repetition of errors can also be prevented by effective knowledge management.

Effective Knowledge Management can also result in significant cost savings by avoiding rework on projects, and save substantial time, as well as better decision making that in turn contributes to better performance of projects and project-based organisations. (Wiewiora et al. 2009, Rus & Lindvall 2002)

### 2.3.3 Consequences of Ineffective Knowledge Management

In the view of Polyaninova (2011), many companies document lessons learned, templates, WBS (Work Breakdown System) and other past project related documentation and aspects of past projects, however they somehow fail to record the knowledge and experiences acquired during project implementation.

Polyaninova (2011) believes that this inability to effectively manage the organisational knowledge is due to time constraints, resource deficiencies, lack of ways and methods of sharing and reusing knowledge, as well as management’s inability to understand the importance and benefits of Knowledge Management processes, such as capture and sharing. In her view, absence of Knowledge Management can result in project failures, as no records, required to support the implementation of existing and future projects, might possibly exist. Ineffective Knowledge Management can also significantly increase project risk, completion time and cost, hence negatively impact project success and completion, as well as success of the organisation as a whole (Polyaninova, 2011).
Ajmal & Koskinen (2008) aptly support this reality, highlighting that a failure to exercise effective Knowledge Management practices in project-based organisations can result in inability to appraise and learn from past projects, hence the chances of past errors repetition in future work and projects are very high.
CHAPTER 3: RESEARCH METHODOLOGY

“Organisational research has a primary goal in the explanation, prediction and gaining of a greater understanding of situations, events and phenomena in the workplace” (Cronin, 2002)

The research intention of the author is to obtain a deeper understanding of the Knowledge Management practices utilised by small project-based Irish software development organisation Enverian. This will allow the author to devise a set of recommendations to enhance and improve the management of knowledge within Enverian.

With this in mind, and to better understand Enverian’s current Knowledge Management strategy, following are the research questions that will guide the author throughout the data collection process:

- Is Knowledge Management central to Enverian’s strategy?

- Have Enverian established Knowledge Management structures that enable people to make their knowledge productive and encourage creation, acquisition and sharing of their knowledge?

- Does organisational culture supports the Knowledge Management processes within Enverian?

- What Knowledge Management Systems Enverian implement to evaluate knowledge, to determine the knowledge gap, and to acquire, develop and share knowledge?
Before choosing the appropriate methodology, numerous factors had to be considered:

- The research questions researcher intends to answer
- The population on which the research was to be conducted – profile of the participants on which the research was to be carried out (CEOs, software developers, business analysts etc.)
- The researcher’s own profile and a possibility of an “insider bias” as a result of the researcher’s experience and knowledge of the workers, and the role the researcher holds in the company

A good research is considered to be the one where the research data are related back to the theory. By collecting and analysing the data, it can be determined whether the theory is valid or not. The method researcher decides to proceed with in the research will highly impact the results and the conclusion of the findings. For that reason, it is very important to decide on the most suitable and the most appropriate method for the research before conducting it.
3.1 Research Philosophies and Approaches

For the purpose of this research and to underpin the research strategy, interpretivism paradigm was decided on by the author to better understand the culture of the company, current practices and attitudes towards knowledge management within Enverian.

3.1.1 Research Philosophies

**Interpretivism**

Interpretive research is concerned with “understanding people” (Patel, Patel, Tang, & Elliot, n.d.). Central to this approach is the idea that only observed phenomena, situations and events lead to the creation of credible data, therefore rejecting the positivist belief of the existence of social reality independent of the researcher who examines it.

In the view of interpretivists, the reality is meaningful and socially constructed by the individuals who play a part in it, knowledge is subjective, dependent on human minds and related to a specific context.

Saunders et al. (2009) emphasise that, in interpretivism, it is necessary for the researcher to “understand the differences between humans in our role as social actors” (Saunders et al., 2009). It is crucial for the researcher to understand the world of research subjects from their perspective and point of view (Saunders et al., 2009), hence the researcher needs to adopt “an emphatic stance” (Saunders et al., 2009).

The purpose of the research, from interpretivists's point of view, is to understand and explore the reality people experience, rather than the discovery of universal laws. Interpretivist research procedures mainly include qualitative methods (Saunders et al., 2009).
3.1.2 Research Approach

Research Approach chosen for the purpose of this research is primarily Deductive, but elements of Inductive approach will be applied if necessary.

3.2 Research Strategy

There is a need for clear research strategy, suggest Saunders et al. (2009). The choice of strategy is highly dependent on the research question, the researcher's existing knowledge and experience, as well as timeframe for the completion of the research (Saunders et al., 2009). Survey Research Strategy is believed to the most suitable and appropriate for the purpose of this research.

Survey Research Strategy

According to Saunders et al. (2009), survey research strategy is “a popular and common strategy in business and management research and is most frequently used to answer who, what, where, how much and how many questions.” Survey is usually linked with deductive approach and allows the researcher to collect a large amount of data in a very economical way (Saunders et al. (2009).

Using a survey research gives author more control over the research process, suggest Saunders et al. (2009). Data are often obtained by using a questionnaire administered to a sample, and can be characterised as standardise, allowing easy comparison (Saunders et al. 2009).
The most common data collection techniques in survey research strategy include structured interviews with standardised questions that are asked to all interviewees, questionnaire, and structured observation (Saunders et al. 2009).

3.3 Research Design Overview and Data Collection

Data Collection
Data for this research were collected by means of structured interviews with key investigation players, and 2001 version of Knowledge Management Assessment Tool (KMAT).

Knowledge Management Assessment Tool (KMAT)
Knowledge Management Assessment Tool (Andersen, 2001) is a “survey questionnaire designed to help organisations conduct an initial and rapid assessment of its readiness for Knowledge Management” (Young, 2010). This tool, developed by the American Productivity & Quality Center and Arthur Andersen (Andersen, 2001), has been created to help organizations self-assess where their strengths and opportunities lie in managing knowledge. As a result, organisation can then design its KM programs to address the gaps uncovered through this knowledge assessment process.

For the purpose of this project, the KMAT tool was used to:

- determine to what degree is Knowledge Management being practised and applied in Enverian
- assess Enverian’s strengths, weaknesses and opportunities for improvement in managing knowledge in their knowledge management process
- gain the insight into company’s attitude towards management of knowledge

The 2001 version of the tool is divided into five sections (Young, 2010):

- **Knowledge Management Process**
  - This category evaluates “how knowledge is used in managing, implementing, and improving the organization’s key work processes, and the extent to which the organization continually evaluates and improves its work processes to achieve better performance” (Young, 2010)

- **Leadership in Knowledge Management**
This category assesses organisational leadership capabilities, and leadership in terms of “efforts to initiate, guide, and sustain KM practices in the organization” (Young, 2010)

- **Knowledge Management Culture**
  - This category evaluates organisational culture in terms of efforts to encourage and facilitate knowledge sharing, innovation and learning process within organisation

- **Knowledge Management Technology**
  - The category assesses technological capabilities of the organisation with regard to development and delivery of collaborative tools and content management systems, as well as accessibility and reliability of these tools within the organisation

- **Knowledge Management Measurement**
  - Measures and ways to link knowledge to financial results are assessed in this category

There are total of 24 questions covering the five assessment categories with a maximum score of 120 points. Each of the questions can be rated on a scale from 1 (doing poorly) to 5 (doing very well). Based on the points acquired, the total score of the assessment is then compared against KM Maturity Levels (Young, 2010):

<table>
<thead>
<tr>
<th>Knowledge Management Maturity Level</th>
<th>Points Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Reaction Level</td>
<td>24 – 47</td>
<td>• Not aware of what KM is and its importance in enhancing productivity and competitiveness</td>
</tr>
<tr>
<td>Level 2: Initiation Level</td>
<td>48 – 71</td>
<td>• Beginning to recognize the need to manage knowledge</td>
</tr>
<tr>
<td>Level 3: Expansion Level</td>
<td>72 – 95</td>
<td>• Institution-wide KM implementation</td>
</tr>
<tr>
<td>Level 4: Refinement Level</td>
<td>96 – 107</td>
<td>• KM implementation is continuously evaluated and improved</td>
</tr>
<tr>
<td>Level 5: Maturity Level</td>
<td>108 – 120</td>
<td>• KM is mainstreamed in the institution</td>
</tr>
</tbody>
</table>

*Figure 7 Knowledge Management Maturity Levels*

Source: Young, R (2010), Knowledge Management Tools and Techniques Manual, Asian Productivity Organisation

For the KMAT template, please refer to Appendix B.
**Structured Interview**

After analysing the findings from Knowledge Management Assessment Tool (KMAT), the author developed a better understanding of company’s knowledge management practices and organisational knowledge management maturity. The structured interviews with open-ended questions were conducted in order to get a better understanding of the company’s culture, practices and attitudes towards knowledge management.

Structured Interview was conducted with key investigation players – Company Director/Director of Strategy, and Chief Technology Officer/Lead PM. The reason for selecting the above mentioned participants were:

- The research subjects are the founders of the company
- The research subjects recognised and acknowledged the need for an improved Knowledge Management practices within the company

Hence, the author believes that the answers provided by the above mentioned participants would be accurate and honest, so that a set of recommendations can be based on the answers provided and targeted at the improvement of the company’s knowledge management practices. False statements provided by interview participants would jeopardised the end results and had no direct benefit to the company.

The main themes of the interview were “the four crucial means with which one can organise knowledge” proposed by Beijerse (2000):

- Strategy
- Structure
- Culture
- Systems

The standardised questions of the structured interview helped the author to seek and provide the answers to the questions formulated for the purpose of this project. The interview questions that served as a guide for the researcher are enclosed in the Appendix A – Structured Interview Questions.
3.4 Ethical Issues and Considerations

Saunders et al. (2009) define ethics as “the appropriateness of researcher’s behaviour in relation to the rights of those who become the subject of the research, or are affected by it”. Hence ethics is an imperative part of the research process and cannot be overlooked.

To avoid any violations of the University’s Code of Ethics, a research proposal was submitted to a research ethics committee for an approval. Detailed proposal details and reasoning on how to deal with any ethical issues, may they arise during the course of the research, were inputted into the Ethics form and sent for approval before Kemmy Business School Committee.

The purpose of this research was clearly communicated to every potential informant on an information sheet in advance of their participation. Prior to data collection, it was clearly communicated to the participants that they have the right to refuse to participate or withdraw at any time. This message was also clearly communicated in the questionnaire. Any data and information collected were stored on the private pc. Any hard copy information which was collected was securely stored in author’s locker which was securely locked.
CHAPTER 4: RESEARCH FINDINGS

4.1 Knowledge Management Assessment Tool (KMAT) Findings and Data Analysis

The data collected by the KMAT are analysed and presented in this section.

4.1.1 Company KM Score

The tool was handed out to 7 Enverian employees in total. The table below presents the total score given by each of the research participants, as well as the overall company knowledge management score.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Points Scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td>49</td>
</tr>
<tr>
<td>Participant 2</td>
<td>65</td>
</tr>
<tr>
<td>Participant 3</td>
<td>56</td>
</tr>
<tr>
<td>Participant 4</td>
<td>63</td>
</tr>
<tr>
<td>Participant 5</td>
<td>61</td>
</tr>
<tr>
<td>Participant 6</td>
<td>57</td>
</tr>
<tr>
<td>Participant 7</td>
<td>76</td>
</tr>
</tbody>
</table>

COMPANY KM SCORE 61

Enverian’s total company KM score was 61. Based on the Knowledge Management Maturity Levels suggested by Young (2010), Enverian occupies Level 2: Initiation Level position in the table. According to Young (2010), company with a Level 2: Initiation Level maturity of knowledge management “is beginning to recognize the need to manage knowledge or may already be initiating a pilot KM project” (Young 2010). The level of Knowledge Management maturity is very understandable, as Enverian was established in 2011 and has only been in operation for 2 years.

The KMAT assessment also revealed Enverian’s strongest and weakest Knowledge Management category. According to KMAT results, Knowledge Management Measurement,
as well as Leadership proved to be the weakest sides of Enverian’s management of knowledge. Score analysis of the individual knowledge management sections is provided in the table below.

<table>
<thead>
<tr>
<th>Knowledge Management Section Analysis</th>
<th>Max Category Score (Points)*</th>
<th>Score Achieved (Points)**</th>
<th>%***</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Knowledge Management Process</td>
<td>175</td>
<td>77</td>
<td>44%</td>
</tr>
<tr>
<td>II. Leadership in Knowledge Management</td>
<td>140</td>
<td>58</td>
<td>41%</td>
</tr>
<tr>
<td>III. Knowledge Management Culture</td>
<td>175</td>
<td>125</td>
<td>71%</td>
</tr>
<tr>
<td>IV. Knowledge Management Technology</td>
<td>210</td>
<td>126</td>
<td>60%</td>
</tr>
<tr>
<td>V. Knowledge Management Measurement</td>
<td>140</td>
<td>40</td>
<td>29%</td>
</tr>
</tbody>
</table>

*Max Category Score = Category Score * Number of Participants (7)  
**Score Achieved = Achieved Category Score * Number of Participants (7)  
***% = (Score Achieved/Max Category Score)*100

The strongest knowledge management category of Enverian, based on the results, is Knowledge Management Culture, followed by the Knowledge Management Technology. The visual representation of the Maximum vs. Category Score Achieved is presented in Figure 7.

Figure 8 Knowledge Management Categories Score Analysis
Maximum vs. actual Category score diagram (Figure 8) also graphically represents the KMAT findings. The orange lines represent the maximum possible category score. The blue lines represent the actual category score for Enverian. From the diagram, we can clearly see the Enverian’s knowledge management immaturity and areas where improvement is needed the most – KM Measurement and Leadership.

Figure 9 Maximum vs. Actual Category Score Diagram

Detailed analysis of the individual KMAT categories is presented in Appendix B.
4.1.2 Summary of KMAT Findings

The Knowledge Management Assessment Tool analysis of Enverian’s current knowledge management practices revealed that the organisation is starting to recognise the need for the effective Knowledge Management, however the current practices are very immature and require further improvement.

Enverian scored very high in Knowledge Management Technology and Knowledge Management Culture category. The areas of the highest improvement needed are the Knowledge Management Leadership and Knowledge Management Measurement.

The following table highlights the areas, with significantly lower score than the rest of the KM areas, where the improvement would be required:

<p>| KNOWLEDGE MANAGEMENT AREAS THAT REQUIRE IMPROVEMENT |
|------------------------------------------|---------------------------------|</p>
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>AREA OF IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. KM Process</td>
<td>P1. Knowledge Gaps are systematically identified and well-defined processes are used to close them.</td>
</tr>
<tr>
<td></td>
<td>P4. The association has formalized the process of transferring best practices, including documentation and lessons learned.</td>
</tr>
<tr>
<td></td>
<td>P5. “Tacit” knowledge (what staff and volunteers know how to do, but cannot express) is valued and transferred across the association.</td>
</tr>
<tr>
<td>II. KM Leadership</td>
<td>L1. Managing organizational knowledge is central to the association’s strategy.</td>
</tr>
<tr>
<td></td>
<td>L2. The association understands the revenue-generating potential of its knowledge assets and develops strategies for marketing and selling them.</td>
</tr>
<tr>
<td></td>
<td>L3. The association uses learning to support existing core competencies and create new ones.</td>
</tr>
<tr>
<td>III. KM Technology</td>
<td>T4. The association fosters development of “human-centered” information technology.</td>
</tr>
<tr>
<td>IV. KM Measurement</td>
<td>M1. The association has invented ways to link knowledge to financial results.</td>
</tr>
<tr>
<td></td>
<td>M2. The association has developed a specific set of indicators to manage knowledge.</td>
</tr>
<tr>
<td></td>
<td>M3. The association’s set of measures balances hard and soft as well as financial and non-financial indicators.</td>
</tr>
<tr>
<td></td>
<td>M4. The association allocates resources toward efforts that measurably increase its knowledge base.</td>
</tr>
</tbody>
</table>
4.2 Structured Interview Findings and Data Analysis

For the anonymity purposes, interview participants will be referred to as Participant A (PA) and Participant B (PB). The interview findings are analysed in accordance with "the four crucial means with which one can organise knowledge" proposed by Beijerse (2000): Strategy, Structure, Culture and Systems.

**STRATEGY**

When assessing the Knowledge Management strategy of Enverian, the emphasis was on finding out whether managing organisational knowledge is central to Enverian's organisational strategy, and why customers buy Enverian's products and services rather than those of its competitors. The author also attempted to find out whether the company is aware of its competitive strategy by asking the following strategy related questions suggested by Hansen et al. (1999):

- Do you offer standardised or customised products?
- Do you have a mature or innovative product?
- Do your people rely on explicit or tacit knowledge to solve problems?

The executives of Enverian are clearly aware of their competitive strategy. Their innovative Renewable Portfolio Manager (RPM) software provides functions and solutions to the problem like no other products on the market as of yet. The product is standardised, however customisation to the needs of the client organisations is offered as an additional service. The solution was built on the knowledge and experience of the industry experts. When resolving the software related issues, the employees within Enverian mostly rely on the explicit knowledge, such as software code, issue logs, bugs etc., as well as experience and expert knowledge of their team.

“It was designed based on our personal experience and knowledge we had from working with energy companies in the past. Our solution is unique in the way that it offers and combines all the features that assist energy companies to manage a portfolio of development opportunities into one cloud-based software solution, whereas none of our competitors were able to do it as of yet. We had the experience and knowledge to do it.” (PA)

The management of Enverian supports the idea of knowledge management, however it is not officially embedded in the company's short nor medium organisational strategy as of yet. Knowledge management is practiced in a very informal and unstructured manner, the
knowledge gaps are not identified systematically, and there aren’t any formal processes to close these gaps in place.

“The management is committed, and I agree that these practices are good, and that managing organisational knowledge should be central to the organisational strategy, but do we actually do it? No. We do not identify our knowledge gaps systematically, neither have we the well-defined processes to close these gaps.” (PA)

“I strongly believe that a knowledge management strategy is important in managing organisational knowledge and should be central to organisation’s strategy, however in Enverian, we have never assigned a time to properly sit down and come up with one.” (PB)

When asked what is the reason for not having a formal knowledge management strategy in Enverian, two things were highlighted by the interviewees – it requires time and it is often perceived as an overhead.

“One could blame it on being a start-up company, however in my 20 years of project management experience, I was in non-start-ups and this stuff wasn’t done very well. I believe that primary reason for not doing it right in the case of Enverian is that it requires and takes time to formulate and integrate knowledge management strategy into organisational strategy. (PA)

“Knowledge Management is often perceived as an overhead. We were too busy trying to get our software developed, setting up demos with potential clients and marketing the solution, that knowledge management got simply neglected.” (PB)

**STRUCTURE**

When assessing the structure, the emphasis was on finding out whether the structure within Enverian facilitates people to make their knowledge productive. The things that were looked at included the organisational structure and communication channels between management and employees.

The company structure can be characterised as flat with very informal and open communication channels between the employees, as well as between the management and employees.
“Our organisational structure could be characterised as flat, every person employed by Enverian has a dedicated section to look after and role assigned, however there is no departmentalisation within the company. There is a clear communication between team members within Enverian. We are coordinating and involving our employees in day-to-day company and management activities through consultation and open communication channels.” (PA)

“Our organisational structure is very flexible, we are aware of each other’s responsibilities and we actually give people responsibility, but at the same time make sure that they are able to handle it. As a small company, we have a benefit of organising informal meetings whenever required. We try and keep our communication channels very informal and value opinions and ideas of our employees.” (PB)

CULTURE
When assessing the culture in Enverian, the author focused on the issues in relation to cultural formality, openness and learning, and building trust.

“Enverian is an innovative company with a clear core business. We put emphasis on learning and personal development. Our staff is very committed, capable and takes responsibility for their own learning. We enjoy working in a very open and friendly environment.” (PA)

“We always try to keep our door open. Enverian is a flat organisation with hierarchy levels kept at minimum. We believe in learning, however we do not always learn and collect experiences of past projects ourselves. We are innovation driven, our product is customisable, and we rely on our people to solve the problems.” (PB)

From the interview, it appeared that building trust in a small company is much easier than it would be in the large companies, with a large number of employees, departments and projects. Enverian builds its trust through an informal meetings, held every morning called “team huddles”.

“We have our own way of building trust - we are holding an informal team huddle and building a trust this way – and this is the benefit of being a small company. It is a huddle, so we limit the stress and build the trust. We do not do it only when there is a problem, we do it every day, so people are confident, comfortable and this way we
eliminate problems and build the trust. It is the consistency that builds the trust and consequently makes people to share openly. This meetings can never be used for pulling anybody up. I do not like socialising personally, and most people do not like it either. The best way for me is to keep your work and social life separate.” (PA)

Dealing with tacit knowledge has always been a problem, particularly in small companies that are hugely dependent on their key people. This is one of the oldest problems in the books— “the key person dependency” (KPD).

“In a small company like us, there is going to be a number of key people, in fact we are all key people in what we are doing. The way we manage around that is that we have a release process, whereby we chunk what we deliver into manageable bite-size chunks, so that we never radically change the tool. That way we reduce the risk. The other thing is that the technology that we use is well understood, so we don’t do anything radical. So in practice it is basically management of risk that comes with knowledge management – small chunks, do not do anything radical. Technology is standard, well understood in the industry, so that if we need to get someone to come in then all they have to learn is our stuff, they do not have to learn all the technology. This is the benefit of Microsoft.”(PA)

SYSTEMS
When assessing the systems in Enverian, the author focused on the Knowledge Management Systems that Enverian have in place, what they are used for, as well as the use and importance of lessons learned and project post-mortems in capturing and transferring knowledge in software development.

Following are the systems used in current knowledge management process within Enverian:

**SharePoint**
SharePoint is used as a storage space for documents, templates, presentations, and any internal documentation. The social side of SharePoint is not used by Enverian yet.

**Skype**
Usage of Skype seems to be very limited, as it is only used for instant messaging.

**FogBugz**
FogBugz is used for trouble ticketing, and capturing issues such as bugs, product features and dealing with customer enquiries.
**Email**
Enverian uses organisational email for communicating internally with their employees, as well as externally for communicating with their customers and third party organisations.

**Google Chat**
Google Chat is used for internal instant messaging purposes only.

**Lessons Learned and Project Post-Mortems**
According to the results from the interview, the company recognised a couple of problems with project post-mortems and lessons learned:

- Usually when a project is finished, people do not want to go back over the rake of the coals, to talk about unpleasant things from the past
- They want to move on to the new thing or the next thing straightaway
- People do not want the mistakes to get revealed

“From my own experience, sometimes people are afraid that if we do actually do lessons learned, that it would show up where we failed. It will bring the stakeholders focused in on “did they get the value of what was delivered?” and very often we are afraid that they won’t get the value and that is tied back to the business case not being done properly. We are a small company and we know what we have spent, how much time it took us to develop the project and we know whether we have reached our sales objectives. We do know it all, but we just do not have it formally documented. Also it is our first project and we didn’t feel the need for it. I am sure that going forward and with the increased workload we would need a Lessons Learned system and documentation in place.” (PA)

“Very often I see that a business case, that in my opinion should be done by project stakeholders, isn’t done properly and that is why nobody is willing to go back and evaluate what has been done.” (PB)
CHAPTER 5: DISCUSSION OF FINDINGS

From the research it is evident, that Knowledge Management plays a very important role in small-scaled software development companies. The research correlated with Bjørnson & Dingsøyr (2008), Aurum et al. (2008b), Boden & Avram (2009), Desouza et al. (2006), Dingsøyr & Røyrvik (2003) and Edwards (2003) in that software engineering is considered to be one of the most “knowledge-intensive” lines of work.

In highlighting the main conclusions from this research, the author draws on Beijerse (2000) definition of knowledge management: “management of knowledge (information, the capacities and the attitude within an organisation) by steering the strategy, structure, culture and systems and the capabilities and attitudes of people with regard to their knowledge.”

Knowledge Management appears in Enverian to get its form especially at an operational and tactical levels, however lacks formal structure and management leadership on a strategic level.

Strategy
The research correlates with the findings of Beijerse (2000) and Durst & Edvardson (2012) in that most SMEs have hardly any explicit and systematic policy on strategic level of Knowledge Management. For the Knowledge Management to work, organisations need in place Knowledge Management strategy that will help them to define the medium and short term goals in relation to knowledge (Beijerse 2000). The research showed that there is no systematic Knowledge Management policy on a strategic level within Enverian. The Knowledge Management idea in Enverian is supported by the executives, however Knowledge Management was not central to the organisation’s strategy from the start, and therefore was not included into company’s short nor medium term strategy. The knowledge gaps aren’t systematically identified, and there are no formal or well-defined processes in place to close these gaps. The process of transferring best practices, including documentation and lessons learned, has not been formalised and Knowledge Management is perceived as an overhead, and requires time and resources, that are both quite limited in Enverian.

The research also correlates with the findings of Nonaka (1991), Davenport & Prusak (2000), Birkinshaw (2001), Wong (2005), Wong & Aspinwall (2005), Yeh et al. (2006), Migdadi (2009), in that knowledge is now considered one of the critical driving forces for
gaining competitive advantage and business success. Enverian achieved their competitive advantage with extra expert knowledge and experience (tacit knowledge) than competitors. This allowed Enverian to create a cloud-based software that provides functions and solutions to the problem like no other products on the market as of yet.

Codification of software design is used as a standard for the same process in the company, which reduces the time by not having to reinvent the wheel, it reduces the design cycle, lead time and costs associated with rework. The findings correlate with the work of Wiewiora et al. (2009) and Rus & Lindvall (2002), in that the effective Knowledge Management can result in significant cost savings by avoiding re-work on projects, and save substantial time for the organisation.

The research findings also correlate with the findings of Rus & Lindvall (2002) in that Knowledge Management processes are used in Enverian as a way of risk mitigation strategy for risks associated with key person dependency.

Findings correlate with the research of Hansen et al. (1999) in that the two prevailing Knowledge Management strategies within Enverian are Codification, in the form of documents, presentations, issue logs, and software code, as well as Personalisation in the form of “Team Huddles”. However, the strategies lack formal structures and are not central to the Enverian’s organisational strategy.

**Structure and Culture**

The research does not correlate with the findings of Beijerse (2000) who suggested that SMEs have hardly any explicit and systematic policy on tactical (Structure and Culture) level of Knowledge Management. The company structure of Enverian allows and assists people to make their knowledge useful, productive and creative, suggests. The company structure of Enverian is flat and flexible with very informal and open communication channels between the employees, as well as between the management and employees. This goes in line with the suggestion of Durst & Edvardson (2012) who suggest that SMEs have a flat structure, organic free-floating management style with owners taking on central position. Enverian’s organisational culture positively impacts motivation of people to make their knowledge productive. There is an effective communication channel between all the employees in Enverian. Emphasis is on trust. Enverian builds its trust through an informal meetings, held every morning called “team huddles. The option of having this informal meeting every morning is considered by the executives one of the biggest advantage small companies
have over large ones. Most of Enverian’s internal knowledge is created, shared and transferred at the team huddles, however it is not properly documented.

Management within Enverian are very open and supportive of sharing of knowledge, opinions and thoughts with their employees, however Knowledge Management is not on their top priority list. The reason for it is that Enverian has not invented the ways to link its knowledge to financial results yet, and therefore the revenue-generating potential of its knowledge assets isn’t measurable. Consequently, formal Knowledge Management practices lack executive drive and full management support.

**Systems**

The research findings correlates with the findings of Beijerse (2000) in that Enverian has systems and instruments that support Knowledge Management in place, however the use of these instruments is very limited and often not seen as an instrument for management of knowledge within the company.

The knowledge in Enverian is managed through internal email, Skype, SharePoint, FogBugz, Google Chat and informal team huddles. However, Enverian does not explore or utilise the functionality offered by these instruments to their full potential. The author believes, that the current choice of KMS within organisation is satisfactory, however the organisation should explore the Knowledge Management, as well as social functions that the solutions offer.
CHAPTER 6: RECOMMENDATIONS AND CONCLUSIONS

6.1 Recommendations

In reviewing the research findings above, following is a summary of recommendations for improved Knowledge Management within Enverian:

- In Enverian, there is a need to develop a formal Knowledge Management strategy that will help the company to maximise the value of Knowledge Management and improve current practices. Based on the study of Hansen et al., (1999), Enverian would benefit from both, Codification and Personalisation. Codification should drive the management of software and technical knowledge (software code, bugs, customer issues, lessons learned). Personalisation should dominate the management of tacit knowledge of the employees within Enverian (knowledge created and shared in team huddles, knowledge created and shared in product customisation workshops with clients, creative innovations and new ideas).

- Senior executives must drive the strategy formulation, as they have the ultimate control over the company culture, structure and technology that is used within Enverian. Enverian must develop their own ways of linking their organisational knowledge to financial results.

- Enverian should consider nominating, from their current employee base, or hiring, if possible, a “knowledge manager” that would be responsible for the Knowledge Management activities within the organisation. The person would assist in formalising the Knowledge Management practices and help with maximising the value of Knowledge Management within Enverian.

- Enverian should also explore the functionality of their current Knowledge Management systems, in particular the “social business” features of SharePoint. Instead of using tools like Skype and Google Chat, Enverian should consider using SharePoint, which would ensure that all the content generated by the employees would be stored in the same platform. Enverian would be able to provide/restrict access to this information as necessary. It would help the company to create, capture and share tacit knowledge of their employees faster, safer and more effectively.
• Enverian should consider recording the “Team Huddles” meetings. This will help in documenting the tacit knowledge of their employees very efficiently and at no cost. It will also serve as a great update material for those who were not able to attend the meeting.

• Lessons Learned need to be created after every project completion. It will accelerate learning, uncover areas of improvement, and save time and rework on future projects.
6.2 Conclusions

Benefits of Knowledge Management has been widely accepted in Knowledge Management literature and amongst academics. Knowledge Management is viewed as a source of competitive advantage (Nonaka 1991, Davenport & Prusak 2000, Birkinshaw 2001, Wong 2005, Wong & Aspinwall 2005, Yeh et al. 2006, Migdadi 2009). It can serve as a risk prevention and mitigation strategy for risks that are often ignored by organisations, to include key person dependency, loss of knowledge due to attrition and people forgetting their knowledge (Rus & Lindvall, 2002). Knowledge Management can also result in significant cost and time savings, and eliminate the need for rework (Wiewiora et al. 2009, Rus & Lindvall 2002).

Based on the findings from both KMAT and structured interview, it can be concluded that Knowledge management in Enverian operates at a very informal level. The company culture and structure are very supportive of Knowledge Management. However, the company lacks a formal and strategic approach to Knowledge Management. Enverian has no systematic Knowledge Management policy on the strategic level and Knowledge Management lacks management drive and leadership. As a result, Knowledge Management isn’t central to the Enverian’s organisational strategy. The organisation does not realise the revenue-generating potential of its knowledge and Knowledge Management systems are not used to their full potential.

In order to maximise the value of Knowledge Management in Enverian, the company is in need to develop a formal Knowledge Management strategy, that will set out the goals towards and formalise the process of organisational Knowledge Management. Strategy steers the company towards becoming knowledge based, as well as provides a rationale for pursuing Knowledge Management (Wong 2005). Formulation of Knowledge Management strategy must be driven by senior executives, as they have a direct influence on the organisational culture, structure and systems within Enverian. The company would also benefit from having a knowledge manager on board, who would assist in formalising the Knowledge Management practices and help to maximise the value of Knowledge Management within Enverian. Social sides of current Knowledge Management systems should be also explored and considered, as it can significantly improve management of organisational tacit knowledge. The author believes that this work will inform and help company to realise the value Knowledge Management can bring to an organisation like Enverian, and enhance current organisational practices in relation to Knowledge Management.
6.3 Limitations

Although this research has reached its aims, there were some unavoidable limitations that the author is aware of. First of all, sample size was very small as the company only employed seven people at the time of the research. Secondly, longitudinal effects can also be considered a limitation, as the time available to investigate the research problem was constrained by the due date of the thesis. Lastly, since the research was carried out by the author only, it is unavoidable that a certain degree of subjectivity can be found in this research.

6.4 Directions for Further Research

The author believes that a significant contribution to the existent body of knowledge on this subject could be achieved if a qualitative survey informed by the content and findings of this research was carried out for Knowledge Management practices in a number of small-scaled software engineering companies in Ireland. Larger sample size is required to ensure a representative distribution of the population.
REFERENCES


APPENDICES
Appendix A  Structured Interview Questions

1. **Strategy**
   - Is managing organisational knowledge central to the Enverian’s organisational strategy?
   - Do you offer standardised or customised products?
   - Do you have a mature or innovative product?
   - Do your people rely on explicit or tacit knowledge to solve problems?

2. **Structure**
   - Are there established structures that enable people to make their knowledge productive and encourage creation, acquisition and sharing of their knowledge within Enverian?
   - Are roles, tasks and responsibilities clearly outlined and clarified?
   - Is formal training provided to the employees in order to sustain and enhance software development knowledge?

3. **Culture**
   - Is there a clear communication between team members and management team?
   - Is management committed to sharing of knowledge and knowledge transfer activities?
   - Does Enverian exploit existing organizational knowledge to the maximum?
   - Do you always learn from past project failures and past experience?

4. **Systems**
   - What KMS does Enverian have in place?
   - What are they used for?
Appendix B    Knowledge Management Assessment Tool (KMAT)

The tool is divided into five sections: the KM process; leadership; culture; technology; and measurement. The following is a subset of the items and information in the KMAT, with a simplified scoring system.

Directions: Read the statements below and evaluate your association’s performance. The scale is as follows:
1 = no, 2 = poor, 3 = fair, 4 = good, and 5 = excellent

I. The Knowledge Management Process
P1. Knowledge Gaps are systematically identified and well-defined processes are used to close them.
_1_  _2_  _3_  _4_  _5_

P2. A sophisticated and ethical intelligence gathering mechanism has been developed.
_1_  _2_  _3_  _4_  _5_

P3. All staff and volunteers of the association are involved in looking for ideas in traditional and non-traditional places.
_1_  _2_  _3_  _4_  _5_

P4. The association has formalized the process of transferring best practices, including documentation and lessons learned.
_1_  _2_  _3_  _4_  _5_

P5. “Tacit” knowledge (what staff and volunteers know how to do, but cannot express) is valued and transferred across the association.
_1_  _2_  _3_  _4_  _5_

Total of items P1 through P5. _______

II. Leadership in Knowledge Management
L1. Managing organizational knowledge is central to the association’s strategy.
_1_  _2_  _3_  _4_  _5_

L2. The association understands the revenue-generating potential of its knowledge assets and develops strategies for marketing and selling them.
_1_  _2_  _3_  _4_  _5_

L3. The association uses learning to support existing core competencies and create new ones.
_1_  _2_  _3_  _4_  _5_

L4. Individuals are hired, evaluated and compensated for their contributions to the development of organizational knowledge.
_1_  _2_  _3_  _4_  _5_

Total of items L1 through L4. _______
III. Knowledge Management Culture
C1. The association encourages and facilitates knowledge sharing.
1 2 3 4 5

C2. A climate of openness and trust permeates the association.
1 2 3 4 5

C3. Customer value creation is acknowledged as a major objective of knowledge management.
1 2 3 4 5

C4. Flexibility and a desire to innovate drive the learning process.
1 2 3 4 5

C5. Staff takes responsibility for their own learning.
1 2 3 4 5

Total of items C1 through C5. __________

IV. Knowledge Management Technology
T1. Technology links all members of the association to one another and to all relevant external publics.
1 2 3 4 5

T2. Technology creates an institutional memory that is accessible to the entire enterprise.
1 2 3 4 5

T3. Technology brings the association closer to its members.
1 2 3 4 5

T4. The association fosters development of “human-centered” information technology.
1 2 3 4 5

T5. Technology that supports collaboration is rapidly placed in the hands of staff.
1 2 3 4 5

T6. Information systems are real-time, integrated, and “smart.”
1 2 3 4 5

Total of items T1 through T6. __________

V. Knowledge Management Measurement
M1. The association has invented ways to link knowledge to financial results.
1 2 3 4 5

M2. The association has developed a specific set of indicators to manage knowledge.
1 2 3 4 5
M3. The association’s set of measures balances hard and soft as well as financial and non-financial indicators.

__ 1 __ 2 __ 3 __ 4 __ 5

M4. The association allocates resources toward efforts that measurably increase its knowledge base.

__ 1 __ 2 __ 3 __ 4 __ 5

Total of items M1 through M4. __________

Total Score __________ out of a possible ___120_________

Rating =

Comments for Future Action

This tool has been adapted from the Knowledge Management Assessment Tool (KMAT) developed by the American Productivity & Quality Center and Arthur Andersen to help organizations self-assess where their strengths and opportunities lie in managing knowledge.
Appendix C  Knowledge Management Individual Category Analysis

<table>
<thead>
<tr>
<th>KM Category</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>P7</th>
<th>Actual Score</th>
<th>Max Score</th>
<th>%</th>
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<tbody>
<tr>
<td><strong>I. Knowledge Management Process</strong></td>
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<tr>
<td>P1. Knowledge Gaps are systematically identified and well-defined processes are used to close them.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>14</td>
<td>35</td>
<td>40%</td>
</tr>
<tr>
<td>P2. A sophisticated and ethical intelligence gathering mechanism has been developed.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>17</td>
<td>35</td>
<td>49%</td>
</tr>
<tr>
<td>P3. All staff and volunteers of the association are involved in looking for ideas in traditional and non-traditional places</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>22</td>
<td>35</td>
<td>63%</td>
</tr>
<tr>
<td>P4. The association has formalized the process of transferring best practices, including documentation and lessons learned.</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>11</td>
<td>35</td>
<td>31%</td>
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<tr>
<td>P5. “Tacit” knowledge (what staff and volunteers know how to do, but cannot express) is valued and transferred across the association.</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<td>3</td>
<td>13</td>
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<td><strong>II. Leadership in Knowledge Management</strong></td>
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<tr>
<td>L1. Managing organizational knowledge is central to the association’s strategy.</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>11</td>
<td>35</td>
<td>31%</td>
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<tr>
<td>L2. The association understands the revenue-generating potential of its knowledge assets and develops strategies for marketing and selling them.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>14</td>
<td>35</td>
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<tr>
<td>L3. The association uses learning to support existing core competencies and create new ones.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>14</td>
<td>35</td>
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<tr>
<td>L4. Individuals are hired, evaluated and compensated for their contributions to the development of organizational knowledge.</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>19</td>
<td>35</td>
<td>54%</td>
</tr>
<tr>
<td><strong>III. Knowledge Management Culture</strong></td>
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<tr>
<td>C1. The association encourages and facilitates knowledge sharing.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>71%</td>
</tr>
<tr>
<td>C2. A climate of openness and trust permeates the association.</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>35</td>
<td>71%</td>
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<tr>
<td>C3. Customer value creation is acknowledged as a major objective of knowledge management.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>71%</td>
</tr>
</tbody>
</table>
C4. Flexibility and a desire to innovate drive the learning process. | 3 | 3 | 4 | 3 | 3 | 4 | 3 | 23 | 35 | 66%
C5. Staff takes responsibility for their own learning. | 4 | 4 | 5 | 4 | 3 | 3 | 4 | 27 | 35 | 77%

**IV. Knowledge Management Technology**

| T1. Technology links all members of the association to one another and to all relevant external publics. | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 22 | 35 | 63%
| T2. Technology creates an institutional memory that is accessible to the entire enterprise. | 3 | 2 | 3 | 4 | 3 | 4 | 3 | 22 | 35 | 63%
| T3. Technology brings the association closer to its members. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 21 | 35 | 60%
| T4. The association fosters development of “human-centered” information technology. | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 16 | 35 | 46%
| T5. Technology that supports collaboration is rapidly placed in the hands of staff. | 3 | 3 | 3 | 5 | 4 | 3 | 3 | 24 | 35 | 69%
| T6. Information systems are real-time, integrated, and “smart.” | 3 | 2 | 3 | 4 | 3 | 3 | 3 | 21 | 35 | 60%

**V. Knowledge Management Measurement**

| M1. The association has invented ways to link knowledge to financial results. | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 12 | 35 | 34%
| M2. The association has developed a specific set of indicators to manage knowledge. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 35 | 20%
| M3. The association’s set of measures balances hard and soft as well as financial and non-financial indicators. | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 8 | 35 | 23%
| M4. The association allocates resources toward efforts that measurably increase its knowledge base. | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 13 | 35 | 37%
I. Knowledge Management Process

- P5. "Tacit" knowledge (what staff and volunteers know how to do, but cannot express) is valued and transferred across the association.
- P4. The association has formalized the process of transferring best practices, including documentation and lessons learned.
- P3. All staff and volunteers of the association are involved in looking for ideas in traditional and non-traditional places.
- P2. A sophisticated and ethical intelligence gathering mechanism has been developed.
- P1. Knowledge Gaps are systematically identified and well-defined processes are used to close them.

II. Leadership in Knowledge Management

- L4. Individuals are hired, evaluated and compensated for their contributions to the development of organizational knowledge.
- L3. The association uses learning to support existing core competencies and create new ones.
- L2. The association understands the revenue-generating potential of its knowledge assets and develops strategies for marketing and selling them.
- L1. Managing organizational knowledge is central to the association's strategy.

III. Knowledge Management Culture

- C5. Staff takes responsibility for their own learning.
- C4. Flexibility and a desire to innovate drive the learning process.
- C3. Customer value creation is acknowledged as a major objective of knowledge management.
- C2. A climate of openness and trust permeates the association.
- C1. The association encourages and facilitates knowledge sharing.

IV. Knowledge Management Technology

- T6. Information systems are real-time, integrated, and "smart."
- T5. Technology that supports collaboration is rapidly placed in the hands of staff.
- T4. The association fosters development of "human-centered" information technology.
- T3. Technology brings the association closer to its members.
- T2. Technology creates an institutional memory that is accessible to the entire enterprise.
- T1. Technology links all members of the association to one another and to all relevant external partners.
V. Knowledge Management Measurement

- M4: The association allocates resources toward efforts that measurably increase its knowledge base.
- M3: The association’s set of measures balances hard and soft as well as financial and non-financial indicators.
- M2: The association has developed a specific set of indicators to manage knowledge.
- M1: The association has invented ways to link knowledge to financial results.