Exploring the Conflict of Interest Between Knowledge Sharing and Information Security Practices: An Empirical Case Study

by

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Abstract

Knowledge sharing and information security have become well-established concepts in academia and within organisations. Knowledge sharing aims to encourage individuals to share tacit and explicit knowledge with colleagues and stakeholders, yet on the other hand, information security initiatives aim to apply controls and restrictions to the knowledge that can be shared and how it can be shared, where the primary focus is usually on protecting explicit knowledge or information. This thesis draws attention to the largely unexplored and under-developed area of 'knowledge protection'; it investigates the paradoxical and concurrent nature of knowledge sharing and information security practices by exploring their relationship and understanding how this can affect an organisation and subsequently identifies ways of achieving a balance between the two practices.

The empirical work was carried out through an interpretivist case study approach in the Energy Technologies Institute (ETI) – an organisation that combines knowledge and expertise from partnerships with academia, industry and the UK government, in order to deliver innovative low carbon solutions. A novel team-based action learning approach was developed to generate individual, team and organisational learning and to help initiate change; the data was collected from three project teams about their knowledge and experiences of knowledge sharing and information security practices, which was then analysed and further supplemented with the ETI's organisational perspective and the researcher's own experience of collaborating with the ETI to contextualise the findings.

Eight predominant overarching themes were identified that play an important role in and influence the organisation's knowledge sharing and information security practices. When looking at the practices of knowledge sharing and information security independently at the ETI, proactive and conscious efforts towards achieving the goals of each practice are evident. Knowledge is recognised as the ETI's core product and its effective dissemination is key for the organisation's success, which is why there is a keen attitude towards improving knowledge sharing internally and externally. On the other hand, a great deal of importance is given to protecting valuable knowledge and meeting stakeholders' confidentiality requirements, thus, there are good systems, access controls, and information restrictions in place. In addition, strict legal and approval processes to protect information value and accuracy are implemented. However, when both – knowledge sharing and information security - practices are compared from a broader perspective, evidence of issues arising from their conflicting nature is evident. Moreover, operating in a complex governance structure with various expectations and contractual agreements with stakeholders regarding confidentiality, has created a protective culture in the organisation surrounding its knowledge, which causes a hindrance to formal and informal knowledge sharing (including both, tacit

and explicit forms) and makes identifying opportunities for fully exploiting knowledge and Intellectual Property an ongoing operational challenge.

The research process facilitated the achievement of effective learning at individual, team and organisational level for the ETI about its practices, identification of challenges and areas of improvement, incorporation of learning and recommendations into its knowledge management strategy alongside existing activities to improve knowledge sharing. The contents of this thesis – particularly the eight themes that have emerged from the research findings - are also contributing significantly to a project the organisation is carrying out to reflect on and review what has been learned from operating the ETI for the last 10 years.

The thesis contributes to the existing body of knowledge, theoretically and practically, in the disciplines of knowledge management and information security; what was predominantly overlooked by previous literature, the empirical research findings surface evidence of the relationship between knowledge sharing and information security practices, showing their interconnectedness, and, the negative consequences of the two practices being treated and managed separately. For the action learning arena, a novel methodological approach underpinned by the action learning philosophy has been introduced that demonstrates how team action learning (i.e. using intact teams as opposed to conventional action learning teams) can be used to engage employees to share and combine their knowledge on real organisational issues, generate new learning and develop actions to initiate improvements in the organisation.

Dedication

To God, for blessing me so richly and teaching me that which I knew not.

Ithaka

As you set out for Ithaka
hope the voyage is a long one,
full of adventure, full of discovery.
Laistrygonians and Cyclops,
angry Poseidon—don't be afraid of them:
you'll never find things like that on your way
as long as you keep your thoughts raised high,
as long as a rare excitement
stirs your spirit and your body.
Laistrygonians and Cyclops,
wild Poseidon—you won't encounter them
unless you bring them along inside your soul,
unless your soul sets them up in front of you.

Hope the voyage is a long one.
May there be many a summer morning when,
with what pleasure, what joy,
you come into harbours seen for the first time;
may you stop at Phoenician trading stations
to buy fine things,
mother of pearl and coral, amber and ebony,
sensual perfume of every kind—
as many sensual perfumes as you can;
and may you visit many Egyptian cities
to gather stores of knowledge from their scholars.

Keep Ithaka always in your mind.
Arriving there is what you are destined for.
But do not hurry the journey at all.
Better if it lasts for years,
so you are old by the time you reach the island,
wealthy with all you have gained on the way,
not expecting Ithaka to make you rich.

Ithaka gave you the marvellous journey.
Without her you would not have set out.
She has nothing left to give you now.

And if you find her poor, Ithaka won't have fooled you.
Wise as you will have become, so full of experience,
you will have understood by then what these Ithakas mean.

C. P. Cavafy

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1. INTRODUCTION

1.1 Research background

This research bridges the disciplines of knowledge management and information security by exploring the conflict between knowledge sharing and information security practices in an organisational setting.

Knowledge management (KM) has had a great influence on managing and organising practices in recent years, and subsequently, "the academic community is increasingly interested in the relevance of knowledge and its management in producing relevant research on value creation in the twenty-first-century organizations" (Heisig et al, 2016: 1169). Moreover, as knowledge is often recognised as a competitive tool for organisations and an important strategic resource, knowledge management is considered critical to organisational success (Martelo-Landroguez and Cepeda-Carrión, 2016) and organisations are thus paying particular attention to knowledge management activities (Mueller, 2012). According to Martelo-Landroguez and Cepeda-Carrión (2016), four key knowledge management processes or areas of focus are identified in the literature, which are (i) knowledge creation, (ii) knowledge transfer, (iii) knowledge storage/retrieval and (iv) knowledge application.

In a fast changing environment where there is increasing need to understand customers' demands and competitors' strategies (Lin et al, 2012), knowledge sharing has been recognised as a vital activity for organisational success (Wasko and Faraj, 2005; Renzl, 2008). Knowledge sharing underpins the success of knowledge management initiatives (Wang and Noe, 2010), thus, it has been receiving increasing attention in both research and practice (Yi, 2015). Fullwood et al (2013) argue that there is a strong body of research into knowledge sharing in commercial environments, particularly due to the widespread recognition of knowledge sharing enhancing organisational performance and competitive advantage. Moreover, knowledge sharing is a valuable practice as it benefits the organisation by creating new knowledge and allows individuals to gain access to knowledge that will support them in their work (Alavi and Leidner, 1999; Fischer and Ostwald, 2001; Raab et al, 2014).

Organisations continuously aim to exploit existing knowledge, seek new ways to improve and increase knowledge sharing activities, as well as to identify and reduce possible knowledge sharing barriers. However, despite the integral role and benefits of knowledge sharing having been widely recognised in knowledge management, knowledge protection or security has largely been overlooked in research and practice (e.g. Desouza, 2006; Shedden et al, 2011; Manhart and Thalmann, 2015; Ilvonen et al, 2016).

Information security is another discipline that has progressed to becoming globally recognised (Gifford, 2009) receiving attention from academics and practitioners (Wiant, 2005). The purpose of information security is to protect the valuable information resources of an organisation and "through the selection

and application of appropriate policies, standards, and procedures, an overall security program helps the enterprise meet its business objective or mission charter" (Peltier, 2016: xiii). It is stressed by de Oliveira Albuquerque et al (2014) that, despite heavy investments in the information security, the problem of adequate information protection remains as the efforts may still be insufficient to protect against security risks and breaches. It is also claimed that information security is not well understood by organisations due to the security approaches not being designed tailored to the problem itself or considering all the necessary facets of what is required to be protected (de Oliveira Albuquerque et al, 2014).

Despite organisations' investments in prevention measures, information security breaches are still common where the most common security vulnerability is caused due to human carelessness (Yeniman Ebru Akalp et al, 2011), making humans the weakest link in information security (Soomro et al, 2016). Much of security breaches are caused by internal employees, thus, a major weakness in information security is the individual user within the organisation, yet existing research on information security has predominantly focused on technical facets (Gordon and Loeb, 2006; Coles-Kemp, 2009; Crossler et al, 2013: Soomro et al, 2016). Moreover, Coles-Kemp and Hansen (2017: 465) argue that the information security design process has rarely addressed the human security needs of the individual.

According to Coles-Kemp and Hansen (2017: 465), the focus of information security in practice and in academic research has mainly been on Information Technology security that consists of protection of data and information and the technological infrastructure. Ahmad et al (2014) also argue that traditionally in information security, the focus of measures has been on protecting 'information' or 'data', and the concept of 'knowledge' has been overlooked. Moreover, although information security practices are considered to be aligned with organisational goals, they typically are not designed with the competitive advantage in mind (Ahmad et al, 2014). However, in recent years, the practice of information security and its associated issues are starting to be recognised as wide-spanning that should be considered in a wider management context (e.g. Phillips, 2013; Siponen et al, 2014; Soomro et al, 2016). Soomro et al (2016) synthesise existing information security literature and stress the need for a more holistic approach for information security management.

From the literature review carried out for this PhD, it is evident that knowledge sharing and information security have become well-established concepts in academia and within organisations. However, the middle ground between these two equally important, and adjacent, practices, has received inadequate attention.

1.2 Problem overview

By reviewing the literature on knowledge sharing and information security, and more importantly, by exploring the relationship between the two practices, an inherent conflict (see Figure 1) has been identified (e.g. Desouza, 2006; Shedden et al, 2011; Ahmad et al, 2014; Manhart and Thalmann, 2015; Ilvonen et al, 2016). The conflict is caused by their intrinsically opposing goals; knowledge sharing aims to encourage individuals to share knowledge with colleagues, organisational partners and suppliers; on the other hand, information security initiatives aim to apply controls and restrictions to the knowledge that can be shared and how it is shared.

Figure 1: Conflict of interest between knowledge sharing and information security

Knowledge management has focused on facilitation of knowledge sharing and overlooked knowledge protection, whereas information security has focused primarily on technical aspects and protecting 'information' and 'data', and subsequently neglected the development of more holistic approaches that also include the protection of knowledge (Manhart and Thalmann, 2015). The limited previous research on this issue of knowledge protection (e.g. Ilvonen et al, 2016; Manhart and Thalmann, 2015; Shedden et al, 2011; Desouza, 2006), has predominantly been of a conceptual nature that lacks empirical validation, has been biased towards the aim to improve protection of knowledge and has typically been grounded in the knowledge management domain. This surfaces a gap (Figure 2) for empirical research that takes a holistic and unbiased approach to exploring the practices of knowledge sharing and

information security, focusing on their middle-ground and identifying ways of improving the balance between them.

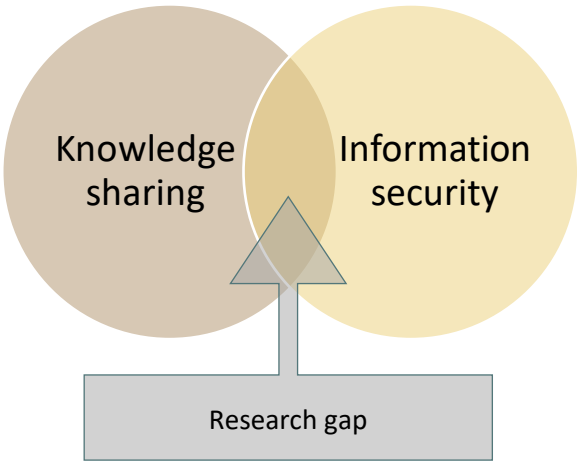

Figure 2: Middle-ground between knowledge sharing and information security

In this research, the two practices were studied in the context of project teams in a project-based organisation, with the assumption that knowledge sharing and information security are both vital in such knowledge-intensive and pressured environments. According to Choi et al (2010), knowledge sharing improves decision making and coordination which subsequently can lead to better team performance, thus, it is vital for project team members to share and combine their specialist knowledge (Wang and Ko, 2012). Congruently, a study by Park and Lee (2014: 160) found that knowledge sharing "significantly influences project team performance". On the other hand, information security measures must be implemented in projects in order to protect intellectual capital created as part of any innovation and to prevent the loss or leakage of the valuable project knowledge (Ryan, 2006). Therefore, effective management of both, knowledge sharing and information security, is a fundamental component of teamwork, especially in the case of projects where teams are intentionally formed with a diverse range of members with specialist skillsets, knowledge and experiences in order to collaborate and produce a unique product or service (Hsu et al, 2011).

1.3 Aims and objectives

The research gap identified in section 1.2 led to the development of the following research questions:

1. How does the paradoxical nature of knowledge sharing and information security affect organisational practices?
2. How can the findings be used to improve the relationship between knowledge sharing and information security practices?

In order to understand the paradoxical and concurrent nature of knowledge sharing and information security in practice and identify ways of achieving balance between the two practices, a qualitative case study approach was taken which will be discussed in Chapter 3. Further, to find answers to the research questions, the research had to meet the following aims:

a) investigate the relationship between the practices of knowledge sharing and information security, and,
b) identify ways of informing organisational strategy for balancing the relationship between knowledge sharing and information security practices.

Objective 1: *develop and implement a methodological framework using action learning which generates team and organisational learning and drives change.*

Objective 2: *collect and analyse data from selected ETI project teams about their knowledge and experiences of knowledge sharing and information security practices.*

Objective 3: *identify whether information security measures have impacted knowledge sharing, and vice versa.*

Objective 4: *identify how the conflict between knowledge sharing and information security has impacted (i) individuals in their day-to-day activities, (ii) project teams and (iii) the organisation's practices.*

Objective 5: *devise appropriate theoretical, practical and methodological guiding principles based on the research findings, in order to improve the relationship between knowledge sharing and information security practices.*

1.4 Case study organisation

The Energy Technologies Institute (ETI) has been formed as a public-private partnership between the UK government and various energy and engineering organisations. The ETI is an organisation that combines knowledge and expertise from partnerships with academia, industry and the UK government, in order to develop and deliver innovation in low carbon energy solutions that will help the UK address its long-term emissions reductions targets. Operating within a complex governance structure, the organisation works to meet the expectations of various stakeholders, comply with legal parameters of its membership model (to protect its unique knowledge and arising intellectual property), deliver innovative solutions - many of which are of a competitive nature - and, disseminate its knowledge effectively and on time.

Thus, the management of both, 'knowledge sharing' and 'information security', is an operational responsibility for the ETI.

Prior to this PhD starting, the PhD researcher was involved, as a research assistant, on a knowledge audit research project at the ETI carried out by staff at Loughborough University (see Ragsdell et al, 2014). During the knowledge audit project, the researcher was able to experience the working practices of the ETI and gain insight into the crucial role knowledge plays in the organisation, the complexity of operating in a knowledge-intensive environment, and develop an understanding of the organisational practices and culture. It was recognised that effective knowledge management, particularly knowledge sharing and dissemination, contributes to the success of the ETI's projects and returns value to its investors. The organisation recognises this and places knowledge management high on its strategic agenda with several initiatives underway.

In addition, the ETI has a keen and open-minded attitude towards organisational learning and improving its knowledge management practices, thus welcomes input from and collaboration with external entities. Following the successful outcomes and learning of the knowledge audit project, the ETI was keen to further explore and invest in its knowledge management; thus, the organisation's interest in being involved as a case study for this PhD research was triggered by the outcomes of the knowledge audit.

1.5 Structure of thesis

The structure of the thesis consists of six chronological chapters - although it is important to note that the research process itself was not strictly chronological as the research methodology was designed and adapted along the process where necessary. Chapter 1 introduces the research and thesis, providing its background, highlighting the research problem as well as the research setting. Chapter 2, the literature review, provides a critique of the relevant literature on the topics involved in this research, including knowledge sharing, information security and project teams, highlighting their antecedents and presenting the research gap that has been identified. Chapter 3 explains how the research methodology was developed, the elements that informed it and how the researcher applied this methodology to elicit the findings and meet the research aims. Chapter 4 presents an analysis of the research findings and draws out important themes that emerged from it. Chapter 5 presents a discussion of the main research findings, i.e. the eight research themes identified, in light of existing literature, highlighting their implications for the ETI and drawing out new learning. Chapter 6, the final chapter of the thesis, presents the conclusions of the PhD research in light of the original research aims and objectives. This chapter also highlights the original contribution to knowledge, recommendations and directions for future research.

2. LITERATURE REVIEW

2.1 Introduction

This chapter provides an analysis of the relevant literature on the topics involved in this research. Firstly, the chapter reviews literature on knowledge sharing practices, establishing how knowledge sharing is defined and the most common factors identified by researchers that influence this practice. Secondly, information security literature is reviewed, determining how the concept is defined, and the various types of information security threats and subsequent protection measures that are commonly implemented in modern organisations. Thirdly, the literature on project teams is explored, identifying the common definitions, factors that influence project team work, importance of knowledge sharing in project teams, and the differences identified between permanent and non-permanent project team members. Finally, the literature on knowledge sharing and information security is amalgamated to identify the research gap in their middle-ground which led to the development of the aims and objectives of this research.

The aim of conducting the literature review presented in this chapter was to provide the researcher with an understanding of the antecedents and the state of current research on each topic, identify and establish the research gap to ensure that this research was addressing a new problem, filling an important research gap and contributing to the existing body of knowledge. The findings of the literature review also aided the researcher and informed the design of the research methodology.

2.2 Knowledge and knowledge management

According to Alavi and Leidner (2001: 107), "knowledge is a broad and abstract notion that has defined epistemological debate in western philosophy since the classical Greek era". A prominent definition of knowledge identified in literature is "justified true belief" (e.g. Nonaka et al, 2000; Kakabadse et al, 2003; Rowley, 2007; Kimble, 2013; Oeberst et al, 2016). Nonaka et al (2000) advance on this definition and suggest that their focus is on the 'justified' aspect of belief, rather than the 'true'. It is argued that in traditional Western epistemology, true, absolute, static and non-humanistic view of knowledge is often adopted, however, this view "fails to address the relative, dynamic and humanistic dimensions of knowledge. Knowledge is dynamic, since it is created in social interactions amongst individuals and organisations. Knowledge is context-specific, as it depends on a particular time and space. Without being put into a context, it is just information, not knowledge" (Nonaka et al, 2000: 7).

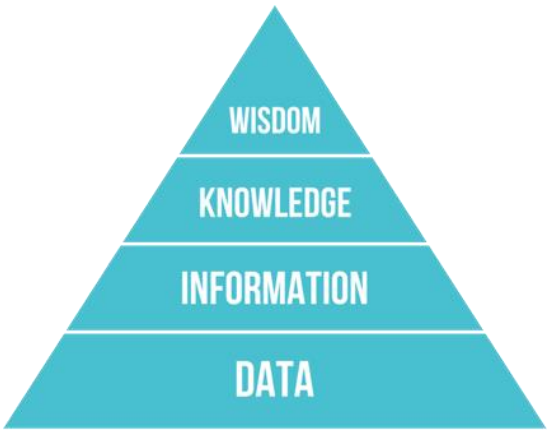

Figure 3: The DIKW hierarchy (Ackoff, 1989)

In both, theory and practice, the terms 'knowledge' and 'information' are often used interchangeably (Kakabadse et al, 2003). However, researchers have attempted to create a distinction between the two concepts, for example, Kakabadse et al (2003: 77) explain that knowledge "can be conceived of as information put to productive use", and Davenport et al (1998) argue that knowledge is a high value form of information, it emerges when information is combined with experience, context, interpretation and reflection. According to Nonaka et al (2000: 7), knowledge is subjective, relational and humanistic i.e. related to human nature, thus "information becomes knowledge when it is interpreted by individuals and given a context and anchored in the beliefs and commitments of individuals". A prominent method of distinguishing knowledge from information is the data-information-knowledge-wisdom (DIKW) pyramid – also known as the 'knowledge hierarchy', the 'information hierarchy and the 'knowledge pyramid' (Rowley, 2007; Kebede, 2010; Baskarada and Koronios, 2013). The DIKW hierarchy, as shown in Figure 3, is widely associated with and recognised as emerging from Ackoff's (1989) article entitled *From data to wisdom*, however, other researchers such as Cleveland (1982) and Zeleny (1987) have also mentioned this hierarchy. The DIKW hierarchy aims to contextualise and show the relationships between the four concepts, as well as the processes required to transform an entity into the next entity in the hierarchy e.g. from data to knowledge (Rowley, 2007).

The following definitions describe the interrelationships and distinguish the differences between the four concepts of the DIKW pyramid.

> **Data** – symbols representing the properties of objects and events (Ackoff, 1989); "the elementary and crude form of existence of information" which, when consolidated, becomes information (Kebede, 2010: 417).
>
> **Information** – "represents data endowed with meaning" (Kebede, 2010: 417); data that is processed in order to increase its usefulness and for the purpose of providing descriptions and answers to questions; similarly to data, information also represents properties of objects and

events, but in a most compact and useful manner i.e. the difference between data and information is functional, rather than structural (Ackoff, 1989).

Knowledge – knowledge is 'know-how' (Fricke, 2009), the highest form that information can take and is created when information is consolidated with human insight, experience and context (Kebede, 2010) and is conveyed via instructions and answers to questions such as 'how-to…' (Ackoff, 1989).

Wisdom – wisdom is the 'know-why' Zeleny (1987), "a matter of using that practical know-how to achieve appropriate ends" (Frické, 2009: 141) and the ability to increase effectiveness (Ackoff, 1989).

Whilst making a distinction between the concepts, Kebede (2010: 418) also describes data, information and knowledge as the logically incremental "three manifestations of information", making knowledge the higher-level manifestation that is inclusive of data and information, and upon which data and information rely to be properly interpreted and understood. Moreover, Kebede (2010) argues that in the past decades, the focus of information science literature has logically progressed through the hierarchical positions of the different manifestations of information i.e. during the 1980s the focus and emphasis was on the management of data and information, and since the early 1990s, the management of knowledge has taken a dominant position in literature.

Tuomi (1999) challenges the conventional, and incremental, DIKW hierarchy and the relationships between data, information and knowledge presented above. Further, a reversal of the hierarchy is proposed supported by the argument that data only emerges after we have information, and similarly, information only emerges after we already have knowledge. Building on this argument, Jennex (2009: 2) argues: "our understanding of the world through our wisdom and knowledge drives us to collect specific information and data to support our use of our knowledge and wisdom. In this view, the hierarchy flows down the pyramid rather than up the pyramid and data does not exist as a collection of unrelated facts as all collected facts are related to our basic knowledge and wisdom."

According to Nonaka and Takeuchi (1995), knowledge can take two forms - tacit knowledge, that which cannot be articulated, and explicit knowledge, that which can be codified. To describe the distinction between tacit and explicit knowledge, Nonaka and Takeuchi (1995) use the iceberg metaphor where explicit knowledge is represented by only the tip of the iceberg and the remaining hidden part represents tacit knowledge. Similarly, Haldin-Herrgard (2000) also refer to organisational knowledge resources as an iceberg as follows:

> *"The structured, explicit knowledge is the visible top of the iceberg. This part of the knowledge resource is easy to find and recognize and therefore also easier to share. This is also done in*

organization through different forms of technological and pedagogical methods. Beneath the surface, invisible and hard to express, is a momentous part of the iceberg. This hidden part applies to tacit knowledge resources in organizations. We know more than we can express (Polanyi, 1966) and therefore this part of the knowledge resource can be more difficult to share." (Haldin-Herrgard, 2000: 358)

Whilst a distinction is made between tacit and explicit knowledge, it is also emphasised that they do not exist separately but rather form a continuum i.e. visible and submerged parts of an iceberg (Nonaka et al, 2008). According to Nonaka and Takeuchi (1995: 8), explicit knowledge can be expressed in words and numbers, tacit knowledge on the other hand, is difficult to visualise and express and is "highly personal and hard to formalize, making it difficult to communicate or to share with others…tacit knowledge is deeply rooted in an individual's action and experience, as well as the ideals, values and emotions he or she embraces". Nonaka and Takeuchi (1995: 8) segment tacit knowledge into two dimensions, a technical dimension that consists of informal and difficult to pin-point skills or crafts usually described as 'know-how', and a cognitive dimension - our image of reality that "consists of schemata, mental models, beliefs, and perceptions so ingrained that we take them for granted".

Whilst the description of tacit and explicit knowledge by Nonaka and Takeuchi (1991, 1995) is seen as the most pivotal in an organisational context (Grant, 2007), several researchers have critiqued these definitions, particularly those regarding the tacit dimensions of knowledge. Further, Grant (2007) argues that Nonaka and Takeuchi's (1991) description of knowledge is that successful innovation results from organising and converting tacit knowledge via four processes of knowledge conversion including socialisation, externalisation, combination and internalisation (SECI model), and it is through this paper that Polanyi's (1966) famous quote "We can know more than we can tell" became widely disseminated. "Thus, Nonaka and his co-authors have taken Polanyi's work on "personal" knowledge and extended it to a new field of "corporate" or organisational knowledge." (Grant, 2007: 174). Virtanen (2013) claims that Nonaka and Takeuchi's (1995) view about tacit knowledge being seen as convertible into explicit knowledge, thus making the identification of valuable tacit knowledge to codify into explicit knowledge the most integral KM process, has theoretical problems, particularly in relation to Polanyi's theory of tacit knowledge. Moreover, it is argued that whilst various authors claim so, Polanyi's theory of knowledge does not suggest the existence of two types of knowledge ontologically, but rather that tacit and explicit knowledge are connected to two different types of awareness, subsidiary awareness and focal awareness respectively (Virtanen, 2013). The two types of awareness are further explained as follows:

"The things that we are attending to and that we are consciously aware of (e.g. propositional belief, mental image, external object, read sentence etc.) belong to focal awareness. However,

> *all focal awareness is dependent on subsidiary awareness that consists of variety of clues, elements and processes (personal knowledge structures, emotional processes, past experiences, motor responses etc.) that enable focal awareness giving rise to the personal meaning of its contents. This is the structure of all acts of knowing (Polanyi, 1969). Hence, the focal object is always identifiable and in this sense explicit, whereas subsidiary content is unidentifiable, tacit. In addition, the two kinds of awareness are mutually exclusive; when the attention is switched to something hitherto subsidiary, it becomes focal losing its subsidiary meaning (Polanyi, 1964). Most importantly, this tacit explicit structure concerns all acts of knowing; tacit knowledge is not a separate category of knowledge but an integral component of all knowledge."* (Virtanen, 2013: 120)

Thus, dividing knowledge into two categories is seen as a problem and contradictory to Polanyi's thinking and approach (Virtanen, 2013; Grant, 2007; Tsoukas, 2003; Hedesstrom and Whitley, 2000). Virtanen (2013) also challenges Nonaka and Takeuchi's (1995) categorisation and the idea of conversion of tacit knowledge into explicit knowledge and stresses that this generates an inherent epistemological contradiction. Further, it is argued that Nonaka and Takeuchi (1995) saw tacit knowledge, which they describe as subjective and intangible, being simply converted into explicit knowledge, however, "the process of explication (or externalization) does not explain how tacit knowledge becomes justified and true. The main point of Polanyi's epistemology was that specifically due to the tacit dimension of knowledge it could never be objective or fully justified" (Virtanen, 2013: 120).

In his book entitled Nicomachean Ethics, the Greek philosopher Aristotle distinguished between three kinds of knowledge, including 'episteme', 'techne' and 'phronesis' (Nonaka and Toyama, 2007; Erden et al, 2008). Episteme is described as universal truth (Nonaka and Toyama, 2007), explicit, context-free and objective knowledge which can also be referred to as scientific knowledge (Erden et al, 2008). Techne is the practical and context-specific technical know-how, that includes tacit knowledge in the form of skills and crafts (Erden et al, 2008) and thus relates to technique, technology and art (Nonaka and Toyama, 2007). Phronesis is described by Erden et al (2008: 11) as prudence, practical wisdom and practical rationality, and Nonaka and Toyama (2007: 378) describe it as "intellectual virtue" that is "generally understood as the ability to determine and undertake the best action in a specific situation to serve the common good".

According to Alavi and Leidner (2001), defining knowledge has been a challenge that philosophers and scientists have faced for thousands of years. The concept of knowledge as "justified true belief" – as discussed earlier in this section - is often attributed to the Greek philosopher Plato and it remains one of the most frequently used definitions of knowledge (Baskarada and Koronios, 2013; Kimble, 2013), particularly in Western philosophy, despite being imperfect in terms of logic (Nonaka and Takeuchi,

1995; Kakabadse, 2003). Plato's theory of knowledge - referred to as ***rationalism*** - suggests the path to understanding a phenomenon is rational thinking rather than intensive observation (Willis and Jost, 2007). Plato's rationalism emphasised on thinking and reflection in order to understand as "you could not study the physical objects in your world and empirically arrive at a full understanding of an object because all the physical representations of the object were flawed. Instead, you had to think your way to an understanding of the ideal form of that object. The ideal form does not exist in the physical world." (Willis and Jost, 2007: 49). Plato's idealistic approach was challenged by his student, Aristotle (Kakabadse, 2003). Aristotle supported a theory known as ***empiricism***, meaning that "what we know about the world comes from experience" (Willis and Jost, 2007: 36). Aristotle suggested that our knowledge about the world is acquired through human senses and derived from hands-on experience - and suggested that to understand nature, its careful observation and study are required (Willis and Jost, 2007).

Drawing on the definitions and arguments reviewed in the literature in this section and the researcher's own understanding, combined with the adoption of a predominantly Aristotelian view of knowledge i.e. empiricism, knowledge is defined in this research as follows:

> Knowledge is an understanding, belief or interpretation held by a person or collectively by a group of people about a phenomenon. Contrary to the definition of knowledge as being "justified true belief" (e.g. Nonaka et al, 2000; Kakabadse et al, 2003; Rowley, 2007; Kimble, 2013; Oeberst et al, 2016), knowledge can be true or untrue, thus the focus is on 'justified belief' or how it is interpreted rather than the knowledge being factual. Knowledge is formed by combining information with human experience, context, interpretation and reflection, and is ready to be applied to decisions and actions (Davenport et al, 1998; Nonaka et al, 2008). The DIKW hierarchy and the relationships between the concepts of data, information and knowledge - where knowledge is the highest form that information can take (Kebede, 2010) - are incorporated into the definition of knowledge in this research, however, the reversal of this hierarchy, i.e. where specific data or information can be accessed, shared or created based upon certain knowledge and wisdom (e.g. Tuomi, 1999; Jennex, 2009) is also recognised as equally important. Moreover, a holistic view of knowledge is adopted, where the "tacit explicit structure concerns all acts of knowing; tacit knowledge is not a separate category of knowledge but an integral component of all knowledge." (Virtanen, 2013: 120). Tacit and explicit knowledge are recognised as inseparable and a part of the same continuum (Nonaka et al, 2008) supported by Grant's (1996: 111) epistemological distinction between tacit and explicit knowledge characteristics; tacit knowledge is 'knowing how', subjective, personal, procedural and difficult to communicate and transfer as it is revealed through application and acquired through practice;

explicit knowledge is 'knowing about', objective, prepositional, declarative and easy to communicate and transfer.

The definition of knowledge adopted in this research plays an integral role as it not only enlightens the researcher's epistemological perspective, but also the subsequent methodological choices and analysis of findings, as discussed in the Chapter 3. Thus, the definition of knowledge is not only relevant to the subject areas of this research, but also the way the research is carried out.

2.2.1 Knowledge management

Alavi and Leidner (2001: 108) argue that the knowledge-based view of the firm enabled knowledge to be recognised as "embedded in and carried through multiple entities including organization culture and identity, routines, policies, systems, and documents, as well as individual employees", which increased the organisation's interest in using existing knowledge and producing new knowledge that would lead to long term sustainable competitive advantage. This growing interest in treating knowledge as a significant organisational resource (Alavi and Leidner, 2001) and knowledge being recognised as an important asset, led to organisations paying attention to managing it and "exploring what it is and how to create, transfer and use it more effectively" (Davenport et al, 1998: 43). Further, particularly in the modern knowledge-intensive economy where knowledge "signifies intangible assets that are unique, inimitable and non-substitutable", it is treated as a fundamental strategic resource for competitive advantage (Wu and Zhu, 2012: 1463) and facilitating organisational success. Therefore, knowledge management is receiving particular interest in organisations (Mueller, 2012).

Heisig et al (2016: 1169) argues that in recent years, knowledge management has significantly influenced managing and organising practices, due to which, "the academic community is increasingly interested in the relevance of knowledge and its management in producing relevant research on value creation in twenty-first-century organizations". According to Kebede (2010: 417), the inference that the knowledge hierarchy (see Figure 3) makes is that knowledge is the highest form that information can take in the information science discipline, making knowledge and its management the ultimate goal. Thus, the emergence of the knowledge management discipline is argued to be a natural and long-awaited development in information science, with respect to the manifestations of the information hierarchy, that "can be considered as the logical framework for a comprehensive management of the object of study" (Kebede, 2010; 418). Rowley (2007: 165) suggests that knowledge management is a broad-spanning subject that "has been influenced by a variety of disciplines, including: philosophy, cognitive science, social science, management science, information science, knowledge engineering, artificial intelligence, and economics".

On the other hand, Wilson (2002) describes it as either an interchangeable term for 'information management', or, a means of managing working practices in order to add improvements to knowledge sharing in organisations. Davenport and Marchand (1999) argue that although knowledge management does entail 'information management', it consists of two sub-domains; the creation of new knowledge and managing the way this knowledge is shared and applied. Prusak and Matson (2006) recapitulate knowledge management as 'the process of lowering the transaction costs associated with creating, sharing, and applying knowledge, and developing improved strategies to support these activities'. Similarly, Martelo-Landroguez and Cepeda-Carrión (2016) suggest that knowledge management is considered critical to organisational success and the four key processes for achieving this success are identified in the literature as (i) knowledge creation, (ii) knowledge transfer/sharing, (iii) knowledge storage/retrieval and (iv) knowledge application. Based on a comparison of 160 knowledge management frameworks from around the world and their respective activities for systematically handling knowledge resources, Heisig (2009: 13) concludes that the "result of the analysis shows that there are five most frequently mentioned broad categories of KM activities: share, create, apply, store and identify knowledge".

Figure 4: Knowledge management in this research

Knowledge management in this research is defined as a holistic practice that enables an organisation to manage and benefit from its intangible knowledge resources. Consisting of processes including sharing, creating, applying, storing and identifying - as identified by Heisig (2009) - where knowledge sharing is recognised as the most integral process of knowledge management in this research and will be discussed and defined in section 2.3. In addition to the five processes of knowledge management which Heisig (2009) identified, this research recognises and incorporates 'knowledge protection' (discussed further in sections 2.3.4 and 2.6) as an important part of knowledge management and thus, as a potential sixth

process as shown in Figure 4, explores the role this process plays in knowledge management, particularly in relation to knowledge sharing.

It is also important to highlight in this research that knowledge management is a complex and multi-faceted concept (Alavi and Leidner, 2001), therefore, the efforts in knowledge management need to be holistic as individual efforts, such as focusing on 'knowledge management technologies' in isolation are insufficient (Heisig, 2009). Moreover, the aim should be "to implement a holistic approach towards the management of organizational knowledge while considering the specific boundary conditions of the organization" (Heisig, 2009: 16). Lastly, this research also acknowledges that the said knowledge management activities are often engrained in the processes of modern organisations - regardless of whether the organisation is consciously 'doing knowledge management'.

2.3 Knowledge sharing

In the fast changing environment where there is a great need to "understand customers' demands and competitors' strategies" (Lin et al, 2012: 42), knowledge has become a vital strategic and competitive resource for organisations (Martelo-Landroguez and Cepeda-Carrión, 2016), and accordingly, an increasing amount of attention has been given to knowledge management in academic research (Heisig et al, 2016). Knowledge sharing in particular has been recognised as an integral activity for organisational success (e.g. see Dyer and Nobeoka, 2000; Wasko and Faraj, 2005; Renzl, 2008) and is receiving increasing attention in both research and practice (Yi, 2015). "A fundamental component of both KM and learning is the concept of knowledge sharing" (Chinowsky and Carrillo, 2007: 127), and according to Wang and Noe (2010) and Stenius et al (2016), KM's success is dependent on knowledge sharing. According to Fullwood et al (2013), there is a strong body of research into knowledge sharing in commercial environments, particularly due to the widespread recognition of knowledge sharing enhancing organisational performance and competitive advantage. This has led to organisations continuously seeking new ways to improve and increase knowledge sharing activities, as well as identifying and reducing possible knowledge sharing barriers.

The following sections aim to firstly compare some of the definitions of knowledge sharing presented by various researchers, explore factors that influence knowledge sharing, and finally discuss the importance of protecting valuable organisational knowledge in knowledge sharing activities.

2.3.1 Definitions of 'knowledge sharing'

"Knowledge sharing (KS) is a critical behaviour in knowledge-based organizations and, therefore, a crucial element of knowledge management (KM). The organization is reliant on effective utilization of its collective knowledge pool, particularly its knowledgeable employees, which is why KS is a highly

desirable behaviour from an organizational perspective" (Stenius et al, 2016: 181). According to Chinowsky and Carrillo (2007) knowledge sharing is about encouraging knowledge collection and dissemination throughout the organisation. Similarly, Christensen (2007: 37) stresses that knowledge sharing intends to exploit existing knowledge and is "defined as being about identifying existing and accessible knowledge, in order to transfer and apply this knowledge to solve specific tasks better, faster and cheaper than they would otherwise have been solved". Raab et al (2014) assert that knowledge sharing means having the right information available, in the right place, and at the right time to facilitate an individual to complete their task effectively. On the other hand, Jackson et al (2006) argue that knowledge sharing is the essential mechanism through which employees are able to not only apply knowledge but also contribute to the organisation's innovation, whereas Gibbert and Krause (2002) suggest that knowledge sharing is about the willingness of employees to share the knowledge that they have produced and gained.

However, the depiction of knowledge sharing as being a way of identifying, transferring and applying existing knowledge is not shared by all theorists and different definitions are presented. For example, Huysman and De Wit (2002: 23) claim that "knowledge sharing forms the basis for organisational learning" and therefore associate and visualise organisational learning processes with a knowledge sharing cycle whereby each part of the process i.e. internalisation, externalisation and objectification, is supported by different knowledge sharing activities. Hendriks (1999: 92) also presents a slightly different definition of knowledge sharing to those already presented by describing it as being something besides but related to communication and information, and argues that "in a strict sense, knowledge cannot be shared". Hendriks (1999) explains that because knowledge is entwined with a knowing subject, certain prior knowledge is required to reconstruct what is being learnt in order to acquire knowledge. Moreover, the behaviour of knowledge sharing is said to be influenced by various elements, for example, Wu and Zhu (2012: 1463) argue that "knowledge sharing does not happen in vacuum, but is influenced by psychological, organizational and technological factors".

Based on their review of knowledge sharing literature, Wu and Zhu (2012) summarise that an all-round definition of knowledge sharing does not appear to exist, as researchers often define knowledge sharing from their personal point of view or based on the research context. In addition to the varying definitions of knowledge sharing amongst researchers, there also exists a lack of clarity of the terms used to refer to knowledge sharing activities. For example, the act of sharing knowledge is not always referred to with the term 'knowledge sharing' but the terms 'knowledge transfer', 'knowledge exchange' and 'knowledge flows' are also sometimes used interchangeably for referring to knowledge sharing activities (e.g. Foss et al, 2010; Wu and Zhu, 2012). Furthermore, the terms knowledge transfer and knowledge sharing are both used interchangeably by O'Dell and Grayson (1998) to refer to the sharing of best practices within an organisation, the term knowledge transfer is used instead of knowledge sharing by Osterloh and Frey

(2000), and, Inkpen and Tsang (2005) also use both terms to refer to knowledge sharing between network members. Similarly, the terms knowledge sharing and knowledge exchange have also been used interchangeably, for example, Alavi and Leidner (2001), Cabrera et al (2006) and Wasko and Faraj (2005). In some cases, such as Christensen (2007), Haas and Hansen (2007), Levin and Cross (2004) and van den Hooff and de Ridder (2004), the terms 'knowledge exchange' and 'knowledge transfer' are actually used to explain or define what knowledge sharing is.

Though all the definitions and perspectives of knowledge sharing presented above vary in many respects, some similarities between some definitions are also identified. For example, the following five chronological aspects have been identified in relation to what constitutes knowledge sharing for the said theorists:

I. Making use of or exploiting the already existing knowledge within the organisation (e.g. Jackson et al, 2006; Christensen, 2007; Chinowsky and Carrillo, 2007; Raab et al, 2014; Stenius et al, 2016)
II. Sharing the knowledge from one person or source to another (Gibbert and Krause, 2002; Levin and Cross, 2004; van den Hooff and de Ridder, 2004; Jackson et al, 2006; Christensen, 2007; Haas and Hansen, 2007; Chinowsky and Carrillo, 2007; Stenius et al, 2016)
III. Applying the knowledge to tasks or solving problems (Grant, 1996; Christensen, 2007; Raab et al, 2014; Stenius et al, 2016)
IV. Contributing to individual and organisational learning (Huysman and De Wit, 2002; Hansen, 2002; Goffin and Koners, 2011; Park and Lee, 2014; Heisig et al, 2016)
V. Contributing to performance or innovation (Huysman and De Wit, 2002; Hansen, 2002; Jackson et al, 2006; Park and Lee, 2014; Heisig et al, 2016)

Drawing upon the various definitions of knowledge sharing offered by other researchers, and by summarising these and identifying the core components, knowledge sharing is defined as the following in this research:

> The process of identifying and communicating existing tacit or explicit knowledge through any means – i.e. direct human interaction, documented or electronically - from one entity to another for the purpose of generating learning, reciprocity, completing a task, solving a problem or generating improvement. The 'entity' may be a single individual, a group, an organisation or a system.

The distinction between the definition of knowledge sharing adopted in this research and that of 'knowledge management' in section 2.2.1, is that knowledge management is the overarching practice that enables organisations to manage and benefit from their intangible knowledge resources, consisting

of five sub-processes - sharing, creating, applying, storing and identifying (Heisig, 2009). From these five sub-processes, the effective and efficient sharing of knowledge is recognised in this research as the most important activity and the ultimate goal of the various knowledge management activities and processes.

2.3.2 Factors that influence knowledge sharing

According to Wu and Zhu (2012), many organisations make it a priority to identify factors that will motivate their employees to share knowledge. Based on previous literature, Riege (2005) identified three categories of factors that form barriers to knowledge sharing, that include individual factors (e.g. lack of trust, fear of loss of power, and lack of social network), organisational factors (e.g. lack of leadership, lack of appropriate reward system, and lack of sharing opportunities), and technological factors (e.g. inappropriate information technology systems and lack of training). Although Riege (2005) categorises these factors on 'individual', 'organisational' and 'technological' levels, it is understood that knowledge sharing is a behaviour of choice for individuals (e.g. Ajzen, 1991) and thus these factors can motivate or hinder people's intentions and the subsequent behaviour. Therefore, the factors are reviewed on the basis of how they affect individuals. This is also in accordance to the unit of analysis adopted in this research, discussed in section 3.2.4, where the aim was to understand individuals' knowledge and experiences and amalgamating these in light of the organisational context to understand the overall organisation's practices.

The following sections identify a number of human, organisational and technological factors that that have been found to motivate or hinder knowledge sharing from existing literature. The factors identified include social interconnection, trust, perceived benefits, support from management and the use of technologies and systems. In addition, the issues of knowledge hiding and hoarding and the importance of knowledge protection will also be discussed.

2.3.2.1 Human

2.3.2.1.1 Social connections

According to Fullwood et al (2013), intrinsic aspects such as personal obligation, gratitude and trust are more likely to influence social exchange such as knowledge sharing behaviour, as opposed to extrinsic aspects. Further, Reagans and McEvily (2003) argue that social connection with the knowledge receiver is likely to motivate the knowledge owner to share knowledge.

On a group level, however, a study by Thomas-Hunt et al (2003: 464) contradicted Reagans ad McEvily's (2003) argument and found that "socially isolated members participated more in discussions and emphasized more of their unique knowledge than did socially connected members" as this improved the way other team member perceived them. Moreover, Thomas-Hunt et al's (2003) study also found

that, within groups, those members who were better socially connected, tended to give superior attention to the knowledge contributed by the socially secluded members versus that by their socially connected colleagues, although they were more favourable in evaluating the knowledge of the latter. Furthermore, another study of groups by Phillips et al (2004) identified that groups with congruence of social and knowledge ties effectively utilised information and outperformed those groups with incongruent social and knowledge ties. However, the outcomes of another part of the same study with slightly larger groups suggested that congruence can lead to divisions amongst subgroups which can have a negative impact on performance. Therefore, the results of this study by Phillips et al (2004) to some degree coincide with that by Thomas-Hunt et al (2003) where findings suggest that, in groups where members with unique information are a minority, knowledge contribution is better acknowledged.

Assessing the outcomes of the two studies, by Thomas-Hunt et al (2003) and Phillips et al (2004), the results suggest that individuals may be motivated to contribute their knowledge where (i) they feel it is unique and (ii) being shared with individuals who are not socially connected to them. This could be because the individual feels he or she is making a new and valuable contribution and because the less socially connected recipients show high interest in receiving that knowledge. However, although the recipients show interest in receiving the knowledge, they may not always evaluate it favourably. One possible reason for this could be a lack of trust due to the lack of social connection between the knowledge provider and receiver. Moreover, Raab et al (2014) make the argument that whilst weak ties may be favourable for discovery of new knowledge, it is strong social ties that support complex knowledge sharing and facilitate effective knowledge dissemination. It was also noted that individual-level knowledge sharing requires common ground for understanding to enable all the individuals involved to extract what they find useful (Raab et al, 2014).

2.3.2.1.2 Trust

When looking at knowledge sharing from a human behaviour perspective, the role of trust has been recognised as an important element by various researchers (e.g. Pillai et al, 1999; Wasko and Faraj, 2005; Ritala et al, 2015). According to Mayer et al (1995: 712), trust is “the willingness of a party to be vulnerable” and Wasko and Faraj (2005: 43) argue that trust “develops when a history of favourable past interactions leads to expectations about positive future interactions”. Trust between the interactions of individuals is one of the fundamental principles of an effective social exchange (Blau, 1964). Various authors associate trust with a variety of behaviours.

For example, Pillai et al (1999) associate it with organisational citizenship behaviour (i.e. voluntary behaviour that falls outside normal job duties and that which benefits the organisation), Dirks (1999)

relates it to team performance, Butler (1999) with the sharing of information, and Naquin and Paulson (2003) link it to the desire for future interactions. Staples and Webster (2008) stress trust is a perquisite for social exchange such as knowledge sharing. Moreover, they break down this trust into two different types between a knowledge sender and receiver; a knowledge requester needs trust in the knowledge provider to ensure that the knowledge provided is accurate and helpful, and, the knowledge provider must trust the knowledge receiver to handle and use the knowledge appropriately (Staples and Webster, 2008). Similarly, Park and Lee (2014) also describe trust between two individuals as a prerequisite for knowledge sharing behaviour.

Knowledge sharing is an act of reciprocity between two or more parties, which can take place for the benefit of the individual(s), team or the wider organisation, and therefore trust based relationships could play a fundamental role in driving successful knowledge sharing. Research has identified that when there is trust present, an individual's motivation to supply useful knowledge improves (e.g. Tsai and Ghoshal, 1998; Andrews and Delahaye, 2000), as well as the motivation to listen to and understand the knowledge given by others (Mayer et al, 1995). Moreover, Ritala et al (2015: 24) claim that significant trust between the collaborative partners deepens knowledge sharing as "trust and positive reciprocity serve as important moderators between shared tacit knowledge and innovation". Yet, a lack of trust between the knowledge provider and receiver becomes a barrier to knowledge sharing (Levin and Cross, 2004). However, Bakker et al (2006: 595) argue that knowledge sharing should not be determined based on 'trust' because social capital, generated when social structure or network in the organisation leads to positive outcomes to goals, does not inhabit in trust but rather in team membership. On the other hand, they also claim that, while the presence of high levels of trust does not necessarily mean that individuals are more likely to share knowledge, a lack of trust may inhibit individuals' knowledge sharing motivation.

2.3.2.1.3 Perceived benefits

Cabrera et al (2006: 250-251) explain that an employee may adopt knowledge sharing by the perceived rewards associated with it, because "perceived rewards have been shown to have a significant effect on many work behaviours". Cabrera et al (2006) also argue that rewards are tied to behaviours that are separate from the usual duties of a job role, such as voluntary training and organisational citizenship behaviour that entails additional activities to the job specification. Such voluntary training and development activities are attractive to individuals for various reasons, such as receiving rewards in the form of interesting work in the future, pay rises, promotions or being able reach their full potential (Cabrera et al, 2006).

Whilst some studies identified the benefits of monetary rewards for more formal and measurable types of knowledge sharing (e.g. Bartol and Srivastava, 2002), Sedighi et al (2016) argue that knowledge management incentives have typically been of a psychosocial and intangible nature in accordance with social exchange theory where individuals voluntarily engage in activities such as knowledge sharing if the benefits are perceived to be greater than the costs. Based on social exchange theory – the assumption that individual self-interest is the driver behind people's actions – every time something of value is given, it should prompt the receiver to reciprocate as this would create the basis of a mutually rewarding exchange process (Serenko and Bontis, 2016). Thus, Serenko and Bontis (2016) assert that based on the social exchange theory, the motivation behind employees sharing knowledge with their colleagues is the expectation to receive something valuable in return i.e. reciprocation, for example: "employee A may share his or her knowledge with employee B upon request only after negotiating or assuming that B will also share his or her knowledge with A when needed" (pp. 1206).

Although Yao et al (2007) claim that a lack of incentives can be a knowledge sharing barrier, there are opposing arguments that claim that extrinsic reward schemes can sometimes become a barrier to knowledge sharing. For example, Huber (2001) debates that payment rewards based on performance can discourage knowledge sharing if they make individuals struggle with distinguishing themselves from their peers in terms of performance. Furthermore, studies such as Osterloh and Frey (2000) and Robertson and Swan (2003), have recognised that formal initiatives such as extrinsic reward systems may have a counter-effect on existing intrinsic practices and motivations amongst individuals and this could lead to long term damage to knowledge sharing behaviour and thus, organisational behaviour.

2.3.2.2 Organisational

2.3.2.2.1 Leadership

Martiny (1998) claims that change must be driven by management in the form of clear support and motivation. Furthermore, Martiny (1998) also asserts that employees are willing to share knowledge if they feel that it is a type of behaviour that is desirable and expected by management. A study which investigated factors such as employees' perceptions of the support from management for knowledge sharing found that "employees are interested in acting in accordance with management direction" and therefore seeing management's commitment to knowledge sharing creates a more positive knowledge sharing culture amongst employees (Connelly and Kelloway, 2003: 298). This is further supported by another study a few years later by Cabrera et al (2006) who investigated possible factors that could encourage knowledge sharing and found that in conjunction with various other factors, perceived support from peers and supervisors was reported by employees as a significant predictor of knowledge sharing.

Donate and Pablo (2015) highlight the importance of knowledge-oriented leadership in knowledge-intensive organisations as such leadership "behaves like a dynamic capability, with a focus on the continuous reconfiguration of a firm's knowledge position through initiatives to articulate, codify, and utilize both tacit and explicit knowledge" (pp. 366). Their study results found that knowledge-oriented leadership contributed to creating the right conditions for KM by integrating disparate organisational practices and best mediating KM practices, leading to improvement in the organisation's innovation (Donate and Pablo, 2015). Riege (2005) argues that a lack of support and direction from management in terms of clarity in communication and the benefits and values of knowledge sharing can be a barrier to knowledge sharing.

Other literature and researchers' views about the role of management in knowledge sharing come to different conclusions. For example, Mueller (2012) argues that knowledge sharing is recognised as a key activity in the workplace, it is still not classified as a formal part of work and thus the responsibility of creating a knowledge sharing culture lies with all employees in the organisation, not just the management. Mueller (2012) also argues that management should not interfere with informal activities such as knowledge sharing, as this would enable employees to take personal responsibility for knowledge sharing.

Raab et al (2014) explored the role of management in the effectiveness of knowledge sharing in a globally dispersed organisation. The study found that whilst management involvement reduced cultural barriers to knowledge sharing, it did not have any influence on trust – which has been widely recognised as a necessary prerequisite for effective knowledge sharing, particularly concerning tacit knowledge (Raab et al, 2014). This study by Raab et al (2014) may be supportive of Mueller's (2012) argument that employees' trust in management, and vice versa, is what fosters knowledge sharing. This may be suggesting that rather than management directly being involved in knowledge sharing initiatives, playing a supportive role and nurturing a culture that facilitates knowledge sharing may be more important.

2.3.2.2.2 Organisational culture

The role of organisational culture in knowledge sharing has been acknowledged by various researchers (e.g. McDermott and O'Dell, 2001; Riege, 2005; Wang and Noe, 2010; Fullwood et al, 2013; Ni et al, 2016) in the discipline of knowledge management. According to Ni et al (2016) knowledge management needs an environment that facilitates the capturing, utilising, sharing, and creation of knowledge, such an environment is intangible and usually associated with the organisational culture. Moreover, it is argued that an organisational culture has direct and indirect influences on the knowledge sharing behaviour of individuals, thus it is important for an organisation to take into account the role of culture when developing its practices (Ni et al, 2016; Wang and Noe, 2010). Similarly, Fullwood et al (2013) stress

the importance of accommodating the organisational culture when designing knowledge management strategies, particularly when the aim is to foster and facilitate knowledge sharing.

McDermott and O'Dell (2001) claim that culture is often perceived as the key barrier to effective knowledge sharing, and, Riege (2005) also emphasises that organisational culture becomes a barrier when it does not provide the necessary support for knowledge sharing. However, cultural barriers to knowledge sharing are described to arise from how the knowledge management is designed and implemented, rather than the culture itself (McDermott and O'Dell, 2001). Thus, it is not the culture that is required to change but rather "involves balancing the visible and invisible dimensions of culture; visibly demonstrating the importance of sharing knowledge and building on the invisible core values" (McDermott and O'Dell, 2001: 84).

Whilst the connection between organisational culture and knowledge sharing has been commonly acknowledged (e.g. Riege, 2005; Mueller 2012; Raab et al, 2014), there are some differences of opinions regarding which of the two concepts takes precedence. Islam et al (2015) describe the right organisational culture as a prerequisite for knowledge sharing, and similarly, Rivera-Vazquez et al (2009) stress the importance of establishing a pertinent culture that will encourage individuals to share knowledge, as the resistance to knowledge sharing and change is affected by cultural aspects (Davenport and Prusak, 1998). On the other hand, Riege (2005) concludes that organisations attempting to adjust their culture to fit the knowledge management strategies and initiatives often leads to the failure of knowledge sharing, thus, instead, the initiatives should be designed to fit the organisation's existing culture. The role of culture is not always seen from the perspective of a knowledge sharing enabler or barrier, but researchers such as Liebowitz (2008) offer an alternative view and discuss the possibility of using knowledge management to inform or influence organisational culture. When exploring whether culture should be changed as part of the knowledge management initiatives, McDermott and O'Dell (2001) draw the following conclusion:

> *"Even when you plan to use sharing knowledge as a way to change the organization, our research suggests that the best strategy, ironically, is to first match the values and style of your organization. Don't start out a new campaign and new structures for sharing knowledge. Find the knowledge sharing networks that already exist and build on the energy they already have"* (McDermott and O'Dell, 2001: 85).

2.3.2.3 Technological

2.3.2.3.1 Technologies and systems

In modern organisations, there are demands for the right knowledge to be available at the right time for various stakeholders, which has led to the implementation of appropriate technological systems to

support knowledge management (Davison et al, 2013). Moreover, Hendriks (1999) suggested the use of new software systems that facilitate knowledge sharing as this would reduce obstacles such as chronological, social and physical distances and can create new motivation for the users to share knowledge. These systems are sometimes also known as knowledge management systems (KMS) and are specifically implemented to facilitate the documenting, distributing and transfer of information between employees (Noe et al, 2003; Voelpel et al, 2005). According to Tampoe (1996) the motivation behind organisations introducing technological systems was to provide their employees with tools that support and enhance their knowledge sharing skills. The implementation of technologies not only provides the means to access knowledge and information, but also enables people to find and access what they need, when they need it (Paghaleh et al, 2011).

The significant reduction in the cost of information and communication technologies in recent years has created more opportunities for organisations to connect their employees and facilitate knowledge sharing to accomplishing their tasks, regardless of geographic distances (Raab et al, 2014). However, Babcock (2004: 47) claims, "since knowledge management became all the rage in the high-flying 1990s, companies have poured tremendous resources into knowledge management technology that has failed miserably or shown little results". Further, Babcock (2004) states that there are various reasons for such failures; however, it is primarily due to technology being too complex and a lack of consideration given to the barriers posed by human nature to knowledge sharing. Similarly, Raab et al (2014) reports that at the group level, technologies are unable to prevent breakdowns of knowledge transfer across distributed sites. Thus, the role of technology in knowledge sharing should be of an enabler, rather than the driver (Martiny, 1998).

Ruddy (2000: 38) says that a "delicate marriage of technology with a keen sense of cultural or behavioural awareness" is essential in order to effectively share knowledge. Riege (2005), argues that although technology use is encouraging and supportive as it offers instantaneous access to large sources of knowledge and information and enables collaborative working, it can also bring a number of challenges and barriers. For example, knowledge sharing becomes challenging for people if there is a "lack of integration of IT systems and processes", "lack of technical support", a gap between what individuals require and what the systems provide, and a lack of familiarity and training on systems (Riege, 2005: 29). Furthermore, Riege (2005) also claims that unrealistic expectations of employees in relation to the technology's capability, as well as a lack of communication about the advantages a new system can bring over existing systems can also have a negative impact on knowledge sharing. In addition to the reasons identified by Riege (2005), Davison et al (2013) add that employees are often unwilling to use knowledge management systems due to poor alignment between the organisational strategy and the system, and, the system being designed around the existing 'available' knowledge, i.e. the focus being on the supply of knowledge rather than the demand.

Further, in relation to knowledge management technologies, previous research has focused primarily on the explicit and formal types of knowledge, whereas a significant amount of organisational knowledge is held tacitly by individuals (Davison et al, 2013). Davison et al (2013: 93) claim that although efforts are made to convert this knowledge into explicit forms for valuable formal representation, the challenge is that "efforts to document knowledge often fail to preserve its contextual richness. The remaining knowledge is rather dry and context-free".

2.3.3 Knowledge hiding and hoarding

The concepts of 'knowledge hiding' or 'knowledge hoarding' have also been highlighted (e.g. Davenport and Prusak, 1998; Hislop, 2003; Connelly et al, 2011; Serenko and Bontis, 2016) as possible barriers to knowledge sharing. The term 'knowledge hiding' has been defined by Connelly et al (2011: 65) as "an intentional attempt by an individual to withhold or conceal knowledge that has been requested by another person". Further, Connelly et al (2011) also make a distinction between the behaviours of knowledge hiding and a lack of knowledge sharing in the following way:

> *"Behaviourally, the two constructs might appear quite similar but the motivations behind knowledge hiding and a lack of knowledge sharing are strikingly different. Knowledge hiding might be motivated by a number of different reasons (e.g., prosocial, instrumental, laziness, etc.), whereas a lack of knowledge sharing is likely only driven by an absence of the knowledge itself." (*Connelly et al, 2011: 67).

Moreover, Serenko and Bontis (2016: 1199) also stress that "knowledge hiding and knowledge sharing belong to unique yet possibly overlapping constructs". As per the social exchange theory discussed earlier, reciprocation plays an important role in knowledge sharing behaviour (Hall et al, 2010), which means that negative actions, such as intentional knowledge hiding, may equally be reciprocated (Serenko and Bontis, 2016).

'Knowledge hoarding' on the other hand, is when an individual accumulates knowledge that may or may not be shared in the future (Hislop, 2003; Evans et al, 2015). Although there may be some overlap between the two concepts e.g. both "can be characterised as a repertoire of possible behaviours that can be classified as withholding knowledge" (Connelly et al, 2011: 66-67), the key difference between them is that 'knowledge hiding' is when an individual intentionally conceals knowledge that is requested by another individual, whereas 'knowledge hoarding' is the accumulation of knowledge not necessarily requested by another individual.

Both behaviours can be barriers to knowledge sharing and therefore require further research from a humanistic perspective. However, changing the behaviour of individuals has been recognised as the fundamental challenge faced by organisations aiming to increase their employees' knowledge sharing

behaviour (Bock et al, 2005). One reason for this could be the natural human tendency of hoarding knowledge as a way of caution (Davenport and Prusak, 1998) to prevent unintended exposure of the knowledge. According to Hansen et al (2005), the problem of hoarding knowledge may not necessarily be an inclination but due to competition between peers, which leads to the hoarding and lack of cooperation.

Connelly et al (2011) note the results of a newspaper poll carried out among 1700 individuals which shows that 76% of employees hide knowledge from their co-workers (The Globe & Mail, 2006). However, a more recent study by Serenko and Bontis (2016) found that individuals believe that they engage less in knowledge hiding behaviours as compared to their colleagues. Moreover, the study also found that having knowledge policies or knowledge management systems implemented in the organisation did not impact intra-organisational knowledge hiding, whereas having a positive organisational knowledge culture reduced such behaviours (Serenko and Bontis, 2016). One possible reason identified behind knowledge hiding motivation was job security, as well as the employee tendency to reciprocate negative knowledge behaviours (Serenko and Bontis, 2016).

Serenko and Bontis (2016) stress that counter-productive behaviours such as knowledge hiding are unrepresented in the KM research. Thus, further research into knowledge hiding and knowledge hoarding is likely to unveil other possible causes, their impact on knowledge sharing and the organisation.

2.3.4 Knowledge protection

Despite knowledge sharing having been widely recognised in research as a central aspect of KM, knowledge protection has not received the same level of attention (Ilvonen et al, 2016). As discussed earlier in this literature review, knowledge is a source of competitive advantage and thus knowledge sharing is a valuable practice as it benefits the organisation by creating new knowledge and allows individuals to gain access to knowledge that will support them in their work (Raab et al, 2014; Fischer and Ostwald, 2001; Alavi and Leidner, 1999). However, Gold et al (2001) stress the importance of protecting valuable knowledge from illegal or inappropriate theft. Furthermore, Desouza and Awazu (2004: 22) argue that “organisations are naïve in their attempts to secure their most valuable resource: knowledge” and if an organisation loses its key resource, i.e. its proprietary knowledge resources and innovative capabilities, it would collapse.

According to Desouza (2006) and Desouza and Vanapalli (2005), securing knowledge should occur at three levels, which are ‘product’, ‘process’ and ‘people’. However, it is also acknowledged that achieving knowledge protection is not easy and has various challenges associated with it. Desouza (2006) asserts that – unlike the case of protecting explicit knowledge or ‘information’ through information security

tools - knowledge protection is a problem as knowledge is difficult to visualise, in particular tacit knowledge that resides in people's heads or is embedded in processes, thus if this knowledge cannot be visualised, how can it be managed? Moreover, knowledge has a 'flux' nature and constantly changes as it is exchanged between entities which makes it difficult to pinpoint, capture and protect (Desouza, 2006).

When reviewing the literature, the scarcity of literature and empirical research on knowledge protection was noted, particularly in the years prior to 2010. Some of the empirical studies identified from those years includes that by De Faria and Sofka (2010) who researched formal and informal protection strategies for preventing knowledge spillovers in multinational organisations; Norman (2004) also researched into protection of knowledge in strategic alliances; and Zhao (2006) investigated intellectual property rights (IPR) protection levels in multinational organisations.

According to Shedden et al (2011), a possible reason for such limited research on knowledge protection in the past could be the natural conflict between knowledge sharing and knowledge protection. Further, they explain that on the one hand, knowledge sharing is a valuable and encouraged practice that provides useful knowledge to employees for their job, whilst on the other hand, from an information security perspective, knowledge sharing activities bring new risks to the organisation of knowledge leaking into the wrong hands (Shedden et al, 2011). However, research has lacked focus on knowledge protection, in particular about making knowledge sharing a more 'secure' activity in organisations.

Although, overall, there are very few studies that have addressed the importance of knowledge protection, in more recent years, this area has started to gain more attention. For example, Vayrynen et al (2013) explored knowledge protection challenges of social media for organisations, Ahmad et al (2014) studied organisational knowledge protection strategies in organisations in the interest of competitive advantage and preventing leakage, and Manhart and Thalmann (2015) investigated relevant literature on knowledge protection and highlighted the scarcity of such literature. Ilvonen et al (2016) also explored the contradictory nature of knowledge sharing and protection in various organisations in Finland; the research found that there was uncertainty around 'knowledge security' as it was not considered as a broad-spanning concept but rather seen merely as a technological issue. It was therefore emphasised that there is the need for developing and implementing a clear knowledge protection strategy in organisations that is clearly understood by employees (Ilvonen et al, 2016).

Despite the scarcity of knowledge protection literature in previous years (e.g. Shedden et al, 2011; Manhart and Thalmann, 2015; Ilvonen et al, 2016), knowledge protection and its integral role in knowledge management is starting to gain more attention in recent years.

2.4 Information security

Information security has become a globally recognised discipline (Gifford, 2009) within organisations and academia, and, according to Albrechtsen (2007), it is one of various requirements of an employee's or employer's working day. The purpose of information security is to protect the valuable information resources of an organisation through the application of appropriate policies, standards and procedures as part of the complete information security program supports the organisation to meet its business objectives (Peltier, 2016). However, from reviewing a wide variety of information security literature, it has been found that there exist differences in the definitions, purpose and adoption of information security by different researchers and organisations.

The following sections of this literature review analyse and discuss various definitions of 'information security', different human, organisational and technological level information security threats, followed by a discussion of various human, organisational and technological information security measures, and finally a discussion of the impact that information security has on human behaviour.

2.4.1 Definitions of 'information security'

The information security phenomenon is far reaching and involves various approaches that attempt to protect valuable information assets and mitigate threats (Crossler et al, 2013). According to Winkler (2011) information security consists of the management of loss of information and any resulting cost of that loss. However, a more common definition of information security is that it involves protection of the confidentiality, integrity and availability of information, also commonly known as the CIA triangle (Gordon and Loeb, 2006; Grama, 2010; Gifford, 2009; Kim and Solomon, 2010). Gordon and Loeb (2006: 121) elaborate on each of these terms, i.e. "confidentiality (protecting private information from unauthorized individuals), availability (providing timely access to information to authorized users), and integrity (protecting the accuracy, reliability, and validity of data and databases) of information". In addition, authentication i.e. ensuring that the correct individuals are using the system, and non-repudiation i.e. ensuring that a legitimate user is not able to deny having performed a task on the system, are also presented as parts of definitions of information security (e.g. Calabrese, 2004; Gordon and Loeb, 2006; Siponen and Oinas-Kukkonen, 2007).

In the literature discussed so far, information security has been described from a technical perspective where the focus has been on protecting valuable organisational information via technological means. In relation to this, Coles-Kemp (2009: 181) points out that information security not only consists of the conventional technologies such as "access control technologies, authorisation technologies, authentication technologies, etc. but also organisational policies and procedures that are constructed

into a material form by organisations". Similarly, a variety of literature discusses the role of policies in defining information security. For example, it is the view of Bishop (2006: 3) that security should not be treated in a purely technical way, as "policy defines security". Klaic and Hadjina (2011) also argue that information security cannot be achieved via technology alone but with a more comprehensive approach of the information security policy that consists of people, processes and technology. In addition, according to von Solms (2001), information security policy is a 'mandate' and prerequisite that must be in place before the initiation of any information security implementation.

Other literature (e.g. Coles-Kemp, 2009; Albrechtsen, 2007; Stanton et al, 2005), observes information security from a human perspective, taking into account the important role of humans in defining information security policies and putting information security into practice. Traditionally, information security has been dominated by mathematical scientists and technologists as it was seen as a technological or mathematical problem only, however, this is no longer the case, as the human dimension to information security is now being recognised (Coles-Kemp, 2009). Further, Bishop (2006: 3) argues that security is a human issue and if information security is treated as a purely technological issue, it will create gaps that technology is unable to fill and not enable the organisation to produce proficient security experts. Albrechtsen (2007) makes a similar case where he argues that the role of users is a vital component in the achievement of a holistic information security management.

Comparably, Stanton et al (2005) claim that correct and constructive human behaviour can enhance the effectiveness of information security whereas incorrect and negative behaviour could inhibit the effectiveness. Yet, there are contrary views to the role of humans in information security. For example, Odlyzko (2010) argues that humans are incapable of developing secure systems, or, if they do manage to develop them, they are unable to use them in a secure manner due to the level of flexibility in their work habits. Moreover, Besnard and Arief (2004) argue that, in the case where information security might inhibit their work, humans are likely to overlook security if it means that their work becomes easier.

Anderson (2001: 9) brings another viewpoint to the definition of information security and argues that "Information security is about power; it is about raising barriers to trade, segmenting markets and differentiating products" and claims that information security is a far deeper problem than it is understood to be, where simple technical approaches are guaranteed to fail. Additionally, by associating information security with ethics and looking it at from a moral point of view, Siponen (2001) claims that security activities will be inspired by a concern to prevent certain negative actions.

The definitions of information security discussed so far aim to provide an overview of the variety of differing perspectives held by researchers in this discipline and show evidence of the ambiguity in an overall definition of the subject as discussed earlier. However, an interesting observation made at this

point is that very rarely do researchers discuss security from the point of view of protecting 'knowledge', which would include tacit knowledge in addition to information or explicit knowledge. In information security studies "there is a tendency to focus on the materiality of security using epistemologies related to positivist forms of knowledge" (Coles-Kemp and Hansen, 2017: 466). Further, almost all of the literature reviewed discusses the security of 'information', primarily in relation to technological systems or about humans having the right awareness about information security (e.g. Albrechtsen, 2007; Anderson, 2003; Gordon and Loeb, 2006; Klaic and Hadjina, 2011; Lebek et al, 2013). Yet, only a brief mention of protecting 'knowledge' is made by Von Solms and Von Solms (2004). This does pose the question about the value and importance of protecting knowledge of individuals, in particular *tacit* knowledge, in the discipline of information security.

Within this research, information security is defined as any technical or non-technical measure taken by an organisation to prevent the loss or leakage of its valuable 'knowledge' and 'information' to third parties, whether it is intentional or accidental. Furthermore, the knowledge could be in the form of tacit knowledge (unarticulated and held by employees or embedded in processes) or explicit knowledge (codified in the form of documents or held within systems).

2.4.2 Information security threats

Gordon and Loeb (2006) argue that, despite organisations implementing prevention measures, information security breaches are common, thus organisations must have the ability to detect and rectify information security breaches as they happen. Yet, Anderson (2003) claims that even well-established organisations that have disaster response measures in place, could still suffer significantly from the occurrence of a security breach.

Regardless of the type of security breaches and how they occur, significant costs can incur for organisations to investigate these breaches as well as dealing with the cost and impact of the loss of valuable organisational information. Similarly, Albrechtsen (2008: 60) argues that "although information security is resource demanding, information security breaches may cost even more". It is therefore important to understand not only the information security threats for organisations but also the prevention mechanisms that are being used in the industry.

The following sections draw attention to the types of threats i.e. human, organisational and technological, and address some of the key prevention measures that organisations have adopted.

2.4.2.1 Human

Marks and Rezgui (2009) assert that most security managers focus primarily on technical facets and solutions, yet research in the information security discipline strongly suggests that non-technical aspects

are equally as important as the technical in protecting an organisation's sensitive information (Siponen and Oinas-Kukkonen, 2007; Dhillon and Torkzadeh, 2006). Siponen and Oinas-Kukkonen (2007) also argue that in many studies, due to their quantitative nature, there tends to be a lack of emphasis drawn to the non-technical aspects of information security, such as, the role of human behaviour. Crossler et al (2013) also draw the same conclusion - a predominant weakness in information security is the individual human user with the organisation, yet existing research on information security has predominantly focused on technical issues.

"Only amateurs attack machines; professionals target people" (Schneier, 2000).

Often in information security, humans are seen as the weakest link against internal and external threats (Spears and Barki, 2010; Siponen, 2000), and the vast majority of breaches of security are caused by existing internal employees (Crossler et al, 2013; Dhillon and Backhouse, 2000). This has been the case despite the significant developments in security technologies, policies and procedures (Crossler et al, 2013; Hu et al, 2012). Yet, the majority of the research carried out to prevent information security breaches is technical and concentrates on encryption and access control (Coles-Kemp 2009; Gordon and Loeb, 2006).

Not enough attention has been given to information security awareness amongst individuals and its incorporation into their behaviour in the workplace. This awareness is crucial as studies suggest that to address the information security management issues and strategies and in order to protect an organisation's information assets, human input is essential (e.g. Vroom and Von Solms, 2004; Albrechtsen, 2007; Bulgurcu et al, 2010).

Dhillon and Backhouse (2000) make the claim that an employee's integrity in their role does not always remain and once they have been employed in the organisation, the organisation needs to consider ways of maintaining their integrity. Further, it is also argued that most security breaches are caused by existing employees which could be due to pressures on individuals, personal problems such as marital, financial or medical issues, or perhaps "office romances are common backdrops for internal computer frauds" (Dhillon and Backhouse, 2000: 127). Similarly, Shropshire (2009: 296) carried out a study and found congruence to this argument where it was found that a "significant relationship exists between financial hardship, relationship strains, and the theft and sale of proprietary data by insiders; and recent firings, substance abuse, and relationship strains are related to information system sabotage". Contrarily, according to Cappelli et al (2006), the security breaches caused by humans in many cases are not spurious or with any malicious intent, but rather unintentional, accidental or out of the involved party's control.

Stajano and Wilson (2011: 70) argue that, although humans are recognised as the weakest point in information security, the responsibility does not fall entirely on their shoulders as attacks are only

possible because “security engineers only thought about their way of protecting the system, not about how real users would react to maliciously crafted stimuli”. Further, Coles-Kemp and Hansen (2017: 464) suggest the need for a sociotechnical approach to information security that “must be modelled to acknowledge, at least, the connection between an individual's security needs and the protection of assets”.

2.4.2.2 Organisational

According to Al-Omari et al (2012), information security policy compliance is currently one of the biggest challenges and concerns for organisations. Compliance by employees is critical to making information security programs successful, but it is also argued that humans are the weakest link in the security domain, whilst they are also assets that need to be managed effectively by organisations (Al-Omari et al, 2012). Further, an employee’s attitude towards compliance of security policies may be determined by possible consequences that they may experience. For example, the time and effort required if they comply or the punishment if they do not comply (Bulgurcu et al, 2010).

2.4.2.3 Technological

With the aim to become more effective, efficient and responsive, organisations have given great importance to the use of networks and IT based information and communication systems. However, the use of such systems has resulted in an increase in information security abuse (Dhillon and Backhouse, 2000). Furthermore, the increase in the use of computers and the Internet has also led to an increase in the importance of information security (Siponen and Oinas-Kukkonen, 2007). Stajano and Wilson (2011: 70) argue that “systems are often vulnerable to attack despite being protected by elaborate technical safeguards”. Modern organisations require collaborative working and sharing of information between different departments, sites, clients and third parties, where such collaboration has meant that more organisations are increasingly connecting to the Internet. Yet, Herley (2009: 133) argues that, Internet related security attacks are immense and increasing as “computers are constantly targeted by viruses, worms, port scanning software, spyware, adware, malware, keyloggers, rootkits, and zombie and botnet applications”. In a more recent study, Skopik et al (2016: 154) argue that the Internet threat landscape is fundamentally changing where there is a major shift from amateur attacks to highly organised, targeted and sophisticated cyber-crime that bypass common security measures, where the intensions behind such attacks are commercial.

Shropshire (2009: 297) asserts that “hackers, bots, viruses, and worms are capable of severely crippling or disabling information technologies and systems”. However, this is only possible once they have gained access to the organisation’s internal resources. One of the channels used to gain this access into organisations’ internal resources is the use of personal Internet-enabled devices such as mobile phones

and tablets. Many employees use these devices to access organisational systems, emails and data as well as their personal information and programs under the 'Bring Your Own Device' trends that many organisations allow.

2.4.3 Information security measures

Posthumus and von Solms (2004) make the argument that the presence of information in organisations does not only expose it to technological risks but also to people and processes that come into contact with it. Furthermore, according to Smith (2013: 20), "IT systems will never be impervious to attack – recommendations to improve seem endless. Combating a persistent actor who would like something you've got is a very hard challenge. The only solution is many solutions – a truly layered approach to security at every level – no single technical solution can help you win". Yet on the other hand, de Oliveira Albuquerque et al (2014) argue that despite heavy investments in the information security, the problem remains that it may still be insufficient to protect against security risks and breaches. It is also claimed that information security is not well understood by organisations, where the security approaches are not designed tailored to the problem itself or take into account all the necessary facets (de Oliveira Albuquerque et al, 2014).

Referring to it as 'a divided field of study', Coles-Kemp and Hansen (2017: 466) highlight the separation in information security "between the human security needs of the actors and the data security needs of the infrastructure" identified commonly in studies. The focus of information security in academic research and in practice has primarily on information technology systems, their infrastructure and protecting "positivist forms of knowledge" (Coles-Kemp and Hansen, 2017: 466) including data and information. Furthermore, Ahmad et al (2014) also argue that traditionally in information security, the focus of measures has been on protecting 'information' or 'data', and consequently, the concept of 'knowledge' has been overlooked. Thus, although information security practices are considered to be aligned with organisational goals, they typically are not designed with the aim to maintain the organisation's competitive advantage and prevent *knowledge* leakage (Ahmad et al, 2014).

The following sections discuss the imperative measures that organisations take to prevent theft or accidental loss of its critical business information. This includes human, organisational and technological level measures.

2.4.3.1 Human

Furnell and Thomson (2009) argue that in information security, humans are often perceived as an obstacle instead of an asset. Further, they are also of the opinion that one of the key goals of information security should be about "establishing the correct mind-set, and ensuring that people are working for

(or at least with) security rather than against it" (Furnell and Thomson, 2009: 5). To inaugurate this mind-set and begin to improve individuals' information security behaviour, it is vital to create awareness and provide education of the importance and purpose of information security. Siponen (2001: 24) describes the concept of information security awareness as the process that makes humans "aware of security objectives (and further committed to them)". Furthermore, Siponen (2001) also argues that information security awareness should form an integral part of the general knowledge of individuals where anyone who sees information as an important asset, should also be aware of the potential threats associated with that information.

Not realising the fundamental importance of information security awareness between humans is described as one of the ten most 'deadly sins' of information security management by Von Solms and Von Solms (2004). In addition, Von Solms and Von Solms (2004) stress that awareness programs will make humans aware of the risks of the organisation's IT infrastructure, the potential destruction they can cause, the organisation's policies, procedures and standards, as well as the precautions that can be taken to prevent security threats.

The pace at which organisations move forward, in particular with implementing new technologies and working in collaboration with third parties and customers, make it vital for them to educate employees continually and consistently and provide awareness of the existing and potential security threats. Additionally, Coles-Kemp (2009) argues that awareness and education should be designed to respond to the cultural variations within organisations to avoid the difficult and expensive gaps from emerging between the security policies and security practices.

2.4.3.2 Organisational

The challenge for organisations is creating awareness of the policies and ensuring that these policies are followed by all employees. Al-Omari et al (2012) argue that compliance with security policies is influenced by quality of information, facilitating conditions and habits of employees. On the other hand, according to Knapp et al (2006) it is the support from top management without which the level of enforcement of security policies will diminish.

In relation to this, Al-Omari et al (2012) argue that security policies need to be designed to be effective, and this can only be achieved if users' security awareness is enhanced to comply with the policies. Thus, the role of humans in putting security policies into practice is an important element.

2.4.3.3 Technological

In academia and in practice, the focus of information security has been on technological systems and their infrastructure to protect data and information (Coles-Kemp and Hansen, 2017). Similarly, according

to various researchers, a majority of the research in preventing information security breaches has also been on technically focused solutions (Gordon and Loeb, 2006; Coles-Kemp, 2009; Crossler et al, 2013; Soomro et al, 2016). Furthermore, Albrechtsen (2007: 277) argues that technological information security solutions impact and frame the users' behaviour when using information technology systems and act as a "foolproof security mechanism" when they perform an action. However, the "design of security technologies focuses on the protection of data and the usability requirements for that technology. Rarely does the security technology design process address the human security needs of the individual" (Coles-Kemp and Hansen, 2017: 464).

When looking at technical information security protection measures, it is important to do this in the context of the attributes which commonly define information security i.e. confidentiality, integrity and availability. Moreover, Siponen and Oinas-Kukkonen (2007) claim that the use of anti-virus software aims to guarantee that the requirements of confidentiality, integrity and availability are satisfied by a way of ensuring that no malicious access takes place. However, Smith (2013: 20) argues that "many organisations feel protected through simple measures such as antivirus software – which is necessary, but it's just the beginning and certainly not sufficient as part of a layered security strategy".

Organisations need to develop improved measuring mechanisms for technology related information security breaches but, more importantly, they need to develop an information security strategy first and then invest in security measures to protect their valuable information assets (Jones et al, 2009). Jones et al (2009) also stress that these measures must include investment in not only physical IT security e.g. firewalls, anti-virus programs, but also training documentation for employees on the organisation's policies and practices. Thus, the desired level of protection an organisation requires determines the types of information security measures it implements and the amount of money, time and resources spent on these.

Ahmad et al (2014) claim that although information security practices are intended to be aligned with organisational goals, they are typically not wide-spanning and designed with competitive advantage in mind. In addition, Ahmad et al (2014) stress that traditionally in information security, the focus of measures has been on protecting 'information' or 'data', and the concept of 'knowledge' has been overlooked. On the other hand, Coles-Kemp and Hansen (2017: 466) draw attention to the gap in information security between human security needs of individuals and the data security needs of the infrastructure. Soomro et al (2016) synthesise existing information security literature and also stress the need for a more holistic approach for information security management to address such gaps. However, the practice of information security and its associated issues are starting to be recognised in recent years as wide-spanning and being considered in a wider management context (e.g. Phillips, 2013; Siponen et al, 2014; Soomro et al, 2016). Therefore, information security in the current research was recognised as

a multi-layered concept that can affect the organisation in various ways which will be discussed in the Analysis and Discussion chapters.

2.5 Project teams

West (2012) argues that modern organisations continuously face new demands and are required to be innovative, which subsequently makes cooperative work in teams vital to achieve central organisational tasks. In addition, it is also claimed that organisations are now moving away from the conventional and rigid hierarchical structures as "the team rather than the individual is increasingly considered the basic building block of organisations" (West, 2012: 16). Furthermore, within the area of projects in particular, the role of teams is recognised as a key determinant of project outcome and Gido and Clements (2008: 332) argue that the level of effectiveness of the project team can make the difference between project success and failure.

The case study organisation in this research was a project based organisation and the research aimed to explore the practices of knowledge sharing and information security in the context of project teams, therefore it was important to understand this context from existing literature which would subsequently inform the rationale for the research methodology. The following sections of the literature review explore and discuss various definitions of 'teams' and 'project teams', different human, organisational and technological level factors that influence project team performance and success, knowledge sharing in project teams as well as comparing the roles of permanent and contractor project team members.

2.5.1 Definitions of 'team' and 'project team'

Researchers have presented various definitions of a 'team' or 'teamwork'. For example, a common and popular definition still adhered at present is by Cohen and Bailey (1997: 241): "a team is a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems (for example, business unit or the corporation), and who manage their relationships across organisational boundaries".

According to Powell et al (2004: 7), the features of a team are "its unity of purpose, its identity as a social structure, and its members' shared responsibility for outcomes". Similarly, Adair (2011) argues that a team as a group of individuals with a common aim where the roles and skillsets of each individual compliment those of the other individuals. On the other hand, whilst recognising that various business decisions are taken by teams, Bär et al (2011) take into account the diversification of individual team members' opinions and describe a team as an instrument for achieving a compromise-based consensus

whilst reflecting the opinions of all of the team members.

Other research has explored the diversity of teams by making comparisons between 'homogeneous' and 'heterogeneous' teams (e.g. Crown, 2007; Somech, 2006; Earley and Mosakowski, 2000; Cox and Blake, 1991). Further, Adler and Gundersen (2007) describe a homogeneous team as one where all team members come from a similar background and the team generally observes, interprets and evaluates things in a similar manner. On the other hand, heterogeneous teams are those that contain members stemming from different cultural areas (Sembdner, 2011), for example, varying in cultures, skillsets, views and life experiences. Both types of team can bring a variety of benefits as well as challenges to organisations in relation to performance and effectiveness. These will be discussed and compared further at a later stage in this literature review in section 2.5.2.1.2.

The terms 'team' and 'group' are also sometimes used interchangeably, for example, by Purvanova (2013), Bär et al (2011), Adams et al (2006) and Cohen and Bailey (1997). However, other research makes clear distinction between the two terms, since not all groups can be classed as teams (Galbraith and Webb, 2013). Further, Perusich et al (2007) argue that a team contains the same elements as a group, but what differentiates it from a group is that it additionally includes mutual accountability, interrelated parts, corresponding skills and common goals.

A particular type of team known as a 'project team', has become increasingly used by organisations of today as well as receiving a large amount of attention in academic literature. According to Hsu et al (2011), a project team is formed with a set of members with diverse knowledge for the purpose and duration of the project in order to produce a unique product through a set of interdependent tasks. Project teams are used in many industries and are formed to deliver industry-defined products to outside customers or to manage change and deliver value within the organisation (Chiocchio and Essiembre, 2009).

Characteristics such as being temporary in existence, having clearly defined goals and producing outputs of a new product or service, are what differentiate a project team from other types of teams in organisations. Yet, project teams are not always perceived in the same way. For example, despite recognising project team as having a defined purpose, common function and existing for a defined period of time, Benfield (2011) challenges the categorisation of project teams as a type of 'team' and makes a contrary argument that at times, a project team is not a 'real' team because allocating a group of individuals based on an available project does not necessarily mean that those people are in reality working as a team (Benfield, 2011). Despite such views held by some researchers, projects and project teams are increasingly employed by organisations to accomplish numerous organisational goals in the "attempt to survive and grow in dynamic and often unstable business environments" (Sense and Fernando, 2011: 504).

In addition to the project manager, the types of members in a project team can be quite varied. For example, Camilleri (2011) asserts that members can have specific roles based on their specialist skillsets or be flexible where their skillsets can be utilised in a variety of ways, for example, some members could be working full-time on the project whilst others work part-time and members can be cross-functional i.e. from a variety of organisational departments. Furthermore, very often projects require specialist skills that are not available within the organisation and thus the employment of third-party firms or individuals such as contractors, suppliers or vendors are required to work with or as part of the project team (Camilleri, 2011).

Project teams can be 'traditional' where a group of co-located people work interdependently face-to-face to accomplish a project objective (Gido and Clements, 2008), or 'virtual' where a group of people who are distributed geographically, organisationally or by time differences, collaborate to work on a project via technological means (Powell et al, 2004). Hence virtual teams can also sometimes be known as 'computer-mediated' teams (Branson et al, 2008). Further, with focus on the heterogeneity aspects of virtual teams, an in-depth review of literature on virtual teams by Connaughton and Shuffler (2007) found that researchers have used a variety of terms to describe cultural and distributed dimensions of teams. For example, the identified terms used for describing cultural dimensions were 'transnational', 'multicultural', 'multinational', 'global', 'intercultural' and 'international', whereas the common terms used for distributed features of teams were 'virtual', 'dispersed' and 'distributed' (Connaughton and Shuffler, 2007: 390).

In the context of globalisation, various studies have been carried out to identify human, organisation and technological level factors that influence the effectiveness or create challenges for traditional and virtual project teams.

2.5.2 Factors that influence the effectiveness of project teams

Project teams, as compared to other intact organisational teams, typically have a greater level of heterogeneity between the team members, for example, geographic, cultural, religious, educational, experience levels, skillsets and communication levels. With these added levels of complexities, it is important to understand how effective project teams can be nurtured by recognising the motivations and dominant influences within them.

The following sections aim to address and discuss some of the main human, organisational and technological factors influencing project teams.

2.5.2.1 Human

2.5.2.1.1 Social dynamics

When looking at project teams from a social or psychological perspective, Gido and Clements (2008: 332) argue that an understanding of the following are required in order to develop an effective project team:

- the development and growth of teams
- characteristics of effective project teams and barriers to effectiveness
- team building
- valuing team diversity
- ethical behaviour
- sources of conflict during the project and approaches to handling conflict
- problem solving
- effective time management

Cohen and Bailey's (1997: 241) definition of a team has already been quoted: a group "seen by others as an intact social entity embedded in one or more larger social systems (for example, business unit or the corporation), and who manage their relationships across organizational boundaries". In relation to the social aspect of a team, Joshi et al (2007) argue that socialisation fosters the relationships that are essential for collaborative work within teams. Similarly, a study by Kotlarsky and Oshri (2005) found that human related factors, such as social ties, are key to making collaboration successful. However, in contrast, Kotlarsky and Oshri (2005: 39) also argue that, whilst the importance of social aspects has been acknowledged in project teams, it is "very difficult to encourage or foster in the context of globally distributed projects".

In other research, Serva et al (2005) raise the possibility of a negative effect of social influence where issues such as domination or coalitions could create bias in teamwork. The issue of possible social 'loafing' or 'free-riding' where some team members will provide a reduced level of effort when working collectively with peers as a result of social interconnection in teams has also be raised by various researchers as a hindering factor to teamwork (e.g. Crown, 2007; Akgün et al, 2006; Stewart, 2006; Jarvenpaa and Leidner, 1999; Guzzo and Dickson, 1996). On the other hand, it can be argued that 'loafing' or 'free-riding' is less likely to occur in project teams, as compared to other organisational teams such as intact departmental teams, primarily because of the pressures that project team members work under combined with the focus required from them due to their specialist roles in the project.

In addition to the social elements, psychological factors have also been widely recognised as important determinants of project team performance, and thus project success (Chiocchio and Essiembre, 2009). Furthermore, research into team literature by Rasmussen and Jeppesen (2006) discovered a positive connection between psychological variables and teamwork, in particular team autonomy and interdependence across different team types, sizes and circumstances. Moreover, project team members are often physically or geographically separated, especially in the case of virtual teams, which can lead to "feelings of isolation and imbalance created by this physical separation (psychological distribution)" (Connaughton and Shuffler, 2007: 404). Javidan et al (2006) stress the need for team members possessing 'cultural adaptability' which entails mental and psychological abilities to shift between different situations, for example, "ability to do a good job of developing personal relationships while in Egypt and then doing it very differently in France" (p. 404). The influences of cultural factors on project teams will be further discussed in the next section.

Purvanova (2013) carried out a study based on project teams and has introduced the concept of 'feeling known' when interacting with others in a team. The study aimed to find connection between the team members' sense of feeling known and the level of relational trust, own learning and project satisfaction. It was found that feeling known in a team is a significant predictor of team member outcomes for teams interacting face-to-face as well as virtual teams, although it was argued that virtual teams reported feeling less known than face-to-face teams (Purvanova, 2013). Similarly, other related concepts such as social connection and trust between team members have also been recognised as determinants of teamwork effectiveness (e.g. Akgün et al, 2005; Kotlarsky and Oshri, 2005; Connaughton and Shuffler, 2007; Sense and Fernando, 2011).

2.5.2.1.2 Permanent vs. non-permanent team members

As discussed earlier in this section, organisations have increasingly adopted the culture of outsourcing to third parties or hiring contractor staff with specialist subject knowledge to work within project teams. Thus, project teams often consist of a mixture of permanent employees employed by the organisation, third parties working onsite or offsite and contract staff or consultants. Redpath et al (2008) describe this latter category of employees as 'contingent' due to their employment contracts lasting only for the duration of specific tasks or projects. They also argue that contingent staff "typically includes part-time, temporary, seasonal, contract, agency, and self-employed workers" (Redpath et al, 2008; 75). In this research, the two types of staff on project teams will be categorised as 'permanent' and 'non-permanent'.

A study by Ang and Slaughter (2001) identified significant differences between permanent and non-permanent staff. The study revealed that non-permanent staff members tend to have lower autonomy

and task identity, as their roles tend to be specific and task-focused. On the other hand, they identified that permanent staff have greater autonomy and better knowledge of projects from start to finish. The study also revealed that non-permanent members can have restricted access to various resources such as systems and users, and there may be policies that prohibit or restrict their involvement. On the contrary, the study by Redpath et al (2008) found that non-permanent team members are more satisfied overall in terms of hours of work, schedules and employment arrangements, although pay and employee benefit satisfaction were reported as being the lowest. Similarly, Raghavan et al (2008) report that non-permanent employees feel less fairness of benefits when compared to permanent employees, whereas Loi et al (2006) argue that permanent employees are more committed to the organisation.

In addition, non-permanent members, who have significant involvement in projects usually within specialist areas, may feel a lack of trust due to the differences highlighted above as well as the restrictions and exclusions they may face when compared to permanent members on the team. Moreover, this could also inhibit their communication with the project team and the wider organisation, which consequently would lead to less knowledge sharing where critical project knowledge may not get transferred. It is therefore important for project managers to recognise the differences between permanent and non-permanent project team members, not just from an employment perspective but also the level of commitment, involvement and knowledge sharing that takes place in the project by each type of member.

2.5.2.2 Organisational

2.5.2.2.1 Culture

Connaughton and Shuffler (2007: 387) assert, “teams that span multiple geographic, temporal, and cultural boundaries have become prevalent in many industries and sectors”. They also argue that in a global context, distance and culture are two critical factors to team effectiveness. As discussed earlier in this literature review, the level of cultural diversity in project teams exceeds other types of organisational teams, primarily because of the large amount of opportunities diverse team members offer (Wright and Drewery, 2006). This diversity of team members also makes cultural influences on project team performance an important area of research in academic literature because of the opportunities and challenges they bring.

Researchers’ views on the influences that multiculturalism has on project teams differ to quite a large extent. For example, Chudoba et al (2005: 280) argue that teams can work effectively, despite some of the participants not even being able meet face-to-face and having to “work across major time zone differences, across internal business units, and across cultures”. On the other hand, Stahl et al (2009) argue that the effects of cultural differences may not be easily recognised as they often tend to be

beneath the level of consciousness. Nonetheless, they also assert that culture is a strong source of stereotyping and categorisation, therefore, cultural diversity may have stronger effects as compared to other differences (Stahl et al, 2009). The study also suggested a link between (i) cultural diversity and process losses due to conflicts and decreased social integration and (ii) cultural diversity and process gains due to an increase in creativity and satisfaction (Stahl et al, 2009).

2.5.2.2.2 Management

Project managers or team leaders play a vital role in the level of effectiveness achieved by teams, particularly global virtual teams (Levina and Vaast, 2008). Miller et al (2000: 19) argue that "the inherently diverse nature of project work, coupled with the increasingly diverse nature of project teams, makes for an interesting leadership opportunity for project managers". However, forming and nurturing a diverse project team is a challenging task. For example, Ochieng and Price (2010: 452) list a number of typical challenges that project managers face, which are "developing team cohesiveness; maintaining communication richness; dealing with coordination and control issues; handling geographic distances and dispersion of teams; and managing cultural diversity, differences and conflicts".

According to Wang and Ko (2012: 431), management style is "the practices adopted by leaders in decision making, as well as the management of information, knowledge, social relationships, motivation, and subordinates". Moreover, they argue that management style can influence various project team factors such as, control of project activities, amount of delegation and the time taken and approaches used for decision making (Wang and Ko, 2012).

Ochieng and Price (2010) stress the need for managers to *demonstrate* awareness of the cultural variation in multicultural project teams in order to make communication more effective. Further, they also add that organisations must help their project managers to understand the global context and foster the ability to understand common issues from various cultural perspectives.

Another challenge that project managers often face is developing a bond between project team members. Further, bonding amongst team members is a fundamental aspect of project teams, but is a challenge to achieve because of the transitory nature of project teams, difficulty in forming trust between members and developing an understanding of the task-specific knowledge between members (Han and Hovav, 2012). Therefore, a project manager should understand the importance of bonding and foster it amongst his team (Han and Hovav, 2012), since a genuine interest in the project team by the project manager in the initial stages of the project often creates good morale in the team (Miller et al, 2000).

2.5.2.3 Technological

Communication between team members began to take place via computer-mediated technologies due to teams becoming increasingly virtual and geographically dispersed (Jarvenpaa and Leidner, 1999). High quality of communication in a project increases the likelihood of its success (Bond-Barnard et al, 2016). Further, the most common types of collaborative communication technologies are "e-mail, chat (e.g. Instant Messaging), phone/teleconferencing, video-conferencing, intranet, group calendar, discussion lists and electronic meeting systems" (Kotlarsky and Oshri, 2005: 38), as well as groupware, shared devices, remote access tools and file transfer systems (Ebrahim et al, 2009).

Though the computer-mediated communication technologies for project teams provide numerous solutions and possibilities, Kanawattanachai and Yoo (2007) point out that, coordination in virtual project teams is problematic because of the time and geographic separation between team members and primary form of communication being computers. Kotlarsky and Oshri (2005) also argue that the management of dispersed projects has far more challenges associated with it than co-located projects, though the continuing innovations in information and communication technologies are providing better possibilities for collaboration for dispersed teams. On the other hand, a study by Bond-Barnard et al (2016) finds that instant messaging and video conferencing tools lead to increased frequency, timeliness and amount of communication and subsequently project effectiveness in geographically dispersed teams. However, the performance of geographically disparate teams is not only impacted by the available communication mechanisms, but also, according to Weimann et al (2013: 332), by conditions such as "Internet availability and bandwidth; lack of training for certain tools; the selection and appropriate use of tools; integrated tool support for task management; as well as the promotion of transparency about progress made".

2.5.3 Knowledge sharing in project teams

"Project management calls for pooling and levelling human resources across time, space, and organisational boundaries, which reduces idle time and promotes expertise sharing and knowledge transfer" (Chiocchio and Essiembre, 2009; 383). Effective management and sharing of knowledge is a fundamental component of teamwork, especially in the case of projects where teams are intentionally formed with a diverse range of members with specialist skillsets, knowledge and experiences in order to collaborate and produce a unique product or service (Hsu et al, 2011). Further, according to Wang and Ko (2012: 425), in the body of project management literature related to knowledge sharing, "there is a consensus that individual team members do not have all of the knowledge a project requires, and must therefore acquire the knowledge needed in order to accomplish their work".

According to Hsu et al (2007), groups where there is better interaction and knowledge sharing are more likely to reduce uncertainties and have improved performance. Furthermore, they explain that knowledge or information sharing is highlighted by effective human communication, not only amongst the team but also with external stakeholders, which makes it a significant boundary-spanning activity (Hsu et al, 2007). Similarly, a study by Hong et al (2008) found that project team members' knowledge, tacit knowledge or know-how in particular, and the ability to communicate effectively leads to positive project performance. Similarly, Deeter-Schmelz and Ramsey (2003) stress that for better individual and group level performance, sharing and combining knowledge is crucial amongst team members, and according to Park and Lee (2014), knowledge sharing is the most valuable activity in the project environment as it can support the maintenance of social capital by project participants, improve performance and lead to innovation.

In co-located project teams, knowledge sharing often takes place face-to-face (Joshi et al, 2007) in the form of conversations and meetings. On the other hand, in virtual teams, due to many project teams being geographically dispersed, much of the communication and knowledge sharing takes place via computer-mediated technologies. Turner et al (2012) argue that computer-mediated tools play a 'critical role' in knowledge sharing between members of virtual teams as that is their main method of communication. However, Connoughton and Shuffler (2007: 401) claim that "face-to-face communication is tied to team effectiveness", while Oertig and Buegri (2006) argue that face-to-face communication is critical in the earlier development phases of a team. Although computer-mediated communication does not offer the same characteristics, e.g. social and interpersonal cues, as face-to-face communication does, Branson et al (2008) make the argument that virtual teams have gained more adoption and popularity due to the advancements in computer-mediated technologies. Furthermore, Rosen et al (2007) emphasise that the fundamental elements of knowledge sharing are not just technological, but rather the willingness and skills of team members to contribute in knowledge sharing processes.

Ochieng and Price (2010) raise the importance of essential learning required for a project team to develop and thus suggest the need to share knowledge or 'lessons learned' from previous projects. According to Sharp et al (2003), sharing of lessons learned can help to avoid duplication of work and ensure knowledge is reused across projects. Further, in a lessons learned log, project team members capture the knowledge and learning they gain from the project, typically done when a project reaches completion or a particular milestone is achieved, and is then added into the project documentation (Newell et al, 2006) or shared in post-project reviews (Goffin and Koners, 2011). Furthermore, Goffin and Koners (2011: 300) provide some examples of lessons learned in their research that are linked closely to the tacit knowledge of project team members, i.e. "dealing with project budgets, problem solving, coping with time schedules, and coping with changes in product specifications".

Although projects have clearly defined requirements, budget and resources, it is in the nature of projects to adapt based on arising changes. Wang and Ko (2012) argue that project scope can change unexpectedly based on the project owner's request, which subsequently has an impact on the team performance and can create stressful situations. Additionally, critical and timely decisions need to be made in such circumstances that require knowledge sharing from various team members. Wang and Ko (2012: 423) also stress that "undesired consequences may occur if the knowledge cannot be effectively shared among the team", for example, reduced efficiency in work, higher chances of failure and delays in deliverables. Ni et al (2016) also highlight the challenges of knowledge sharing in project environments, particularly project organisations in the engineering and construction sector, caused by the decentralisation and fragmentation of the project teams, as well as the complexity of the project knowledge. Moreover, the researchers found that whilst knowledge sharing within individual teams was effective, cross-project and cross-departmental knowledge sharing due to reasons such as geographic separation and each team being independent and focused on its own objectives. Cross-project and departmental knowledge sharing was recognised as an important component in the organisations in order to improve efficiency, avoiding duplication of mistakes and reduce risks of failure of projects (Ni et al, 2016).The research findings suggested that to overcome these challenges and achieve effective knowledge sharing in such knowledge-intensive environments, it is important for the organisation to establish a good knowledge sharing culture and strategy, that nurtures trust and encourages interaction amongst and between teams (Ni et al, 2016).

2.6 Amalgamation of research topics and research gap

In the previous three sections of this literature review, the widespread recognition of the importance of 'knowledge sharing', 'information security' and 'project teams' was discussed. All three subjects have become well-established concepts in academia and within organisations and have increasingly attracted the attention of various researchers. Figures 5, 6 and 7 show a chronological view of how the amount of research and its popularity has increased in the past few decades for knowledge sharing, information security and project teams. The graphs have been produced on the Web of Science database by searching for relevant literature on these topics. For example, for project teams' literature, the search included "project teams" in either the article 'title' or 'topic', all available publication years i.e. 1945 – 2016 were included and the results arranged by their publication date from the oldest to the newest.

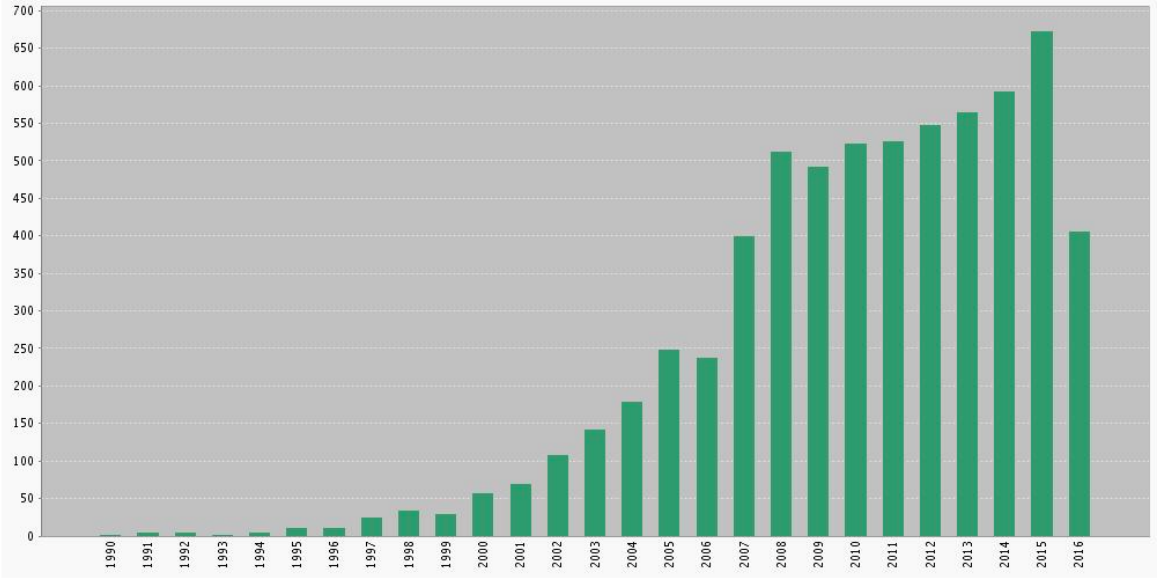

Figure 5: Knowledge sharing research publications on Web of Science

The graphs show that the amount of literature published on the three topics has increased continuously and significantly over the years, particularly onwards from the 1990s.

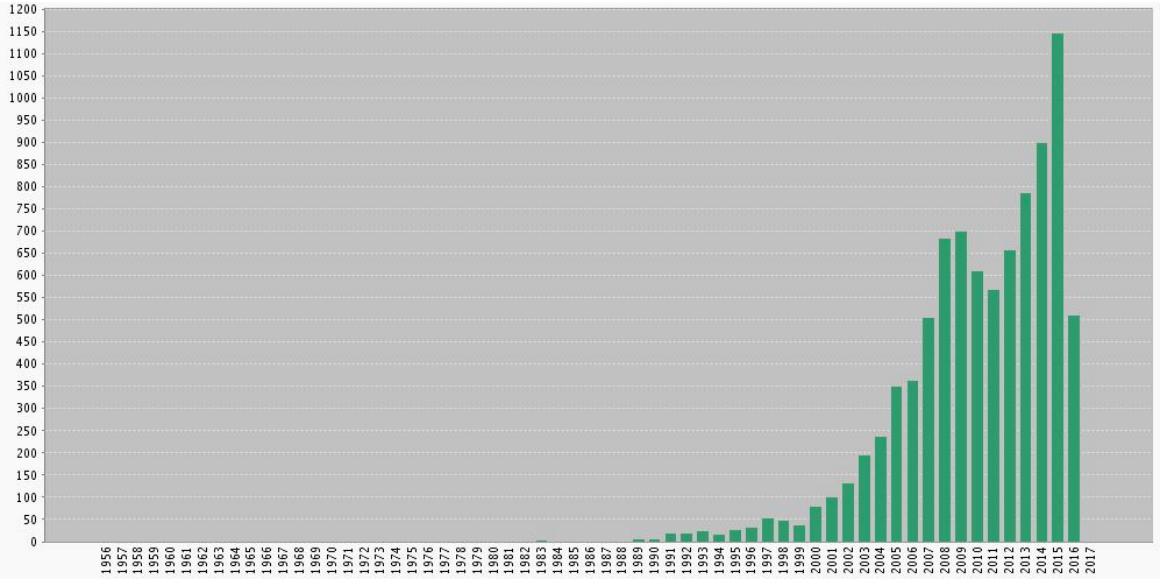

Figure 6: Information security research publications on Web of Science

Each of the three topics has attracted growing attention, particularly in the last two decades. This is primarily because of the changing nature of modern organisations and the ways people work, combined with the advancement of technologies, the Internet and globalisation. This was the first, but not the main, reason for the amalgamation of the three topics in this research. The conflicting nature of knowledge sharing and information security - where one practice aims to encourage and facilitate the sharing of knowledge, and the other aims to protect this knowledge and prevent its loss - can have an influence on the behaviour of employees as well as the practices of the organisation. Further, exploring

this conflict in the context of projects in particular was pertinent, as both practices are important for achieving the objectives of a project.

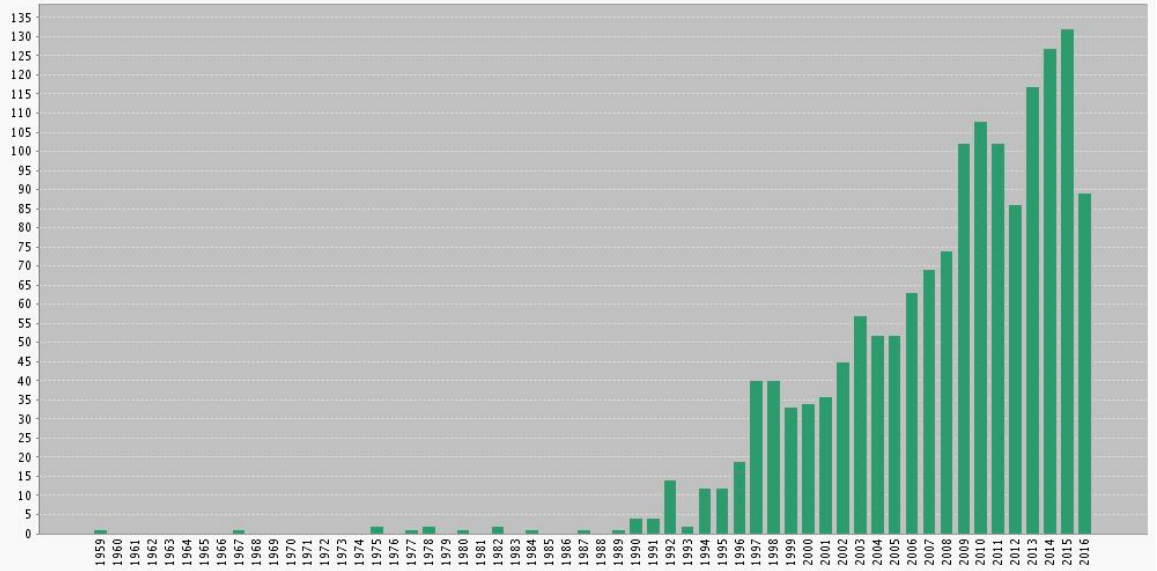

Figure 7: Project teams research publications on the Web of Science

2.6.1 Conflict between knowledge sharing and information security

In section 2.3 of this literature review, it was established that the practice of knowledge sharing is vital in order for organisations to gain advantage from their most valuable asset – their knowledge. As knowledge is a source of competitive advantage for organisations, effective knowledge sharing is critical as it benefits the organisation by creating new knowledge and enables individuals access to knowledge to support their daily activities (Raab et al, 2014; Alavi and Leidner, 1999). Knowledge sharing underpins various organisational activities and is not only encouraged, but special initiatives are often implemented to facilitate it amongst employees and partners. Through the literature review on knowledge sharing, it has also been established that research in this discipline has primarily focused on exploiting and sharing existing knowledge, and consequently the protection of knowledge has not received the necessary level of attention.

On the other hand, section 2.4 discussed how and why organisations implement information security measures to prevent and manage the loss of their valuable information and knowledge. This practice, directly or indirectly, affects the day-to-day activities of all employees in the workplace, and may also affect other partners and customers that the employees interact and engage with. However, much of the literature on information security has focused on technical aspects of information security such as technologies, access controls and policies (Coles-Kemp, 2009) – despite the integral role of constructive human awareness and behaviour in making information security practices successful being

acknowledged by various researchers (e.g. Coles-Kemp, 2009; Albrechtsen, 2007; Bishop, 2006; Stanton et al, 2005; Besnard and Arief, 2004).

When the two disciplines, knowledge sharing and information security, are reviewed holistically and amalgamated, an overlapping area emerges where an inherent conflict of interest is evident. This conflict has been recognised and addressed by some researchers. For example, Figure 8, was developed by Desouza (2006) to draw attention to a research gap that he calls, 'Knowledge Security', which he claimed exists between the research areas knowledge management and information security (Desouza, 2006; Desouza and Awazu, 2004). Desouza (2006: 2) describes knowledge security as "a research space that is in dire need of attention" and emphasises the key role knowledge plays in organisations and argues that, knowledge based resources are the drivers behind other resources, consume significant amount of resources to develop and are difficult to substitute, thus, organisations need to apply significant efforts to prevent the misappropriation and sabotage of its valuable knowledge - in order to retain its value.

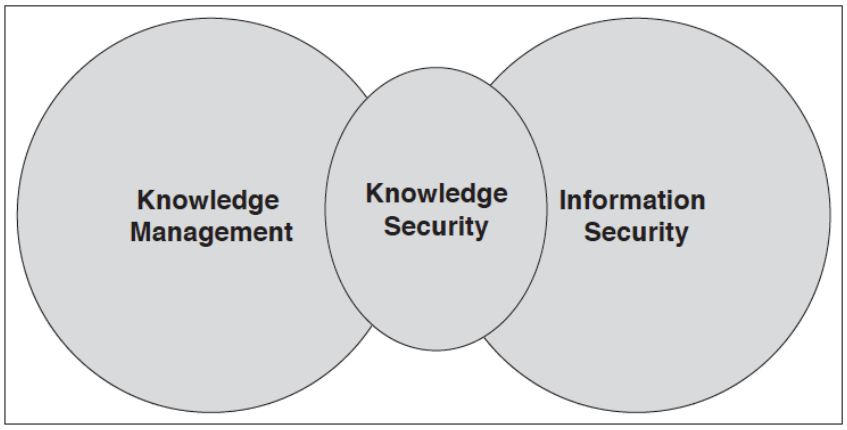

Figure 8: Knowledge security (Desouza, 2006: 2)

Similarly, Ryan (2006: 45) also addresses this conflict and argues that it is caused by the "intersection of the nature of innovation and the rewards of innovation"; innovation requires novel ideas and concepts to be imagined and shared, but on the other hand, there are needs to protect the intellectual capital that is developed from that innovation. Moreover, it is the view of Ryan (2006) that organisations typically implement information security tools and technologies by determining which information assets need protecting in terms of confidentiality, integrity and availability. However, in the context of knowledge management, different questions need to be asked when designing protection architectures, particularly with innovation and the return on investment from information sharing in mind. For example, "It may be true in some enterprises that allowing a certain amount of intellectual capital leakage could return a larger amount of innovation than keeping a very tight lid on information assets" (Ryan, 2006: 46).

In a more recent study, Ahmad et al (2014: 29) argue that increasing knowledge sharing naturally increases the risk of knowledge leakage, i.e. "the need to reconcile preserving confidentiality on the one hand and increasing the sharing of knowledge on the other is a key dilemma for organizations". Pawlowski et al (2014: 83) argue that the "challenge of finding a balance between knowledge sharing and knowledge protection has been exacerbated by recent developments", particularly social technologies and social working styles where the lines between work and leisure become blurred e.g. using personal devices to access organisation's knowledge, or employees working off-site. Such social knowledge environments create challenges for compliance with legal parameters, yet a systematic knowledge protection strategy that is tailored to such environments and considers the role of social technologies in knowledge-intensive environments is often missing in organisations (Pawlowski et al, 2014).

Manhart and Thalmann (2015) conducted a literature review to understand the present state of research on knowledge protection in KM research. It is argued that the fear of security breaches and knowledge theft have led to organisations becoming security-conscious and investing in information security measures, however, paradoxically, whilst the value of knowledge assets and the importance of protecting them is widely recognised, knowledge managers do not pay sufficient attention to security issues. It is highlighted that a key barrier to knowledge protection measures in KM, is ironically, knowledge protection often being considered as a barrier to knowledge sharing, or that knowledge protection is considered as a separate part, falling into the intellectual property domain (Manhart and Thalmann, 2015). The neglect of knowledge protection can hinder exploitation of innovations, and knowledge leakage can result in loss or reputational damage, thus, "finding a balance between protecting and sharing knowledge is crucial to solving the boundary paradox" (Manhart and Thalmann, 2015: 191).

Ilvonen et al (2016) carried out an empirical study into the KM practices in various Finnish organisations, particularly focusing on their activities that promote 'knowledge sharing' and 'knowledge security' as the researchers assert that there is a need to find balance between the two practices. Moreover, it is also claimed that 'knowledge sharing' and 'knowledge security' may be seen as the 'flip sides of the same coin', both practices are intertwined which can create complex and sometimes controversial scenarios, and thus need to be managed effectively by organisations (Ilvonen et al, 2016). Ilvonen et al (2016: 4021) describe this conflict between knowledge sharing and knowledge protection as "contradictory views on knowledge" which need to be balanced.

2.6.2 Research gap

By reviewing the literature on knowledge sharing and information security, and more importantly, by exploring the relationship between the two practices, an inherent conflict has been identified (e.g. Desouza, 2006; Shedden et al, 2011; Ahmad et al, 2014; Manhart and Thalmann, 2015; Ilvonen et al, 2016). Further, knowledge management has focused on facilitation of knowledge sharing and overlooked knowledge protection, whereas information security has focused primarily on technical aspects and protecting information and explicit knowledge, and subsequently neglected the development of more holistic approaches to also include knowledge protection (Manhart and Thalmann, 2015). Although, some researchers have highlighted concerns regarding the conflict and aimed to explore the area of knowledge protection (e.g. Ilvonen et al, 2016; Manhart and Thalmann, 2015; Ahmad et al, 2014; Vayrynen et al, 2013; De Faria and Sofka, 2010; Desouza, 2006; Ryan, 2006; Holsapple and Jones, 2005; Desouza and Awazu, 2004; Gold et al, 2001), the level of overall research on this topic in knowledge sharing literature, or in the wider discipline of knowledge management, is sparse.

The need for more empirical research on knowledge protection has been identified (Ilvonen et al, 2016; Manhart and Thalmann, 2015; Shedden et al, 2011; Desouza, 2006), to ensure that the valuable knowledge assets of an organisation are adequately protected as part of the broader KM strategy. Existing research mainly points towards the need for organisations to develop informed knowledge protection strategies, from a KM perspective and in the interest of protecting valuable knowledge from leakage or loss. For example, it is argued by Ahmad et al (2014) that researchers who have attempted to address the importance of knowledge protection in the past, have failed to provide appropriate guidance for organisations about the types of mechanisms required, as well as strategic and operational guidelines for protecting their sensitive knowledge. Pawlowski et al (2014) suggest that a tailored, systematic knowledge protection strategy that considers the role of social technologies in knowledge-intensive environments is required by organisations.

Similarly, according to Manhart and Thalmann (2015) a successful approach to knowledge protection would be thorough planning of systematic protection of explicit and tacit knowledge and by finding a balance between knowledge sharing and protecting. Manhart and Thalmann's (2015) view is that knowledge protection strategy should always be linked to the organisation information security strategy, as both form a vital component of risk management, and the researchers suggest that further research into how to adapt proven information security measures to knowledge protection could be of value. Ilvonen et al (2016) also identified an important issue related to 'knowledge security' awareness in organisations, where it was suggested that uncertainty about the practice amongst employees led to the assumption that protecting knowledge was merely a technological issue rather than a broader concept. This highlighted an important area about employee awareness and it was concluded that organisations

need an adequately articulated KM strategy, as well as a strategy to protect knowledge (Ilvonen et al, 2016).

Reviewing the existing literature enabled the researcher to understand the progress and position of research on the conflict between knowledge sharing and information security practices. However, it can also be concluded the majority of research around knowledge protection is driven by the aim to generate improved security of knowledge, and is primarily considered to be a sub-domain of KM. Contrarily to Manhart and Thalmann (2015) and Ilvonen et al (2016) who categorise knowledge protection as separate to information security, in the current research, knowledge protection was not treated as an entirely separate concept but rather considered as a part of the broader area of information security that impacts knowledge management practices, particularly knowledge sharing. Moreover, in the current research information security was considered as a broad concept, inclusive of any measures that aim to protect the data, information and knowledge of an organisation.

By conducting the literature review on knowledge sharing and information security, the present researcher established certain assumptions about the concepts of knowledge sharing and information security, which clarified the following research gap and formed the basis for the present research:

I. Knowledge sharing and information security are in most cases entirely separate initiatives in organisations; knowledge sharing is perceived as a 'soft', human-oriented approach, whereas information security focuses mainly on technical facets.
II. Knowledge protection has not received a great deal of attention in the discipline of KM, however, the role that information security plays in how it directly impacts and overlaps KM is an underdeveloped area to an even greater extent.
III. The conflict between knowledge 'sharing' and 'security' is mainly categorised as a knowledge management issue, however, the issue arises in the intersection or overlapping areas of knowledge sharing and information security, thus a broader perspective is required to better understand this issue and to begin to create more harmony between the two practices.
IV. Previous research on knowledge protection and the conflict between knowledge sharing and security has been primarily guided by the aim to improve protection of knowledge and has typically been grounded in the KM domain; there is a need for empirical research that takes a balanced approach to exploring the practices of knowledge sharing and information security, and their middle-ground.
V. A majority of the previous research on knowledge protection, or the conflict between knowledge sharing and security has been at an abstract level and conceptually-orientated, with a lack of empirical validation.

VI. Previous research on knowledge protection, or the conflict between knowledge sharing and security, has typically taken an organisational or knowledge perspective, thus there is a need to explore the issue holistically also taking into account the employee perspective.

VII. The lack of knowledge protection theories, frameworks, strategies and guidance for organisations have been highlighted by previous literature, where the main reasons attributed to this are the lack of empirical research and the challenging nature of the conflict between knowledge sharing and security.

VIII. Information security has, for the most part, overlooked the protection of tacit knowledge and the role of humanistic or social aspects such as human awareness and behaviour, which needs further research.

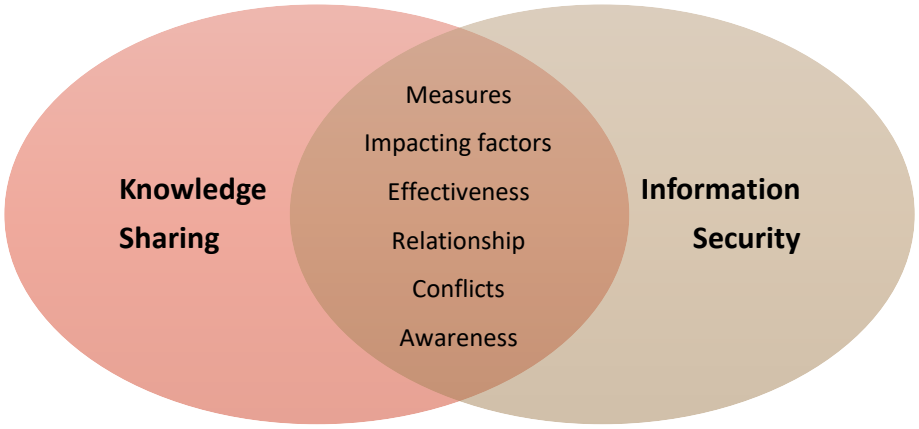

Figure 9: The research gap

Through combining the organisational and employee perspectives, this research explores the middle-ground between knowledge sharing and information security practices in an organisation (see Figure 9). Particular attention was paid to areas such as the measures employed for facilitating each practice, impacting factors, the effectiveness of each practice individually, the nature of the relationship between the two practices, the existence of any conflicts, and, the level of awareness amongst employees about the practices.

This research explored the above research gap in the context of project environments in particular, as the two practices, knowledge sharing and information security, are both integral in such knowledge-intensive and pressured environments. Knowledge sharing is a necessity in generating new ideas, sharing the specialist knowledge of team members to complete project tasks in the given time, budget and scope and, subsequently, achieving project success. On the other hand, in theory, information security must be practised in projects in order prevent the loss or leakage of the valuable project knowledge, which ultimately leads to project success in the form of generating a new product or service for the organisation.

2.7 Chapter summary

This chapter of the thesis provided an overview of the literature on knowledge sharing, information security and project team practices. The literature review enabled the researcher to understand the antecedents and the state of current research on each topic, through which the research problem and gap were identified.

The research gap is in the intersection of knowledge sharing and information security, in the form of a conflict between the two practices. Whilst the conflict has received some attention by researchers in recent years, the nature of the research on it has been primarily conceptual, lacking empirical evidence and the subsequent practical and strategic guidance for organisations to deal with the issue, as well as the development of any concrete theories. Thus, the aim of this research was to address this problem and research gap, by empirically and holistically exploring the relationship between the practices of knowledge sharing and information security in a project based organisation, and, informing organisational strategy for balancing and improving the relationship between the practices.

As well as the identification and clarity of the research problem, the findings of the literature review also facilitated the development of and informed contents of the research methodology which is presented in the next chapter.

3. METHODOLOGY

3.1 Introduction

According to Kothari (2004) a research methodology is a multi-dimensional and systematical way of solving a research problem, whereas Tracy (2012: 260) argues that a methodology is "the philosophical approach toward inquiry". Hesse-Biber and Leavy (2010) assert that research methodology should be approached holistically so as to bridge the gap between the philosophical standpoint and the methods, such that, attention is drawn to the significant connections between the philosophical framework and corresponding methods that are chosen. For this holistic approach, they propose a framework referred to as a 'research nexus' shown in Figure 10, amalgamating ontology, epistemology, methodology and method (Hesse-Biber and Leavy, 2010: 7). Further, it is claimed that this holistic approach sees research as a 'process' rather than an 'event', which differentiates it from event-based choices that consist of a set of sequential steps (Hesse-Biber and Leavy, 2010: 7-8).

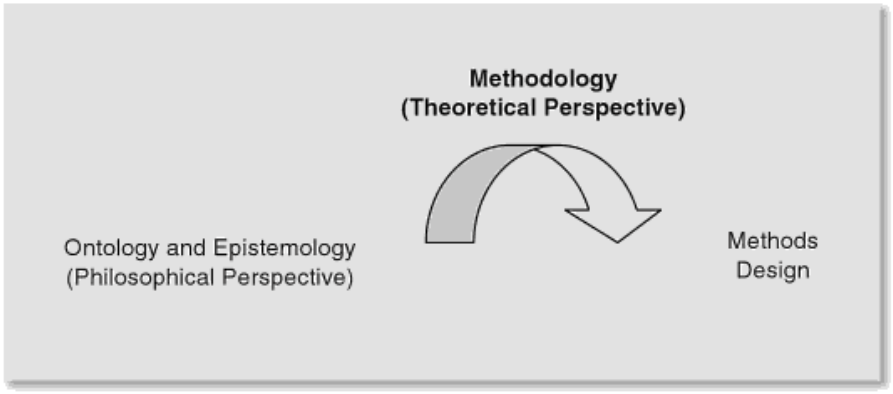

Figure 10: Methodology: theoretical perspective (Hesse-Biber and Leavy, 2010: 7)

This chapter aims to explain how a holistic research methodology was developed, the elements that informed the approach taken and how the researcher applied this methodology to elicit the findings and meet the research aims. In section 3.2, the researcher draws attention to the research philosophy that underpins the research and methodology, including the role of empiricism and interpretivism, the reasons behind the choice of a case study approach, and defining the unit of analysis. Section 3.3 draws attention to the theory of action learning, its philosophy and origin, application and its suitability for the case study organisation. In section 3.4, the research model developed for this research is introduced, explaining the reasoning behind the model and what each of its phases entailed. The research methods used for data collection and analysis, as well as details about the research participants and the logistics of conducting the research are explained in section 3.5.

3.2 Research philosophy

Philosophy is defined in the Macmillan dictionary as "a system of beliefs that influences someone's decisions and behaviour". A research philosophy is about the development of knowledge and the knowledge itself, and, contains the necessary assumptions about the researcher's view of the world (Saunders et al, 2009). To meet the aims and objectives of this research, establishing the philosophical underpinning and subsequently taking a logical approach to designing an appropriate methodology was vital. The definition of knowledge adopted in this research (as discussed in Chapter 2, section 2.2) played a pivotal role in not only shaping the research subject area and determining the unit of analysis (discussed in section 3.2.4), but also in establishing the philosophical underpinning of the research methodology.

3.2.1 Empiricism

Aristotle supported a materialist ontology and an empirical epistemology, this approach leads to the conclusion that we derive all our ideas from experience (Willis and Jost, 2007) and emphasises inductive reasoning e.g. observation, experience and experimentation (Teddlie and Tashakkori, 2009). In contrast, Plato's idealist ontology and a rational epistemology supports the proposition that there are innate ideas which humans already have in their minds when they are born." (Willis and Jost, 2007: 36), thus emphasising deductive reasoning such as formal deductive logic or mathematics (Teddlie and Tashakkori, 2009). Whilst the research methodology was predominantly guided by an empiricist approach to knowledge, it is important to acknowledge the role of rationalism incorporated within certain elements. According to Willis and Jost (2007), combining rational and empirical perspectives, for example, rationally developed evidence and empirical data to support a theory, has become a typical practice among scholars who acknowledge that good research comprises of both rational decision making and interpretation and empirical data. Furthermore, Willis and Jost (2007:37) also argue that "the modern conception of scientific method combines experimentation (e.g. experience or empiricism) with rational thought (e.g. the selection of topics, methods, data to be collected, the process of interpretation)". Similarly, Walsham (2014:12) states that he sees "both experience and reason as being valuable and, indeed, inextricably interlinked", and combining both of these in research can provide valuable sources for developing an understanding of the world.

The empirical approach was best suited to the nature of the research aim and context of this research. Moreover, the aim of the research was to (a) investigate the relationship between the practices of knowledge sharing and information security, and (b) identify ways of informing organisational strategy for balancing the relationship between the two practices. To achieve this, it was vital to explore the practices of knowledge sharing and information security and collect empirical data in a real

organisational context. As discussed in the literature review in Chapter 2, knowledge protection, the area of research that explores the conflict between knowledge sharing and information security is underdeveloped, particularly lacking empirical findings and evidence of the issues in an organisational context (e.g. Ilvonen et al, 2016; Manhart and Thalmann, 2015; Shedden et al, 2011; Desouza, 2006). Further, due to the lack of empirical research on knowledge protection in organisational settings, Ahmad et al (2014) suggest that researchers have failed to provide appropriate guidance for organisations about the types of mechanisms required, as well as strategic and operational guidelines for protecting their sensitive knowledge. Consequently, the lack of guidance can create knowledge protection awareness issues and the adoption of incorrect assumptions among employees (Ilvonen et al, 2016). For such underdeveloped research areas, Walsham (2014: 13) stresses that the collection, analysis and use of empirical data is essential in contexts that are new or underexplored and require accumulation of experience in a particular domain, or "where access to new situations may challenge old ideas and theories".

Empiricism is the doctrine that experience is the source of our knowledge of the world (Stahl, 2014: 4), in accordance with this, to develop an in-depth insight into the day-to-day organisational practices and the arising practical issues of knowledge protection in an organisational context, the knowledge and experience of employees was an essential element in this research which subsequently informed the methodological choice of an action learning approach being adopted (discussed further in section 3.3). To collect the empirical data for this research, an interpretivist case study approach was taken at the Energy Technologies Institute (ETI).

3.2.2 Interpretivism

Interpretivism "emphasises the difference between conducting research among people rather than objects such as trucks and computers" (Saunders et al, 2012: 137) and is based on the belief that it is essential for a researcher to understand the similarities and differences between humans in their roles as social actors. Walsham (2006: 320) argues that interpretive research methods begin "from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors. Our theories concerning reality are ways of making sense of the world, and shared meanings are a form of inter-subjectivity rather than objectivity". This research aimed to empirically explore and understand the paradoxical nature of knowledge sharing and information security practices and how it affects organisational practices. To achieve this, an interpretivist case study approach was adopted as this enabled the researcher to recognise and understand the phenomena by analysing the meanings that humans assign to them based on their knowledge and experience, and derive the correct 'sense' from the data based on the context (Myers, 2013).

The research context was intricate as it not only consisted of exploring the practices of knowledge sharing and information security individually, but also their paradoxical nature and complex relationship in the middle-ground between the practices. To develop an in-depth understanding within such a complex context, following an interpretivist approach was most appropriate as interpretivism assumes that knowledge is gained through social constructions, and "it focuses on sense making in complex and emerging situations and it attempts to understand phenomena through the meanings assigned to them by individuals in situations" (Stahl, 2014: 2). As interpretivism views all research as subjective (Willis and Jost, 2007), the researcher aimed to piece together the empirical findings into a coherent picture by understanding and interpreting the meaning that participants ascribe to their environment and "make sense of the world by understanding how other people make sense of their world" (Stahl, 2014: 2).

3.2.3 Case study approach

Case study approach was identified as the most fitting and was chosen for a number of reasons in this research. Moreover, the aim of this research was to understand how the paradoxical nature of knowledge sharing and information security affects organisational practices and how this understanding may be used to improve the relationship between knowledge sharing and information security practices. Yin (2018) argues that case study approach is particularly favourable where the research questions are aiming to understand 'how' or 'why' about a particular phenomenon and explain this in-depth. Further, this research was of an empirical nature aiming to explore and understand organisational practices in their actual context without any control or influence from the researcher; a case study approach is particularly suited in such empirical studies where the researcher has or requires little or no control over the behavioural events in the research context (Yin, 2018).

The ETI is a knowledge-intensive organisation, pooling together knowledge and expertise from various sources, carrying out many collaborative projects and developing innovative technological solutions. Effective knowledge sharing is crucial for the organisation, whilst appropriately protecting its valuable knowledge and maintaining various levels of confidentiality in the interest of its partnership with various organisations is of equal importance. So, managing the intricate relationship between knowledge sharing and information security is an ongoing operational challenge for the ETI. It was recognised that to understand the practices in such a knowledge-intensive organisation in an in-depth manner, exploring the role that employees played in these practices and the subsequent knowledge and experience they developed would play an integral role (this is further discussed in section 3.2.4). As discussed in the previous section, an interpretivist approach was adopted in this research as such an approach is based on the ontology that reality is subjective, a social product constructed and interpreted by humans; interpretive research attempts to understand phenomena by retrieving the meanings that humans assign to them (Darke et al, 1998). This generated the need for an empirical approach that allowed the

researcher to design, carry out and analyse an in-depth and context based inquiry into the ETI's practices, the basis of which was the organisation's employees. Thus, a case study was recognised as the most appropriate and valuable approach as it enables the researcher to examine a problem or question in a practical setting (Farquhar, 2012) and "investigates a contemporary phenomenon (the "case") in depth and within its real-world context" as the contextual conditions are likely to be pertinent to the case (Yin 2018: 15). The findings from a particular case or situation can then be used to draw some conclusions about the phenomenon being studied more generally (Myers, 2013).

As discussed in the literature review in Chapter 2, prior research that has attempted to draw attention to the paradoxical nature of knowledge sharing and information security has primarily focussed on the issue theoretically and a need for understanding the issue in practice through empirical research has been stressed by researchers such as Ilvonen et al (2016), Manhart and Thalmann (2015), Shedden et al (2011) and Desouza (2006). Thus, in the current research, the aim was not only to address this gap by conducting an empirical study, but also, by using a single case study, the researcher was able to develop a rich and comprehensive view about the complex and dynamic nature and relationship of the two practices. A common challenge in case study research is "to separate the phenomenon of interest from the context because the context itself is part and parcel of the story" (Myers, 2013: 77). Yin (2018) explains that to address this challenge, a case study has methodological characteristics that allow the researcher to explore a technically distinctive situation by using theory to guide the research processes, and using multiple sources of evidence and converging the data in a triangulating fashion.

According to Farquhar (2012: 8), case study is not just a research method but rather a research strategy upon which other elements of the research rest, where the aim of the strategy is to "dig deep, look for explanations and gain understanding of the phenomenon through multiple data sources and through this understanding extend or test theory". Similarly, the case study approach in current research was not limited to being a data collection technique alone, but rather an all-encompassing mode of inquiry "with its own logic of design, data collection techniques, and specific approaches to data analysis" (Yin 2018: 16). The unit of analysis for the case study is discussed in the next section.

3.2.4 Unit of analysis

In Chapter 2, a comprehensive literature review was carried out to understand the antecedents and current state of the existing body of literature and to identify the research gap for the case study. According to Gephart (2004: 458), a "case study is research that describes a single event or unit of analysis determined by the researcher". Thus, the literature review also served as a basis for the design and scoping of the case study research, including determining an appropriate unit of analysis (Darke et al, 1998). The unit of analysis related to the way the research questions were defined, was at the level

being addressed by the research questions and provided adequate breadth and depth of the data that was to be collected in order to answer the research questions (Darke et al, 1998). The research questions focused on organisational practices i.e. knowledge sharing and information security, therefore, the unit of analysis needed to be at the organisational level and aimed to represent a holistic view of these practices at the ETI.

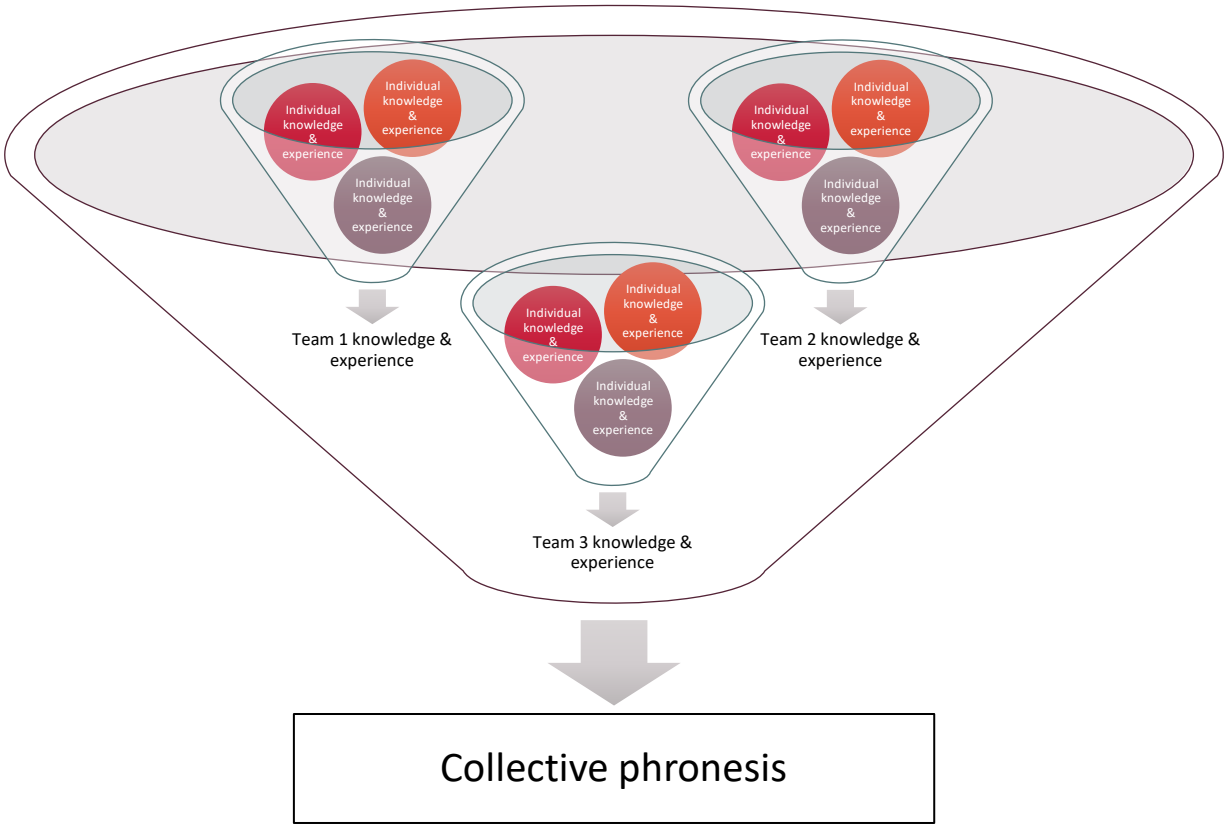

Figure 11: Unit of analysis

In section 2.2 of the Literature review chapter, the three types of knowledge - 'episteme', 'techne' and 'phronesis' - were discussed briefly. Kessels and Korthagen (1996:19) distinguish episteme and phronesis as two different types of knowledge; episteme as scientific understanding, universal wisdom or 'theory', and phronesis as practical wisdom or 'practice'. Further, it is argued that the "…difference between scientific and practical knowledge, one concerning their "locus of certitude". With scientific knowledge, that certitude lies in a grasp of theoretical notions or principles. In practical prudence, certitude arises from knowledge of particulars. All practical knowledge is context-related, allowing the contingent features of the case at hand to be, ultimately, authoritative over principle" Kessels and Korthagen, 1996:19). The focus of this research was on obtaining phronesis; "Aristotle's knowledge, *phronesis*, is situated in a context and is dependent on that context" (Willis and Jost, 2007: 120). This type of knowledge best categorises professional practice or research, and is about idiosyncrasy and uniqueness,

as opposed to 'episteme' which is universal rules or facts (Kessels and Korthagen, 1996; Willis and Jost, 2007). To carry out a context-specific case study and represent a holistic view of the ETI's knowledge sharing and information security practices, the empirical data collection was at the level of an integrated organisational unit. Moreover, this consisted of an amalgamation of practical knowledge and experiences of employees through the participating project teams as depicted in Figure 11.

To elicit the collective organisational knowledge or 'phronesis', an action learning approach was adopted which is discussed in detail in the following section. The empirical data elicited from the teams was then analysed and further supplemented with the ETI's organisational perspective and the researcher's own experience of collaborating with the ETI to contextualise the findings. This will be discussed further alongside the full research model in section 3.4.

3.3 Action learning

In section 2.2 in the literature review chapter and section 3.2 in this chapter, phronesis, the type of knowledge this research focused on and aimed to elicit was discussed. This type of knowledge has played a significant role throughout this research, including informing the adoption of action learning as a methodological choice. Because of its relationship with phronesis and its suitability for this research context, action learning was adopted and served as a philosophical underpinning for parts of the research design and the methodological choices. The following sub-sections explore action learning and discuss why it was chosen and incorporated in this research.

3.3.1 Philosophy, history and definitions

"There can be no learning without action, and no action without learning" (Revans, 2011: 85).

Action learning is a process of learning and reflection that takes place in a collaborative and supportive environment with a group or 'set' of colleagues working together with real problems with the aim to solve those problems by developing appropriate actions (McGill and Beaty, 2001). In his book, Boshyk (2016: xi) argues that organisational driven action learning "is a process and philosophy that can help change a company's strategy, and the behaviour of its people" and has the capability to provide breakthrough business results and personal and organisational learning and development. In relation to generating *phronesis* which is the type of knowledge this research focused on, action learning facilitates participants "to interpret all they are doing through the looking glasses of reflective argument" (Revans, 2011: 69). The aim of this research was not only to learn about and understand the paradoxical nature of knowledge sharing and information security practices and the arising issues at the ETI, but also to identify practical ways of improving the relationship between the two practices. Action learning aligned well with this aim because "as a philosophy, business driven action learning is based on the belief and

practice that learning should be tied to business realities, and that some of the best business solutions can and should come out from fellow executives and employees" (Boshyk, 2016: xi).

The concept of 'action learning' was originated by Reginald Revans (1907-2003) in the 1940s (Marquardt and Waddill, 2004; Johnson, 1998; Smith and O'Neil, 2003; Sofo et al, 2010). The first reference to this concept was made in a 1945 report on the British coalmining industry (Revans, 1982). In this report, Revans recommended that managers should be encouraged to "learn with and from each other using the group review to find solutions to their immediate problems" (Revans, 1982: 64). Although the practice of action learning was conceived since the 1940s, between 1945 and 1975, it received little favourable attention in the management literature (Revans, 1982). In the 1980s action learning began to attract growing interest, primarily due to its revival by Revans (e.g. 1980, 1982, 1983a, 1983b, 1986) and then gained further interest in the 1990s due to the growing trend in learning organisations and continuous learning i.e. the "awareness that organizations as human systems must constantly learn to adapt if they are to survive" (Dilworth, 1998: 30).

Revans (1982) differentiates action learning from other forms of learning, such as education and development, by highlighting its key objective as being about learning how to ask questions in circumstances of risk, instead of finding answers to questions that have already been defined by others. Further, rather than defining it, Revans (1983b: 44) claims that action learning is different from the following training and learning approaches.

- Business games
- Organisational development
- Case studies Project work
- Client-centred therapy
- Transactional analysis
- Consultancy
- Role playing
- Group dynamics
- Sandwich courses
- Job rotation
- Site visits
- Operational research
- Work study
- Non-directive counselling

What differentiates action learning from other types of learning approaches is the fact that it is question-based, rather than answer-based, which enables individuals to learn about themselves (Revans, 1982). Further, Revans (1983b) argues that the above learning and training approaches "are nearly all loaded with the notion of expert and authoritarian teaching. One pays somebody else to put one right, although, to be sure, after one is called upon to say what appears to be wrong. In action learning, there are no authorities (just as there are none in any real world) to put one right" (Revans, 1983b: 44).

Despite not providing any single definition of action learning, Revans provides several descriptions or relevant contexts of action learning. For example, it is the act of people in a difficult situation learning with and from each other (Revans, 1986), it consists of three prime features including interpersonal understanding, stimulating self-awareness and satisfying physical needs (Revans 1998), and, it is concerned about reality and helping individuals to see more clearly (Revans, 1983a). Revans argues that

“the tackling of real problems by real managers in real time cannot, of course, be left to discussions in seminars undertaken away from the settings of those real problems” (Revans, 1983b: 43). However, despite providing these descriptions of action learning, Revans still argues that action learning cannot be ‘packaged’ and the “day it is accurately described in words will be the day to stop having anything to do with it” and thus the only way to fully understand action learning is to practice it, compare ideas and learn with and from each other (Revans, 1983b: 49).

Revans’ (1998) philosophy behind action learning was that learning cannot be achieved without action, and, action cannot take place without learning. Other researchers have described action learning in the following ways. According to Vince (2008), action learning offers a reproductive learning model to improve practices where individuals can develop strategic actions, which can then be tested and transformed in practice. Pedler (2011: xxi) claims that action learning is “a pragmatic and moral philosophy based on a deeply humanistic view of human potential that commits us, via experiential learning, to address the intractable problems of organizations and societies”. According to McGill and Beaty (2001:11) it is a "continuous process of learning and reflection, supported by colleagues, with an intention of getting things done". Dilworth (1998: 29) argues that action learning is “not easy to do” as it can take diverse forms, for example, in some cases it can be intertwined with other initiatives and be referred to as organisational development, management development, team building, and transformative learning. To emphasise the difficulty of defining what action learning is, Dilworth (1998) argues that even Revans, with his extensive research on this subject, has avoided defining ‘action learning’. However, Dilworth (1998) does suggest that action learning can be associated with organisational learning and the creation of a learning organisation, as well as being a vital instrument for transforming organisational culture, increasing learning capacity and empowering employees.

There are various takes on action learning by different researchers and thus it becomes difficult to accurately define it because it means different things to different people (Weinstein, 1995). However, despite the differences, some common elements that are recognised as integral to action learning are identified and are summarised into the following five areas. Firstly, the importance of learning from existing practices has been highlighted, not just for individuals but also organisational learning (Dilworth, 1998; McGill and Beaty, 2001; Revans, 2011; Pedler, 2011; Boshyk, 2016). Secondly, reflection on existing organisational practices and past experiences (McGill and Beaty, 2001; Revans, 2011; Boshyk, 2016), and thirdly, engaging existing employees in the action learning process who share knowledge and collaborate to facilitate individual and collective learning (Dilworth, 1998; McGill and Beaty, 2001; Vince, 2008; Revans, 2011; Boshyk, 2016). Fourthly, working on and addressing real organisational problems or challenges (McGill and Beaty, 2001; Pedler, 2011; Boshyk, 2016), and lastly, taking action to solve problems and improve practices (McGill and Beaty, 2001; Vince, 2008; Revans, 2011; Pedler, 2011;

Boshyk, 2016). In addition, action learning has also been recognised as a humanistic philosophy that can help an organisation to learn and improve its practices (Pedler, 2011; Revans, 2011; Boshyk, 2016).

The definition of action learning used in this research incorporated these five elements i.e. action learning is where a group of individuals come together and engage in a process of collective reflection, knowledge sharing and learning to address a real organisational problem and devise actions to improve practices or situations, which results in generating individual, group and organisational learning. This process has an Aristotelian philosophical underpinning due to its approach towards the nature and process of generating knowledge, i.e. phronesis, through reflection and learning (e.g. Revans, 2011). Halverson (2004) argues that phronesis is developed through habit and embodied in individuals' character, and is expressed through certain actions in the way they assess a situation, devise and execute appropriate plan of action. Thus, phronesis is as much a way of knowing something, as it is a type of knowledge (Halverson, 2004), making it not only the outcome of this research, but also a fundamental vehicle through which that outcome is reached.

Dilworth (2010) argues that, although Revans did not expect all action learning approaches to be identical to his own approach, he did hope for certain basic elements to remain present. These include empowering the learners, minimal interferences in the process by external expert facilitators, using real life problems that are of genuine difficulty and urgency, getting individuals out of their comfort zones by having them operate in unfamiliar settings and deal with unfamiliar problems, and reflecting throughout on these experiences and the assumptions behind their actions, including their implementation of actions to the real problem addressed (Dilworth, 2010: 3). However, Dilworth (2010) raises the concern that much of the action learning that takes place currently does not adopt these basic precepts that Revans had hoped for, and neither has the growth of action learning, in general, given a great deal of acclaim to Revans. In the present research, the researcher was mindful of these important elements when designing and conducting the action learning approach.

3.3.2 Action learning in practice

3.3.2.1 Role of reflection

Reflection is an integral component of the theory of empiricism which underpins this research. Moreover, to generate 'phronesis', reflection on experience is essential. Researchers have stressed the importance of reflection as being an integral part of effective learning. Hammer and Stanton (1997) suggest that various failures faced by organisations and teams all share one underlying cause – failing to reflect. According to Marquardt (2011) reflection is about individuals recalling, thinking about, pulling apart, making sense, and attempting to understand. Pedler (2011: xxi) argues that learning is 'cradled in the task' and occurs through reflection on the experience of taking action. Reflection has played a

central role in many learning approaches. For example, in the field of experiential learning, Kolb (1984) and Schön (1983), who have both had extensive impact on management education (Reynolds and Vince, 2004), emphasise the importance of reflection in learning. Smith (2001) provides a number of reasons why managers and executives may want to reflect, including:

- Reflection being a natural element of learning
- Developing insight and understanding
- Solving problems and developing new ideas
- Challenging norms and gaining new perspectives
- Gaining multiple viewpoints
- Making tacit knowledge explicit

Marquardt (2011) claim that reflection does not come easily or naturally to individuals as reflective inquiry occurs when people are given space to stand back and relax their presuppositions and assumptions, as it is further argued that in group environments efforts to generate reflection often fail. However, in the case of action learning groups, reflection occurs naturally and continuously because of the time and conditions that are deliberately carved for reflection and listening (Marquardt, 2011). To emphasise the importance of reflection in action learning, Pedler (2011) draws our attention back to Revans' original philosophy behind action learning where it is argued that learning cannot take place without action, and vice versa (Pedler, 2011: xxii). Similarly, Dilworth (1998) makes a strong argument that reflection is equally as important as the action itself. Thus, what action learning offers "is elevated levels of discernment and understanding through the interweave of action and reflection" (Dilworth, 1998: 42).

According to McGill and Beaty (2001: 11) action learning in itself is a "continuous process of learning and reflection, supported by colleagues, with an intention of getting things done". Reflection is essential to convert tacit experiences into explicit knowledge (Raelin, 2001) and individuals tend to learn effectively when they reflect with like-minded colleagues on real problems arising in their organisation (Cho and Egan, 2009). Further, Cumming and Hall (2001) claim that, after an action learning set activity has taken place, the set reflecting on the impact of changes that resulted from the activity will enable individuals to learn and benefit from each other as well as provide opportunities for transferring this learning to other parts of their work and life.

There appears to be a consensus amongst various researchers about the integral role of reflection in action learning (e.g. Haith and Whittingham, 2012; Pedler, 2011; Marquardt, 2011; Cho and Egan, 2009; McGill and Beaty, 2001; Cumming and Hall, 2001). Thus, through the reflection in action learning, individuals get the opportunity to work on real issues that exist within their workplace, develop the skills

to reflect upon their own and their colleagues' actions, learn from shared experiences and develop further courses of action and decisions accordingly. Lee (1999) makes the claim that the fundamental difference between action learning and other organised approaches of reflection is the fact that it takes place in a mutually supportive group and because it is facilitated by an appointed individual. The role of the action learning facilitator has attracted a large amount of attention and caused debate amongst researchers some of which will be discussed in the next section.

3.3.2.2 Role of a facilitator

The role of an action learning facilitator, also sometimes referred to as a 'coach' or 'advisor', has received attention and caused debate amongst researchers. Dilworth (2010) argues Revans saw 'expert facilitators' as unnecessary in action learning sets. Revans (1998) advised that a facilitator at the initial stage of the action learning process is beneficial, however, he warns against dependency emerging on the facilitator if the interference is not kept to a minimal level thereafter. Once the process of the action learning set has begun, the facilitator should stand back and allow the set individuals to become their own facilitators. In contrast, Johnson (1998) describes having a facilitator in an action learning set as 'optimal' in order to nurture an encouraging learning atmosphere.

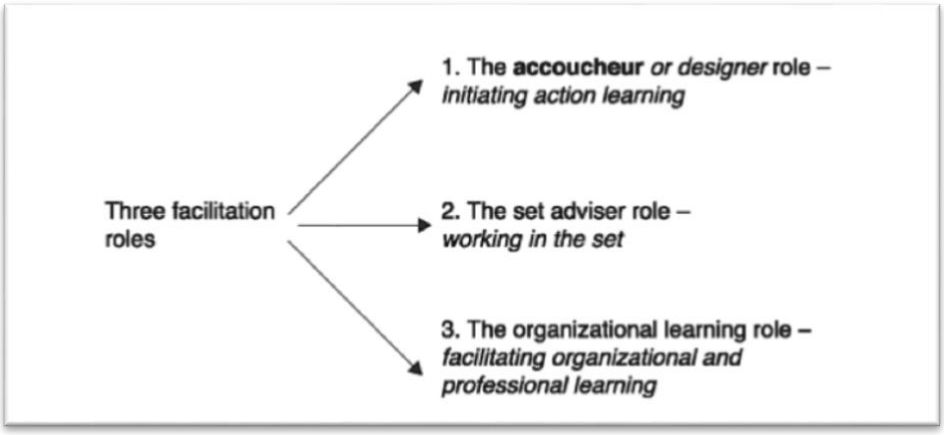

Figure 12: Three roles of the action learning advisor (Pedler and Abbott, 2013: 3)

The facilitation in action learning contexts is different from other forms of facilitation (Haith and Whittingham, 2012) as they need to be equipped with the correct 'people' skills such as active listening, handling emotions, thought-provoking individuals and being empathetic (McGill and Brockbank, 2004)

Pedler and Abbott (2013) have identified three roles of an action learning facilitator as shown in Figure 12. The first role is described as the '**accoucheur'** or **designer** role and is that of an advisor and initiator of action learning. Abbott and Taylor (2013) argue that this role closely matches Revans' description of a facilitator in action learning and is the least visible or intervening role for the action learning set. The second role is the **set advisor**, which also involves acting at an advisory capacity to help individuals in

the action learning set to develop the relevant skills in order to make the set valuable and effective. The third role of an action learning advisor is the **organisational learning** role. This role has been described as very important yet the most challenging because it involves transferring the generated learning from individuals and the action learning set into the organisation (Pedler and Abbott, 2013).

Together these researchers provide important insights into the integral role a facilitator plays in action learning sets. Although the opinions of researchers differ on the level and type of involvement of the facilitator, the overall aim of the facilitator will be to enhance the effectiveness of the learning set (Haith and Whittingham, 2012). Therefore, within this research vital importance was given to the role of the facilitator in 'setting the scene' and cultivating a comfortable and stimulating atmosphere in which individuals could openly discuss problems, share experiences, reflect and seek advice where necessary. Equally, careful consideration was given to and efforts were made to ensure that the researcher's role as a facilitator was as impartial as possible and did not influence the ALS discussions and the autonomy was given to the participants.

3.3.2.3 'Action learning' vs. 'action research'

The terms 'action learning' and 'action research' are often used interchangeably. According to Weisbord (1987) the roots of action learning may be traced to action research – which is a concept and term invented by the German psychologist Kurt Lewin in the 1940s. According to Coghlan and Coughlan (2008), independently, with their own heritages and backgrounds, both practices are well established in relation to their broad literature, methodology and proven research records. The similarities between action learning and action research are that they share the same values, are centred on a similar learning cycle and concentrate on learning in action. Both enclose concepts for individual learning and group exploration and stress collaborative relationships where action learning takes place within a learning set. Action research, although it can be undertaken alone, usually entails collaboration with others (Coghlan and Coughlan, 2008). However, the fundamental difference in terms of their primary aim, according to Coghlan and Coughlan (2008), is that action learning is an educative process with the focus on learning, whereas action research focuses on research and is positioned away from traditional positivist research methods.

Similarly, Zuber-Skerritt (2001) and Fletcher and Zuber-Skerritt (2008) argue that the fundamental difference between action learning and action research is the same as that between 'learning' and 'research' in general. Both practices involve active learning, searching, problem-solving and collaborative review, "however, action research is more systematic, rigorous, scrutinisable, verifiable, and always made public (e.g. in publications, oral or written reports)" (Fletcher and Zuber-Skerritt, 2008: 76).

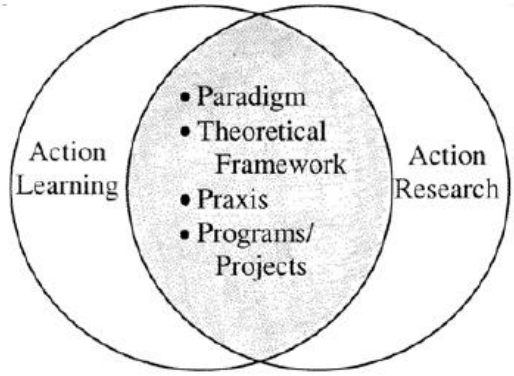

Figure 13: Commonalities of action learning and action research (Zuber-Skerritt, 2001: 3)

Zuber-Skerritt (2001) argues that there are four shared areas where action learning and action research overlap. These areas include the paradigm, theoretical framework, praxis and programs or projects (see Figure 13).

Despite the comparisons of the similarities and differences between action learning and action research, there is evidence that both approaches can complement each other by being adopted and integrated into a single methodology. For example, Coghlan and Coughlan (2008), Coghlan and Coughlan (2006), Zuber-Skerritt (2002), Zuber-Skerritt (2001), Sankaran et al (2001), Swepson et al (2003), Middel et al (2005) and Du Toit et al (2010), have all combined action learning and action research to form an integrated research approach, also known as ALAR. Further, a dedicated journal named 'ALAR: Action Learning and Action Research Journal' has been created since 1996 which promotes the research and practice of action learning, action research and other related approaches. Such a journal reiterates the common interchanging between action learning and action research, as well as the formulation of integrated approaches of action learning and action research.

Professor Bob Dick, an action research and action learning practitioner and researcher from Australia, explains his view on the similarities and differences between the two practices as follows:

> *"I don't think there is a lot of difference at all really. People use different language to describe it, but if you were looking at something like a cooperative inquiry group and an action learning team working side by side, I think you would have a hard time telling them apart. There is a different emphasis as action learning focuses on concrete outcomes from the project. So people usually set up action learning teams when there is some project they want completed, or when there is a number of people who have individual projects to complete. And the learning tends not to be written up. There is a focus on learning and learners don't talk about those same kinds of cyclical processes that action research uses. But the processes are the same and people just describe them differently." (Zhao et al, 2012: 442)*

Bob Dick argues that the two practices have predominantly separate literatures; the roots of action research can often be traced back to Kurt Lewin or South American approaches, whilst action learning is typically recognised as originating from Reg Revans in England (Zhao et al, 2012). It is also argued that most forms of action research "use a cycle where you plan what you are going to do, you carry it out, then you reflect critically on what worked and what didn't", the theory is stronger and more concrete as compared to action learning where the theory is less explicit, despite a similar cyclic approach being used, thus action learning can be treated as a subset of action learning (Zhao et al, 2012: 443).

Although there is a great deal of overlap between the two concepts, action learning was the approach the researcher adopted in this research as the aim was to generate learning through reflective exercises of the teams about the ETI's knowledge sharing and information security practices, which not only generated learning for the individuals and teams that participated in this research, but also generated organisational learning for the ETI.

3.3.2.4 Action learning examples

Although the commonality between the definitions of action learning discussed earlier (in section 3.3.1) involves learning based on 'action', due to the flexibility that it offers, the application of action learning has taken a variety of forms by different researchers and practitioners. In addition to the variety of approaches taken, there is evidence of action learning approaches being applied in a wide range of contexts – a few of which are discussed below.

Thornton and Yoong (2011) carried out a case study based on a blended action learning approach (one that comprises of both face-to-face and online interaction) for leadership development. The areas of interest in this case study were the role of the facilitator in the context of blended action learning, the way leadership learning is supported by blended action learning, the ICT tools most appropriate in blended action learning and the kind of the leadership journeys the participants took (Thornton and Yoong, 2011).

In a study, Coghlan and Coughlan (2008) used a combination of action learning and action research (ALAR) to form a methodology of a research project that concentrated on collaborative improvement in a supply chain. The project, called CO-IMPROVE, aimed to formulate a business model that is supported by a web-based software system and an action learning approach was taken to guide the implementation of the project via a collaborative improvement between partners in Extended Manufacturing Enterprises (EMEs). In the project, the participating managers used action learning to achieve their commercial objectives, whereas action research was used by academic researchers to consolidate the action learning processes and to generate the subsequent actionable knowledge (Coghlan and Coughlan, 2008: 97). By using this combination, the researchers were able to commit to

scientific rigour and combine technical elements, process and action learning (Coghlan and Coughlan, 2008).

Higgins (2002) reports on another action learning approach used as a participatory research process with mills in the Australian sugar industry. The model developed in this research, a novel integer-programming model, was underpinned by action learning and consisted of a sequence of cycles including plan, action, reflect and revised plan. The model enabled the participating mills to overcome barriers and improved their infrastructure and transport efficiency. It is argued that without a participatory approach, the focus of the study would have been drawn towards academic science. Thus, by having equal participation from industry participants and researchers in the research process, combined with an equal level of interaction between the two, all participants achieved faster and better learning and the researchers' ability to add value to industry processes was also improved.

To give an idea of the variety of its types and applications, Cho and Egan (2009: 446) in their review of action learning literature, argue that examples include "business-driven action learning, inter-organisational action learning, critical action learning, auto action learning, self-managed action learning, project action learning, developmental action learning, work-based learning, and Web-based action learning". Although the above examples provided are only a few, they provide a solid evidence of the diverse application and flexible nature of action learning that can be applied in different organisational settings.

3.3.2.5 Research models based on action learning

A few research models have been identified where action learning has been adopted to guide the research process. These are presented and discussed below in a chronological order.

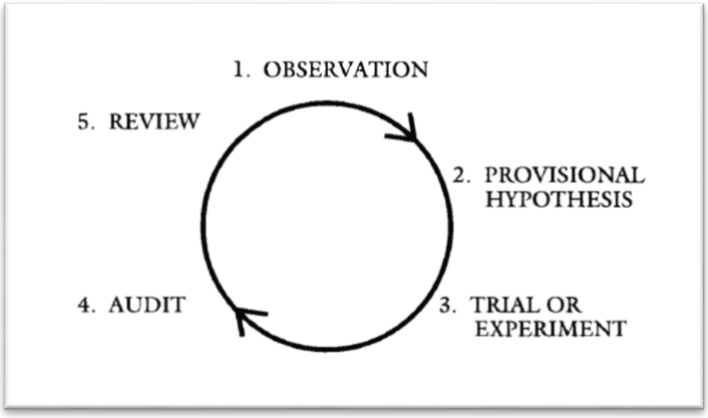

Figure 14: The action learning cycle (Vince and Martin, 1993: 207)

Vince and Martin (1993) present a rational model of action learning that they unearthed from their analysis of various organisations where action learning was seen to be an important component of

training and development strategy. This model, presented in Figure 14, is structured as a cycle that consists of five stages of reflecting on experiences, including, observation, provisional hypothesis, trial or experiment, audit and review (Vince and Martin, 1993). It is argued that that this cycle or 'development loop' encourages flexibility where the action learning team can return to different situations where necessary.

Vince and Martin (1993) argue that, learning is not achieved solely by intellectual or rational skills and psychological and political elements also need to be considered in action learning because this approach moves away from the traditional taught ways of learning. Further, although this model shown in Figure 14 is based on Revans' principles of action learning, it brings challenges when the researchers attempt to explore the psychosocial and political processes embedded in action learning sets (Vince and Martin, 1993). Thus, Vince and Martin (1993) propose two further models, or underlying cycles, of psychological and emotional elements that can promote action learning (see Figure 15) and those that can hinder it (see Figure 16).

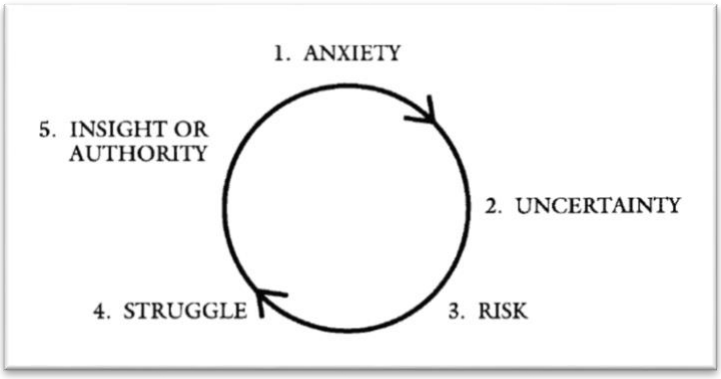

Figure 15: Cycle of emotions promoting learning (Vince and Martin, 1993: 208)

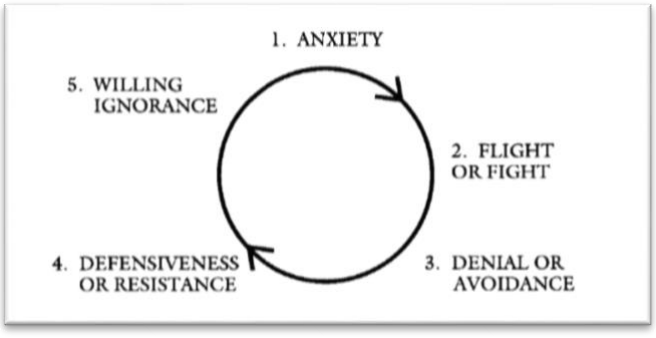

Figure 16: Cycle of emotions discouraging learning (Vince and Martin, 1993: 209)

Vince and Martin (1993: 211-212) claim that they have found it advantageous to introduce the intellectual, emotion and political perspectives to the action learning model as the "participants do not then focus solely on finding different ways of understanding and improving the intellectual meanings of

their work, they also begin to address those psychological and political forces that shape their own identities within the work". It is also noticeable that these two underlying cycles of the individual and team level emotions involved in action learning bring the conventional action learning model, shown in Figure 16, from a positivist towards an interpretivist approach. However, despite taking these social elements into consideration, the researchers continue to describe the action learning model being of a "highly structured format" (Vince and Martin, 1993: 211), which overlooks the basic action learning philosophy, e.g. focusing on learning and reflection in a flexible manner.

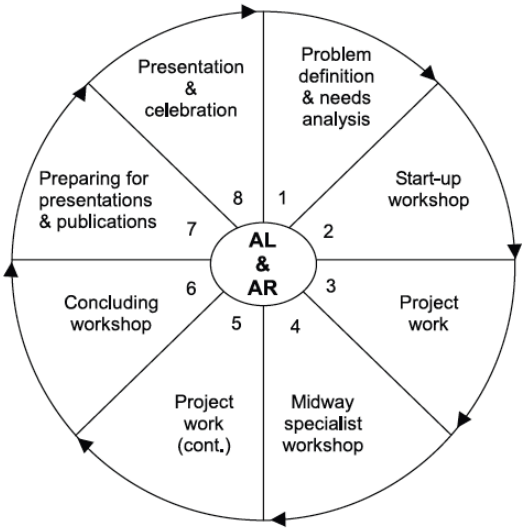

Figure 17: A generic model for action learning and action research (Zuber-Skerritt, 2002: 144)

Zuber-Skerritt (2002) presents a generic model, as shown in Figure 17, that combines action learning and action research into an integrated approach. This model uses action research as a methodology for addressing organisational issues and consists of eight components of a systematised action learning programme, including:

1. problem definition and needs analysis,
2. start-up workshop,
3. project work,
4. midway specialist workshop,
5. project work continued,
6. concluding workshop,
7. preparing for presentations and publications, and,
8. presentation and celebration.

Although the model appears to depict a one-way process of a larger action learning program, Zuber-Skerritt (2002) does explain that all phases of the model contain an underlying cyclical processes of the following:

- planning which includes situation and problem analysis,
- taking action or implementation of the plan,
- observing and evaluating the action,
- reflecting on the continuing process of planning, acting, observing and evaluating, and,
- revising the plan for a new cycle.

Integrating the above processes into each phase of the model by (Zuber-Skerritt, 2002) provides the action learning team the ability to follow an iterative and flexible method through which action, learning and reflection can take place at each stage.

Kuhn and Marsick (2005) have designed an action learning model for initiating and empowering strategic innovation and sustained growth in mature organisations that are facing new competitive challenges (see Figure 18).

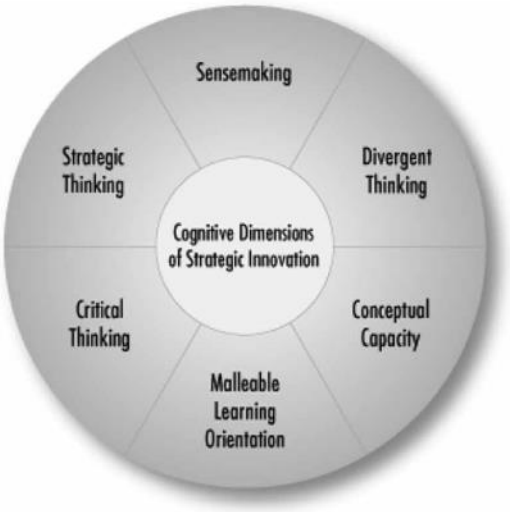

Figure 18: The cognitive dimensions of strategic innovation (Kuhn and Marsick, 2005: 30)

The core of this model is a set of refined cognitive capabilities including sense-making, strategic thinking, critical thinking, malleable learning orientation, conceptual capacity and divergent thinking (Kuhn and Marsick, 2005). It is argued that individuals who are able to acquire these cognitive capabilities through action learning will begin to think differently about their business, learn how to spot changing trends and develop the ability to foresee the future. Subsequently, this provides challenge, opportunity and support for the organisation to overcome orthodoxies that can hinder innovation (Kuhn and Marsick, 2005).

By drawing attention to the importance of cognitive dimensions, this model is underpinned by the core principals of action learning. It integrates 'learning' and 'action', whilst taking into account the importance of reflection, questioning norms and collective learning. Thus, bringing 'learning' into the

centre of the strategy for organisational success, without insisting on a linear approach or a set of rigid steps. However, although this model aims to provide a "holistic enterprise-level developmental experience" that drives change and innovation (Kuhn and Marsick, 2005: 45), it is important to take into account that driving change is not such a simple process. In particular, driving innovation in a mature organisation where existing practices are deeply embedded in the culture, this approach can bring about a disconcerting experience, resistance and other challenges relating to the change for employees.

Based on their extensive review of action learning literature, Cho and Egan (2009) propose a conceptual framework (see Figure 19) of action learning research and also argue that this framework amplifies, tests and critically analyses the key characteristics of action learning.

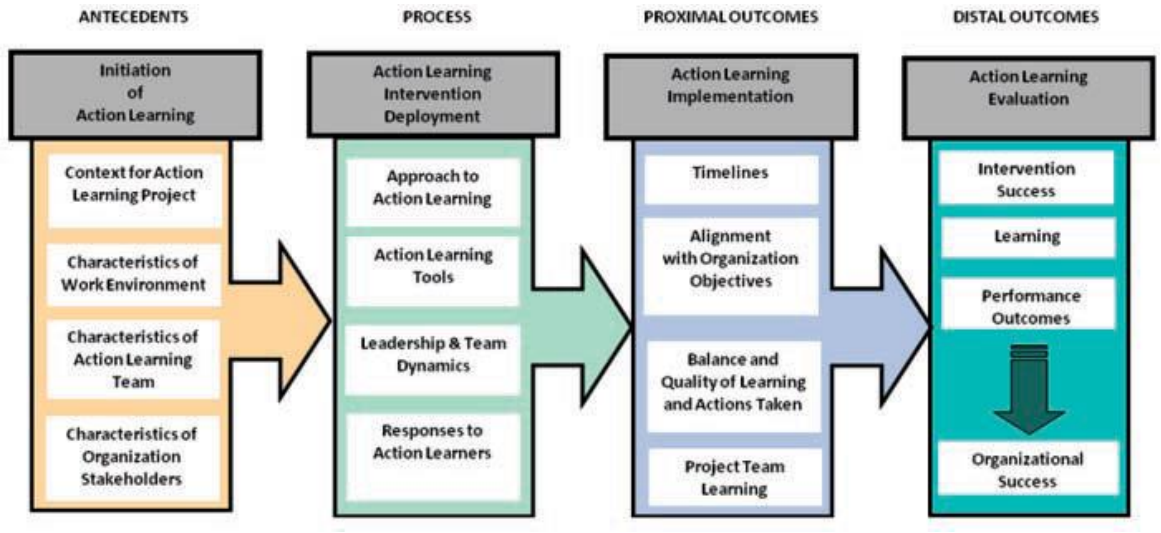

Figure 19: Dimensions of action learning: A conceptual framework (Cho and Egan 2009: 445)

This model represents the key dimensions of action learning as highlighted in their literature review, including, relevant antecedents, process of action learning, proximal and distal outcomes. Further, the model treats action learning as a process consisting of four critical stages, i.e. the initiation of action learning, action learning intervention deployment, action learning implementation, and action learning evaluation (Cho and Egan, 2009). As compared to the models discussed prior to this, Cho and Egan's (2009) framework offers a more comprehensive and detailed approach to carrying out action learning, by taking into account various characteristics that need to be considered about the methodology, tools, team, environment, learning, outcomes and the organisational impact in the form of the success achieved from the intervention.

Although the models discussed here have been designed with the aim of following the philosophy of action learning, i.e. learning through reflection on action, a model which is philosophically underpinned by action learning and aims to improve knowledge sharing practices in project teams had not been proposed until now.

3.3.2.6 Challenges in action learning

Whilst evaluating the definitions of action learning success by different researchers is important to understand the impact of action learning, there is no one-size-fits-all formula for action learning due to contextual differences (Bong and Cho, 2017; Edmonstone, 2015). Any way of seeing may also be a way of not seeing, thus, the success of action learning requires better design of the action learning process and organisational support (Bong and Cho, 2017: 174). In this research, the researcher not only reviewed the core elements required for achieving successful action learning from previous literature, but also the following design and practical challenges that needed to be considered and the risks that needed to be mitigated.

As discussed earlier in this chapter, there are various takes on action learning by different researchers which makes it ***difficult to define*** accurately because of its various interpretations (Weinstein, 1995). There are 27 variations of action learning approaches in the world according to Boshyk (2016). The variety of action learning approaches makes it difficult for practitioners and researchers to distinguish between action learning and non-action learning approaches, and, may reduce the value and appreciation of action learning (Bong and Cho, 2017: 161) which subsequently creates the risk of adopting practices which contradict the action learning principles which Revans had hoped would remain. However, on the other hand, the advantage of the fluidity in action learning is that it leaves flexibility for action learning facilitators to design and tailor their approach to the specific context.

As well as the challenge of defining what exactly action learning is, it is also difficult to ***measure its success***. Further, Bong and Cho (2017) stress that despite the previous research on action learning and its various approaches, there is a lack of focus on how action learning can deliver expected performance when it is successful. From their research comparing action learning, Bong and Cho (2017: 170) state that "we also learned a lesson that success of action learning should concern the long-term impact that it has had on people and organizations rather than just focusing on visible changes which are possible within a short timeframe". Similarly, Pedler and Trehan (2010: 117) stress that the success of action learning is often evaluated "in terms of the focal challenge, but this is really seeing the set as just a task force and the more important question is: What is carried forward from action learning to make future success more likely?". For example, participants' confidence and ability to learn, and most importantly, "the usefulness of action learning in improving our capabilities in dealing with the wicked problems spread around complex systems and networks" (Pedler and Trehan, 2010: 117).

Generating ***impact*** on individual learning as well as the business has been recognised as a major challenge in action learning according to Cho and Egan (2009), and Yoon et al (2012) argue that to achieve a balance between these depends on the appropriate selection of the problem type for the participants. Further, a study by Tushman et al (2007) supports this argument where participants

working on individual issues achieved lower levels of learning as compared to those working collectively on a team project on real organisational issues who achieved significantly greater individual learning, individual behavioural change and organisational changes. Dotlich et al (2010: 341-342) address the challenge of ***relevance*** of action learning for issues in modern organisation and argue that "…several years ago the business challenge might have been more static, such as how to revise an internal process, now the challenges are more fluid, messy and complex, and even unstructured – such as how to sell global products in an emerging market while maintaining margins and first-tier positioning in developed markets. Most action learning challenges today are paradoxes, not problems, which need to be managed, not solved".

Resistance from participants has been raised as an issue in action learning by Burger (2013). Burger (2013: 264) describes resistance as "an attempt of self-protection that is manifested in action learners' struggles with their sense of self-efficacy and their social Self. These struggles are an inherent part of the action learning process and may elicit defensive undercurrents that constrain learning". Each action learning set consists of different individuals, works differently, has its own dynamics and challenges, thus it is the responsibility of the facilitator to learn from this and adopt an approach tailored to not only the set as a whole, but also taking into account the individuals in the set (Burger, 2013). Another challenge identified by Bong and Cho (2017: 168), and one which is possibly related to the issue of resistance, is the matter of ***time investment*** from participants e.g. "We're too busy to do action learning", and from the organisational perspective, the emphasis on short term results combined with the challenge of measuring the outcomes of action learning.

Although efforts were made in this research to reduce the impact of the above challenges identified in the literature, some challenges were experienced whilst others were overcome, which will be discussed in the conclusion chapter.

3.3.3 Action learning for the ETI

From previous experience of working on a research project and through subsequent reflection, the researcher was in a position to understand the ETI as an organisation, its goals, practices, ethos and organisational culture. Further, as discussed in the Introduction chapter, the ETI is a UK-based organisation - a public-private partnership set-up by the UK government and global energy and engineering companies - BP, Caterpillar, EDF Energy, Rolls-Royce and Shell. By combining the knowledge and expertise from partnerships with academia, industry and the UK government, the ETI researches, develops and delivers innovation in low carbon energy solutions to help the UK address its long-term emissions reductions targets. Operating within a complex governance structure, the ETI works to meet the expectations of various stakeholders, comply with legal parameters of its membership model (to

protect its unique knowledge and arising intellectual property), deliver innovative solutions (many of which are of a competitive nature) and, disseminate this knowledge effectively and on time. Thus, the management of both, 'knowledge sharing' and 'information security', is an ongoing operational challenge for the ETI. At the time this research was carried out, the ETI was at a midway stage where several projects were underway and not yet delivered to the stakeholders. The volume of knowledge generated for and within each project was substantial and of a technical and complex nature. Thus, the organisation was keen to learn about its knowledge management practices, the problems that might exist, new ways of improving knowledge sharing, protecting sensitive and valuable knowledge and engaging effectively with stakeholders for disseminating knowledge. Based on this understanding of the research context, combined with the aims of the research i.e. to firstly understand the knowledge sharing and information security practices at the ETI, and secondly, identify ways of improving knowledge sharing within and beyond the organisation, action learning was regarded as a suitable and beneficial methodological approach for a number of reasons.

Operating within an intricate membership structure, pooling knowledge from various sources, creating innovative solutions where the main outcome or 'product' itself is knowledge, makes the ETI a knowledge-intensive organisation and to understand the practices in such an organisation required an in-depth exploratory approach. Further, by considering the integral role of employees in the organisation's practices, it was recognised that the research would need to be designed with the knowledge - particularly tacit know-how - and experiences of the ETI's employees at its core. To elicit individual's knowledge and experiences and develop an insight into the knowledge sharing and information security practices, any qualitative data collection method, such as one-to-one interviews, questionnaires or focus groups, would have been sufficient. However, the aim of this research was more than understanding the current practices; the intention was to learn about current practices and issues, and develop ways of improving those practices, which would subsequently lead to improved effectiveness and efficiency in the organisation's knowledge management. Therefore, it was critical that the employees were engaged and become an active part of the research that would enable organisational change.

Action learning focuses on the importance of learning from existing practices and experiences through reflection (e.g. McGill and Beaty, 2001; Revans, 2011; Boshyk, 2016), provides an environment that is specifically designed to be conducive to reflection, openness, knowledge sharing and learning, and, enables an organisation to solve real business problems (Weinstein, 1999; Marquardt, 2011). Furthermore, as the ETI's set-up consists of various intact project teams, this setting enabled an effective action learning approach to be developed which would allow individuals and teams to collectively reflect, share their knowledge and experiences and develop new ideas about improving organisational practices (e.g. Dilworth, 1998; McGill and Beaty, 2001; Vince, 2008; Revans, 2011; Boshyk, 2016).

Further, an action learning approach would also simultaneously increase awareness of employees engaged in the process (Haith and Whittingham, 2012) and generate learning at the individual, team and organisational levels, which is imperative in helping the organisation to solve problems and initiate change (e.g. McGill and Beaty, 2001; Vince, 2008; Revans, 2011; Pedler, 2011; Boshyk, 2016). With that in mind, a creative action learning approach was developed which is presented in the next section.

3.4 Research model

A new research model was developed for this research that incorporated input from the research participants, the ETI and the researcher, with the aim to develop a holistic perspective on the ETI's knowledge sharing and information security practices and meet the objectives of this research.

3.4.1 Research approach

The researcher's aim was to understand the *experiences*, *knowledge and opinions* of individuals in relation to knowledge sharing and information security practices. To achieve this, a qualitative study approach was adopted. Qualitative research is designed to enable researchers to study and understand people and their behaviour (Myers, 2013) which was the aim of this research. A key benefit of qualitative research is that it places the researcher in the best position to understand the 'why' of the study subject; understanding of the social and cultural context provides an insight to the researcher about the decisions and actions that people take, as well as the underpinning motivations, reasons and beliefs (Myers, 2013).

Qualitative research is descriptive, inferential and facilitates the exploration of complexities that cannot be explored through other more 'controlled' approaches (Gillham, 2000). Moreover, the approach enabled the researcher to develop an in-depth and focused understanding of the ETI's knowledge sharing and information security practices and their associated issues, and facilitated the development of potential recommendations to address and overcome the issues. The qualitative approach developed not only enabled the researcher to gain an in-depth understanding of the organisation and learn about actual practices, but also to see things from the perspective of the participants that were involved in the research (Gilham, 2000: 11).

3.4.2 Holistic research model

The novel research model developed for this research is shown in Figure 20. It aimed to follow a holistic approach by incorporating combined input from the (i) research participants i.e. the ETI employees, (ii) the ETI as an organisation and (iii) the researcher.

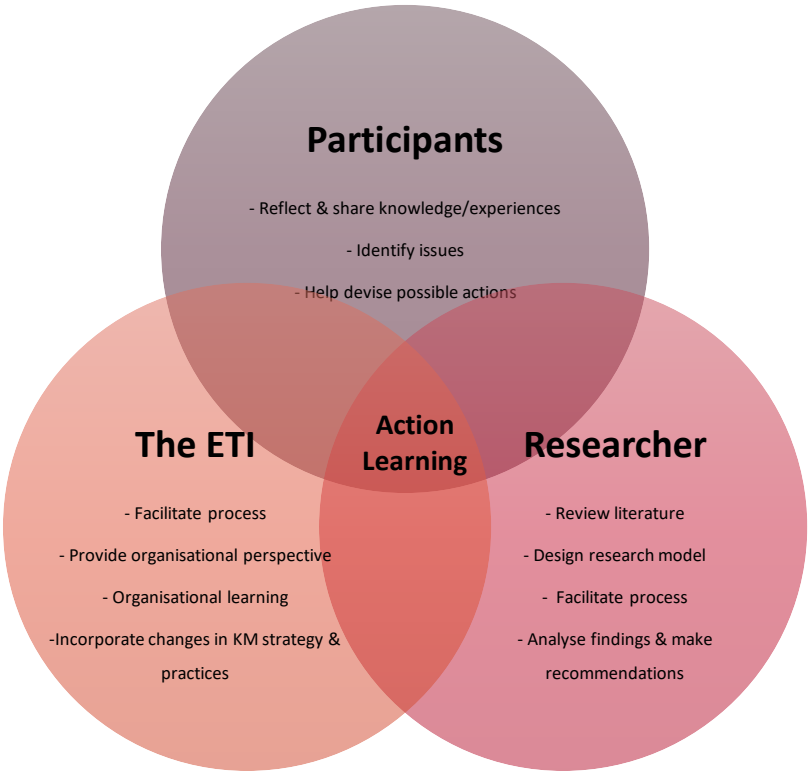

Figure 20: Holistic research model

Through collective reflection, knowledge and experience sharing with their team, the research participants explored the ETI's knowledge sharing and information security practices, identified challenges and issues and helped to devise possible actions in order to improve the organisation's knowledge sharing. In addition to facilitating the research design and data collection process, the ETI's input was incorporated in the analysis stage to contextualise the findings and provide an organisational perspective. The research has enabled the ETI to learn as an organisation and incorporate this learning in its KM strategy in order to make its knowledge sharing practices more efficient. The researcher's role consisted of developing a tailored research model based on the literature review, facilitating the data collection, analysing the findings and providing recommendations to the ETI. The researcher's knowledge and experience of collaborating on a previous project with the organisation (see Ragsdell et al, 2014) was also used to inform the research design and analysis and contextualise the findings. Thus, the aim was to generate rich organisational, team and individual learning through the amalgamation of knowledge and experiences from the three parties, i.e. integrating academic, organisational and individual perspectives. At the heart of the research model was action learning through which a multi-cyclic process was developed to carry out the research.

3.4.3 Research model phases

The research model was underpinned by the philosophy of action learning and consisted of five chronological phases (see Figure 21), serving as a practical framework for the researcher. As discussed earlier in section 3.3, action learning is an approach based on the belief that learning cannot be achieved without action, and, action without learning. action learning enables employees to form an action learning set (ALS); an ALS is when a group of individuals come together to collectively engage in a process of learning and reflection in a mutually supportive environment with their colleagues, whilst tackling real organisational problems and developing practical actions to improving organisational practices.

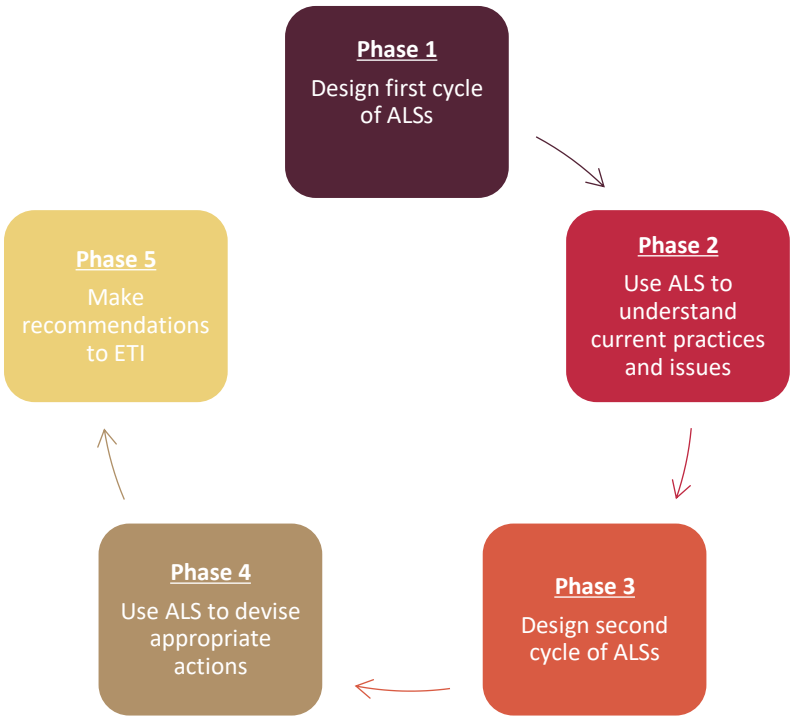

Figure 21: The research model for this research

Each of the five research phases contained action learning sub-cycles that followed an 'action-reflection-learning-planning' process - in varying orders. In addition to the reflection and learning of the participants, at each phase of the model, the researcher and the ETI were also able to reflect on the process and content of the model. A cyclical approach provided the flexibility to design and tailor each subsequent research phase based on the outcomes of the previous phase - or to return to the previous phase if necessary - and to ensure that the approach remains relevant and that the important areas receive the required attention.

The five phases of the model and their stages are explained in the following sections.

3.4.3.1 Phase 1 - Design first cycle of ALSs

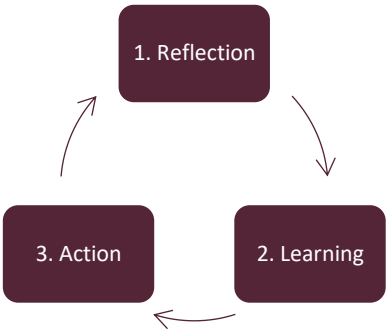

Figure 22: Research phase 1

The aim of Phase 1 of the research model was to design and plan the first cycle of ALSs. This phase, shown in Figure 22, consisted of a reflection-learning-action cycle as follows.

Reflection - the researcher reflected on their own prior knowledge of relevant literature, combined with experience of the ETI's organisational and project team practices from the knowledge audit project involvement.

Learning - based on the reflection, the researcher learned about and identified the relevant knowledge sharing and information security areas at the ETI that should be incorporated into this research, as well as identifying which project teams would be best suited.

Action - learning about the ETI's practices and project teams enabled the researcher to devise the content for the first cycle of the ALSs (i.e. a set of discussion themes and questions), invite the selected project teams to participate in the research and schedule the first set of ALSs.

3.4.3.2 Phase 2 - Understand current practices and issues

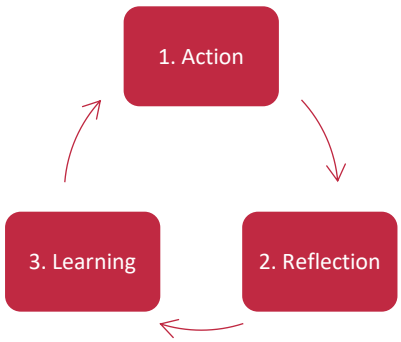

Figure 23: Research phase 2

Phase 2 aimed to identify and understand the current knowledge sharing and information security practices and their associated issues at the ETI, through a set of ALSs with three project teams. The ALS

was delivered through a peer discussion group, facilitated by the researcher to create an atmosphere conducive to individual and team reflection, knowledge and experience sharing of organisational practices and identification of issues (Haith and Whittingham, 2012). This phase consisted of an action-reflection-learning cycle, as shown in Figure 23, that involved the following.

Action – ALSs were conducted with three project teams at the ETI, during which the project teams were encouraged to focus and reflect on their organisation's practices based on the discussion themes and subsequent questions asked by the researcher.

Reflection – during the ALS (see sub-section 3.5.1.2 for the discussion themes), a reflection process was triggered where the project team participants were encouraged to reflect on their previous 'actions' i.e. their own knowledge and experiences of knowledge sharing and information security practices at the ETI, and share their opinions about these within the team.

Learning – through the collective reflection and sharing of knowledge and experiences, the project teams generated new learning for themselves and the researcher about their organisation's knowledge sharing and information practices and their associated issues.

3.4.3.3 Phase 3 - Design second cycle of ALSs

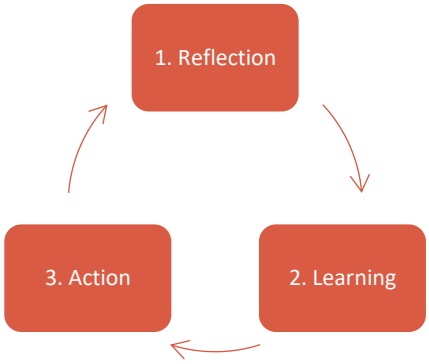

Figure 24: Research phase 3

The aim of Phase 3 of the research was to analyse the outcomes of the first cycle of ALSs i.e. understanding the current knowledge sharing and information security practices and issues, and based on the learning, designing the second cycle of ALSs. This phase consisted of the following reflection-learning-action cycle as shown in Figure 24.

Reflection: the researcher reflected and analysed the discussions and outcomes of the first cycle of ALSs for each team.

Learning: the researcher learned about the current knowledge sharing and information security practices at the ETI, identified the strengths, weaknesses and issues of both practices and shared this learning with the ETI.

Action: using the learning from the first ALS cycle, the second ALS cycle was designed tailored specifically for each team and the ALSs were scheduled with the three project teams.

3.4.3.4 Phase 4 - Devise appropriate actions

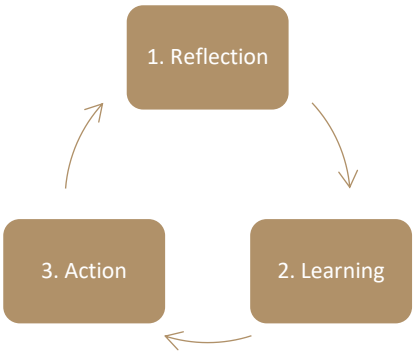

Figure 25: Research phase 4

Phase 4 of the research consisted of a second, follow-up cycle of ALSs with the project teams. The aim of this phase was for the participating teams to use the learning about the ETI's knowledge sharing and information security practices (that they identified from the first cycle of ALSs in Phase 2), particularly focusing on the issues that impact these practices the most, to devise possible actions that would help the organisation improve its practices. As shown in Figure 25, this phase consisted of a reflection-learning-action cycle.

Reflection: in the ALSs, the researcher shared with each project team their findings from their previous ALS, which initiated a process of reflection and discussion within each team.

Learning: by reflecting on the findings from their first ALS, each team learned about their viewpoints on the ETI's knowledge sharing and information security practices, which areas they identified as being strengths and weaknesses.

Action: each team collectively discussed and identified the weaknesses that they believed had the biggest negative impact on the ETI, then constructively explored the root causes of issues and subsequently devised a set of actions that they wanted to propose to the ETI in order to improve its organisational practices.

3.4.3.5 Phase 5 – Make recommendations to the ETI

The last part of the research model, Phase 5, aimed to combine and analyse the learning from (i) the teams generated through the ALSs, (ii) the ETI's organisational perspective and the researchers experience of the research process and prior knowledge of working with the ETI, and to make appropriate recommendations to the ETI to help improve its knowledge sharing practices. This phase consisted of the following reflection-learning-action cycle, as shown in Figure 26.

Figure 26: Research phase 5

Reflection: the researcher and the ETI reflected on the research process and the outcomes i.e. the key findings about the knowledge sharing and information security practices in Phase 2 and the actions devised and suggested by the teams in Phase 4.

Learning: by carefully analysing the research outcomes and mapping them against the existing KM initiatives at the ETI that are already underway, suitable areas of improvement were uncovered.

Action: recommendations were made to the ETI to incorporate into its KM strategy to initiate improvements.

3.5 Research methods

3.5.1 Data collection

The data collected from the ETI for this research was mainly of a qualitative nature, with some data of a quantitative nature. The following sections describe the type of data collected and the methods used for it.

3.5.1.1 Participant consent

At the start of the research - during the first ALS with each of the teams - the participants were provided with a detailed explanation of the research process and what their involvement would entail and were asked to complete a brief consent form (see Appendix A). The consent form required the participant's name, signature and date, and this information was treated as confidential and was not linked to any other content in the research.

3.5.1.2 ALS content

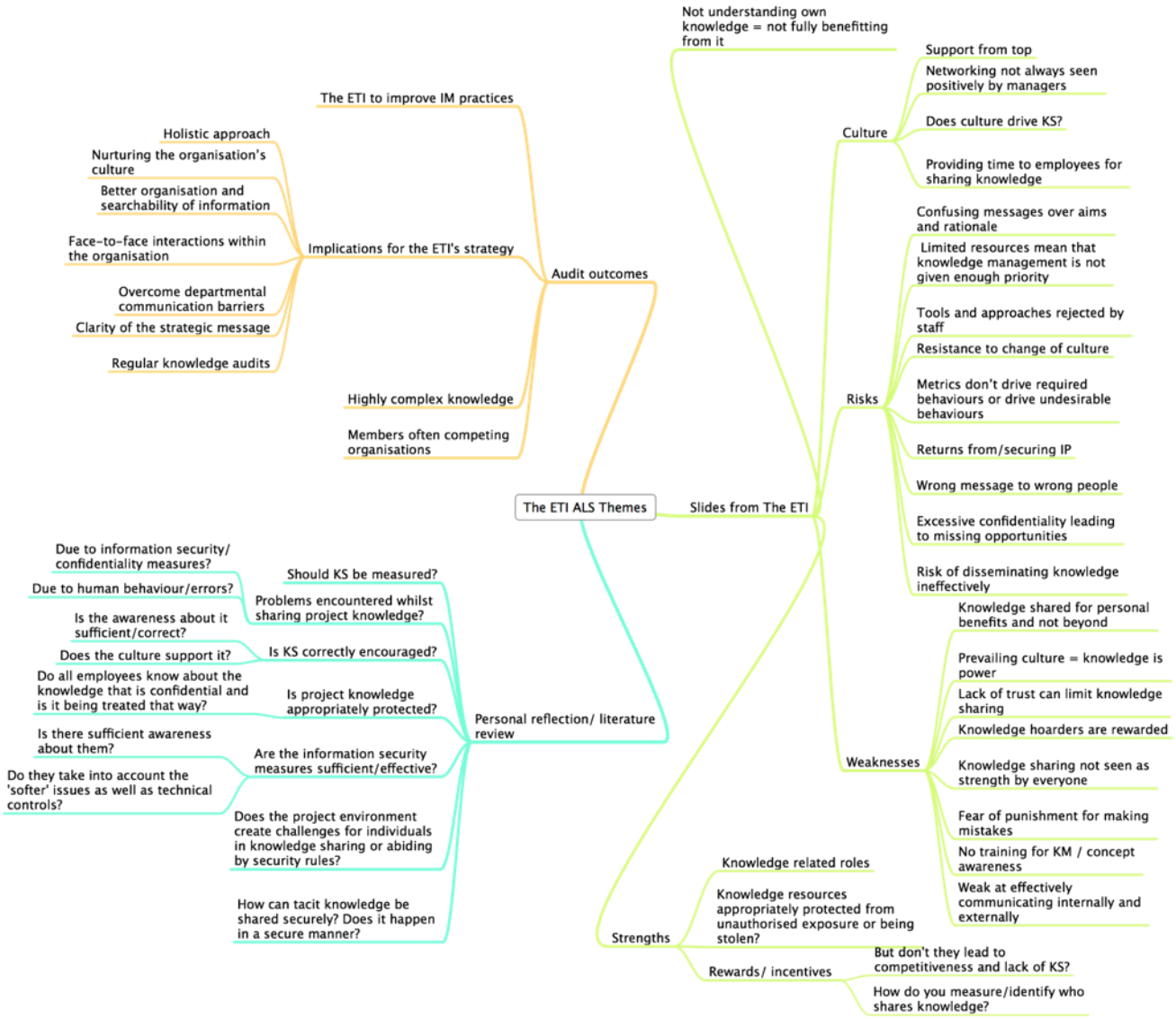

Figure 27: ALS theme ideas and sources

The themes for the ALSs were derived from a combination of the researcher's personal reflection on experience at the ETI, review of relevant knowledge sharing and information security literature, the knowledge audit findings and the relevant documentation provided by the ETI in relation to its KM strategy. A mind-map of the different ideas that were gathered and their sources to generate the themes can be seen in Figure 27. The content of the ALSs was divided into three themes to provide structure to the sessions and to ensure that all relevant areas of the research were being covered in the discussions by the teams; the themes included 'knowledge and information sharing', 'the ETI culture' and 'protecting the ETI's knowledge' (see Figure 28).

During ***the first cycle of ALSs***, each theme consisted of a set of questions as shown in Figure 30, and for each question, the participants were asked to engage in either (i) a team discussion or (ii) a team activity through which they could contribute their opinions, have a discussion, constructively challenge each other's views and work together as a team to make decisions.

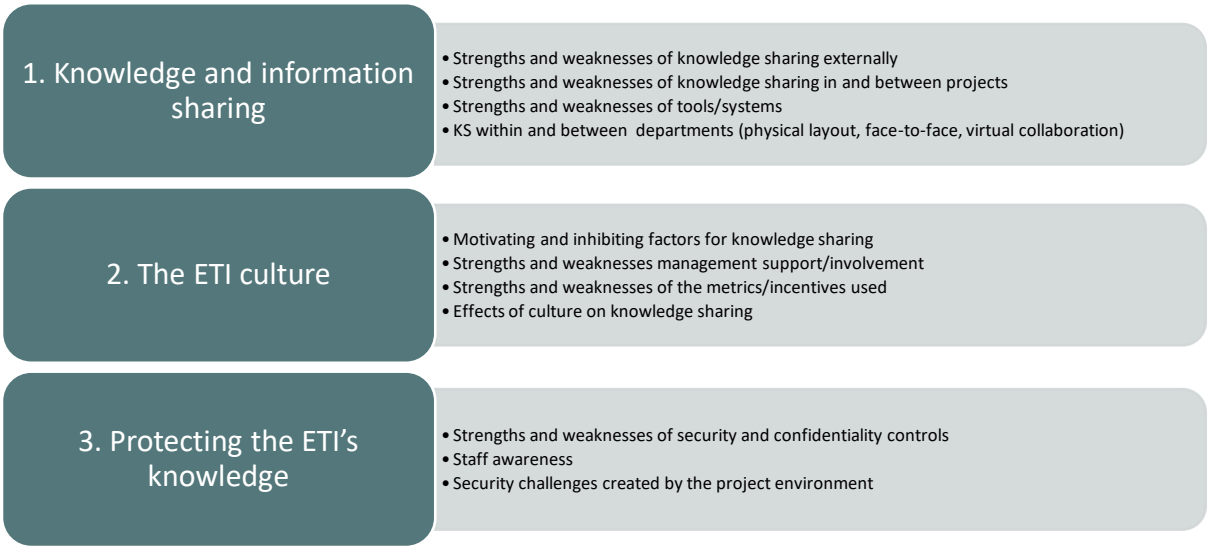

Figure 28: The ALS themes

Some questions required the team to engage in a team discussion, such questions were labelled with the following symbol:

Other questions that required the team to engage in a team activity were indicated with the following symbol and steps:

- *Step 1 - researcher asks question*
- *Step 2 - each participant writes their own response in keywords on post-it note*
- *Step 3 - everyone shares their post-its with the team*
- *Step 4 - team discusses and collectively puts the post-its in order of importance on the chart*

The discussions that took place for both types of questions were later transcribed from the audio recordings, and for the team activity questions, the discussions were merged with the respective flip-charts and post-it notes that the teams produced. A sample of the flip-charts that were placed on the

walls at the start of the ALS (left) and a completed flip-chart after the completion of an activity (right) can be seen in Figure 29.


Figure 29: The ALS flip-charts at the start (left) and end (right) of the session

During ***the second ALS cycle***, the findings from the first cycle were shared with each team, following the same thematic order. Each team was encouraged to focus and reflect on the areas of improvement they identified and devise a set of proposed actions to improve the relevant aspects of knowledge sharing and information security at the ETI. The actions were either team or organisational level, and due to time restrictions, the teams were asked to prioritise and focus on the biggest issues first. The teams were asked to write down the actions that they devise on documents provided with the following information for each action:

1. *What needs to be done?*
2. *What should it ultimately achieve?*
3. *Who needs to do it?*
4. *What can we do as a team to support it?*
5. *How can we take ownership and track its progress?*

The documents produced by each team containing the actions that they devised were incorporated into the full transcription of the ALSs and the relevant discussions that took place when they were being devised.

3.5.1.3 Questionnaire

At the end of the first ALS, participants were asked to complete a brief questionnaire (see Appendix C) about their personal opinions about the effectiveness of knowledge sharing and information security

practices at the ETI. The questionnaire firstly requested the participants to provide some personal information including their name, department, role, gender and the length of their employment at the ETI, and then the participants were asked to rate the effectiveness of the following subjects based on their own experience of working at the ETI (where 1 = ineffective and 10 = extremely effective):

1. *ETI's knowledge sharing with external stakeholders*
2. *Knowledge sharing between project/programme teams at the ETI*
3. *Knowledge sharing between departments at the ETI*
4. *Knowledge sharing within your team*
5. *The role of the ETI's governance/management in nurturing knowledge sharing*
6. *The role of the ETI's culture in nurturing knowledge sharing*
7. *The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools*
8. *Confidentiality policies/controls for sharing knowledge/information internally*
9. *Confidentiality policies/controls for sharing knowledge/information externally*
10. *The role of the ETI's governance/management in protecting knowledge/information*

3.5.1.4 Feedback questionnaire

Following the completion of the first ALS, an anonymous feedback questionnaire via SurveyMonkey (see Appendix D) was sent to all of the participants via email requesting their feedback on the discussion topics, ALS approach, learning and awareness, logistics, researcher, useful aspects of the ALS, aspects that can be improved, additional topics that could be added to future ALSs and any suggestions that participants may like to make to the researcher.

3.5.2 Data analysis

As described in the previous section, a variety of data was collected during the research cycles at the ETI, ranging from mainly qualitative to a small amount of quantitative data. Due to the sequential nature of the research model phases (see Figure 23) the data collection and the subsequent analysis was also undertaken sequentially.

From the first ALS cycle, the researcher manually transcribed the audio recordings for each team and documented them in Microsoft Word documents shortly after the completion of the cycle. From the transcripts combined with the flipcharts that the teams created, mind-maps were drawn to aid the analysis using MindNode software. The mind-maps visually depicted the key findings for each team, maintaining the priorities or hierarchies that the teams created for certain activities, and categories of findings were maintained in the transcripts based on the ALS themes and questions for each team.

The questionnaires (see section 3.5.1.3) containing quantitative data completed at the end of the first ALS by all participants were combined for each team and an average rating for the entire team was created for the different aspects of knowledge sharing and information security at the ETI. The questionnaires were analysed and presented in tables created in Microsoft Excel. A report was produced for the ETI at the end of the first ALS cycle (see Appendix E) which contained an amalgamation of the findings for the three teams to make the report concise and to ensure anonymity of the teams.

The data collected from the second ALS cycle consisted of the audio recordings of the sessions and the documents produced by each team containing the list of actions that they devised. The audio recordings were manually transcribed by the researcher in a similar manner to the previous cycle, and the documents containing the actions were typed up and enhanced using the corresponding discussions from the transcripts.

The findings from both ALS cycles were then amalgamated for the Analysis chapter, through which common themes emerged. To identify the themes, the data was categorised based on the most common discussion topics, following this, the categories were compared to the priorities the teams had created to identify the most impactful factors affecting knowledge sharing and information security. Many themes emerged from the analysis, from which, the eight most impactful themes were taken forward to the Discussion chapter, discussed in light of relevant literature and contextualized based on the organisational and the researcher's perspective.

All of the research data was anonymised during the analysis process.

3.5.3 Research participants

When identifying potential research participants, many important factors were considered, including, the participants being a part of or working closely with a project team, from a variety of hierarchical positions and roles (which included programme managers, project managers, project management officers, department heads, advisors to analyst.), having a variety of experiences of working at the ETI and a representative mix of male and female employees. Due to the in-depth nature and the cyclic process of the research, it was decided that a smaller amount of project teams would be sufficient to participate, thus the research participants consisted of three project teams from the ETI's Loughborough office. The teams were primarily intact, with some individuals playing a cross-functional role based on their involvement with particular projects.

Table 1 shows the details of the participating teams and their respective participants' profiles to provide an overview of the dynamics and diversity of the teams. Although individuals from particular project teams were approached with an invitation for participation, participation took place on a voluntary basis in line with Loughborough University's 'Ethical Code of Practice'. Participants were provided with

sufficient information about the nature and purpose of the research, as well as their involvement in the research through a participant information sheet (Appendix B), their questions and queries were answered, their participation was kept anonymous and they were asked to complete a consent form (Appendix A) at the start of the research.

	Team 1						
Name	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
Gender	Male	Male	Male	Male	Female	Female	Male
Length of employment with the ETI	3 years 8 months	1 year	6 months	5 years	1 year 6 months	7 months	1 year 3 months
	Team 2						
Name	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5		
Gender	Male	Male	Male	Male	Female		
Length of employment with the ETI	6 years	2 years 6 months	1 year	1 year 2 months	4.5 months		
	Team 3						
Name	Participant 1	Participant 2	Participant 3	Participant 4			
Gender	Female	Male	Male	Male			
Length of employment with the ETI	8 Months	8 Years	4 Years 6 Months	-			

Table 1: Research teams and participants

3.5.4 Logistics

To enable the researcher to focus on facilitating the ALSs, the sessions were audio recorded with permission from the teams and transcribed at a later date. PowerPoint slides were used as visual aids to display information about the research, the discussion themes and questions in the first ALS cycle (see sample in Appendix F), and the research findings for each team were presented to them through the slides in the second ALS cycle (see sample in Appendix G). During the ALSs, for certain activities that required the participants to generate and write-down their personal responses to questions and then discuss these with the team, post-it notes and flip charts were provided. Following the first cycle of ALSs, each of the participants were sent an anonymous feedback form about the process and contents of the ALS to complete via SurveyMonkey.com. During the analysis process of the first ALS cycle, Mind-Map software on Mac OS was used to create mind-maps that presented some of the findings in a pictorial format.

The ALSs took place in meeting rooms at the ETI where every effort was made to ensure the environment was suitable for the required activities and respected the participants' confidentiality. The rooms were set-up in advance by the researcher (see Figure 30) i.e. with PowerPoint slides, research information

sheets, participant consent forms, post-it notes, pens and flip charts. The room was set-up with the aim to create an environment conducive for discussions and teamwork.


Figure 30: The ALS set-up

The first cycle of ALSs was carried out during June to August 2014, following which the sessions were transcribed, analysed and the follow-up cycle of ALSs was designed. Originally the aim was for the second cycle of ALSs to be carried out during Autumn 2014, however due to the researcher's and the ETI's demanding schedules, the second cycle was planned for and carried out during January and February 2015. The duration of each ALS was originally planned as two hours, however due to experiencing difficulty in completing all of the planned activities for the first session in two hours, the duration for subsequent sessions was increased to three hours for both cycles.

3.6 Chapter summary

The aim of this chapter was to demonstrate how the research methodology was informed and a novel research model was developed. The methodology was not only underpinned by an interpretivist qualitative research philosophy, but also the philosophy of action learning as this was well-suited to the aims of the research and the context of the case study organisation, as well as the dynamic nature of qualitative research. The final research methodology discussed in this chapter was not predetermined in that form at the start of the research process, but rather evolved and matured through the various stages of the research journey and the researcher's personal growth and understanding. Thus, the flexibility and appropriateness of choosing a qualitative approach for this research was realised and valued.

The holistic research methodology developed enabled the researcher to gain an in-depth understanding of and the reasoning underlying the ETI's knowledge sharing and information security practices. This was achieved through amalgamating knowledge from three different perspectives on the same subject

matters i.e. the participants' input provided a humanistic perspective, then by contextualising the findings in light of the ETI's organisational perspective and aims, as well as incorporating the researchers own experience and understanding of the research context.

Through the research methodology, relevant data was collected and rich findings were elicited for the analysis which will be discussed in the next chapter.

4. ANALYSIS

4.1 Introduction

In this chapter, the key findings from the data collection of this research are analysed. The data was collected in two cycles of action learning sets (ALS) from three project teams at the ETI. Cycle 1 of data collection aimed to identify and understand the current knowledge sharing and information security practices and their associated issues at the ETI. Cycle 2 consisted of a follow-up ALS with each team, which aimed to encourage reflection on the findings of the previous ALS and develop actions that could help the ETI improve its knowledge sharing practices.

In section 4.2, the research findings from each team are analysed in order to identify similarities and differences (see Figure 31); starting with the findings of Cycle 1, followed by Cycle 2 and finally highlighting the overall similarities and differences identified between the teams.

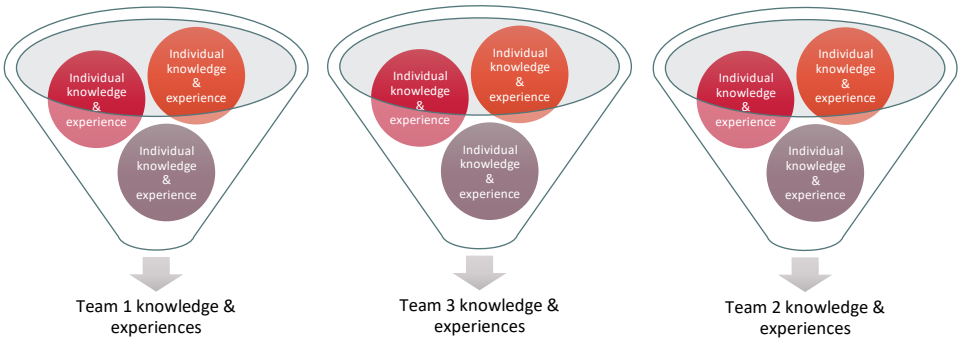

Figure 31: Comparison of teams' findings

In accordance with the chosen unit of analysis discussed in section 3.2.4, following the analysis of the individual teams and their comparisons, the empirical data was then analysed at the level of an integrated organisational unit. Further, section 4.3 amalgamates the findings from all of the teams (see Figure 32), in order to holistically analyse and understand the ETI's overall knowledge sharing and information security practices and surface common themes that impacted these practices. Finally, Section 4.4 summarises and categorises the research themes that have been elicited from the analysis of the research findings, which will be taken forward into the Discussion chapter.

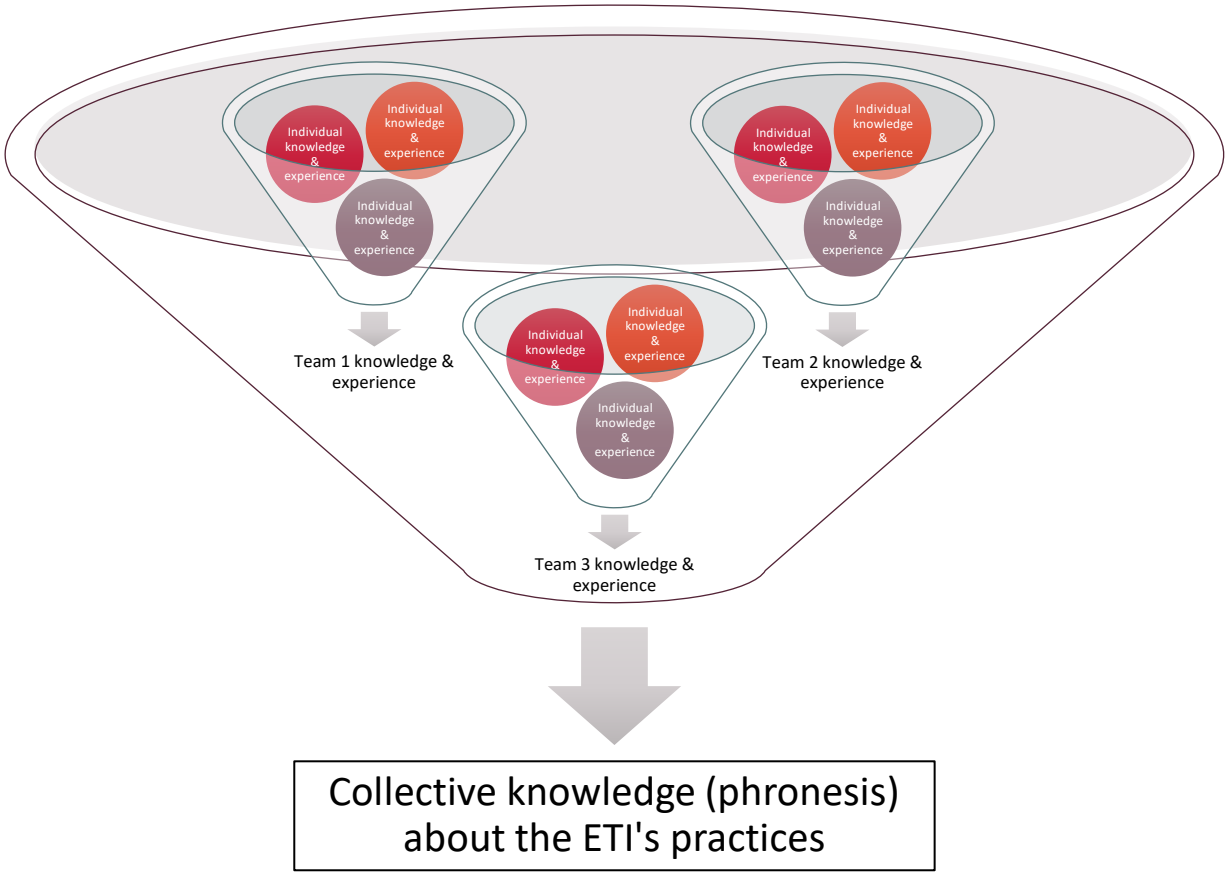

Figure 32: Amalgamation of findings

4.2 Comparison between the research teams' findings

The aim of this section of the chapter is to analyse the findings from each of the three research teams and compare the similarities and differences. In section 4.2.1, a comparison is made between the discussions the teams had in response to the questions asked during their first ALS in Cycle 1, as well as the questionnaire responses provided by each team. Section 4.2.2 analyses the areas each team decided to focus on during their second ALS and the actions they developed respectively. Section 4.2.3 presents an overview of the similarities and differences between the teams.

4.2.1 Cycle 1: Views on the current practices

In this section, the research findings from Cycle 1 are analytically compared to identify the similarities and differences in the teams' responses, starting with the team discussions about knowledge sharing and information security, followed by the questionnaire results.

4.2.1.1 Discussions

The teams were asked to identify and rank the strengths of external knowledge sharing for the ETI. The responses, shown in Table 2, showed several similarities. Firstly, all the teams commended the quality of the knowledge that the ETI generates and the knowledge creation processes - particularly the insights creation through the Energy Systems Modelling Environment (ESME) system. Secondly, Teams 1 and 3 described the Member Portal as being a strength for external knowledge sharing.

	Team 1	Team 2	Team 3
What are the strengths of knowledge sharing externally for the ETI?	1. Strategic Advisory Group (monthly meeting with the ETI member representatives to discuss outcomes from projects - not just relying on written reports; encourages active engagement from members) 2. Insights (lots of intelligent people who are able to explain project outcomes i.e. knowledge and insights creation) 3. Member Portal (access to project data; deliverables formally stored and organised; wide range of data and statistics available for sharing) 4. Ability to leverage member influence 5. Third parties (third party interest in the ETI; key players (members) in the market; benefit to market) 6. Build on and expand existing knowledge	1. High quality knowledge (good engineering knowledge base; respected authority; well-reasoned and evidenced) 2. Strong knowledge creation management processes 3. Typically manage a 'voice of reason' tone/style 4. Good access (access to large number of able partners; access to external channels to share knowledge; ETI seen as uniquely positioned) 5. Freedom and trust 6. Membership structure 7. Good relationship with the government 8. Explanation of legal frameworks	1. Evidence based output 2. Insights are often robust 3. Member Portal for sharing project outputs and information with ETI's members 4. Taking interested parties and building on trust 5. Engagement in various forums to share information 6. Various presentations in conferences 7. Strategic Advisory Group meetings to share information with members

Table 2: Strengths of knowledge sharing externally

The main difference identified regarding external knowledge sharing was regarding the Strategic Advisory Group meetings which Teams 1 and 3 are involved in and both described as a strength, yet Team 1 identified it as the biggest strength for external knowledge sharing with the ETI's members, whilst Team 3 ranked it the lowest. When studying the team differences, it was identified that only the Team 2 focused on the ETI from an external perspective, looking at the organisation's profile, describing it as a well-respected authority in the energy industry, being uniquely positioned and having good access to external channels and partners including the UK government.

Discussions about weaknesses of the external knowledge sharing (see Table 3), highlighted a number of similarities and differences in the teams. The commonalities between all of the teams were the discussions regarding security restrictions and operational processes such as confidentiality restraints, processes and protectiveness around knowledge as being inhibitors for external knowledge sharing. A similarity between both Teams 1 and 3 was their claim about having insufficient knowledge about what

can and cannot be shared externally, however, this was not raised as an issue by the Team 2. Another similarity identified between Teams 1 and 3 was regarding publishing formal outputs, which both teams described as a weakness; Team 1 expressed that there was a lack of resources for publishing the data, whilst Team 3 stated that outputs were not published and communicated on time. The mention of timely publishing of outputs may also tie in with an argument made by Team 2 about the existence of "too much obsession and defensiveness around IP protection" which was reported to have led to timelines for publishing being missed for time-sensitive material.

	Team 1	Team 2	Team 3
What are the weaknesses of knowledge sharing externally for the ETI?	1. Third parties (difficult to disseminate information to people who might be interested; difficult to identify *who* might be interested) 2. Publishing (resource to publish technical data about the ETI projects in journals) 3. Acting on feedback (the ETI is poor at acting on feedback; lack of available time) 4. Finding information (difficult to find information on web-based report archive) 5. Information limitations (ETI has either large reports or very high-level summaries – nothing in-between; some external knowledge coming into the ETI is restricted; changing priorities from members) 6. Confidentiality/security (confidentiality restraints; lack of knowledge of what can be shared externally; risk that sensitive information could leak; risk of reduced value of the ETI; limited to what information can be shared; license agreements can hold up sharing of data and information; difficult to be specific about what ETI does as much of the information is confidential)	1. The ETI's appearance ('closed' appearance from outside; over-protective; too corporate) 2. Intellectual Property (too much obsession with IP can be damaging; defensiveness around IP) 3. Bureaucracy with external sharing with stakeholders 4. The ETI's profile (appears small scale; who and what is the ETI?; lack of external profile) 5. Legal compliance 6. Too much science and too many engineers 7. Lack of clarity (complex 'informing' policy role; lack of clarity regarding commercial vs. intellectual aims) 8. Communications function (differences in subject matter understanding and expertise)	1. Not communicating all outputs 2. Not been able to publish project outputs 3. Weak at timely release of information 4. Not being heard and grabbing attention 5. Taking audiences along the journey 6. Perception of 'secret members club' 7. Confidentiality requirements can slow things down 8. Difficult to know instantly what is allowed to be shared 9. Need to improve sharing of large confidential file downloads

Table 3: Weaknesses of knowledge sharing externally

Some differences were also identified from Table 6. Firstly, only Team 1 argued that there was a difficulty in identifying target audiences for the ETI's external knowledge dissemination. Team 2 took a different approach and focused on the organisation's appearance by putting themselves in the target audiences' shoes. This team expressed the opinions that the 'closed appearance' and the lack of external profile hinders opportunities for outsiders to approach the ETI.

	Team 1	Team 2	Team 3
What are the strengths of knowledge sharing between programmes?	1. Coordination (programme team is well coordinated; co-location of team) 2. Contracts are written to allow project information to be shared 3. Project workshops organised within project consortia/the ETI 4. Presentations at team meetings 5. Lunch and learn sessions 6. Most people keen to share knowledge 7. Organisation size (small organisation; people know each other) 8. Approval (information sharing approved by the Strategy Director; ensures accuracy) 9. Lessons learned (knowledge sharing and process improvement across programme areas) 10. Between consortia and the ETI - maximise value out of project; the ETI staff knowledge	1. Governance and regular reviews 2. Team working 3. Knowledge sharing actively encouraged 4. Size - small team; supported by closeness or 'information connections; small size of the organisation 5. Initiatives (lunch and learn sessions; away days) 6. Translation between different 'languages' (e.g. technical, economics) 7. Openness, freedom and trust	1. Cross programme activities 2. Informal process related knowledge shared between project and programme teams 3. Lunch and learn sessions 4. Integration of outputs e.g. ESME 5. Cross programme challenge of findings 6. Delivery team meetings 7. Intranet

Table 4: Strengths of knowledge sharing between programmes

When asked about the strengths of knowledge sharing between programmes at the ETI (see Table 4), the discussions amongst the teams indicated a number of similarities. All of the teams stated that knowledge sharing is actively encouraged at the ETI through the governance, coordination and initiatives, and, there is closeness and opportunities for knowledge sharing because of the small size of the organisation. Further, all three of the teams acknowledged and expressed appreciation for the knowledge sharing initiatives the ETI has implemented, such as, lunch and learn sessions, away days, presentations at team meetings and cross-programme activities. Thus, the teams unanimously recognised that knowledge sharing between teams, in theory, is encouraged at the ETI and initiatives are in place to facilitate this.

Table 5 shows the reported weaknesses of knowledge sharing between teams or departments. All of the teams suggested that knowledge sharing between departments at the ETI needs to be improved. Although the teams provided different reasons for this, there was a strong emphasis towards people's mind-sets, the need and motivation towards knowledge sharing between teams, and it was identified that all of the teams used the word 'silo' in their discussions.

All three teams also highlighted some of the formal and informal processes as being ineffective for knowledge sharing (see Table 5). For example, Team 1 participants emphasised that they were not always aware of changes and decisions that were being made, and so expressed the need for improvements in formal communication through methods such as a formal weekly cascade. Team 1 also expressed that the lessons learned process needs to be strengthened at transferring learning across

programmes as well as the standardisation of practices between programmes, particularly due to the geographic separation of one programme team from the rest of the ETI. Team 2 argued that knowledge sharing in formal settings needs to be more reciprocal and that the informal knowledge exchange was often reliant on personal relationships due to insufficient knowledge sharing practices between teams. Team 3 reported the need for greater awareness of what knowledge can be shared or should be shared, as well as more continuous communication between teams to understand team outputs. A notable difference was that, inversely to the other two teams, Team 3 claimed that the insights produced by the Strategy Department may be a hindrance to cross-department activity due to the content being very technical and complex to understand.

	Team 1	Team 2	Team 3
What are the weaknesses of knowledge sharing between projects/programmes?	1. Programmes are siloed (one programme appears to be a completely remote company, behind a firewall; programme areas limited) 2. Internal knowledge sharing (the ETI has "small company approach" to knowledge sharing; internal formal communication is poor; no formal weekly cascade) 3. Overviews (lack of overviews; would be useful to do project overviews for programme team) 4. Knowledge dissemination (lack of standardisation and best practice makes knowledge transfer difficult; accessing processes; some project teams geographically disparate; no proactive process for dissemination from meetings) 5. Contracts 6. Lessons learned is weak (weak knowledge transfer between projects of lessons learned 7. Between consortia and the ETI - could bias project with knowledge from the ETI staff 8. Information sharing delayed through Strategy Director check	1. Sometimes programmes don't feel the 'need' to share 2. Lack of emphasis on identifying and communicating significance 3. Very reliant on personal relationships 4. 'Timelines' very tricky and often missed 5. Knowledge sharing is less effective between functions than between programmes 6. Knowledge sharing is not always two-way 7. Knowledge sharing often becomes a 'reporting session' 8. Lack of focus on implications 9. Limited time to share information between different programmes 10. Stakeholders and project participants tend to sit in silos	1. Strategy insights creation not well understood by most 2. We do not generally have time to know what other programmes and projects are doing and what learning is coming out 3. Weak communication between programmes that have overlapping projects 4. Insufficient awareness (internally) of knowledge sharing between programmes 5. Not enough cross programme work (too siloed) 6. Lack of continuous communication, particularly where there are interdependencies

Table 5: Weaknesses of knowledge sharing between programmes

When asked about factors that motivate the ETI employees to share knowledge (see Table 6), some differences in views were noticed. Team 1 claimed that the key motivation is the ultimate value and benefits of knowledge sharing, for example, through the ETI's exploitation work and returning value to the members. Team 2's responses focused on the humanistic or intrinsic aspects, such as genuine interest in wanting to make a difference and a positive work ethic of employees. The responses provided

by Team 3 differed in that they indicated that knowledge sharing is less of an intrinsic or voluntary behaviour and more of a formal requirement.

	Team 1	Team 2	Team 3
What motivates the ETI employees to share knowledge?	1. Exploitation work is getting individuals to think more about KM 2. Member value returns (by publishing to Member Portal) 3. Like-minded people in the team 4. Staff are friendly and approachable for tacit knowledge sharing 5. Sharing achievements e.g. doing successful and innovative projects.	1. Interest and engagement in wanting to make a difference 2. Work ethic (wanting to do a good job) 3. Personal/team benefits (team working, learning through sharing, shared benefit, mutual interest) 4. Professional duty or job description 5. Closing of a project	1. When there is a need to do so 2. Engaging support 3. Requirement to do so 4. Promoting successes 5. Desire to improve processes 6. To provide an alternative view 7. Willingness/desire to share

Table 6: Motivators for knowledge sharing

	Team 1	Team 2	Team 3
What hinders the ETI employees from sharing knowledge?	1. Lack of clarity of ETI (ETI is a knowledge creating and communicating business but sees itself as an engineering organisation) 2. Lack of clear guidance of requirements for sharing 3. Lack of summarised programme/project data available to everyone in the organisation i.e. the ETI intranet 'wiki' 4. Weak communication (continuous changes not being communicated across teams; top down communication is poor; no weekly brief; process changes not communicated) 5. Sensitive material/IP	1. Can't see the wood for the trees 2. Lack of clarity - not sure what party is interested in; lack of experience of audiences 3. Split between one team and the rest of the ETI 4. Mentality (lack of time; not part of my job/role; focus on project delivery) 5. Organisational structure (the way the ETI is set-up; some offices are like a 'library'; offices are too quiet) 6. Limited member interest in project area 7. Culture (weak culture and values; working from home; 'water cooler' effect)	1. Lack of time 2. Silos (organisational structure, incentives, limited access to required data/information on systems) 3. Culture doesn't facilitate knowledge sharing 4. A perceived lack of need to share 5. Diversity of project areas 6. Tools (not fit for purpose, siloed design)

Table 7: Inhibitors for knowledge sharing

The teams were also asked about inhibitors of knowledge sharing at the ETI (see Table 7). Team 1 argued that it is unclear how the ETI perceives itself i.e. the ETI may identify itself as an engineering organisation, and also argued that the significance of top-down communication and guidance for knowledge sharing receives inadequate attention. Somewhat similarly, Team 2 also stressed that because the ETI is engrossed in its projects, it does not always see the bigger picture, therefore greater clarity about target audiences is required. Team 2 also referred to people's mentality as being an inhibitor, whilst both Teams 2 and 3 suggested the organisational structure and culture does not stimulate knowledge sharing.

Thus, the main similarity identified is that the majority of the inhibitors related to organisational culture and practices. A common issue Teams 1 and 3 reported was about the restrictions on system access to relevant project information. Another similarity was Teams 2 and 3's reference to perceived 'lack of time' for knowledge sharing.

	Team 1	Team 2	Team 3
Which Information security aspects are the most challenging for ETI employees?	1. Complexity (legal licenses are too complex and lengthy; often include legal involvement as rules can be complex; systems not clearly understood i.e. complicated for staff and the ETI members) 2. Confidentiality/approval (weak procedure for reviewing presentation material to public; who approves external presentations for IP?; approval for publication and dissemination by various people/organisations means material is not useful) 3. Lack of clarity (errors have been made regarding publishing knowledge as limited people can upload to Member Portal; not clear what the confidentiality levels are or how much can be shared; no guidance document on confidentiality) 4. Lack of guidance so often we "protect" just in case i.e. cautious withholding 5. Web (lack of IT control for sensitive data; people put information on iCloud; web based reports) 6. Restrictions internally are sometimes too tight (Y: drive read/write access) 7. We don't automatically store all information on PIMS 8. User awareness	1. Ensuring trust between commercial competitors 2. 'Highest common denominators' syndrome i.e. need to meet security culture of all stakeholders 3. Lack of independent ETI voice (the ETI position as a potential 'reputational risk' for members; no clarity on how to deal with this other than taciturnity) 4. Entirely protects value for members 5. Conflict of interest (also by Board members) 6. Missed opportunities for sharing knowledge 7. Timelines/resources needed to navigate security 8. Confused about exploitation 9. Ensuring relations with the government are handled appropriately (i.e. no suspicion of corruption). 10. Creates a lack of trust 11. Competition Law compliance	1. Very bureaucratic and heavy-handed legal approach to confidentiality (no ability to select appropriate levels of security) 2. Can cause delays in accessing & providing information 3. Appropriate use of IP and photos 4. Overly strict access control 5. Internally seem a little blunt for certain areas 6. CRM and its use cuts through security measures 7. Member information licensing is cumbersome

Table 8: Challenging information security measures

When asked about the information security aspects that the ETI employees find the most challenging, all three teams referred to the confidentiality, legal requirements for protecting information and approval processes (see Table 8). This was particularly apparent in Teams 1 and 3; Team 1 commented on the complexity of legal licences and subsequent delays, confidentiality and approval processes, and insufficient clarity on confidentiality levels; Team 3 described the legal approach to confidentiality as bureaucratic and heavy-handed, and said that this causes delays in processing information for external knowledge sharing. Teams 1 and 3 also expressed concerns regarding the confidentiality levels, where

Team 1 argued that not being clear on what can and cannot be shared externally leads to unnecessary withholding of knowledge. Teams 1 and 3 also identified strict access controls to systems and document repositories as an issue.

In contrast, Team 2 reported security related challenges arising from the ETI governance and membership structure; it was said that ensuring trust between its members who are commercial competitors is a challenge and a great deal of effort is required to protect value for such members. Thus, this team showed a more holistic perspective and highlighted the perceived causes behind the ETI's practices, whereas the other teams showed concerns about internal processes and how this subsequently affects external impact.

4.2.1.2 Questionnaire results

At the end of the ALS, participants completed a brief questionnaire about knowledge sharing and information security practices at the ETI where they were asked to rate the effectiveness of different aspects based on their personal experiences at the organisation.

Aspect	Team 1	Team 2	Team 3
1) ETI's knowledge sharing with external stakeholders	5.14	4.60	6.33
2) Knowledge sharing between project/programme teams at the ETI	4.57	6.00	6.00
3) Knowledge sharing between departments at the ETI	3.29	5.20	4.33
4) Knowledge sharing within your team	8.86	7.00	6.67
5) The role of the ETI's governance/management in nurturing knowledge sharing	4.71	4.00	4.33
6) The role of the ETI's culture in nurturing knowledge sharing	5.43	3.20	4.33
7) The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	7.00	6.80	7.00
8) Confidentiality policies/controls for sharing knowledge/information internally	6.71	5.20	5.33
9) Confidentiality policies/controls for sharing knowledge/information externally	5.29	3.80	6.33
10) The role of the ETI's governance/management in protecting knowledge/information.	5.14	4.00	5.33
Participants were asked to rate the effectiveness of the subjects based on their own experience of working at the ETI (1 = ineffective and 10 = extremely effective)			

Table 9: Comparison of questionnaire results between teams

Table 9 shows a comparison of the average ratings from each team. Through the analysis, it was identified that Team 2 had given the lowest average rating for 7 out of 10 areas as compared to the other two teams (lowest ratings are shown in red text on Table 9), suggesting that, of the three teams, Team 2 believed the knowledge sharing and information security practices in question at the ETI to be the least effective.

Order	Aspect	Team 1	Team 2	Team 3	Difference in average rating (descending)
1	9) Confidentiality policies/controls for sharing knowledge/information externally	5.29	3.80	6.33	2.53
2	6) The role of the ETI's culture in nurturing knowledge sharing	5.43	3.20	4.33	2.23
3	4) Knowledge sharing within your team	8.86	7.00	6.67	2.19
4	3) Knowledge sharing between departments at the ETI	3.29	5.20	4.33	1.91
5	1) ETI's knowledge sharing with external stakeholders	5.14	4.60	6.33	1.73
6	8) Confidentiality policies/controls for sharing knowledge/information internally	6.71	5.20	5.33	1.51
7	2) Knowledge sharing between project/programme teams at the ETI	4.57	6.00	6.00	1.43
8	10) The role of the ETI's governance/management in protecting knowledge/information.	5.14	4.00	5.33	1.33
9	5) The role of the ETI's governance/management in nurturing knowledge sharing	4.71	4.00	4.33	0.71
10	7) The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	7.00	6.80	7.00	0.20

Table 10: Differences between highest and lowest average ratings between teams

Table 10 shows the differences between the highest and the lowest average score of the teams for each aspect, ordered in a descending order. This table aims to show the level of similarity between the opinions of the three teams. The biggest difference in average rating being below 3 points, and, 7 out of 10 ratings only differing by less than 2 points.

To get an overall understanding of how the areas were rated, the average of the three teams' results are shown in Table 11. The teams collectively agreed that the least effective knowledge sharing and protection aspects based on their experiences are related to the ETI's culture, governance and management. As shown in the ranking order in Table 11, these include:

1. role of the ETI's **culture** in nurturing effective knowledge sharing (ranked the lowest at 3.81),
2. the role of the ETI **governance and management** in nurturing effective knowledge sharing (ranked the second lowest at 4.19), and,
3. the role of the ETI **governance and management** in protecting knowledge and information (ranked the third lowest at 4.49).

The confidentiality policies and controls for internal (rated 5.39) and external (rated 4.86) knowledge sharing, and, the ETI's overall knowledge sharing with external stakeholders (rated 5.28), are all represented as being average in terms of their effectiveness. The technical controls for protecting the

ETI's knowledge and information were rated the second highest at 6.89 (see item 9 on the ranking order in Table 11), which suggested that from an information security perspective, the ETI's knowledge was seen as adequately protected from external and internal threats. Finally, all of the teams felt that the knowledge sharing practices within their team were effective, which is reflected by the overall average rating of 7.05, making this the most effective aspect of the ETI's knowledge sharing in the participants' opinion.

Ranking order (ascending)	Aspect	Overall average
1	6) The role of the ETI's culture in nurturing knowledge sharing	3.81
2	5) The role of the ETI's governance/management in nurturing knowledge sharing	4.19
3	10) The role of the ETI's governance/management in protecting knowledge/information.	4.59
4	3) Knowledge sharing between departments at the ETI	4.71
5	9) Confidentiality policies/controls for sharing knowledge/information externally	4.86
6	1) ETI's knowledge sharing with external stakeholders	5.28
7	8) Confidentiality policies/controls for sharing knowledge/information internally	5.39
8	2) Knowledge sharing between project/programme teams at the ETI	5.87
9	7) The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	6.89
10	4) Knowledge sharing within your team	7.05

Table 11: Differences between highest and lowest average ratings between teams

4.2.2 Cycle 2: Reflection and development of actions

Cycle 2 of the data collection aimed to use the learning about the ETI's knowledge sharing and information security practices - identified from the first cycle of ALSs – and to identify areas of improvement in a follow-up cycle of ALSs. By reflecting on the findings from their first ALS, each team collectively discussed and agreed on the weaknesses they felt had the most negative impact on the ETI's effectiveness, constructively discussed and pinpointed the underlying issues and subsequently devised a set of actions that would help the ETI improve its practices.

The following sections discuss the areas the teams chose to focus on and the set of actions they developed.

4.2.2.1 Actions developed by Team 1

After reviewing the findings from their first ALS (from the PowerPoint slides and their team questionnaire results shown in Table 12), Team 1 mutually decided to focus on improving two key areas - 'knowledge sharing externally' and 'knowledge sharing internally'.

	Aspect (effectiveness of)	Average team rating (ascending)
1	Knowledge sharing between departments at the ETI	3.29
2	Knowledge sharing between project/programme teams at the ETI	4.57
3	The role of the ETI's governance/management in nurturing knowledge sharing	4.71
4	ETI's knowledge sharing with external stakeholders	5.14
5	The role of the ETI's governance/management in protecting knowledge/information.	5.14
6	Confidentiality policies/controls for sharing knowledge/information externally	5.29
7	The role of the ETI's culture in nurturing knowledge sharing	5.43
8	Confidentiality policies/controls for sharing knowledge/information internally	6.71
9	The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	7.00
10	Knowledge sharing within your team	8.86

Table 12: Average ratings for Team 1 showing weakest to the strongest aspects

Table 13 shows the set of actions that Team 1 devised to achieve effective knowledge sharing externally, particularly focusing on the ETI's external stakeholders. Firstly, the team reflected and referred back to their first ALS' discussions about the lack of knowledge of target audiences and interested third parties. It was argued that the ETI employees find it difficult to disseminate information to people who might be interested as it was unclear who might be interested. To address this issue, the team developed the action, "*1. identify the audiences*".

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Knowledge sharing externally	Effective knowledge sharing with external stakeholders	1. Identify the audiences 2. Clarity of what we can share 3. Determine sharing guidelines: a) Why I am sharing? b) What do I need to share? c) How will I do that? d) Is the correct legal framework in place to be able to share? 4. Determine the approval: a) Who needs to approve? b) What is the process? c) How long will it take? 5. Determine confidentiality policies/controls for sharing knowledge/information	Strategy/Programme Manager Director – Strategy Development GAT	Update exploitation plan Prepare presentations for various stakeholders related to our projects → and pre-approve	Review exploitation plans – Midyear (June/July 2015)

Table 13: External knowledge sharing actions by Team 1

Following this, the team moved on to what they described as a major issue that employees experienced; the lack of clarity regarding what the confidentiality levels were or how much could be shared externally. This was discussed extensively during the first ALS and the same arguments were reiterated during this session. To find a solution to this issue (see Table 13), the team devised a set of actions to firstly find "*2. clarity of what we can share*", and to clearly "*3. Determine sharing guidelines*" about the purpose behind why something was being shared, exactly which knowledge it is that needs to be shared, the ways in which it can be shared, and, whether the correct legal framework is in place to permit that knowledge to be shared. The team then discussed the approval processes for external knowledge sharing, particularly the complexity around legal licences and the Legal Department's involvement in external knowledge sharing. The team stressed the importance of timely exploitation, particularly time-sensitive IP and so wanted to develop clarity and efficiency around the approval processes. The action - "*4. Determine the approval*" processes was developed, which would help to identify who needed to approve information, what the process was and the timescales. The team also considered the external knowledge sharing from the information security perspective and reflected on their previous discussions about the need for improvement of user awareness to reduce unnecessary withholding of knowledge. Thus, the following action to address this issue was devised – "*5. Determine confidentiality policies/controls for sharing knowledge/information*" (see Table 13).

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Knowledge sharing internally	Improved downward internal communication to remove uncertainty and frustration	1. Pull together evidence/examples of problems our team has experienced in the past 2. Management need to consistently communicate across different teams	All	Team communication What do we want from our communications in team meetings and organisational briefings	See what happens in team meetings and other groups' opinions

Table 14: Internal knowledge sharing actions by Team 1

For knowledge sharing internally (see Table 14), this team's main concern was the lack of formal communication from senior management, which was said to have created uncertainty and confusion amongst staff about current affairs and decisions regarding changes. Thus, the team members collectively agreed that the ETI needs "*improved downward internal communication to remove uncertainty and frustration*", for which they devised two actions. The first action was - "*1. Pull together evidence/examples of problems our team has experienced in the past*" – on the basis of which, it will enable the team to make an informed and evidence-based case to the senior management about the issue. The second action the team developed was "*2. Management need to consistently communicate*

across different teams", for the senior management to take on-board, and this team offered to provide the necessary support and input if required.

4.2.2.2 Actions developed by Team 2

At the start of the session, the team participants highlighted to the researcher that since their first ALS and engagement with this research, the team had been reflecting on the organisational as well as their own team's practices, which was said to have improved their awareness about the ETI's knowledge sharing and information security practices. Further, the learning was said to have triggered some changes in the team, where it was making a conscious effort to firstly improve knowledge sharing within their team, as well as with other teams through better communication, building closer relationships and translating complex knowledge for different kinds of audiences.

The team members reflected on the summary of the discussions from their previous ALS, as well as the results of the questionnaire that they completed, and collectively prioritised the major knowledge sharing and information security problems that they had identified. The team decided to focus on three key areas to improve – 'the ETI's external profile and appearance for knowledge sharing', 'cultural factors affecting knowledge sharing' and 'information security awareness'.

	Aspect (effectiveness of)	Average team rating (ascending)
1	The role of the ETI's culture in nurturing knowledge sharing	3.20
2	Confidentiality policies/controls for sharing knowledge/information externally	3.80
3	The role of the ETI's governance/management in nurturing knowledge sharing	4.00
4	The role of the ETI's governance/management in protecting knowledge/information.	4.00
5	ETI's knowledge sharing with external stakeholders	4.60
6	Knowledge sharing between departments at the ETI	5.20
7	Confidentiality policies/controls for sharing knowledge/information internally	5.20
8	Knowledge sharing between project/programme teams at the ETI	6.00
9	The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	6.80
10	Knowledge sharing within your team	7.00

Table 15: Average ratings for Team 2 showing weakest to the strongest aspects

To improve the ETI's external knowledge sharing by enhancing its profile and appearance, the team agreed that the ultimate aim for this should be to create greater awareness of key ETI messages amongst key target audiences (see Table 15). The team reflected on problems that they had previously identified in relation to the ETI's profile, such as the need for a more 'open' and less protective appearance, and subsequently a wider reach to target audiences through improved exploitation of knowledge.

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Knowledge sharing externally: the ETI's profile/appearance	Create greater awareness of key ETI messages amongst key target audiences	1. Better use of coordinated events to create awareness of our message and brand 2. Making better use of our (already created) content – inserting it into different media sources 3. Leverage insights papers 4. Targeted messages to the media	Collaboration of Communications Team, Strategy Team and Senior Management	Build improved engagement and relationship with Communications Team Enable Communications Team to develop better understanding of our needs Supporting Communications Team to build awareness of and understand the energy sector/industry better	Initial appraisal of our strengths and weaknesses and where we are currently Regular review of progress – a two-way discussion and focus towards improvement Invite Communications Team to our team meetings

Table 16: External knowledge sharing actions by Team 2

To improve the ETI's profile and appearance to the outside world, the team devised the actions - "*1. Better use of coordinated events to create awareness of our message and brand*" and "*4. Targeted messages to the media*" (see Table 16). Likewise, to address the issues related to the lack of external knowledge sharing, the team members decided that it would be practical and beneficial to begin with the existing knowledge and materials, and thus developed the actions "*2. Making better use of our (already created) content – inserting it into different media sources*" and "*3. Leverage insights papers*".

Team 2 had previously underlined the need for improvement in external knowledge sharing, particularly of the complex technical knowledge. As part of their discussion, Team 2 came to the realisation that the challenges the Communication's function experienced would be attributed to the lack of relationships, collaboration and input from other organisational teams and individuals, particularly those with an understanding of the technical knowledge. Thus, to improve external knowledge sharing and the ETI's profile (see Table 16), Team 2 decided to proactively build a better relationship and improve communication with the Communications Team, and provide support where necessary.

Team 2 strongly emphasised the organisational culture's role in nurturing knowledge sharing. Hence, the ultimate outcome that it hoped to achieve was "improved knowledge sharing (and interpretation of what that knowledge means) both internally and externally (to deliver impactful knowledge and insights to key stakeholders)". Team 2 stressed that the ETI has "too much science and too many engineers" which results in a wealth of complex technical knowledge that was often difficult for people to understand which inhibited knowledge sharing. In addition, this team had also recognised that some of

the knowledge they produced - such as the insights they had created - was very technical and not always well understood by the rest of the organisation. Hence, the team developed an action to "*1. Challenge each other to summarise understanding of each other's programme areas/insights (e.g. in quarterly meetings)*" (see Table 17), and agreed to lead by example in initiating the improved engagement and cross programme and departmental knowledge sharing.

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Cultural factors affecting knowledge sharing	Improved knowledge sharing (and interpretation of what that knowledge means) both internally and externally (to deliver impactful knowledge and insights to key stakeholders)	1. Challenge each other to summarise understanding of each other's programme areas/insights (e.g. in quarterly meetings) 2. Use peer review more (horizontal) 3. Learn and share from each other's approaches to knowledge sharing (e.g. review experience with exploitation of scenarios/insights papers after Quarter 1) 4. Improve culture around using email/copying and meetings to share knowledge within teams and programmes in order to achieve clarity of output from knowledge sharing	Our team	Lead by example Discuss and seek buy-in Seek support from department Director	Champion the actions

Table 17: Culture related knowledge sharing actions by Team 2

In their previous ALS, this team had identified a number of weaknesses related to formal knowledge sharing between teams and departments at the ETI. Therefore, the team developed the action "*2. Use peer review more (horizontal)*" as a means for improved understanding and evaluation of each other's work and also a two-way engagement between teams and departments. The informal knowledge sharing between teams and programmes was also described as ineffective for a number of reasons, such as the lack of time to share, individuals' mentality towards knowledge sharing, project teams prioritising project delivery over sharing knowledge, and the organisational structure. Thus, to improve the informal knowledge sharing, engagement and rapport between teams and departments, Team 2 devised the following two actions (see Table 17):

- "3. Learn and share from each other's approaches to knowledge sharing (e.g. review experience with exploitation of scenarios/insights papers after Quarter 1)", and,
- "4. Improve culture around using email/copying and meetings to share knowledge within teams and programmes in order to achieve clarity of output from knowledge sharing".

The final area Team 2 decided to focus on was information security awareness amongst employees at the ETI with the ultimate aim to "*achieve more impact by being less overprotective and adopting a presumption of knowledge openness - with restrictions by exception only*" (see Table 18). It was stated that there is too much focus on the attempts to protect Intellectual Property, which, combined with the comprehensive legal processes and delays, had resulted in time-sensitive IP becoming obsolete on occasions. Therefore, the team felt that the ETI Board needs to introduce new practices and a clear exploitation plan which specifies clear timelines for exploitation, and so devised the action "*1. Championing a discussion by Board of adopting new practices/principles (e.g. setting deadlines on exploiting knowledge, developing an exploitation plan or giving it up)*".

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Information security awareness	Achieve more impact by being less overprotective and adopting a presumption of knowledge openness - with restrictions by exception only	1. Championing a discussion by Board of adopting new practices/principles (e.g. setting deadlines on exploiting knowledge, developing an exploitation plan or giving it up) 2. Action for Board to adopt a presumption of openness to inform all ETI governance and contracting 3. Develop evidence-base for the Board of the difference it could make (i.e. research some case studies and examples of impact arising from openness, or, problems arising from delay/legal constraints)	Our team Board	We can champion it and ensure the message gets to the Board	Champion the actions

Table 18: Knowledge protection related actions by Team 2

To address the issue of the protective culture around knowledge – which was said to have arisen from the ETI's membership structure and complex security requirements of members - and to make knowledge exploitation more effective and efficient.

Team 2 argued that the ETI Board needs to shift its thinking and embrace a view of 'openness' rather than 'protectiveness'. The team developed the action: "*2. Action for Board to adopt a presumption of openness to inform all ETI governance and contracting*" (see Table 18). In order to aid this shift in thinking, the team decided to begin working on gathering relevant evidence from past examples and case studies demonstrating the positive outcomes that can arise from adopting an approach of openness, as well as the negative outcomes resulting from overprotectiveness, by developing the action "*3. Develop evidence-base for the Board of the difference it could make (i.e. research some case studies and examples of impact arising from openness, or, problems arising from delay/legal constraints)*".

4.2.2.3 Actions developed by Team 3

After Team 3 reviewed the summary of their discussions from the first ALS and Table 19 containing the ratings they collectively provided about the knowledge sharing at information security practices at the ETI, it prioritised and decided to focus on the following three areas: 'knowledge sharing between departments', 'cultural factors affecting knowledge sharing' and 'information security controls'.

	Aspect (effectiveness of)	Average team rating (ascending)
1	The role of the ETI's culture in nurturing knowledge sharing	4.33
2	The role of the ETI's governance/management in nurturing knowledge sharing	4.33
3	Knowledge sharing between departments at the ETI	4.33
4	The role of the ETI's governance/management in protecting knowledge/information	5.33
5	Confidentiality policies/controls for sharing knowledge/information internally	5.33
6	Knowledge sharing between project/programme teams at the ETI	6.00
7	Confidentiality policies/controls for sharing knowledge/information externally	6.33
8	ETI's knowledge sharing with external stakeholders	6.33
9	Knowledge sharing within your team	6.67
10	The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	7.00

Table 19: Average ratings for Team 3 showing weakest to the strongest aspects

Table 20 shows the detailed plan of action Team 3 developed in order to initiate improvements in the knowledge sharing between departments at the ETI, with the ultimate outcome being: "*improved knowledge transfer of programme learning across the business; providing a coherent message and improved and aligned dialogue*". The knowledge sharing between departments was ranked amongst the lowest in terms of its effectiveness by this team (see Table 19) and the need for continuous communication between programmes and departments, reducing 'silos', as well as greater awareness of knowledge sharing was stressed. The team emphasised that to improve horizontal communication and knowledge sharing, it needs to be initiated and driven from the top by the senior management collaborating with the programme managers and department directors to ensure that the dialogue is aligned and the messages and communication are coherent. Thus, the team agreed to develop an action to have a "1. Structured dialogue with the Exec" and also to "2. Initiate discussion around this with Management".

Another problem Team 3 had identified, which it argued to be a significant hindrance to cross-departmental knowledge sharing, was system access. Further, it was said that the 'silo' approach reflected in the way access was designed on systems and folders which limited accessibility to information relevant to their projects. Therefore, the team decided to create an action for itself to

"*create a list of what data would be useful to who*" (see Table 21), and intended to raise this at the PM forum with other programme managers with the aim to obtain buy-in for improved access controls.

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Knowledge sharing between departments	Improved knowledge transfer of programme learning across the business; providing a coherent message and improved and aligned dialogue	1. Structured dialogue with the Exec 2. Initiate discussion around this with Management	Programme Managers and Management	Discuss with: Director of Programme Delivery, Director of Strategy Development, Director of Stakeholder Relations and Director of Business Development	Team effort Review at Programme Meeting

Table 20: Cross-department knowledge sharing actions by Team 3

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Knowledge sharing between departments	Access to project specific data which is not currently accessible	Create a list of what data would be useful to who	PM Forum (list) Director of Programme Delivery (in Exec meeting) Staff forum	Programme Manager will raise in PM Forum	Review at Programme Meeting

Table 21: Cross-department knowledge sharing actions by Team 3

In their previous ALS, Team 3 had stated that the ETI culture did not facilitate effectively or timely knowledge sharing, due to reasons such as staff having insufficient awareness about what needs to be shared or what needs to be protected. So, the team expressed the need for "*increased awareness of what needs to be shared and with who*" (see Table 22) as the ultimate outcome through the following two actions: "*1. Inter-departmental exchanges at different levels of the departments*" and "*2. Identify interested parties in other programmes and departments at an as early stage as possible".*

The final area Team 3 chose to focus on was the information security controls due to the need for accelerated process of NDA implementation (see Table 23). The team, therefore, devised the action for the ETI to "allow Project Managers to send NDAs directly" to speed up the process and to also reduce the workload of the Legal Department. The team members informed the researcher that based on their discussions during the last ALS, they had already initiated a request for this to happen and will continue to follow-up and ensure that the action is implemented.

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Cultural factors affecting knowledge sharing	Increased awareness of what needs to be shared and with who	1. Inter-departmental exchanges at different levels of the departments 2. Identify interested parties in other programmes and departments at an as early stage as possible	Initiated by department heads Programme Managers, Project Managers and Strategy Managers	Talk to Management about it Talk to colleagues e.g. other Project Managers, Programme Managers and Strategy Managers Do it and lead by example	-

Table 22: Culture related knowledge sharing actions by Team 3

Area	Ultimate outcome	Actions	Who needs to be involved?	How can the team support it?	How can the team take ownership and track its progress?
Information security controls	Accelerate process of NDA implementation	Allow Project Managers to send NDAs directly	Deputy Director of Legal Director of Legal	Alert Director of Programme Delivery, providing relevant data where possible (underway) –	Follow-up with Director of Programme Delivery to assess progress

Table 23: Security controls knowledge sharing actions by Team 3

4.2.3 Overall similarities and differences between teams

In the previous sections, the findings from the three teams were analysed and compared – from research Cycle 1 and Cycle 2 respectively - where similarities and differences on the discussion points were highlighted and deliberated. When analysing the three teams' findings at an overarching level, a number of similarities and differences have been identified. A summary of the key similarities that emerged from the analysis is as follows, highlighting the common factors identified.

- All of the teams acknowledged and commended the knowledge **content** produced by the ETI, arguing that it is of high quality, well-reasoned and evidenced, especially the insights produced through ESME. The high quality of knowledge generally gives the employees confidence when

sharing knowledge externally. However, it was highlighted that the complex technical knowledge is not understood by all staff members and more efforts are required to translate and communicate it.

- The need for greater **clarity** and **guidance** on the organisation's policies about knowledge sharing and knowledge protection was expressed frequently as it was argued that staff **awareness** about what can and cannot be shared externally is inconsistent and inaccurate.
- Whilst the teams recognised the benefits of the ETI's unique **membership structure** and having **access** to and being associated with a number of reputable organisations, all of the teams found the complexity around the **members' security requirements** and the subsequent organisational **policies and processes** a hindrance to knowledge sharing. Further, all of the teams discussed the external knowledge sharing challenges, such as delays and inconvenience, particularly created by the **legal practices** and members' confidentiality requirements. All of the teams suggested that the **organisational culture** at the ETI favours knowledge protection rather than knowledge sharing as the organisation is very cautious when handling its knowledge and Intellectual Property, and as a result, opportunities for external knowledge sharing are sometimes missed.
- The **knowledge and expertise of staff** at the ETI was recognised and appreciated by the participating teams. Whilst it was suggested that there is a positive **attitude of staff** towards knowledge sharing, in practice more communication and collaboration between teams is required, particularly between the technical and non-technical staff in order to improve the intelligibility of complex technical knowledge. Moreover, although the teams acknowledged the potential benefits of **formal initiatives** the ETI has in place to facilitate cross-team knowledge sharing, in practice, the knowledge sharing between programmes and departments at the ETI was described as being weak. Two of the teams particularly highlighted the lessons learned process as being an appropriate concept for sharing cross-programme learning, but its implementation is not as effective and beneficial as it should be. The need for more top-down communication from **management** was also identified. On the other hand, all of the teams described the knowledge sharing within their own teams as being fairly effective.
- In relation to technologies, the role of the following systems in the organisation's knowledge sharing was acknowledged, although there were a variety of opinions about their benefits and limitations: **Member Portal**, **ESME**, **shared drive**, **PIMS** and **CRM**. Concerns were expressed regarding the usability, maintenance and security access controls on some of these systems.

The common factors identified from the teams' collective findings are highlighted in bold text in the above summary as these are carried forward and used to shape the next part of the analysis in section

4.3, where they are firstly categorised and then the role and influence they have on the ETI's overall knowledge sharing and/or information security practices is analysed.

In addition to the discussions, from the questionnaire results shown in Table 12, it is evident that there is a great deal of similarity in the views of the teams about the ten aspects of knowledge sharing and information security as the average rating between the teams did not vary to a great degree. However, a number of differences have also been identified between the approaches and areas of focus for each of the individual teams, which are explained in the follow sections.

4.2.3.1 Team 1

Firstly, as compared to the other two teams, Team 1 had a more balanced view between internal and external aspects that affect knowledge sharing, e.g. it discussed about systems, reports, Strategic Advisory Group meetings, external audiences and purpose of the ETI as an organisation. As well as being task-focused, this team was also aware of the aims of its work and the wider context in which the ETI operates. Further, the team raised concerns about the conflict between the ETI's actual purpose – an organisation that generates and disseminates knowledge effectively - and the way it incorrectly perceives itself as an engineering organisation. Thus, having a balanced view about internal and external factors, and an in-depth understanding of the organisational purpose, indicates that this team possesses a high level of maturity and experience in the organisation, where it has insight into matters ranging from logistical to cultural.

This team argued that the ETI's employees' knowledge sharing is motivated by ultimately returning value to members. However, the participants also discussed practical examples of difficulties and frustration they experience when attempting to share knowledge externally because of the complexity of the governance structure, lack of clarity and guidance on sharing, and most importantly, the conflicting security requirements of the members who are collaborating on projects. From such discussions, it became evident that having collaborated with competing members, the team was more experienced than the other two teams of practically managing difficult relationships with members and understanding the complexity that has been created. Moreover, it also became clear that this team has been engaged in extensive external collaboration so as to act as a bridge between the internal and external environment, and has subsequently developed a greater awareness of the impact the internal problems have on external knowledge sharing and how this affects the ETI's staff, stakeholders, external audiences in the energy industry and the organisation's goals.

4.2.3.2 Team 2

As compared to the other two teams, Team 2 placed greater importance and focused more on the bigger picture, including the ETI's external profile and how it appears to the outside world, impact in the energy

industry and target audiences. Further, this team emphasised the benefits of the access and powerful position the ETI has gained in the energy sector because of its unique governance structure. The team appeared to have a good understanding of the ETI's external environment and the energy sector as a whole, which can be attributed to this team's strategic role and responsibility in the organisation. Further, the team was responsible for answering complex questions from the energy industry, helping the ETI make important strategic decisions about investment and informing energy policies for the UK government. Playing such a principal strategic role in the organisation and having in-depth industry knowledge, had given an insight to this team about the ETI's ultimate aims and the progress made so far towards achieving them.

As well as showing good strategic understanding of the ETI in the wider energy sector, Team 2 also focused on various internal practices and stressed the ways in which these could be affecting the organisation. For example, the team raised concerns that the ETI is too engrossed in the projects and may consequently be lacking focus on its ultimate purpose and identifying target audiences, i.e. they described the situation as, the ETI "can't see the wood for the trees". It also discussed the implications of the complex governance structure on the ETI, particularly highlighting the issues of overprotectiveness and culture of withholding knowledge, as opposed to being more transparent in line with the nature of the organisational goals. Further, as compared to Teams 1 and 3, this team emphasised more the intellectual property protectiveness, operational processes and missed timelines for external knowledge sharing. Thus, due to its strong understanding of the connections between internal and external environments, Team 2 was in a better position to relate internal practices to the organisational goals, and pinpoint shortfalls and their consequences for the organisation.

This team also argued that the ETI's employees are intrinsically motivated to share knowledge because of their positive work ethic and wanting to make a difference. On the other hand, based on the questionnaire results in Table 12, this team ranked the effectiveness of the given knowledge sharing and information security aspects as the lowest from the three teams, thus suggesting that, although the staff have a positive attitude towards knowledge sharing, the knowledge sharing in practice is weak. A likely reason for demonstrating a slightly deeper understanding of the ETI's knowledge sharing practices as compared to the other teams, is that this team is more involved in organisational activities and practices.

Overall in comparison to Teams 1 and 3, this team's thinking was more strategic and holistic, where the participants demonstrated a good level of understanding of the wider energy sector as well as internal environment in which the ETI operates. So, Team 2 showed a 'rounded' understanding by bringing strategic, operational, cultural and humanistic matters into its discussions, and it became evident that this team's views differed the most from the three participating teams.

4.2.3.3 Team 3

As compared to the other two teams, this team focused more on the day-to-day aspects of knowledge sharing and information security, for example, the usefulness or user-friendliness of systems, access limitations and complexity of the knowledge generated. This team particularly highlighted the complexity of and difficulty in understanding the insights creation from the ETI's energy system modelling work as a hindrance for cross-programme and cross-department knowledge sharing. Further, contrary to the other two teams, this team suggested that the ETI employees may be less intrinsically motivated to share knowledge and more so because it is a requirement to do so.

In comparison to the other two teams, this team was more task focussed and more concerned with internal logistical aspects as opposed to cultural or external issues, which was particularly the case during the first ALS where the team discussed the ETI's current practices and the issues they experience. This could be attributed to the absence of the programme manager for this team during the first ALS, as the discussions in the second ALS - where the programme manager was present - consisted of more strategic and cultural matters such as the need for cohesive communication from senior management and improved awareness about knowledge sharing. Another reason why this team placed greater emphasis on internal activities and day-to-day processes, as compared to the other teams, could be due to this team being smaller in size and working on smaller scale projects. This could mean that its project management style is different and the level of engagement within and beyond the organisation has been limited as compared to the other two teams.

Despite differences in perceptions on the discussion subjects and issues that they identified for each subject, the similarities between the teams in terms of their questionnaire results shows much similarity regarding the same organisational practices.

4.3 ETI's overall practices

In this section of the chapter, in accordance with the unit of analysis for this research, the research findings from the three participating teams are amalgamated and analysed in order to holistically understand the ETI's knowledge sharing and information security practices (see Figure 33). The factors analysed in this section have emerged and are brought forward from the analysis of *similarities* between the teams in the previous section, 4.2.3. They are used to carry out an in-depth analysis into their related findings, through which commonly occurring themes are elicited and highlighted, which will be taken forward to Chapter 5 for further discussion in light of existing literature and the case study organisation's context.

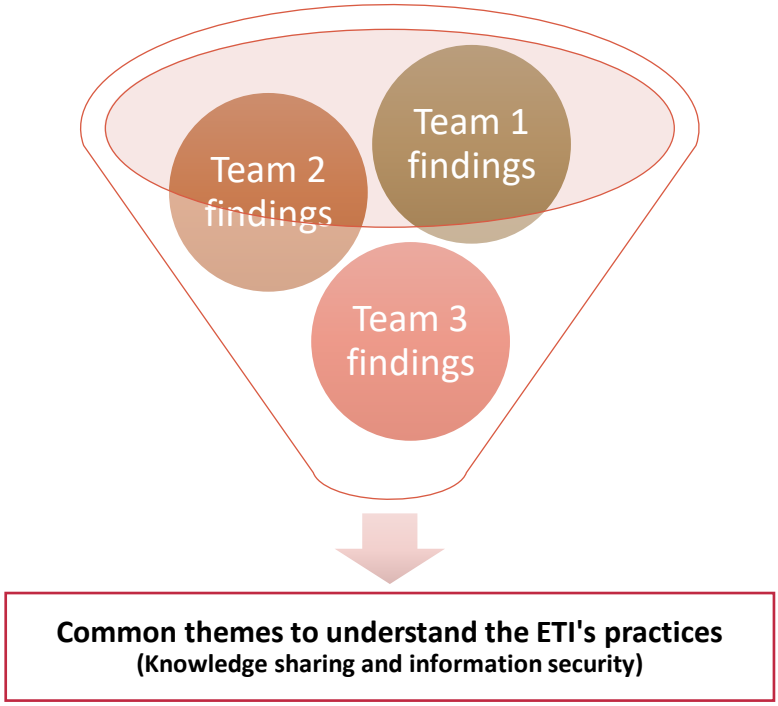

Figure 33: Surfacing common themes

Section 4.3.1 focuses on analysing the factors related to the knowledge sharing practices whereas section 4.3.2 focuses on the information security related factors. Maintaining consistency with the literature review chapter's structure, both sets of factors are intentionally categorised and the sections structured with the sub-category headings '*organisational*', '*human*' and '*technological*'.

4.3.1 Knowledge sharing

This part of the chapter focuses on the research findings relating to the ETI's knowledge sharing practices. In the following three sections, the influence and role of various organisational, human and technological factors are analysed and common themes are highlighted as they emerge in the analysis.

4.3.1.1 Influence and role of organisational factors

Various organisational factors that have been identified to have an influence on or play a role in the ETI's knowledge sharing are analysed in the following sections. The factors include (i) the ETI's membership structure, (ii) the organisation's access to key players in the energy industry, (iii) the knowledge or content the ETI generates, (iv) organisational culture, (v) the existing knowledge sharing initiatives and (vi) the role of the ETI's management.

4.3.1.1.1 Membership structure

When discussing the knowledge sharing practices, the participants paid particular attention to the ETI's distinct membership structure; the organisation was acknowledged as being uniquely positioned. For

example, one participant argued “no other organisation has that advantage or is in a similar situation to the ETI where it can access BP, Shell, EON, Caterpillar, Rolls-Royce and the government” (Participant 3, Team 2). Through its membership structure the ETI has the ability to bridge across various organisations and specialist access to knowledge sources. Association with reputable organisations and the UK government was said to have enhanced employees’ confidence when representing their organisation externally; one participant argued “being associated with these brands develops our credibility” (Participant 1, Team 1). Thus, it is understood that the ETI’s membership structure plays an important role and serves as a concrete foundation for external knowledge sharing, thus the following theme is derived:

Theme: Distinct membership structure

The membership structure and association with reputable organisations was also reported by Team 1 to be contributing to the ETI’s external profile and is helpful when engaging with new audiences. On the other hand, Participants from Team 2 expressed the opinion that the ETI appears ‘overprotective’, has a “lack of external profile and appears small scale” (Participant 3, Team 2); greater awareness is required about the organisation and key ETI messages amongst target audiences in the industry. Regarding the organisation’s external appearance, Team 3 also held similar views to Teams 1 and 2, where it was argued that - in comparison with other groups in the industry - the ETI needs to be heard and grab attention. For example, one participant expressed the following challenge:

> *“There is an external perception of a ‘secret members’ club’ – so the ETI is set-up by the members, for the members – that's it and no information ever comes out. It’s not actually true, but there is risk of perception that you have to battle against.”* (Participant 2, Team 3)

From the above discussions it can be concluded that the ETI’s external profile, and any incorrect perceptions that may have existed about organisational transparency, were addressed as a challenge for employees in their external knowledge sharing and reported to have an impact on the organisation, which surfaces the following theme:

Theme: External profile

The organisation’s complex governance structure had created a unique set of knowledge sharing challenges for the ETI. Moreover, the ETI has a responsibility for carefully ensuring that the contractual confidentiality requirements of each of its members are met, however, it was reported that sometimes these requirements were conflicting as some of the member organisations were commercial competitors.

Such scenarios had created complexity from knowledge sharing and information security perspectives. One participant stressed the impact this challenge had them in the following argument:

> *"…you fill your head with these various levels of confidentiality between various companies…holding all of that in your brain is difficult. That's a challenge with the ETI – it's got all this stuff coming in and all of this stuff coming out, and there are conditions set on a lot of those things"* (Participant 1, Team 1)

Some participants from Team 2 reported being unclear on the terms of engagement with stakeholders, particularly relating to confidentiality requirements and questioned whether this had been documented. Thus, the need for clear guidance about dealing with the complex network of stakeholders appeared to be an important requisite for the ETI employees, and the following theme is identified from this:

Theme: Stakeholder management

Whilst being cautious with handling the complex requirements of the its members, some participants expressed that the ETI has become "too overprotective" (Participant 1, Team 2), which was reported to have impacted external knowledge sharing in particular. Moreover, the legal protection measures pre-determined by the governance structure were a cause of concern for some participants e.g. "heavy-handed legal approach we have doesn't help with nurturing knowledge sharing and affects how we engage externally (Participant 2, Team 3). The governance structure was reported to have impacted the organisational culture where it was argued to have generated a "culture of withholding knowledge rather than sharing it externally" (Participant 1, Team 2) and Team 3 claimed it had also hindered internal top-down communication. Thus, protective organisational culture around its knowledge was attributed to the unique governance structure and complex security requirements. The following two themes emerge from this:

Theme: Protective culture

Theme: Withholding knowledge

4.3.1.1.2 Access

Access to large number of reputable organisations and "key players in the market" (Participant 5, Team 1), offers the ETI a connection to "decision makers and policy makers" (Participant 4, Team 2) in the energy industry. One participant commented "…we are engaged with people who are listening to us,

trust us, are interested" (Participant 3, Team 3). Such connections were said to facilitate the ETI's influence in the energy industry and government energy policies – which reiterates the 'Distinct membership structure' theme.

4.3.1.1.3 Content

Participants accredited the quality of the ETI's output knowledge and argued that when this is shared externally, "it is robust and done in a well-evidenced and well-reasoned way" (Participant 1, Team 2) and depicts the ETI's profile as a "respected authority" (Participant 4, Team 2) and strengthens external knowledge sharing. Team 1 associated the high quality of ETI's knowledge to quick uptake of technologies and impact in the energy market. Sharing its knowledge externally provides a two-way communication; the feedback obtained enables ETI to build on existing knowledge and improve internal practices. Thus, knowledge quality appeared as a common motivating factor in external knowledge sharing, generating the theme:

Theme: Knowledge quality

There were, however, concerns shared about the accessibility and user-friendliness of knowledge. For example, the project reports on the Member Portal were described as being inconsistent; being either very lengthy or too brief, and one participant argued "we don't have a lot of information that sits in between, so the ability of people to digest that becomes difficult" (Participant 1, Team 1). Thus, participants expressed the need for access to knowledge offered in a range of complexities for different audiences. Moreover, participants also felt that an 'internal wiki' offering summarised project and programme information for the ETI staff will improve cross-programme knowledge sharing and visibility of relationships between projects. Thus, having access to relevant information in the correct format was an important knowledge sharing factor. This generates the following theme:

Theme: Access

Some concerns were raised about the challenge in understanding some of the complex technical knowledge, particularly that generated by the Energy Systems Modelling Environment (ESME). ESME system and the resultant insights are managed by the Strategy Team and it was argued that more could be done to communicate the insights outside the team to improve "understanding around the energy system and the bigger picture" (Participant 2, Team 3). The challenges associated with complex technical knowledge generates the following theme:

Theme: intelligibility

4.3.1.1.4 Organisational culture

When asked about the knowledge sharing within the teams, the participating teams described their knowledge sharing practices as being good. One team argued that within the team "we kind of have a de facto to share information across the project and programme" (Participant 1, Team 1) whilst another said "quite a lot of teams including ourselves are good at knowledge sharing amongst themselves" (Participant 2, Team 3). Further, a great deal of informal knowledge exchange, team meetings, sharing of tacit knowledge and lessons learned takes place within the teams.

Concerns were raised regarding knowledge sharing between teams and departments. It was argued that knowledge "sometimes doesn't flow sideways" (Participant 3, Team 3) and participants presented a number of reasons for this. Firstly, each programme area is specialised so the teams tend to work independently and because of this, it was claimed that "programmes can be siloed" (Participant 1, Team 3). Secondly, the formal collaboration and informal knowledge sharing opportunities were described as limited, and due to this, there was reliance on personal relationships (Participant 5, Team 2). Thirdly, some participants felt uninformed of some organisational decisions and reported that continuous changes are not being communicated across the teams.

A strong emphasis was placed on peoples' mentality towards knowledge, where all three teams used the word 'silo' within their discussions. This impacts the organisation's knowledge sharing practices, particularly between departments, thus the following theme emerges:

Theme: Silo mentality

Participants reported another hindrance to cross-departmental knowledge sharing - one of the programme teams being geographically located on a separate site. Described as a 'firewall', participants argued that the divide and disconnection impacted the organisation's knowledge sharing culture, and so the following theme is identified:

Theme: Organisational Structure

When comparing the ETI's aims and its knowledge sharing practices, the participants argued that there is a discrepancy and related this to the self-perception of the organisation. Moreover, the following argument encapsulates Team 1's views about this:

> *"ETI is a knowledge generating and communicating business…but we often and traditionally see ourselves as an engineering company – so about getting things done, rather than getting it communicated, embedded and stored. So we don't look at what we do very well – our product!"* (Participant 1, Team 1)

It was claimed that the organisation's focus is predominantly on developing solutions, driven by Key Performance Indicators. Similarly, Team 2 stressed that the ETI has "too much science and too many engineers" (Participant 1, Team 2) which resulted in the organisation being so engrossed in development of technologies that it was unable to "see the wood for the trees" (Participant 5, Team 2). Further, it was also claimed that, due to the dominance of engineering, the ETI requires more inter-disciplinary focus. The engineering dominance was believed to have strongly influenced the organisational culture where it was argued that technical solutions were being employed to solve cultural or humanistic problems, for example, referring to the CRM system, one participant argued:

> *"…the actual problem was a cultural one that people weren't finding ways to share conversations and contacts with each other naturally. So for a cultural problem, we adopted a technical fix"* (Participant 2, Team 2)

From such discussions, it appeared that the dominant engineering influences have shaped the organisational culture, which impacts the organisation's self-perception. The following theme emerges from this:

Theme: Organisational identity and strategic aims

Due to the organisation being predominantly managed and dominated by engineers, it was reported to have been intrinsically taking engineering approaches to address cultural challenges, primarily those related to knowledge sharing i.e. implementing technologies where more social activity was required or attempting to measure knowledge sharing through tangible methods. From these findings, the following theme is identified:

Theme: Engineering culture

The size of the organisation was reported to have affected people's thinking towards knowledge sharing, for example, "the assumption is we don't do knowledge sharing because we're such a small organisation" (Participant 1, Team 2).

It was expressed that the ETI assumes a small company approach to knowledge sharing, yet in practice, the expected level of informal relationships, clarity and knowledge sharing do not reflect this. Moreover,

the cross functional knowledge sharing was described as "more reactionary than anticipatory…people are very focused on what they have to do…there isn't enough around meeting the requirements of the whole organisation collectively" (Participant 3, Team 3). Thus, the impression was given that the ETI and its employees do not conform to the stereotype of a small company, despite this being assumed, which generates the following theme:

Theme: Organisation size

4.3.1.1.5 Formal initiatives

It was seen as important for an innovative organisation like the ETI to continuously learn and adapt to improve its practices. A 'lessons learned' initiative was implemented with the aim to share learning from programmes with other programme teams and incorporate it into new projects and achieve greater efficiency.

The participants addressed the importance of the lessons learned initiative and its potential benefits, however, it was argued that the initiative "is not best implemented" (Participant 2, Team 1). Further, participants also stressed the need for more standardisation in processes and best practices for this initiative to be effective, for example:

> *"…because we don't have standardisation of best practice and standard contracts, if you do do lessons learned, they don't get embedded, and it just becomes a list of we 'could've' and 'should've' and it's kind of a dream world."* (Participant 7, Team 1)

The lack of standardisation of practices made knowledge transfer difficult and an opportunity for effective collaboration was argued to not have been fully exploited. Nonetheless, other initiatives that facilitate effective knowledge sharing at the ETI were acknowledged, such as, 'away days', presentations at team meetings and particularly the 'lunch and learn' sessions which provide an opportunity for the audience to ask project managers questions about their projects – although some participants stressed a need for translating technical content shared into 'layman's terms' for non-technical employees. Knowledge sharing initiatives were an important factor in knowledge sharing for the ETI employees, so the following theme emerges:

Theme: Knowledge sharing initiatives

4.3.1.1.6 Management

The teams discussed a number of factors relating to the role of management in the ETI's knowledge sharing and information security practices. Team 1 discussed the need for more internal formal communication, such as weekly cascade, changes to be communicated by senior managers and greater transparency about decisions.

Team 3 acknowledged that the management are 'open' and willing to discuss matters, and that the quarterly updates by the CEO are informative, however, this team also stressed the need for more 'sharing' through regular formal top-down communication so that employees are aware of what was happening corporately and could see the bigger picture. Team 3 also collectively agreed that the ETI needs "improved knowledge transfer of programme learning across the business; providing a coherent message and improved and aligned dialogue". Internal communication, particularly top-down communication in the organisation was recognised as integral for knowledge sharing, which reemphasises the previously identified theme 'Management support and communication'.

Whilst Teams 1 and 3 primarily discussed management's communication, Team 2 focused on the impact the ETI's management and governance had on the organisational culture and external knowledge sharing. It was highlighted that in an organisation where ownership is shared and sits outside, and the operational processes are challenging to manage, "it's very hard to build a culture in such an organisation" (Participant 3, Team 2). Furthermore, it was argued that the complex governance resulted in creating a protective culture around knowledge, i.e. "culture of withholding knowledge rather than sharing it externally…being too overprotective about IP" (Participant 1, Team 2). Such protectiveness was attributed to a lack of independent ETI voice, the organisation being cautious of protecting and retaining value for its members, and conforming to matters as opposed to challenging them - has impacted knowledge exploitation and resulted in "missed opportunities for sharing knowledge" (Participant 5, Team 2). The reported low levels of ownership and autonomy within the ETI, has limited the ETI's knowledge sharing capacity. The role and style of management the ETI has to operate in due to its membership structure, appears to have a strong influence on knowledge sharing practices and the culture of the organisation, generating the following theme:

Theme: Management support and communication

Another overarching theme that emerges from the discussions in this section is the level of external knowledge exploitation and subsequent organisational impact, from which the following theme is surfaced:

Theme: Organisational impact

4.3.1.2 Influence and role of human factors

In the following sections, the human related factors that have been identified through the research findings as having an influence on or playing an important role in the ETI's knowledge sharing are analysed. The factors include (i) the knowledge and expertise of the ETI's staff (ii) the attitude of staff and (iii) staff awareness about knowledge sharing.

4.3.1.2.1 Knowledge and expertise of staff

The ETI's purpose is to commission projects that develop and deliver solutions to help the UK address its long-term emissions reductions targets. For this, it combines specialist energy and engineering knowledge from its experienced engineering staff and its member organisations and has implemented "strong knowledge creation management processes" (Participant 2, Team 2). The participants acknowledged that the ETI is "generating enormous amounts of knowledge…with a wide range of data and statistics" (Participant 5, Team 1), and so the organisation has a strong product to share. Despite the project outputs being of a technical and complex nature, the high calibre and genuine interest of its engineering staff were praised for being able to translate and communicate these externally. Thus, the staff knowledge and expertise play an important role in facilitating knowledge sharing, and so the following theme emerges:

Theme: Staff expertise

Team 3 highlighted that the ETI is producing large amounts of beneficial knowledge, but showed concerns about that knowledge not being entirely communicated externally, arguing that "it could be a resource issue, or the relative volume of the outputs to the resources" (Participant 3, Team 3).

Similarly, Team 2 also discussed formal external communication and suggested that the ETI may need more resources with specific subject matter expertise either within or working closely with the Communications Team. It was also stressed that the responsibility of external communication should not be entirely placed on the Communications Team and the rest of the organisational teams and processes should contribute to it.

Arguing that more collaborative effort between technical and non-technical staff was required, Team 2 decided during the ALS to proactively build a better relationship and improve communication with the

Communications Team, and provide support where necessary. This reconfirms the theme 'Silo mentality' and surfaces the following theme about collaboration and social ties within the ETI:

Theme: Social connections

4.3.1.2.2 Attitude of staff

Positive attitude and openness of staff were acknowledged as motivators for knowledge sharing; it was argued that "most people are friendly and approachable and keen to share knowledge" (Participant 3, Team 1) and there is an element of "trust and respect for each other's expertise" (Participant 4, Team 2). Good work ethic and drive in individuals to make a difference through their work, and, the willingness and desire to share knowledge was also acknowledged by the teams. This surfaces the following theme:

Theme: Staff morale

The ETI being a fairly small organisation and the subsequent opportunities for building close working relationships, combined with a great deal of team work in the projects were recognised as beneficial for knowledge sharing. Moreover, there is also a sense of "desire to improve processes" (Participant 1, Team 3) that inspires informal knowledge sharing. Thus, culturally, the employees displayed an ethos of respect, placed importance on interpersonal relationships and valued the importance of effective knowledge sharing.

4.3.1.2.3 Awareness

Knowledge sharing awareness was raised in a number of conversations by the teams. Participants appeared conscious of the integral role and importance of effective knowledge sharing for the ETI's organisational goals. However, the complexity about which knowledge is permitted to be shared and which needs to be protected was a practical challenge and concern. One participant argued, "it is difficult when you're on the spot in a meet and greet situation…we don't know what we can share and stuff that is confidential" (Participant 6, Team 1). Similarly, various participants expressed the frustration caused by the lack of clarity on sharing when attempting to engage with people externally.

Documents containing sensitive material are labelled as 'confidential', however, it was argued that not all of the information within those documents is confidential, so the lack of detail on defining confidentiality levels leads to the entire contents being protected. Also, approval is required for publishing knowledge externally, some participants claimed not being aware about who carried out the

approval process. Thus, the lack of clarity about knowledge sharing has created complexity and challenges for the ETI employees, which reconfirms the theme 'Staff morale'.

Regarding knowledge sharing awareness, a participant from Team 2 made the following argument:

> *"I think there is a general presumption that everything cannot be shared. So there is this kind of conflict there. So, for me the presumption should be switched around in that, knowledge should be shared unless it is genuinely commercially viable, commercially valuable and exploitable by our commercial members."* (Participant 2, Team 2)

According to Team 2, the heavy emphasis on protection and the lack of clarity often lead to unnecessary withholding of knowledge, which was reported to be impacting employees as well as organisational partners. The lack of awareness inhibits the ETI's knowledge sharing and was argued to be cutting off a communication capability at source and impacting the "ETI's capability to communicate the value of its intellectual insights" (Participant 4, Team 2). Team 3 also stressed that insufficient awareness and clarity on knowledge sharing acts as a barrier and it was also argued that there is "a perceived lack of need to share knowledge or lack of awareness about who might be interested" (Participant 3, Team 3). The need for having awareness of existing knowledge sharing activities was also expressed.

To summarise, the lack of awareness and clarity about which knowledge is permitted to be shared externally and which needs to be protected, the ways in which it can be shared and with whom, was reported as a common barrier to knowledge sharing. The following theme emerges from this:

Theme: Awareness and clarity

4.3.1.3 Influence and role of technological factors

In the following sections, five technology related factors that have been identified in the research to have an influence on or play a role in the ETI's knowledge sharing are analysed. The factors include (i) the ETI's Member Portal, (ii) the Energy Systems Modelling Environment (ESME) system, (iii) the shared drive, (iv) the Project Information Management System (PIMS) and (v) the Customer Relationship Management (CRM) system.

4.3.1.3.1 Member Portal

The Member Portal appeared to be the most popular system for discussion amongst the teams. In this system, the ETI formally stores and publishes project information in a structured and organised way. The portal includes a wide range of data, reports, models, analysis, and details about the current and archived projects. Although originally set-up for the benefit of ETI's members, it was reported as being

a significantly valuable source for securely storing information and the main point of contact for accessing project details for the ETI staff. Potential value of this system beyond its existing use, such as publishing and disseminating project outputs and reaching a wider audience, was also recognised. The following theme is identified from this:

Theme: Suitability and value of systems

Some concerns were also raised regarding the Member Portal. Firstly, it was stressed that the system's administration is managed by selected individuals who may not necessarily be subject matter experts on the content they are handling, which has led to accuracy mistakes being made in the past regarding publishing knowledge. Thus, despite the benefits and suitability of the Member Portal, incorrect administration was said to be impacting on the accuracy and reliability of its contents, which generates the following theme:

Theme: Administration

The external access to the Member Portal was also said to be limited to a handful of contacts from the member organisations. This was described as an issue as it restricts exploitation of the ETI's external knowledge sharing, where other - potentially relevant and interested audiences – are unaware and not targeted. So, granting the correct type of access to the right target audiences is an important factor for effective knowledge sharing, which ties in with the previously identified theme 'Access'.

The quality management process, usability and intelligibility of the content on the Member Portal were also raised as concerns. In addition to the difficulty in searching for particular information, it was argued that the portal contains either brief summaries or very complex reports, whereas it needs to offer information tailored to different types of target audiences to increase the impact of the content. The following two themes have emerged from this:

Theme: Target audiences

Theme: Targeted content

4.3.1.3.2 ESME

The Energy Systems Modelling Environment (ESME) is an integral system through which the ETI develops models to identify and guide priorities for a portfolio of technology development programmes. ESME is

managed by the Strategy Team who integrate data from various programmes to generate intelligent outputs, also known in the organisation as 'insights' that inform projects and policies. The insights were highly regarded as a major strength for the ETI's external profile and for external knowledge sharing as the "insight creation is often robust, so the information that is formally shared is evidence-based output" (Participant 3, Team 3). Further, on-going collaborative work and good understanding of the complexity and interdependencies of the insights creation was acknowledged. This reaffirms the previously identified theme of 'Knowledge quality' as playing an important role in knowledge sharing and providing confidence to employees about the ETI's 'product'.

Some participants claimed that the complexity of outputs and interdependencies of the insights are not widely understood in the organisation and this affects external knowledge sharing. One participant explained:

> *"…the understanding around the energy system and the bigger picture…if I go outside the ETI and talk to someone, they expect me to know this and what our view is on this stuff, they expect us to be informed but I don't feel I'm able to do that. As project managers we just focus on the bits we're delivering, and we don't spend enough time understanding that."* (Participant 2, Team 3)

On the other hand, the challenges associated with the sharing of this complex knowledge were also recognised by some participants. For example, it was argued that due to the intricate and continuously changing nature of ESME, a heavy investment of time and effort is required in order to update and support a rolling feedback process with individuals to help maintain a sense of connection to the model.

A challenge identified in relation to developing the insights through the ESME system was receiving inconsistent levels of input and sometimes insufficient understanding of data from different individuals in the organisation. Thus, the need to create more time and mechanisms for effective collaboration between individuals, extracting and sharing of the knowledge was expressed. The themes 'Collaboration' and 'Management support and communication' between the teams and departments at the ETI surface again from these discussions.

Many of the discussions in this section have brought to attention the integral role of the ESME system, the knowledge that it generates and the processes that surround it which reemphasises the theme 'Knowledge quality'.

4.3.1.3.3 Shared drive

For storing and sharing files and documents, the ETI has a shared drive in place, about which the participants expressed mixed opinions. For example, some participants stressed the knowledge sharing benefits if there is "discipline of folder structure, naming convention and version numbers" (Participant

2, Team 3). However, some individuals said they were unsure whether to use the shared drive, whereas others reported falling into the habit of saving documents in personal files whilst working offline or onto their computer desktops as this made it easier to locate and upload files. Thus, the lack of standard practice causes inefficient knowledge management among some employees.

A particular concern relating to the access restrictions on the shared drive was raised by a number of participants, for example, “a lot of the departmental folders are not accessible by other departments e.g. I can’t access the finance data on my own project” (Participant 2, Team 3). Similarly, other participants also stressed that the internal restrictions are ‘too tight’ where access to certain folders is restricted, even though it might be relevant to their work.

It is understood that the access arrangement and the subsequent information on the shared drive had been structured by departments rather than by projects, which was described as an ineffective practice for an organisation trying to deliver projects. Further, although on the surface this may appear to be a simple ‘access control’ mechanism aiming to protect certain information from being accessed organisation-wide, some participants argued that the problem is much more deep-rooted and stems from the organisation’s culture, i.e. “the entire organisational culture is set up on a siloed departmental basis, and therefore all of the systems follow it. So instead of having tools that help to share information, we have tools that build walls between different parts of the projects” (Participant 2, Team 3).

In summary, a common overarching matter that emerges is the design of security and the reasons behind its architecture for a project-based organisation, reconfirming the theme ‘Organisational structure’ and generating the following theme:

Theme: Security design

4.3.1.3.4 PIMS

Project Information Management System (PIMS) is a system that the ETI implemented to store project documentation. The system was described as good landing page for projects to get an overview, find key dates and milestones. However, the majority of participants argued that although the thinking and ambition behind PIMS was correct, there were concerns over its implementation and management. The first concern was about the strict access restriction to information stored on PIMS which aims to prevent information from being modified.

The second concern was about the lack of knowledge amongst employees about where the content uploaded onto PIMS went and who saw it, making it difficult to tailor information for its target audiences and such information potentially being unusable. The issue of limited access coupled with the lack of

knowledge about the purpose and location of the content on this system, echoes the themes 'Awareness and clarity'

Thirdly, the participants questioned the value of using PIMS for the employees and also for the ETI members. The documentation on PIMS was taken from the shared drive, but it was argued that the folder structure was not replicated on PIMS, there was not a naming convention or meta data in place which made it "very difficult to locate files" (Participant 1, Team 3). The system was also reported to be problematic for the users as it sometimes crashed and produced errors.

Further, one participant questioned whether the effort put into accumulating knowledge into PIMS would result in any benefits for the ETI members, i.e. "we are asked to put more and more stuff onto the PIMS system, but the members may not get the value from that" (Participant 6, Team 1). This reiterates the previously identified theme about 'Awareness and clarity' due to the reported lack of understanding about the potential value and benefits of this system, as well as the theme about the 'Suitability and value of systems'.

4.3.1.3.5 CRM

The ETI has implemented a Customer Relationship Management (CRM) system in order to more effectively manage the relationship, communication and activities with its stakeholders. There were a variety of different opinions shared regarding CRM.

Participants from Team 2, expressed that whilst the CRM system might be of value to some individuals in the organisation, others who do not obtain any value from it are expected to use it to support those who do. This was said to inhibit their motivation for using this system, for example, "so if there's no value back to us, then it makes it difficult for us to want to go in and log everything" (Participant 4, Team 2). Participants from Team 3 pointed out that CRM was useful for tagging information to projects and was a "great system for email marketing" (Participant 1, Team 3). Opinions were also expressed that other benefits from CRM are not derived as the system is not tailored to how the ETI works, particularly due to the diversity of its stakeholders and the various ways of engaging with them.

Further, from a usability perspective, CRM was described as requiring a lot of input and maintenance, and some participants preferred to use alternative methods such as using a spreadsheet to manage that information. Some participants also believed that the ETI may have been trying to solve cultural problems through the implementation of systems such as CRM. For example:

> *"To me, CRM is a classic illustration of the ETI culture because the actual problem was a cultural one that people weren't finding ways to share conversations and contacts with each other naturally. So, for a cultural problem, we adopted a technical fix…So I think it was an*

engineering solution to a cultural problem, whereas what we need is a cultural solution to a cultural problem. So, people thinking about who certain information might be relevant to internally and making sure they know about it, for example, making notes of meetings and passing them around." (Participant 2, Team 2)

Whilst the implementation of the CRM system was a part of a broader strategy to change the KM culture at ETI, and the system's implementation process - as well as the reflections generated during this research - helped the organisation to identify deep-rooted cultural problems, the value gained from the system's functionality itself was limited. Thus, discussions such as those presented above, relate to the already identified theme 'Suitability and value of systems'.

4.3.2 Information security

In the previous section, the research findings were analysed to identify various organisational, human and technological influences on the ETI's knowledge sharing practices. In this section, the same approach is used to identify the influence and role of organisational, human and technological factors on protecting the ETI's knowledge and the influences of information security measures on knowledge sharing are also analysed where applicable. From the analysis, common themes are elicited and highlighted throughout the sections.

4.3.2.1 Influence and role of organisational factors

From the research findings, four organisational factors have been identified that have an influence on or play a role in the ETI's information security practices. These factors are analysed in the following sub-sections and consist of (i) policies and processes, (ii) legal practices, (iii) security requirements of the ETI's member organisations and (iv) the level of clarity in the organisation about security or protection.

4.3.2.1.1 Policies and processes

In terms of internal processes and policies to protect the ETI's valuable information, a number of measures are in place. For content to be presented externally, it was argued that the ETI reviews project stakeholders' presentations, with the aim to prevent leakage of sensitive information. However, some participants felt that the procedures for reviewing presentation material to public need to be more efficient; "approval for publication and dissemination by various people and organisations means material is not useful" (Participant 2, Team 1) as it could become obsolete. Some participants reported being unsure about who reviews and approves external presentations for Intellectual Property. Thus, approval processes were identified as an important factor in external knowledge sharing and so the following theme emerges:

Theme: Operational and legal processes

A measure the ETI has in place to protect information confidentiality was document labelling which aimed to "define who the data can be shared with" (Participant 3, Team 3). Participants in Team 1 argued that the confidentiality labelling was too generic and did not specify the level of confidentiality or the exact contents that needed to be protected, resulting in the entire contents of such documents being treated confidentially.

Overall, participants felt confidence that the security policies and process in place adequately protected and the ethos amongst staff was one of being careful and dealing with information cautiously.

4.3.2.1.2 Legal practices

When discussing the protection measures at the ETI, the role of the 'Legal' business function and legal protection measures were heavily emphasised by the research participants. The use of non-disclosure agreements (NDAs) and legal confidentiality controls constituted "good legal protections and procedures" (Participant 2, Team 1). One participant argued that in some cases, the ETI needs to be "careful about competition law and certain conflict of interest and I know our legal people are quite strong on that, and we've trained people on competition law which is very good" (Participant 2, Team 2).

The ETI wants to ensure that any outputs of its projects comply with legal and security requirements of all of its member organisations, and therefore, has implemented a thorough legal approval process before any knowledge is published or disseminated publicly. In relation to the membership structure and the value that the ETI delivers to its members, the participants felt that the security controls provide "entirely protected value for them" (Participant 3, Team 2). Moreover, Team 2 also argued that the legal security processes were unnecessarily overprotective and one participant said the following:

> *One of our biggest weaknesses is bureaucracy paperwork. I mean, whatever system or level of security you have, you ought to be able to turn around paperwork quicker than we do. I think that gives the impression of sluggishness or incompetence externally. I think that could be cleaner."* (Participant 1, Team 2)

The quote above highlights a conflict between the way the ETI operates i.e. comprehensive operational processes and subsequent delays, and the previously identified theme 'Organisation Size'.

It appeared that strong information security and legal protection were in place, but perhaps more than was necessary, which was argued to be potentially negatively impacting the organisation:

"I do think that we obsess and get the risk balance wrong in terms of protection and security measures, particularly IP, which is very damaging for our ability to share knowledge." (Participant 2, Team 2)

The research participants indicated that whilst they appreciate why a rigorous approval process is in place, they raised concerns about hindrances to knowledge sharing activities. Further, it was argued that "the bureaucracy runs through everything that we do" (Participant 1, Team 3) and the comprehensive legal approach does not help with nurturing knowledge sharing and affects how the ETI engages externally. In particular, challenges related to commercially valuable Intellectual Property protection were raised, such as contracts being delayed, which was categorised as a barrier for the ETI **"**being effective as a knowledge generating and knowledge sharing organisation" (Participant 3, Team 2).

The ETI's project outputs are innovative energy-efficient solutions, many of which are time-sensitive and required to be published at the right time. On some occasions, the delays caused by the approval processes were reported to have resulted in missed opportunities for exploitation as "the material is not worth showing to anyone" (Participant 6, Team 1). In order to have a greater impact in the energy industry and further build the organisation's profile, the participants felt that the ETI needs to focus on publishing and disseminating its knowledge at the right time i.e. "crack on and exploit it or give the IP away" (Participant 5, Team 2) to retain its value. All three teams referred to the delays caused by legal and approval processes as being an information security challenge for effective and timely knowledge sharing, which supports the theme 'Operational and legal processes'.

Another important theme identified affecting knowledge sharing at the ETI is the integral role of timely exploitation, yet a number of challenges were also identified that impeded this.

Theme: Timely exploitation

4.3.2.1.3 Members' security requirements

The ETI operates in a complex governance structure and a by-product of such intricacy is the challenge of meeting various levels of security requirements of its members, some of who are otherwise competitors. In addition to this being an operational challenge, this intricacy also affects individual employees. Firstly, it was reported as a challenge for sharing knowledge externally and engaging in collaborative work between competing members. Secondly, the caution around intellectual property and the specific details of what can and cannot be shared was described as "a source of frustration and a barrier to knowledge sharing" (Participant 4, Team 2).

The intricate security requirements of members generate organisational level challenges and influence the ETI's information security choices. The participants conveyed that a difficulty in managing the different conflicts of interest of members, led to the ETI "wanting to satisfy the security or culture of all of its members…so you've got this highest common denominator thing" (Participant 1, Team 2). In addition to the security requirements already enforced, the ETI also has to deal with "changing priorities from the members" (Participant 7, Team 1). Another related challenge identified was the obligation for the ETI to "ensure trust between commercial competitors" (Participant 2, Team 2) by way of cautiously managing relationships. Moreover, the ETI was argued to be compulsorily tailoring external knowledge sharing based on members' expectations, in relation to which, one participant stressed:

> *"I think we're too protective over some of our messages and information and I think that's just wrong…I don't think it's anything that has ever been debated or decided. It's a culture almost." (Participant 1, Team 2)*

Such focus around security of its members was claimed to have generated "the inherent confusion about exploitation" (Participant 3, Team 2) of its project outputs and shaped the organisational culture, which emphasises the previously identified themes 'Protective culture', 'Withholding knowledge', 'Stakeholder management', 'Staff morale' and 'Management support and communication'.

4.3.2.1.4 Clarity

The need for clarity about security requirements i.e. what can and cannot be shared externally, was argued to have resonated not just at the individual level but also at the organisational level. It was argued that, by focusing too much on protecting its knowledge in the interest of its members, perhaps the ETI could not 'see the wood for the trees' and could be getting "the risk balance wrong in terms of protection and security measures" (Participant 2, Team 2). Another participant contended:

> *"There is a general presumption that everything cannot be shared, whereas the presumption should be switched around in that, knowledge should be shared, unless it is genuinely commercially viable, commercially valuable and exploitable by our commercial members"* (Participant 2, Team 2).

Opinions were also expressed about the need for the ETI to carry out necessary risk analysis to determine the value and benefits of sharing something, against the potential risks associated with it. Thus, it was stressed that in order to be more influential and have a high profile in the energy industry, it was vital for the ETI to think holistically, change its culture by shifting the focus from 'protection' to 'sharing', take more risks and subsequently increase its knowledge sharing activities. This surfaces the following two themes:

Theme: Holistic thinking

Theme: Risk analysis

4.3.2.2 Influence and role of human factors

From the research findings, two human related factors have been identified that influence or play a role in the ETI's information security practices, including (i) awareness and (ii) guidance about which knowledge needs to be protected and how. These are analysed in the following sections.

4.3.2.2.1 Awareness

Regarding the complexity of security requirements of the ETI's members, Team 1 highlighted the challenges that individuals experienced as "the pressure on the individual to keep everything in their head and to not trip up" (Participant 1, Team 1).

Whilst discussing the security awareness amongst employees, Team 2 argued that there is too much emphasis on control and security, that when it comes to knowing "what can and cannot be shared, I think there is a general presumption that everything cannot be shared" (Participant 2, Team 2) which often led to unnecessary withholding of knowledge by ETI employees, contractors and project partners. Some participants expressed frustration regarding the security awareness: "so in terms of staff awareness about security, I think the ETI staff are confused, I am confused sometimes about what I can talk to people about and its farcical I find." (Participant 2, Team 2).

So, the lack of security awareness was an inhibitor to knowledge, which relates to the previously identified themes 'Awareness and clarity', 'Risk analysis', 'Withholding knowledge' and 'Staff morale.

4.3.2.2.2 Guidance

The findings suggested that generally there was understanding amongst employees that knowledge should be protected and handled carefully. However, participants expressed feeling unclear about confidentiality levels, i.e. how much information can be shared, and about documents marked with a 'confidential' status but without further clarification. Similarly, some participants stated that the lack of guidelines about security requirements had caused confusion about what they can communicate externally and found that "it's easier in those circumstances to not say anything" (Participant 6, Team 1). So, similarly to what was identified in the previous section, the perceived lack of clarity and awareness amongst employees about specific security requirements had resulted in occurrences of cautious

withholding of knowledge and missed opportunities for sharing. This reiterates the previous themes 'Awareness and clarity', 'Risk analysis', 'Withholding knowledge' and 'Timely exploitation'.

4.3.2.3 Influence and role of technological factors

Two technology related factors have been identified from the research findings that influence or play a role in the ETI's information security practices, which are (i) systems and (ii) access controls. These findings related to these factors are analysed in the following sections.

4.3.2.3.1 Systems

Regarding information security, a few different matters were discussed amongst the participants. Firstly, it appeared that there was a consensus amongst the participants in relation to the robustness and protectiveness of technological systems. For example, it was argued that the ETI has "good systems implemented, which are legally protected well" (Participant 5, Team 1). Further, several participants raised the importance of having strong security and access controls on systems to protect the information. Particular emphasis was placed on systems that are external facing, such as the Member Portal containing important project information accessed by individuals from the member organisations. Some participants felt that the Member Portal "manages data sharing to members effectively, where the access is controlled well" (Participant 3, Team 2). Thus, the commonality identified is that the participants showed confidence in the security on systems for protecting the ETI's valuable knowledge, which reconfirms the theme 'Security design'.

On the other hand, some participants argued that the information security measures are perhaps too restrictive when it comes to knowledge sharing. For example, one participant mentioned that "I think there is too much emphasis on control and security" which had become a "major weakness" (Participant 2, Team 2). This issue relates to the previously identified theme 'Protective culture', where more emphasis was placed on protection measures in comparison to knowledge sharing. Further, the key concern relating to the security controls was about user access on systems, which is discussed in the next section.

Some participants stressed the need for greater clarity and guidance on which information on the systems needed to be protected, as it was argued that the information security "user awareness is weak", leading to some content being protected unnecessarily.

4.3.2.3.1 Access controls

All three of the participating teams raised concerns about the strict access controls on document folders and argued that their design was based on a departmental structure, rather than a project structure.

Due to this access structure, access was prevented to some required information, for example, one participant argued “a lot of the departmental folders are not accessible by other departments…I can’t access the finance data on my own project” (Participant 2, Team 3). Another participant argued that the “restrictions internally are too tight, for instance, on the read/write access on the shared drive, not everyone can put something in a certain folder, even though it might be relevant to their project” (Participant 7, Team 1). The access restrictions discussed here echo the themes ‘Access’, ‘Security design’ and ‘Organisational structure’ as previously identified.

4.4 Themes elicited from research

Throughout the analysis of the findings in section 4.3, several common themes specific to the ETI’s knowledge sharing and information security practices have emerged which will be carried forward to the Discussion chapter. All the themes are summarised in Figure 34, in no particular order.

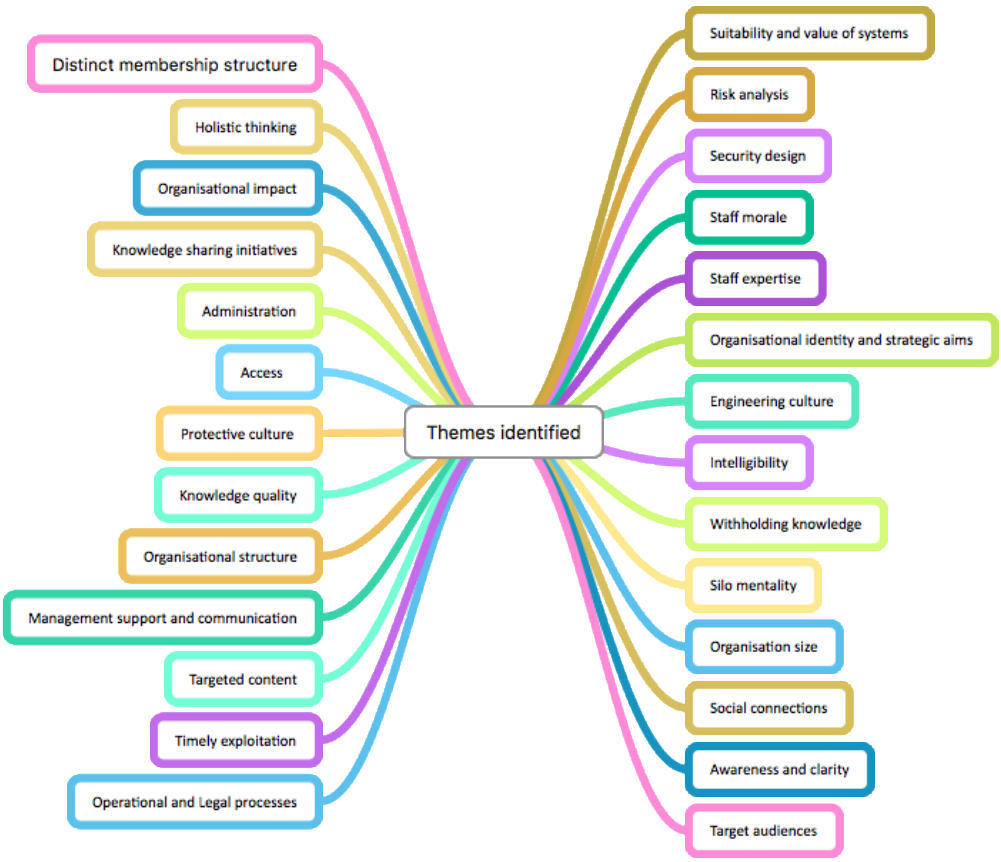

Figure 34: Themes elicited from research

To group the themes that have emerged from the research and to provide a structure for the Discussion chapter, each of the themes have been categorised into the primary area which they affect and/or

belong to. The four categories consist of 'organisational', 'human', 'technological' and 'knowledge' and are shown in Figure 35.

Although the themes have been classified into the category that they affect the most and belong to primarily, it is recognised there is a great deal of overlap and interconnectedness amongst the themes. Further, the themes are often intertwined and affect multiple aspect and thus can belong to more than one category. For example, the theme relating to issues with system 'Access', has emerged in relation to the technological systems, however it also relates to other categories such as 'Knowledge' and 'Human'.

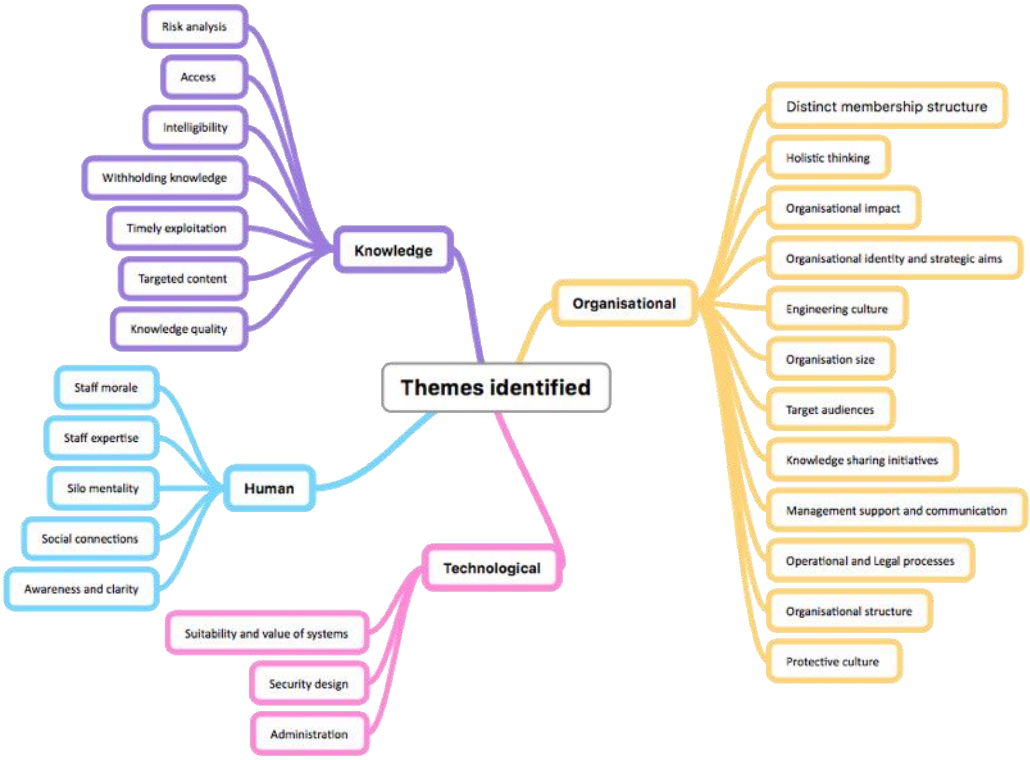

Figure 35: Research themes in categories

4.5 Chapter summary

The key findings from the data collection of this research have been analysed and presented in this chapter. The research findings from each of the three teams were compared in section 4.2 to identify similarities and differences between the opinions of the teams as well as the approaches they took. In section 4.3, all the research findings were amalgamated and analysed based on the relevant organisational, human and technological factors that influence knowledge sharing and information security practices at the ETI. Through the amalgamated analysis of the three teams' discussions, twenty-

seven themes have been elicited that affect the ETI's practices in particular. These themes will be taken forward to the next chapter where they will be discussed in further detail in light of existing literature that was reviewed in chapter 2 and the specific context of the ETI.

5. DISCUSSION

5.1 Introduction

In this chapter, the key themes elicited from the research findings and their implications for the ETI are discussed in light of existing literature (see Figure 36). The aim of the literature review in Chapter 2 was to provide the researcher with an understanding of the antecedents and state of the research of the relevant disciplines, demonstrating how the research is positioned in the field before moving forward and focusing on identifying the research gap to ensure that this research is addressing a new problem, filling an important research gap and making a valuable contribution to the existing body of knowledge. Thus, through comparing and contrasting to the literature review, the discussions in this chapter help to contextualise and identify the research findings that reinforce or contradict what is already known about the research area, and more importantly, new findings are drawn out which have not been covered by existing literature.

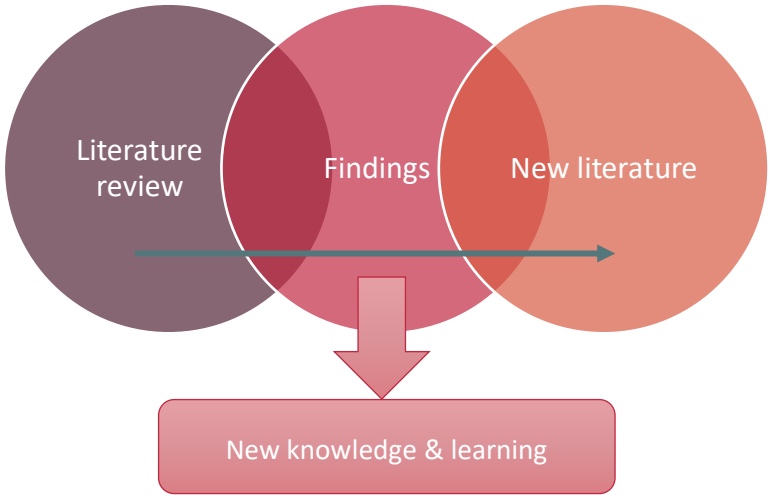

Figure 36: Model of discussion chapter

As recognised in Chapter 2, there has been little prior empirical research that explores the paradoxical nature of knowledge sharing and information security. This led to an empirical case study approach being adopted as in this research, discussed in Chapter 3, which is an approach that "investigates a contemporary phenomenon (the "case") in depth and within its real-world context" and where the researcher has little or no control over the behavioural events in the research context (Yin 2018: 15). In such context-based empirical methodology, the outcomes cannot be predetermined and new findings are likely to emerge. Thus, in addition to the comparison with the literature review, the discussions in this chapter extend further (as shown in Figure 36) through the introduction of new literature that has been identified as being particularly relevant to the research findings that have emerged and which the prior literature had not covered. The new findings as well as the learning from these which impacts

knowledge sharing and information security practices and contributes to the knowledge in these two disciplines is highlighted throughout the chapter.

5.2 Themes

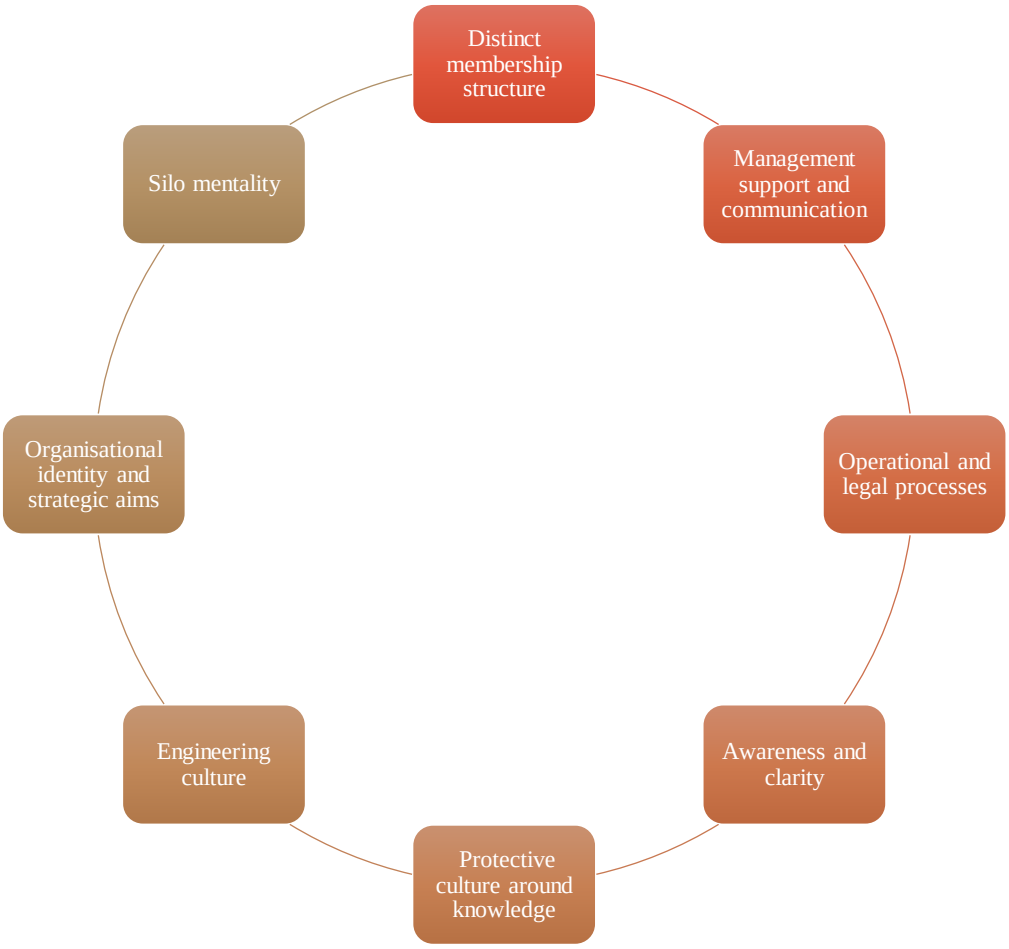

Figure 37: Top research themes

From the research analysis, a significant number of themes were surfaced as concluded in Chapter 4. The themes were then analysed in light of the following:

(i) the level of priority in terms of their impact and importance for the ETI as chosen by the research teams during the ALSs and in the questionnaire results (in keeping with the philosophy of action learning where the participants are given the authority to determine their organisation's problems through deep reflection),

(ii) the impediment they caused for the ETI's knowledge sharing or information security practices and those which affected the relationship between these, and,

(iii) the impact they were having on the organisation's performance, particularly in relation to knowledge sharing and knowledge exploitation.

Following the analysis, it was established that the eight themes shown in Figure 37 were the most crucial and impactful themes identified in the ETI's practices emerging from this research - although it is important to emphasise that all of the research themes identified are interconnected and overlap in various ways as concluded in Chapter 4, which means that some of the omitted themes may form a part of the discussions in this chapter.

Each of the eight chosen themes are discussed in the following sections.

5.2.1 Distinct membership structure – PPP

Whilst the original literature review in Chapter 2 did not find the organisational set-up of a public-private partnership (PPP) as having a significant influence or playing a major role in knowledge sharing or information security, the findings of this empirical research provide strong evidence of the impact the ETI's distinct public-private membership structure has had on the organisation's practices.

From the knowledge sharing perspective, being associated with a group of respectable, large public and private organisations created a solid foundation for the employees and facilitated their external engagement and knowledge sharing activities. In addition, all the members including the UK government were large, reputable organisations with interests in effective knowledge management - this reinforced the ETI's beliefs and efforts in its knowledge management which formed an important strategic process of the knowledge-intensive organisation.

Further, being in an atypical set-up, the ETI has links and access to various pertinent organisations and their resources. This has been recognised as an integral characteristic of PPPs in literature where resources from the public and private members are pooled and managed to successfully achieve the particular aim of a project (Kort et al, 2016: 777) and where there are intensified information exchanges and higher quality of combined knowledge, leading to the development of high quality innovative products (Edelenbos and Teisman, 2008). The ETI's distinct membership structure has not only placed the organisation in an advantageous position in the energy industry but created unique channels for knowledge access and sharing for its projects. The PPP literature recognises the distinct position and the freedom to produce innovative outputs effectively of such organisations i.e. "because PPPs are positioned at arm's length from the political decision-making arena and because they are organized as a distinct organizational identity, they are believed to be able to work more effectively and efficiently" (Kort et al, 2016:778).

As well as the benefits, there were also some unique challenges created by the distinct membership structure, inter-organisational relationships and the complex governance of various stakeholders. Firstly, PPP researchers have noticeably recognised and emphasise the high level of complexity of PPP governance due to the involvement and active interest from various members (e.g. Kort et al, 2016;

Barrows et al, 2012; Van Gestel et al, 2012). In the case of the ETI, the external governance with influences and expectations set by 'large organisation' culture impacted on the decision-making processes and the organisation's management overall. The literature on PPPs confirms this finding, suggesting that decision making processes within PPPs are often limited by the larger network of actors involved and affected by the projects who, therefore, try to influence those projects (Kort et al., 2016; Steijn et al, 2011; Hodge et al, 2010). A study by Petković et al (2015) concluded that, rather than decentralising the decision making power to the individual projects in PPPs, organisation and management decisions are determined in advance by the contractual framework to avoid potential problems and conflicts – which they describe as one of the causes of failure of PPPs. However, Petković et al (2015: 8) also argue that flexibility should be offered to PPP management with sufficient "manoeuvring space to make necessary interventions as they go along". In addition, research carried out by Steijn et al (2011) determined that, although the organisational set-up or 'form' of a PPP that combines knowledge and expertise of public and private partners aims to add more value and achieve greater success of the projects at hand – it is actually effective management strategies that play a greater role in the success of PPP projects (Steijn et al, 2011). Effective management in PPPs is integral to achieving success in project outcomes, thus its role in knowledge sharing and information security practices at the ETI will be discussed in further detail in section 5.2.2.

From the analysis of the empirical research findings it emerged that, due to the complex set-up and various stakeholders involved in its governance, there is a lack of clarity about knowledge ownership within the ETI. Participants' discussions suggested that decisions on releasing knowledge and intellectual property require a great deal of thorough review and knowledge going through extensive approval processes before it can be released - this indicates that the ETI has limited independent authority on the knowledge that it produces, which sometimes causes delays in getting knowledge into the public domain in a timely fashion. Although it is clear that a PPP is a shared initiative between the members and the literature has addressed various important factors playing a role in the dynamics of a PPP, the topic of knowledge ownership, the role of confidentiality and how this impacts the partnership's capability of knowledge sharing was not found in the existing PPP literature.

Whilst it is recognised that one of the drivers behind PPPs is to effectively utilise management expertise, business practices and organisation of the private sector (Petković et al, 2015; Yang et al, 2013) to achieve the goal of the partnership, the findings of this PhD research bring to surface some challenges specific to the members from the private sector in the partnership. It was found that in the ETI's knowledge sharing activities, it is challenging when conforming to knowledge protection requirements of various organisations who are, in some cases, commercial competitors outside of the partnership. Moreover, it was challenging for the employees to effectively manage collaborative activities that involved different commercial members as the confidentiality requirements by different members were

sometimes conflicting with one another. A PPP inter-organisational design should be such that it enables each member to accomplish its individual objectives but also the objectives for which it entered the partnership (Osborn and Baughn, 1990). Whilst a PPP is a conscious collaborative endeavour to accomplish a mutually agreed objective, the complexity of it has been widely recognised in the literature. For example, Robinson et al (2009) – (in their book entitled 'Governance and knowledge management for public-private partnerships') - stress the need for careful planning and structuring of a partnership that involves public and private members to prevent issues arising from the differing value systems driving each sector. Moreover, it is argued that "often, there is some tension between the private sector motive of profit maximisation and the public sector objective of delivering an acceptable level of service for public good in a manner that represents value for money" (Robinson et al, 2009: 4). Although the findings of the current empirical research did not find or explore whether conflict existed between individual members, it was evident from the discussions that the changing priorities of members – particularly those relating to confidentiality - are disruptive to the ETI's operations and impact the organisation's knowledge sharing. Such findings showed that despite having contractual agreements in place, the nature and complex dynamics of a PPP is an ongoing challenge for the management of the ETI.

The issues discussed in this section are a by-product of an organisation operating within a challenging and complex network of actors. For a PPP such as the ETI, the literature emphasises the vital need for effective network management where it has been positively linked to network performance (e.g. Kort et al, 2016; Meier and O'Toole, 2007). Network management is described as a conscious effort consisting of various strategies to arrange the members of a network and facilitate and guide interactions and collaboration between them (Koppenjan and Klijn, 2004; Kort et al, 2016); effectiveness can be achieved by combining the organisational form of that particular PPP with tailored network management strategies (Kort et al, 2016). Moreover, for effective integration of members in a PPP, a holistic strategy is needed that involves soft organisational instruments such as the organisational culture, leadership, trust and communication (Petkovic et al, 2015). In the knowledge audit project carried out in 2012, it was identified that tailored member engagement plans had been developed and implemented at the ETI, which made explicit the communication network between the organisation's employees and its members (Ragsdell et al, 2014). Initiatives such as the member engagement plan were a demonstration of the ETI's proactive approach and a clear strategy to effectively manage the complex network of stakeholders in which it operated. However, despite the ETI's efforts to manage the complexity, the findings of this research demonstrate that the challenges arising from the membership structure have impacted the ETI's knowledge sharing and information security practices and highlight the importance of effective network management and strategies to deal with the arising complexities in PPPs. Somewhat similarly, the literature emphasises a need for better understanding of inter-organisational relationships

of PPPs where, for example, Petkovic et al (2015) argue that the focus of research should shift from individual member organisations to the larger network of the partnership (and the associated issues) in which individual organisations are only nodes that have a common goal. In the case of the ETI this 'common goal' is successful development and dissemination of innovative low carbon technologies.

5.2.2 Management support and communication

In the literature review in Chapter 2, it was identified that for an innovative and knowledge-intensive-organisation - such as the ETI - senior management's commitment and support is vital to create a supportive culture and provide necessary resources for knowledge sharing (Donate and Pablo, 2015; Tan et al, 2012) and the perceived support from senior management is a significant predictor and motivator for knowledge sharing amongst employees (Cabrera et al, 2006). Congruently, from the analysis of the current research findings, it is clear that the involvement from senior management is an expectation and an important factor that employees seek for effective knowledge sharing at the ETI. However, this research also identified factors arising specifically from the membership structure that impact on the ETI management's ability to play an active role in nurturing a knowledge sharing culture in the organisation. Thus, additional literature is explored in relation to this.

Due to the complex nature of the inter-organisational relationships and dynamics arising from the network, Petkovic et al (2015: 1) stress that PPP management, "apart from the general managerial skills and knowledge needs to be specialised in managing PPPs" and have the leadership and a holistic strategy through which it nurtures a culture of effective communication and trust. Raab et al (2014) also found that the presence of trust between employees and management is essential for knowledge sharing, however, they also report that management's direct involvement with knowledge sharing initiatives does not increase trust, thus other ways of nurturing a culture of trust are necessary. However, research on partnerships has found that such organisations are often subjected to ineffective communication which impacts the overall performance effectiveness of the partnership and can lead to its failure (Ruuska and Teigland, 2009). Whilst it appears that the ETI management has been playing an effective role and successfully managing the complex network of its stakeholders, its focus and the level of input that is required for the internal communication within the organisation may have fallen short.

Two of the teams stressed the importance of formal top-down communication from senior management, particularly related to decisions that were made about important organisational matters and those about process changes which affect their work – much of which is of a dynamic nature due to being in the project environment. Great emphasis was placed on the need for more involvement and connection with senior management. It was argued that on occasions, a lack of communication from senior management had resultant negative impact on the organisation's knowledge sharing; this may

have led to incoherent and misaligned dialogue, which particularly affected the knowledge sharing between programmes. Thus, great emphasis was placed by the teams on the need and desire for more involvement and connection with senior management and for them to stay 'in the loop' about important decisions being made. This supports the argument by Riege (2005) that a lack of support and direction from management in terms of clear communication and the values of knowledge sharing can be a barrier to knowledge sharing (Riege, 2005). During the knowledge audit carried out at the ETI in 2012, internal top-down communication was a strong theme that emerged which highlighted the need for greater clarity of the strategic message, for the organisation as a whole, through improvement of internal communication.

One of the participating teams also addressed the issue of management communication and further explored the possible reasons behind it. The team attributed it to the management being in a position with limited decision-making power, resulting from the ETI's shared governance structure. The current research highlights the need for more management communication and direction for employee knowledge sharing and confirms that "employees are interested in acting in accordance with management direction". Seeing senior management's commitment to knowledge sharing is required to create a more positive knowledge sharing culture in an organisation (Connelly and Kelloway, 2003: 298).

Mueller (2012) makes an interesting argument that while knowledge sharing is recognised as a key activity in the workplace, it is still not classed as a formal part of work and so the responsibility of creating a knowledge sharing culture lies with all employees in the organisation, not just the management. Mueller (2012) also stresses that, given there is mutual trust, management should not interfere with informal processes such as knowledge sharing, as this would enable employees to take personal responsibility for knowledge sharing. Furthermore, when bringing the focus back to the context of a PPP – and whilst the concerns raised by the teams may be plausible - it raises the question whether the participating teams' expectations from management are shaped by a conventional hierarchical organisation mind-set as opposed to that of a PPP. Moreover, according to Petkovic et al (2015), a PPP should differ to a hierarchical organisation where more authority and independence should be transferred to the project level rather than all of the decisions and practices being driven from the top; a PPP's efficiency is enhanced as the decision making power and authority is decentralised to individual projects which means that "decisions are made by those who have the greatest knowledge and have the best information, which in turn leads to greater self-reliance of individuals and teams" (p.77). Contrarily, despite being project teams within a PPP, the decision-making power in relation to knowledge sharing is not decentralised to the teams at the ETI – yet it is not clear whether this is actually intended or just perceived - and there is reliance on guidance and support from senior management.

Conflicting to the arguments by Mueller (2012) and Petkovic et al (2015), this research has identified that for the ETI employees, explicit support and communication from senior management is a fundamental requirement for knowledge sharing, and the employees do not feel solely responsible for or feel that they have sufficient authority to initiate knowledge sharing practices without management support and guidance. Since the culture of the organisation emulates the practices of senior management (e.g. Connelly and Kelloway, 2003), being more open and communicative with their employees and leading by example is likely to motivate employees and nurture a more effective knowledge sharing culture at the ETI as active management of the project environment has been found to have a positive impact on the outcomes of PPPs (Steijn et al, 2011).

The opinions of the research participants regarding management's communication and support for knowledge sharing were of a critical nature and this emphasised a need for explicit guidance, support and coherent communication driven from the top throughout the organisation. However, based on the researcher's knowledge and experience of collaborating with the ETI over a number of years, it is clear that these particular opinions identified are not entirely representative of the ETI's practices, specifically the management's efforts towards improving the organisation's knowledge management. For example, it was evident from the findings of the knowledge audit project (see Ragsdell et al, 2014) that the ETI recognised itself as being a knowledge-intensive organisation, had taken a strategic approach and was committed to improving its knowledge management. The ETI has been proactive in seeking new ways for such improvements and has invited input from external sources for this purpose, such as the present PhD research case study, the knowledge audit project and other knowledge management collaborative projects with Loughborough University researchers. The collaborative endeavours not only demonstrate the ETI's eagerness to learn about its practices, its ability to adapt and initiate change where required, but also illustrate the organisation's integrity through the openness and transparency it provides to these external parties and welcomes external opinions. Achieving transparency about its internal practices in such a manner is especially creditable for the organisation as transparency has been acknowledged as a challenge and a cause of concern in partnerships, and has subsequently attracted a great deal of attention in PPP literature (e.g. Reynaers and Grimmelikhuijsen, 2015; Barrows, 2012; Skelcher, 2010; Siemiatycki, 2007).

Drawing the attention back to the role of management, according to Samii et al (2002: 1005), leadership is the key to success in PPPs, however, it has been established that management in such a partnership is "complex, demanding and may require undivided attention". Whilst PPP literature has described how it should be managed, the complexity it needs to work with and what its responsibilities are operating in a partnership network (e.g. Petkovic et al, 2015; Samii et al, 2002; Kort et al, 2016), it typically appears to be of a theoretical nature and evidence of the apparent complexities that are being faced in practice has not been found in the literature.

The findings of the current empirical research confirm that management of a public-private partnership is multi-faceted and a complex responsibility and so, this requires a holistic knowledge management strategy where effective communication is at its core. Congruently, through the knowledge audit it was recommended that the ETI take a holistic and tailored approach when further developing its knowledge management strategy by having a systemic view of the organisation and to avoid sub-optimisation. Although this is the approach the ETI has taken, knowledge management in the dynamic environment of this atypical knowledge-intensive organisation is an ongoing and evolving effort. It is therefore vital for the ETI management to address and respond to the feedback arising from its environment - such as the concerns raised by the research participants regarding internal top-down communication – particularly as the organisation is at a critical stage from a knowledge management perspective where it is disseminating its knowledge outputs from its projects; it is critical for the project teams to receive clear communication and guidance.

5.2.3 Operational and legal processes

Operating in a complex membership structure where many of the members and project partners are commercial competitors outside of the partnership, it is a top priority for the ETI to ensure that the knowledge it produces is meeting the various – and sometimes conflicting - security requirements of all the members and project partners and was being well-protected from external threats. In many cases such safeguards are stipulated in the legal agreements governing each individual project.

The literature review found that information security does not only consist of conventional technologies such as “access control technologies, authorisation technologies, authentication technologies, etc. but also organisational policies and procedures that are constructed into a material form by organisations” (Coles-Kemp, 2009: 181) and that it cannot be achieved without a comprehensive approach to the information security policy, consisting of people, processes and technology (Klaic and Hadjina, 2011). The empirical research has found that the ETI recognises this and has implemented multi-layered security controls, the chief security mechanisms being its dedicated Legal Department and the implementation of rigorous legal and operational systems and processes. These are a dominant part of the ETI’s operations and formed a large part of the discussions by all the participating teams. Further, the research participants showed confidence that the ETI’s knowledge assets are sufficiently protected, comply with the legal and security requirements of its partnership members, are thoroughly reviewed and approved before going into the public domain, and did not report any occurrences of legal compromises, known security threats or breaches due to the comprehensive legal measures that are in place.

Ahmad et al (2014) synthesise a wide range of knowledge and information protection measures from literature that organisations can deploy into the following four categories:

1. strategic level management initiatives,
2. operational level knowledge protection processes,
3. supporting technology infrastructure, and,
4. legal structures.

When Ahmad et al (2014) carried out empirical research into various organisations' knowledge protection measures – guided by the four categories they identified – it was found that organisations were very conscious of their valuable information and knowledge and concerned about the risks of leakage. However, the study also found that despite such awareness, there was no visible "evidence of a formal, comprehensive or strategic approach towards leakage mitigation in the organizations", which were instead dominated by haphazard and informal efforts (Ahmad et al, 2014: 38). When the empirical research findings are compared to the categories identified by Ahmad et al (2014), it reveals the ETI's strategically developed comprehensive approach towards knowledge and information protection succeeded in achieving protection at all four levels. However, all three of the participating teams unanimously described the operational and legal processes as being unnecessarily excessive and heavy-handed, and the word 'bureaucracy' was often used when referring to these. It was argued that these processes were a source of delays and frustration, and subsequently, a major barrier to knowledge sharing within and beyond the organisation. Moreover, the following internal and external issues were identified:

- The dominance of the organisation's systems and processes hindered the nurturing of knowledge sharing internally and created a sense of protectiveness in the organisational culture, which subsequently affected the way it engaged externally.
- Delays caused by the comprehensive processes, particularly when processing commercially valuable and time-sensitive IP, led to some missed opportunities for exploitation because the knowledge was not delivered in a timely fashion or became obsolete. Thus, due to greater focus on protecting IP, there was a risk of imbalance between protection and sharing.
- Withholding and not fully exploiting the knowledge generated had an impact on the ETI's ability to be effective as a knowledge generating and knowledge sharing organisation.
- The delays in processing paperwork and dissemination may have had an impact on the organisation's external profile.

When contextualising the issues found above, a few explanations emerge as to the reasoning behind the implementation of ETI's extensive operational and legal processes. Firstly, reflecting back to the ETI's

PPP membership structure as discussion in section 5.2.1, being in such a partnership means that a whole network of actors is affected by and have active interest in the matters of the partnership and try to influence it throughout the course of its existence (Steijn et al, 2011; Hodge et al, 2010; Kort et al, 2016). Such expectations place a great deal of pressure on the management of the partnership and influence the operational decisions. For example, the research identified that each of the ETI's member organisations have their own contractual agreements in the partnership that define their confidentiality requirements, and sometimes these requirements would conflict between members who are commercial competitors, thus making it an operational challenge for the ETI management to ensure that it is thoroughly conforming to every contractual agreement. It is evident that the ETI strives hard to ensure that it meets the legal expectations and maintains the confidence of its members in its operations and decisions.

Secondly, the ETI is a very knowledge-intensive organisation and such a partnership "results in intensified information exchanges and pooling of knowledge, and by doing so generates more innovative and higher quality products and policy outputs for complex societal problems" (Kort et al, 2016: 780). The literature identifies that project success factors of PPPs are linked to components of governance such as approval processes, project controls, project accountability and risk management (Robinson et al, 2009: 117). Moreover, pooling knowledge from private and public-sector organisations and then producing new knowledge that impacts both, makes the risk evaluation very complex and requires analysis of risk from various perspectives of the public and private sector (Grimsey and Lewis, 2002). It is understood that the ETI carries out necessary risk analysis and exercises a great deal of due diligence and caution when processing its knowledge and information prior to it being disseminated externally.

Thirdly, the ETI's knowledge outputs are of a scientific nature, thus in addition to delivering outputs of value and benefit in the energy sector, the organisation is conscious about the responsibility and accountability of ensuring that the outputs are accurate. The organisation not only worked to meet expectations of its partnership members but also its stakeholders and the energy industry, thus it did not want to distribute any information into the public domain prematurely and without appropriate due diligence through its review processes. Fourthly, it is understood that at the time of the data collection cycles, the majority of ETI projects were still in progress and so there was not a great deal of knowledge that was ready to be disseminated. So, it is possible that the criticism of the research participants about a lack of knowledge dissemination may also be partly attributed to this.

The above issues demonstrate the impact of information security on knowledge sharing, and more importantly the conflict between the two overlapping practices that was identified in the literature review as being caused by the connection between the nature of innovation and the rewards of innovation (Ryan, 2006). These findings also correlate to the findings of a recent study by Nelson (2016:

280) - exploring the tensions between sharing and secrecy around scientific knowledge – who found that "sharing is not a yes/no decision; rather, it is a process influenced by considerations of with whom, when, and what, and by the status of intellectual property protection". Thus, sharing of such valuable scientific knowledge is complex as it requires careful and simultaneous management of social, informational and legal considerations (Nelson, 2016).

When compared to the original literature review, the empirical findings show evidence of the conflict between information security on knowledge sharing that some researchers had identified and stressed the need for more empirical research on (Ilvonen et al, 2016; Manhart and Thalmann, 2015; Shedden et al, 2011; Desouza, 2006). However, the findings do not correlate to the specific concerns that some of the researchers had raised. For example, Desouza (2006) stressed the necessity to secure knowledge but emphasised the difficulty of achieving it, yet the current empirical research findings suggest that securing or protecting its knowledge has been sufficiently achieved by the ETI without any apparent gaps. Moreover, contrary to the arguments that knowledge protection or security is typically overlooked or ineffective in organisations (e.g. Ahmad et al, 2014; Desouza, 2006; Shedden et al, 2011; Manhart and Thalmann, 2015; Ilvonen et al, 2016), the current research demonstrates that knowledge protection is a high priority in the ETI and the organisation has implemented an effective multi-layered knowledge protection strategy, which ultimately has a detrimental impact on knowledge sharing.

5.2.4 Awareness and clarity about guidelines

When asked about their level of awareness of what is required of knowledge sharing at the ETI, the participants expressed the need for better understanding and clarity about which knowledge – both tacit and explicit - can be shared externally. In addition, the participants also reported the need for clarity about who the target audiences are for different types of knowledge and what knowledge sharing is already taking place within and beyond the organisation. It was argued that the need for clearer guidance and awareness about what can and cannot be shared externally, appears not just at the individual level but also resonates at the organisational level. As a result of this, there is a general presumption amongst employees that everything cannot be shared which results in a sense of overprotectiveness in the organisational culture and, on occasions, knowledge is unnecessarily withheld, which impacts formal and informal external engagement and knowledge sharing for the ETI employees and stakeholders. This matter is paradoxical for a knowledge generating and disseminating organisation such as the ETI, which should be operating with the opposite presumption i.e. the focus should be on maximising the value of its knowledge by sharing it to the right audiences at the right time and only protecting knowledge where necessary. According to Siemiatycki (2007), one way of resolving the conflict between confidentiality and transparency in a public-private partnership is for all parties to

adequately justify why certain information needs to be withheld from the public and for this process to be assigned to an independent information commissioner.

Similarly, from the information security perspective, the participants reported the need for greater clarity about security requirements, for example, generic document labelling was used to mark documentation as 'confidential', however, the level of confidentiality was not stated which resulted in the entire contents of such documents being protected, including the information which is not confidential and is permitted to be shared in the public domain. A similar matter regarding handing of confidential information was also identified previously during the knowledge audit project in 2012, and the following recommendation was made to the ETI: "Policies for handling confidential information differently to non-confidential information should be communicated clearly to employees across the organisation" (Ragsdell et al, 2014: 277). The present research findings not only show the persistence of this issue but how it is now having a greater impact on the ETI as the organisation is in a position where more knowledge is being generated through the projects and needing to be disseminated externally.

The findings of this research in relation to guidance and awareness have clearly contradicted much of the literature review around information security. The literature review identified that in information security, humans are seen as the weakest link (e.g. Spears and Barki, 2010; Siponen, 2000), often perceived as an obstacle instead of an asset and one of the key goals of information security should be about "establishing the correct mind-set, and ensuring that people are working for (or at least with) security rather than against it" (Furnell and Thomson, 2009: 5). However, despite the perceived lack of guidance and awareness about which knowledge should be protected and which could be shared, the research has found that employees at the ETI withhold knowledge and refrain from taking risks where there is a potential to make a mistake; the insufficient awareness did not lead to security breaches or risks. In correlation to this, Coles-Kemp and Hansen (2017) stress the need for a broader approach to security that extends beyond just protection and focuses also on the 'freedom' that security provides by incorporating the human security needs. Moreover, the researchers make the following argument in relation to this:

> *"…there is another form of security, this is adjectival rather than normative — "secure" rather than "security" — a quality that conveys the essence of making things possible. This related form is "freedom to" rather than "freedom from" and should not be seen as an alternative to the more traditional conceptualisation of security as freedom from threat but should be seen as an interrelated concept. From this perspective access control to a particular data file, for example, should not only be seen as a mechanism for the protection of the data but also as the granting of access to data that empowers an individual." (Coles-Kemp and Hansen, 2017: 467)*

The empirical research findings also contradict the following arguments found in the literature review.

- Humans are incapable of developing secure systems, or, if they do manage to develop them, they are unable to use them in a secure manner due to the level of flexibility in their work habits (Odlyzko, 2010).
- In cases where information security might inhibit their work, humans are likely to overlook security if it means that their work becomes easier (Besnard and Arief, 2004).
- Achieving information security policy compliance is currently one of the biggest challenges and concerns for organisations (Al-Omari et al, 2012).
- An employee's attitude towards compliance of security policies may be determined by possible consequences that they may experience. For example, the time and effort required if they comply or the punishment for non-compliance (Bulgurcu et al, 2010).

When comparing the findings of this research to the literature review, it is noted that although the information security literature has extensively addressed the role of human awareness and guidance for protecting an organisation's information, it has also overlooked the impact of insufficient guidance and awareness on knowledge sharing, particularly the negative impacts it can have on knowledge sharing. More interestingly, however, it has been noted that the knowledge management literature has also given insufficient attention to the role of guidance and awareness about knowledge sharing and its implications on organisational practices. For example, the only aspects relating to guidance and awareness identified in the literature review were the following two knowledge sharing barriers by Riege (2005):

- "low awareness and realisation of the value and benefit of possessed knowledge to others", and,
- "lack of leadership and managerial direction in terms of clearly communicating the benefits and values of knowledge sharing practices".

Although the above two barriers relate to guidance and awareness, they focus specifically on this in the context of value and benefits of knowledge sharing and not about the specific guidance about which knowledge can and cannot be shared - as found to be an inhibitor to knowledge sharing in this research. This somewhat echoes the following finding from Ilvonen et al's (2016: 4028) study: "the employees were not really aware what parts of business processes related knowledge are confidential and what knowledge is encouraged to be shared. It can be argued that this kind of uncertainty does not enhance either proper knowledge security or effective knowledge sharing". Ilvonen et al (2016) also found that employees did not perceive knowledge protection as a broad-spanning subject, but rather as a technological issue which can make security policies and their compliance ineffective. Contrarily, the current empirical research found that participants from the ETI understand knowledge protection from

a broad strategic level, are aware of the various measures that have been deployed and the reasons behind their deployment, and have good security compliance in the organisation.

This research has revealed that clear guidance and awareness are integral prerequisites for knowledge sharing at the ETI – for both, tacit and explicit knowledge equally - and their deficit is a barrier for knowledge sharing and a source of concern for the ETI employees. This, combined with the other empirical research findings discussed in this section respond to the call by Manhart and Thalmann (2015) who – based on their review of knowledge protection literature – stressed the need for more research into the protection of tacit knowledge, more in-depth empirical studies on this subject, as well as exploration of how organisations can develop effective knowledge management strategies.

In addition, employees reporting on refraining from making the decision to share knowledge, unless clear guidance was provided by management, surfaces the matter of perceptions of trust amongst such employees. Whilst in the literature review in Chapter 2, the subject of trust was identified as an important prerequisite for effective knowledge sharing, this was mainly acknowledged in the context of trust as reciprocity between the knowledge provider and knowledge receiver (e.g. Blau, 1964; Butler, 1999; Riege, 2005; Ritala, 2015). However, in relation to trust between employees and management and its role in the employees' knowledge sharing activities, Mueller (2012) argues that employees' trust in management, and vice versa, is what fosters knowledge sharing. According to Bakker et al (2006), a lack of trust may inhibit individuals' knowledge sharing motivation. Thus, nurturing the perception of trust in its employees i.e. where individuals feel trusted to make appropriate decisions, without seeking detailed guidance from management – may improve the ETI employee's voluntary external knowledge sharing.

Although the research participants claimed that there was a lack of guidance and clarity about knowledge sharing, this does not mean that such guidance was absent or not defined. For a professional organisation of the scale of the ETI, one that is highly organised, managed by experienced experts from industry and set-up and governed by multiple reputable organisations and the UK government - it would be highly unlikely that such rules were not established and instated. Moreover, as highlighted in section 5.2.1, a study by Petkovic et al (2015) concluded that in public-private partnerships decision-making power is not decentralised - to individual projects, for example – as important organisation and management decisions are determined in advance by the contractual framework and governed to avoid potential problems. In this case, if the guidance on knowledge sharing is unclear for the ETI's employees, it is important for the organisation to explore the reasons behind this.

Based on the research findings, some possible reasons are explored. For example, as discussed in section 5.2.3, the ETI has comprehensive approval and legal processes in place due to the complexity of the membership structure and its requirements, and so the governance for information that was to be

disseminated externally was primarily with the Legal Department. Thus, there is a possibility that guidelines for knowledge sharing and knowledge protection are also governed by the Legal Department to ensure accuracy of compliance and are defined in the legal contracts for each project that the ETI has commissioned. If this is the case, then the deficiency in these guidelines being understood throughout the organisation may be due to (i) the guidelines being too technical and defined in legal terms which only qualified legal employees can translate (a number of references were made to the intelligibility of legal terms by the participants in the two project teams), (ii) the guidelines are not transparent enough, or, (iii) the guidelines are not sufficiently communicated to other parts of the organisation. Another possible reason for such guidance on knowledge sharing not being widespread in the organisation may been due to, up until that point in time when this research was carried out, the organisation's primary focus being on commissioning projects and development of technologies where a large number of its projects were at a mid-way stage and output knowledge was not ready to be shared externally.

Nonetheless, ensuring that employees have a clear understanding of knowledge sharing and confidentiality requirements, so that they are able to engage externally with confidence and trust, is an important education requirement at the ETI, particularly as the organisation moves into the stages of knowledge dissemination and project completion, maximising on its external knowledge sharing opportunities is crucial.

5.2.5 Protective culture around knowledge

Research into knowledge protection by Ahmad et al (2014) at 11 knowledge-intensive organisations found that the organisations lacked systematic and comprehensive management approaches to the identification and protection of knowledge and, instead, the approaches were haphazard where the responsibility of knowledge protection was left to individual employees and knowledge owners. The research also found that the organisations had focused primarily on protecting the confidentiality of operational data such as customers' details, and consequently, protecting the organisation's own knowledge and information was overlooked (Ahmad et al, 2014). Thus, through the study findings, Ahmad et al (2014) stressed the need for comprehensive strategic frameworks for protecting organisational knowledge and preventing its leakage. When comparing the findings of the current empirical research, it was found that the protection of its valuable knowledge was high on the ETI's strategic agenda and it had a comprehensive framework in place to achieve this. However, the empirical research found that the participating teams unanimously expressed concerns about and suggested that the ETI's culture and practices around its knowledge were very protective – from both, knowledge sharing and information security perspectives. The teams identified a number of causes or contributors of the protectiveness, as well as the implications they felt these had on the organisation.

The distinct public-private partnership that governs the ETI and the complex – and often conflicting – security requirements of its member organisations have generated an intricate and challenging scenario for the ETI to manage. Further, on the one hand the ETI's aim is to generate new knowledge in the form of innovative low-carbon technological solutions through its projects and disseminate that to the members and target audiences. On the other hand, the organisation is conscious of protecting the confidentiality of its members and thus adopts an approach of great caution and, to some degree, risk avoidance. This matter was reported as a challenge particularly as, whilst being immersed in trying to protect value for its members, the ETI's focus on knowledge sharing has been affected. Moreover, it was argued that the organisation's focus on knowledge protection taking precedence over knowledge sharing, creates a protective culture surrounding its knowledge and shapes the way knowledge is perceived.

In relation to this, the research participants argued that they were unclear about specific guidelines for knowledge sharing or knowledge protection through, for example, an information security policy. This was reported to have caused a lack of awareness and clarity in the ETI, which results in employees following a presumption of protection, rather than openness, where at times knowledge is being unnecessarily withheld and some opportunities for external sharing are missed. This finding from the empirical research strongly refutes the findings of the information security literature in which the lack of guidelines or awareness amongst employees was primarily associated with a lack of compliance, risky behaviour and increased likelihood of security breaches (e.g. D'Arcy et al, 2009; Von Solms and Von Solms, 2004; Bulgurcu et al, 2010).

Moreover, in the information security literature, Bulgurcu et al (2010) emphasised the importance of security awareness and argued that this consists of the following two components:

i. information security awareness (ISA) which is "an employee's overall knowledge and understanding of potential issues related to information security and their ramifications", and,

ii. information security policy (ISP) which defines the specific aims, objectives and requirements that employees must follow.

Similarly, Al-Omari et al (2012) argued that security policies need to be designed to be effective, and this can only be achieved if users' security awareness is enhanced to comply with the policies. Similarly, in the empirical research findings, the term 'awareness' refers to (i) the clear guidelines and (ii) the subsequent awareness about which knowledge is permitted to be shared and which needs to be protected. However, the empirical research findings differ once again to the literature, as they confirm that at the ETI, despite participants reporting on having insufficient awareness and understanding of security policies, they have strong information security compliance – more than that required.

The literature review concluded that in information security, humans are often seen as the weakest link due to the vast majority of breaches being caused by human error (e.g. Al-Omari et al, 2012; Stajano and Wilson, 2011; Spears and Barki, 2010; Siponen, 2000). Although the empirical research did not find any references to breaches occurring at the ETI, from the organisation's protection approaches in terms of access and system security, as well as the comprehensive legal and approval processes, it can be deduced that the ETI may also perceive its employees as a potential weak link in its information security.

Overlooking knowledge protection can be damaging for an organisation and negatively impact the exploitation of innovations (Cheung et al, 2012; Manhart and Thalmann, 2015). When looking at the level of protectiveness reported to be present at the ETI from an information security perspective, it could be argued to be a strength as it satisfies the aims of information security i.e. the organisation's valuable knowledge is protected sufficiently from external and internal threats and there were no reports of any compromises. However, this research has found that the ETI is equally as protective of its tacit knowledge as it is of its explicit knowledge – yet the information security literature prioritised the security of 'information', or explicit knowledge, and overlooked focus on tacit knowledge protection. Moreover, although there were references to certain systems and access controls as being protective as well as document labelling, the majority of the issues raised were 'soft' issues that were deep-rooted, cultural and relating to 'knowledge' as opposed to information – this was not found in the information security or knowledge sharing literature in Chapter 2.

Similarly, in the knowledge management literature, it was identified that researchers have primarily focused on maximising the value of knowledge through exploitation and subsequently research into protection of knowledge has been lacking (Desouza, 2006), with only a few researchers (e.g. De Faria and Sofka, 2010; Desouza, 2006; Ryan, 2006; Holsapple and Jones, 2005) stressing the need for further research on knowledge protection – with the intention to make knowledge management more secure.

In relation to this, Desouza (2006) argued that knowledge should be secured at three levels - 'product', 'process' and 'people' – but he claimed that achieving knowledge protection is not easy, as unlike information, knowledge, particularly tacit knowledge, is difficult to visualise and capture as it is fluid and dynamic which makes it difficult to manage and protect. Surprisingly, this study has found that the ETI has not struggled with knowledge protection and has been successful at protecting its tacit and explicit knowledge at the 'product', 'process' and 'people' level – albeit at the cost of compromising on knowledge sharing. This finding supports the following argument made by Coles-Kemp and Hansen (2017) who stress the need for a more holistic approach to information security that not only addresses the technical-driven 'protection' aspect, but also the human security needs through 'enablement':

> *"…information security is not solely about protection, it is also a story of enablement and achievement that result in the meeting of an individual's human security needs as well as data*

protection needs. A modelling approach that relates human security needs with data protection needs and shines a light on the negotiation process between the two, enables us to connect these two families of security need and identify how each can support the other." (Coles-Kemp and Hansen, 2017: 478)

Ryan (2006) debated that organisations typically implement information security measures by determining which information assets need protecting in terms of confidentiality, integrity and availability but, in the context of knowledge management, different questions need to be asked when designing protection measures, particularly in the cases of innovation where success can be dependent on timely knowledge sharing. This argument is pertinent to the ETI's case where a balance was essential between knowledge protection and sharing. However, this research has found that due to the organisational culture being protective around its knowledge, the ETI has experienced consequences on its knowledge sharing and organisational practices in the following ways:

- hindrance to formal and informal external knowledge sharing opportunities,
- external impact of the organisation in the energy industry, and,
- delays and missed opportunities for timely exploitation of knowledge on occasions, particularly affecting Intellectual Property.

Participants also felt that the above issues arising from confidentiality create a protective appearance of the ETI from the outside, making the organisation seem less transparent. Reynaers and Grimmelikhuijsen (2015) define organisational transparency as availability of information which consists of visibility, accessibility and intelligibility of information to a person or stakeholder. Flinders (2005: 233) addresses the challenge that public-private partnerships face in generating transparency and argues that "commercial confidentiality often frustrates openness; transparency is complicated by dense inter-organisational relationships based upon formal and informal rules". Similarly, a case study about confidentiality and transparency in a public-private partnership in Canada by Siemiatycki (2007: 399) found that whilst the partnership appropriately followed, and in some cases exceeded, internationally recognised best practices for maintaining confidentiality, "the information withheld reduced public transparency and the potential for meaningful oversight and involvement". Moreover, through a study that analysed 'input', 'process' and 'output' transparency in four public-private partnerships in the Netherlands, it was found that input transparency was most highly achieved, whereas achieving process and output transparency was a greater challenge for the organisations (Reynaers and Grimmelikhuijsen, 2015). These studies have a resemblance to the findings of the empirical research, as the issue that the ETI employees felt the organisation needs to improve upon the most is its process and output transparency. Reynaers and Grimmelikhuijsen (2015) also argue that, whilst the literature on public-private partnerships has focused on achieving external transparency i.e. the extent to which internal

information is visible to the outside world, to achieve external transparency, internal transparency is critical.

Managing confidentiality requirements of various reputable stakeholders and working under pressure to deliver innovative solutions, whilst being 'transparent' is a challenging scenario for any public-private partnership and the ETI is no exception to this. During the knowledge audit project, it was also identified that the management of knowledge to support the achievement of organisational goals is complex for the ETI due to its distinct characteristics (Ragsdell et al, 2014). The findings of the current research confirm that this is an ongoing challenge for the organisation, and perhaps the complexity of achieving transparency continuously increases as the organisation matures and becomes even more knowledge-intensive through the growth and deliverables of its projects.

The ETI is aware of the intricacy of its KM and is proactive about seeking ways of cultivating effective knowledge sharing and the subsequent transparency. This is evident through the organisation's keen and open-minded approach to continuous organisational learning, for example, commissioning the knowledge audit project in 2012 or actively participating as a case study organisation in the current PhD research, in order to further develop its broad knowledge management strategy and adapt it as the organisation transitioned through different stages of its projects. This is also reflected through the ETI's implementation of systems that aim to facilitate internal and external transparency through knowledge sharing. For example, the PIMS system to consistently maintain and share key information about each project for its staff, Member Portal to share knowledge directly with its member organisations, and a tailored CRM system for direct external engagement, which maintains details of over 10,000 interested individuals external to the organisation and is a valuable resource for developing active relationships and sharing knowledge externally. Thus, despite the organisation's culture being protective around its knowledge, the ETI is striving to become more transparent as an organisation and make its knowledge sharing more effective. To simplify this process and improve transparency in partnerships such as the ETI - without compromising the legitimate need for confidentiality of certain information - Siemiatycki (2007) suggests that, through an independent regulator, partnership members can adequately justify why certain information needs to be withheld from the public. Thus, by explicitly defining which knowledge needs to be protected - where all other knowledge is permitted to be shared - and ensuring that employees are well-informed about this, could instil self-reliance in employees and improve the ETI's knowledge sharing. Moreover, creating such internal transparency could also contribute towards the existing efforts to nurture a culture of openness, which would lead to enhanced transparency externally.

5.2.6 Engineering culture

Based on the discussions by all three of the participating teams, the empirical research provides evidence of the existence of a rich engineering culture in the ETI and, more importantly, a strong influence of this on the organisation's knowledge sharing practices. By acting as a conduit between academia, industry and the government, the ETI's core business is to bring together engineering projects that develop affordable, secure and sustainable technologies to help the UK address its long-term emissions reduction targets, as well as delivering nearer term benefits. Thus, the reason behind the strong engineering culture appears to be the ETI being predominantly managed by engineers and a large number of its employees, particularly those working on its projects, being from engineering and science backgrounds.

The research participants emphasised the integral role engineering staff has played in the organisation. The high calibre and expertise of its engineering staff is given a great deal of respect as it plays a critical role in implementing strong knowledge creation and management processes. Moreover, a sense of pride in the work the ETI is doing was also apparent in the discussions, particularly for the insights that are generated through the Energy Systems Modelling Environment (ESME) and the knowledge produced by the organisation was described as being robust, well-reasoned and evidenced. Although a significant proportion of the knowledge generated is of a complex technical nature, confidence is shown in the engineering staff's ability to translate this and carry out complex knowledge sharing externally. The participants felt that the ETI is a respected authority in the energy industry and its engineering staff play a key role in achieving this.

Whilst there was strong recognition of the invaluable role the engineering staff play in the ETI – and despite majority of the research participants being from a scientific or engineering background - opinions were expressed about the need for greater significance for other disciplines and more interdisciplinary focus in the organisation. Furthermore, it was said that the ETI has been intrinsically taking engineering approaches which has consequently shaped the organisational culture. The influences of organisational culture – particularly those derived from an engineering culture and the factors identified by the current research – were not identified in the literature review in Chapter 2, however, due to a strong engineering theme found within the ETI, the researcher explored other relevant and comparative case studies based on engineering organisations to identify the ways in which their culture compares to the ETI, as well as exploring the factors impacting their knowledge sharing practices.

Chinowsky and Carrillo (2007) carried out a study into knowledge management at four engineering-construction organisations; the organisations were all UK-based but were specifically selected because they had substantial international operations as this meant there was a greater need for knowledge sharing and dissemination. There was a great deal of similarity to the ETI. From the four organisations, only one organisation stated that it was achieving sufficient success in knowledge sharing whilst all of

the organisations focused on barriers generated by "divisions, geographic distribution, or having the 'will, but not the implementation'" (Chinowsky and Carrillo, 2007: 127). The findings of the current research at the ETI show a strong resemblance to this where similar challenges were reported that impacted on knowledge sharing. For example, it was reported that due to the project areas being specialised, there was not a great deal of overlap between them which innately reduced the amount of cross-team interactions and created a 'silo mentality'. This challenge was also related to the geographic distance between the one programme team and the rest of the ETI, which appeared to be a concerning matter for some participants and was described as a 'separation' within the organisation.

Moreover, it was evident that the right intention for effective knowledge sharing and dissemination was present in the organisation's strategy and it was proactively working towards achieving this, however, this was not consistently reflected in the ETI's practices. Interestingly, the three organisation's in Chinowsky and Carrillo's (2007) study where knowledge sharing was ineffective, a commonality was found where the barriers were attributed to "focus on project delivery over organizational collaboration", which also appeared to strongly resemble the ETI's findings. However, from the point of view of knowledge generation, the current research has determined that the engineering culture facilitated such processes, where each project team was focused on developing and delivering solutions and there were no challenges reported that related to knowledge generation.

Knowledge sharing enablers in Engineering firms	Found in ETI	Role in ETI knowledge sharing & strength
1. **Reciprocity**	✓	Enabler - Weak
2. **Conformity to corporate culture**	✓	Barrier - Strong
3. **Mimicking the behaviour of leaders**	✓	Barrier - Strong
4. **Peer recognition?**	×	Not found
5. **Honouring knowledge sharing commitments**	✓	Enabler - Weak
6. **Perceptions of the value of organisational knowledge**	✓	Enabler - Strong

Table 24: Knowledge sharing factors: Javernick-Will (2012) vs. The ETI

Another comparative study to the ETI, by Javernick-Will (2012), explored the factors which motivate individuals in engineering firms to share knowledge; the vast majority of findings were related to social aspects, where the two most common reasons were conformance to corporate culture and norms and reciprocity – both of which were identified at the ETI as playing a role in knowledge sharing. However, whilst Javernick-Will (2012) endorsed the need for a shift in knowledge sharing research from focusing

on ‘barriers’ to focusing on ‘enablers’, the present research has found that some of the knowledge sharing enablers found by Javernick-Will (2012) were actually barriers at the ETI. For example, a brief comparison is shown in Table 24 where six social factors that Javernick-Will (2012) identified as enabling knowledge sharing in engineering firms are compared to the findings of the current research and the role they play in the ETI.

Thus, contrary to Javernick-Will’s (2012) argument, the present research has established the importance of holistically evaluating factors that affect knowledge sharing, taking into account both perspectives i.e. enablers and barriers, as well as individual organisational contexts. Moreover, whilst some similarities have been found between the findings of the current research and existing case studies in literature, from the point of view of knowledge sharing and dissemination – which is one of the key aims of the ETI’s knowledge management – a strong dominance of engineering culture had created the following challenges that were not identified in existing literature.

Firstly, despite the ETI being a knowledge generating and communicating organisation, it may also have identified itself as an engineering company which may have intuitively affected its focus and subsequently its knowledge management practices. The dominant engineering influence was oriented towards solution development, which reflected in the organisation’s practices. More interdisciplinary collaboration and bridging between engineering and non-engineering staff was required, particularly between the project teams and the Communications Team, in order to increase external knowledge sharing and exploitation of project deliverables, particularly time-sensitive Intellectual Property.

Secondly, the organisation had intrinsically taken engineering approaches to address cultural or humanistic challenges. For example, although the CRM system had been an effective resource for the ETI in its external knowledge sharing - developing and managing relationships with over 10,000 interested stakeholders and aided the organisation to identify some of its cultural problems in relation to knowledge management - some participants expressed the opinion that, for the purposes of encouraging individuals to share and make transparent their external engagement and communication - would have been more effectively achieved through nurturing stronger social connections and informal exchange, rather than using a technological tool.

The implications of the above challenges created by an engineering culture were reported to have impacted on the organisation’s internal and external knowledge activities.

5.2.7 Organisational identity and strategic aims

The research participants stressed the need for greater clarity in the ETI about the organisation’s identity and aims, as this was reported to have an impact on the organisation’s knowledge sharing practices. This finding reflects a challenge also identified in the knowledge audit in 2012 i.e. the management of

knowledge to support the achievement of organisational goals was complex due to the combination of distinct characteristics and the unique identity of the ETI (Ragsdell et al, 2014). Moreover, the ETI was a knowledge creating and disseminating energy innovation organisation, however, some participants stated that the engineering influences on the organisation (as discussed in section 5.2.6), may have influenced the organisation's self-perception. A great deal of focus and resources had been invested in the development and delivery of its technologies – in compliance with specific contractual relationships with its members and project partners – and it was argued that the organisation was so engrossed in its projects, that subsequently, this had led to the ETI perceiving itself more as an engineering organisation that develops technologies and solutions. In comparison to knowledge creation, not enough attention was given to knowledge dissemination. The disparity, was described as a paradox within the ETI by one of the teams, as the organisation espoused to be influential and have a high profile in the energy industry, but on the other hand, its knowledge sharing practices that were essential to help the organisation achieve these aims, required further attention and there was a need to maximise knowledge exploitation opportunities. The need for clarity on the organisation's strategic message was also previously identified in the knowledge audit project as follows:

> *"At the time of the audit, the organisation was going through a mid-term review analysing its future role, but the knowledge audit reemphasised the importance for staff of clear strategic messages about the organisation's purpose and future. Greater clarity will lessen confusion and uncertainty amongst employees and result in a clearer sense of purpose, both in general terms and with respect to information and knowledge needs. In turn, this will have a positive impact overall on information dissemination and on decision making in projects."* (Ragsdell et al, 2014: 276)

Thus, it appeared to be an ongoing requirement at the ETI to ensure that employees constantly remained informed about the organisation's strategic aims and its resulting knowledge sharing requirements, particularly since the organisation matured, the complexity of its knowledge management grew as the knowledge outputs increased.

According to some research participants, the size of the organisation might have shaped the ETI employees' perceptions towards knowledge sharing. It was argued that some employees could have been following and operating on the assumption that due to the small size of the organisation, there is no need to 'do knowledge sharing'. Moreover, it was claimed that whilst a small company approach was assumed, this was not entirely reflected in the formal or informal knowledge sharing practices, particularly as there was a reported need for more collaboration and knowledge sharing between teams and departments (this will be discussed in section 5.2.8). In addition, during the knowledge audit project (Ragsdell et al, 2014), the need for improvement in internal communication of the evolving strategic

message for the entire organisation was identified, and similarly, in the current research, participants stressed the need for more internal communication particularly about organisational decisions and changes. Thus, the ETI did not appear to conform to the stereotype of a 'small company' in its organisational culture and practices, and it was unclear whether the organisation was aware of this.

It was stressed that to make the ETI's knowledge sharing more effective, there is a need to firstly step back and reflect on the bigger picture and think holistically. Secondly, the organisation's original aims should be reviewed to reduce any ambiguity that may have developed in the organisation's identity and to generate alignment between its aims and practices. Thirdly, clarity about knowledge sharing needs should be ensured and communicated throughout the organisation.

5.2.8 Silo mentality

The ETI is a highly knowledge-intensive project-based organisation that operates within a complex governance structure and combines knowledge and expertise from partnerships with academia, industry and the UK government, to deliver innovative energy-efficient solutions. This would imply that effective collaboration and knowledge sharing across the organisation and with the various members is an important requirement for the organisation to succeed and achieve its goals. However, the research has found that there was a lack of collaboration, communication and knowledge sharing across the teams and departments at the ETI. The participants described the knowledge sharing and collaboration within their own team as being effective, due to a great deal of informal knowledge exchange, team meetings, sharing of tacit knowledge and lessons learned taking place within the teams. However, these practices did not appear to resonate a great deal beyond individual teams. The participating teams used the words 'silo' or 'silo mentality' to describe the ETI's internal collaborative efforts and ways of working between the departments and programmes.

It was argued that the silo way of working was deep-rooted and underpinned the organisational culture. The knowledge management literature acknowledged that cooperative work is vital to achieve central organisational tasks in innovative organisations, thus organisations are shifting away from conventional, rigid hierarchical structures as "the team rather than the individual is increasingly considered the basic building block of organisations" (West, 2012: 16). This research has found that the ETI, being a project based and project focused organisation, was set-up in a matrix structure to facilitate collaboration and knowledge sharing, where most employees played a cross-functional role across departments. However, some participants appeared to be unaware of this as they held the opinions that the ETI was based on hierarchical structure and that the design was based around conventional departments rather than projects.

In addition, one of the larger programme teams was located in a different city which the participants reported as a barrier to collaboration and knowledge sharing. This coincides with the literature review about geographically separated project teams having "feelings of isolation and imbalance created by this physical separation (psychological distribution)" (Connaughton and Shuffler, 2007: 404). In the literature review, Benfield (2011) argues that a project team does not always work as a conventional team would in the organisation due to its formation being solely for the purpose of developing and delivering a project – thus, collaboration, communication and social connections with the rest of the organisation may not be a high priority. However, unlike conventional short-lived project teams in other organisations such as those referred to by Benfield (2011), the ETI's project teams were the most integral unit of the organisation through which knowledge was created, managed and published. Thus, it is unclear whether the temporary nature of the projects – or the organisation as a whole - had played a role in the teams' knowledge sharing behaviour.

The system and security and access architecture at the ETI was claimed to have been designed on a departmental basis, rather than a project basis. This meant that some individuals were unable to access certain folders or content related to their own projects, due to access restrictions and the content sitting under a different department's ownership, for example, finance data. This was highlighted as an inconvenience and a knowledge sharing barrier for an organisation trying to deliver time-sensitive projects. This confirms the literature about the importance of having fit for purpose systems that provide the correct access for knowledge sharing (e.g. Riege, 2005). Moreover, this finding also relates to the argument by Coles-Kemp and Hansen (2017: 465) about the need for a socio-technical approach to information security – "standard technical responses of delegated authority and role-based access control do not fully suffice because these technological responses focus on the data and system protection needs, with an assumption that these fully correspond to the human security needs".

Several reasons identified in the empirical research reported to be contributing to the lack of collaboration at the ETI relate to human traits such as communication, motivation, sense of responsibility and the perceived need for sharing. More importantly, limited social connections appeared to be an overarching impeding factor, particularly for information knowledge sharing, which reinforces the literature review findings. For example, Joshi et al (2007) argue that socialisation fosters the relationships that are essential for collaborative work and Kotlarsky and Oshri (2005) found that human related factors, such as social ties, are key to making collaboration successful. Moreover, Serenko and Bontis (2016: 1206) assert that based on the social exchange theory, the motivation behind employees sharing knowledge with their colleagues is the expectation to receive something valuable in return i.e. reciprocation, for example: "employee A may share his or her knowledge with employee B upon request only after negotiating or assuming that B will also share his or her knowledge with A when

needed". Based on this theory, individuals may also reciprocate negative knowledge behaviours such as knowledge withholding or disengagement from knowledge sharing.

5.3 Chapter summary

In this chapter, the eight most crucial and impactful themes for the ETI's organisational practices were discussed in light of relevant previous literature. Whilst some themes confirmed previous literature, the empirical research has brought to surface a number of new important matters that had impacted on the ETI's internal and external practices, as well as its profile and effectiveness as a knowledge generating and disseminating organisation in the wider industry. Being the key product of the ETI, the research has also learned about the integral role 'knowledge' and its effective management played in an innovative organisation and how it had impacted its practices.

Most importantly, what was predominantly overlooked by previous literature, the empirical research findings surfaced evidence of the relationship between knowledge sharing and information security practices, showing that the two are interconnected to a great extent, and, the negative consequences of the two practices being treated and managed separately. Thus, the findings and learning from this research will make a fresh contribution to the knowledge management and information security literature, and will also have implications for the ETI. These will be discussed further in the next, and final, chapter of this thesis.

6. CONCLUSION

6.1 Introduction

This final chapter of the thesis presents the conclusions of the PhD research. The aims and objectives of the research are revisited and evaluated considering the research outcomes to demonstrate whether the research has achieved its goals. This chapter also summarises the key findings that are drawn from the empirical study and makes recommendations to the ETI on ways it can address issues and improve its practices. Further, the original contribution and impact this research has made are highlighted, and finally the reflections, limitations and recommendations for future research directions are shared.

6.2 Aims and objectives revisited

The motivation behind this research was to explore the inherently conflicting nature (see Figure 38) between the practices of knowledge sharing and information security (see Figure 39), learn about the nature of their relationship and the impact this has on individuals and the organisation.

Figure 38: Conflict of interest between knowledge sharing and information security

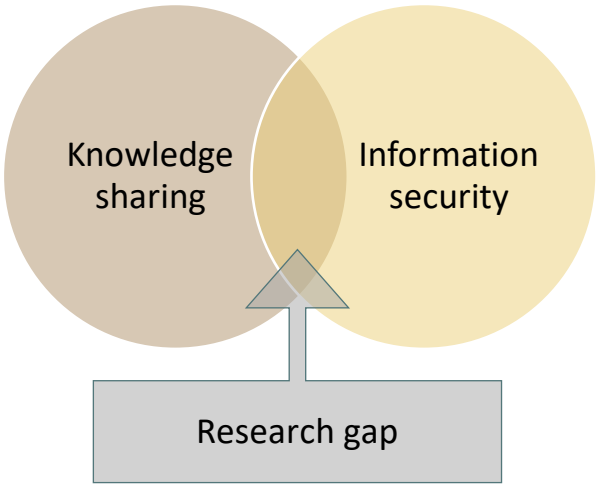

Figure 39: Middle-ground between knowledge sharing and information security

The aims of this research were to:

a) investigate the relationship between the practices of knowledge sharing and information security, and,
b) identify ways of informing organisational strategy for balancing the relationship between knowledge sharing and information security practices.

The research aims were successfully achieved, and as the case study organisation, the ETI became a vehicle through which the aims were accomplished. The ETI is a knowledge-intensive organisation carrying out many collaborative projects and developing innovative technological solutions. Effective knowledge sharing is critical for the organisation, whilst appropriately protecting its valuable knowledge and maintaining various levels of confidentiality in the interest of its partnership with various organisations is of equal importance. Thus, managing the tension between knowledge sharing and information security is an ongoing operational challenge for the ETI.

The research aims were achieved by meeting the following objectives.

> ***Objective 1:*** *develop and implement a methodological framework using action learning which generates team and organisational learning and drives change.*

Objective 1 was met by the development of an innovative methodology that incorporated team action learning in the data collection cycles. The developed approach generated learning and reflection at the individual, team and organisational levels and led to the development of practical recommendations for the ETI to initiate changes in order to make its knowledge sharing and information security practices more efficient and in alignment with one another.

Objective 2: *collect and analyse data from selected ETI project teams about their knowledge and experiences of knowledge sharing and information security practices.*

Objective 3: *identify whether information security measures have impacted knowledge sharing, and vice versa.*

Objective 4: *distinguish how the relationship between knowledge sharing and information security has impacted (i) individuals in their day-to-day activities, (ii) project teams and (ii) the organisation's practices.*

Objectives 2, 3 and 4 were achieved through the first part of data collection; the first cycle of action learning sets (ALS) carried out with three teams at the ETI. This cycle served as a diagnostic tool, where the participants were encouraged to reflect on their organisational practices and personal experiences and collectively discuss these as a team to identify the strengths and weaknesses of the organisation's knowledge sharing practices, particularly focusing on areas where the two practices overlapped. The data was analysed to elicit the most impactful themes as well as focusing on the areas where the relationship between knowledge sharing and information security became apparent.

Objective 5: *devise appropriate theoretical, practical and methodological guiding principles based on the research findings, in order to create better balance and improve the relationship between knowledge sharing and information security practices.*

Objective 5 was achieved by analysing the research findings and comparing them to existing body of literature on knowledge sharing, information security and action learning, and subsequently providing recommendations for further research as well as practical recommendations to the ETI.

6.3 Summary of findings and recommendations for the ETI

The following eight predominant themes were identified in this research that played an important role in the ETI's knowledge sharing and information security practices.

Distinct membership structure – PPP

The ETI's distinct membership structure had a significant influence on the organisation, particularly on its knowledge sharing and information security practices. The membership structure had provided good access to pertinent organisations and knowledge sources, and being associated with large and reputable organisations built the ETI's reputation and profile – which were also recognised as strengths for knowledge sharing. The intricacy of the governance in such a structure had created a unique set of challenges. For example, there were complex, and sometimes conflicting, confidentiality requirements

from members, who were in some cases commercial competitors and driven by their own organisational interests and expectations from the partnership. Having to memorise and abide by such complexity, created a behaviour of great caution amongst the employees, which sometimes led to knowledge withholding. Consequently, the membership structure had played a role in the conflict between knowledge sharing and protection at the ETI.

Management support and communication

The research found that management support and communication was perceived as an integral part of knowledge sharing and information security practices, was an expectation of employees and was argued to have been an influencing factor for employee behaviour. Moreover, for knowledge sharing, the participants expressed the need for clear direction from management. However, the role of management in a complex and knowledge-intensive public-private partnership was recognised as challenging. The dynamic and fast-paced nature of an organisation running various projects meant that internal communication was sometimes inconsistent. So, a great emphasis was placed on the need for more involvement and connection with senior management, particularly more internal top-down communication.

Operational and legal processes

The ETI's comprehensive operational and legal processes played an important role in the organisation. Operating in a complex membership structure, it was a high priority for the ETI to ensure that the knowledge it produced met the various confidentiality requirements of its members and project partners and was well-protected from external security threats. This satisfied the information security requirements, however, the legal and approval processes were described as excessive and time-consuming, which would sometimes lead to delays in processing time-sensitive Intellectual Property, leading to missed opportunities for exploitation. The central role and dominance of these processes was reported as having impacted the organisational culture as well as external engagement.

Awareness and clarity

The research findings showed that a great deal of emphasis was placed on the role of awareness and clarity about knowledge sharing and information security requirements at the ETI. Furthermore, the participants also expressed the need for more knowledge about target audiences, as well as clarity about existing knowledge sharing activities in the organisation. It was reported that insufficient awareness and clarity about knowledge sharing and security requirements had hindered knowledge sharing in that employees followed a general presumption of knowledge protection when engaging externally and refrained from taking risks of sharing knowledge without clear instructions.

Protective culture around knowledge

From an information security perspective, the ETI had implemented a comprehensive multi-layered protection approach and its knowledge was sufficiently protected from internal and external threats. However, due to the complex contractual requirements of members and project partners, knowledge-intensive environment and the nature of innovative projects, the ETI was described as having a protective culture around its knowledge. This, combined with the reported lack of awareness about knowledge sharing requirements, resulted in employees following a presumption of protection, rather than openness, where at times knowledge was being unnecessarily withheld from external sharing. Moreover, this research has found that the ETI is equally as protective of its explicit knowledge as it is of its tacit knowledge.

Engineering culture

The research found presence of a rich engineering culture due to the ETI being predominantly managed by and consisting of engineers, which had an influence on the organisational knowledge sharing practices. The integral positions, high calibre and expertise of its engineering staff was given a great deal of respect as it played a critical role in implementing strong knowledge creation and management processes. On the other hand, the need for greater significance for other disciplines and more interdisciplinary collaboration in the organisation was raised – particularly for facilitating the translation of complex technical knowledge to increase external knowledge dissemination. Furthermore, it was reported that the ETI was intrinsically taking engineering approaches to matters, for example, developing technological solutions to address cultural or humanistic knowledge sharing problems, which consequently shaped the organisational culture.

Organisational identity and strategic aims

Being a knowledge-intensive organisation, focusing on various project areas and being a public-private partnership with a unique identity, generated complexity for the ETI in managing its knowledge. Whilst the ETI was essentially a knowledge creating and disseminating organisation, due to the engineering influences, coupled with the organisation being immersed in its project development and actively managing a network of stakeholders, it was reported to have incorrectly perceived itself as an engineering organisation. The research participants stressed the need for greater clarity in the ETI about the organisation's identity and aims, as this was reported to have an impact on the organisation's knowledge sharing practices.

Silo mentality

Effective collaboration and knowledge sharing across the organisation and with the various stakeholders was recognised as an important requirement for the organisation to succeed and achieve its goals. To facilitate this, the ETI has developed and implemented a knowledge management strategy and

subsequent initiatives to encourage knowledge sharing. However, the research has surprisingly found that the ETI is lacking the required level of collaboration, communication and knowledge sharing across the organisation, particularly between project teams and departments. A number of factors contributed to this. Firstly, the organisational structure which although was originally set-up as a matrix around the projects to facilitate collaboration and knowledge sharing, elements of a hierarchical structure which caused hindrance to this were identified, for example, systems and access being designed on a departmental basis. Secondly, the project teams being focused on project delivery and their own specialist project areas, as well as the geographic separation of some teams. Thirdly, humanistic aspects such as limited social connections, communication, motivation and the perceived lack of need for sharing were identified. The participants recognised the need for more collaboration and social ties, and expressed the desire to eliminate the silo mentality in the organisation.

6.3.1 Recommendations for the ETI

Based on the findings of the research and learning about the ETI's practices, the following recommendations are made to the organisation in order to generate greater efficiency in its knowledge sharing and information security practices, and achieve better balance between both practices.

Nurture a culture of transparency and knowledge sharing

The protective culture around its knowledge had hindered the ETI's knowledge sharing. Since organisational culture is a reflection and the outcome of the way an organisation operates, in order to change the culture, practices and mind-sets need to be changed first. It is recommended that the ETI shifts its strategic and operational focus from knowledge protection to knowledge sharing i.e. allowing a general presumption of knowledge openness, with the exception of cases where certain knowledge needs to be protected. In addition, the culture of the organisation emulates the practices of senior management, thus, it would be beneficial for management to provide support and transparency, and foster trust in employees as this can nurture confidence and increase knowledge sharing behaviour.

Provide guidance and clarity

Employee awareness and clarity about which knowledge is permitted to be shared and which needs to be protected was recognised as a weakness that hindered the ETI's knowledge sharing practices. It is therefore recommended that the ETI address this issue by creating a clear set of guidelines for both knowledge sharing and information security, and communicate these consistently throughout the organisation. Alternatively, following an assumption of openness and sharing, it may be simpler and more beneficial for the ETI to define which knowledge needs to be treated confidentially, and allow all other knowledge to be treated as 'open' for sharing. In addition, increasing the awareness about who the organisation's target audiences are and creating transparency about the various existing external

knowledge sharing activities is likely to give employees more opportunities to engage, and serve as a motivation for knowledge sharing behaviour.

Provide clear and coherent communication

Due to the dynamic and fast-paced nature of being a project-based organisation, the need for management support and guidance in the form of clear communication was found to be an important factor for employees' external knowledge sharing, and it was suggested that this lack of guidance led to knowledge withholding behaviours. Thus, it is recommended that the ETI reviews and enhances its existing internal communication strategy – particularly top-down communication – and provides more frequent, clear and coherent communication regarding organisational strategic messages, decisions and changes. Being regularly informed and reminded about the strategic aims of the organisation is likely to increase employee engagement and reinforce a positive knowledge sharing behaviour.

Increase interdepartmental collaboration

The necessity for increasing collaboration between teams and departments to reduce the silo mentality was found. Based on this, it is recommended that the ETI increases interdepartmental and interdisciplinary collaboration in order to bridge the gap between engineering and non-engineering staff and subsequently increase knowledge dissemination and find more opportunities for exploiting time-sensitive Intellectual Property. Moreover, for such collaboration to also reduce the silo mentality of some teams, it needs to be voluntary and reciprocal – as opposed to being a formal requirement. So, it is recommended that the ETI supports informal initiatives to create an environment that is conducive to informal knowledge sharing, as this would help to nurture social ties and begin to shift the organisational culture towards voluntary collaboration and knowledge sharing.

Streamline legal and operational processes

Whilst the ETI's legal and operational processes are necessary for legal contractual and confidentiality compliance, as well as ensuring accuracy and credibility of knowledge outputs, these processes being very comprehensive and complex were found to cause delays and a hindrance to knowledge sharing. To reduce the delays and prevent missed opportunities for timely knowledge sharing, particularly concerning time-sensitive Intellectual Property, it is recommended that the ETI reviews and makes its legal and approval processes more streamlined and efficient where possible, as this would improve productivity and assist to identify best opportunities for fully exploiting knowledge and Intellectual Property.

Improve confidence in product internally

The ETI's knowledge is of a scientific nature, the organisation has various contractual agreements and expectations from its stakeholders to comply with, as well as maintaining its professional reputation in

the energy industry, thus, there is a strong sense of concern and responsibility ensuring its product is of high quality, accurate and robust. However, the comprehensive efforts of caution and the objective to be 'correct' was identified as a matter of concern as greater efforts were placed on quality-control, than knowledge dissemination. It is therefore recommended that the ETI increases its internal confidence and trust in its product by eliminating the fear of mistakes and reputational risk, and improving the balance between quality-control and timely product dissemination.

Enhance knowledge and information management strategy

To create a better balance and efficiency between its knowledge sharing and information security practices, it is recommended that the ETI takes a holistic and strategic approach to 'knowledge and information management' by connecting the two practices and identifying the overlapping areas – as demonstrated through this research. This would not only increase resource efficiency – and reduce potential duplication of effort – but also reduce the conflict between knowledge sharing and protection in future initiatives if both practices are kept in mind, and help the organisation reach its knowledge sharing goals.

6.4 Original contribution and research impact

This research has made theoretical, methodological and practical contribution to the existing body of literature and has received recognition for its impact.

6.4.1 Theoretical

Prior literature on knowledge protection and the conflicting nature of knowledge sharing and information security is limited and largely of an abstract nature with a lack of empirical evidence to support the proposed arguments. The findings of this research provide empirical evidence to the primarily conceptual body of discussion, where some findings validate existing theoretical arguments and others conflict them and provide fresh learning. Moreover, this research responds to the call expressed by various researchers for more empirical research on knowledge protection and the conflict (e.g. Ilvonen et al, 2016; Manhart and Thalmann, 2015; Shedden et al, 2011; Desouza, 2006) and informs the existing theory.

According to Yin (2018: 49) a single case study "can represent a significant contribution to knowledge and theory building by confirming, challenging, or extending the theory. Such a study even can help to refocus future investigations in an entire field". In a similar manner, the current research findings contribute to a deeper understanding of the opposing goals and interconnectedness of knowledge sharing and information security. However, contrarily to previous literature on knowledge protection

that stressed the need for greater protection strategies for KM (e.g. Ilvonen et al, 2016; Manhart and Thalmann, 2015; Pawlowski et al, 2014; Shedden et al, 2011; Ahmad et al, 2014; De Faria and Sofka, 2010; Desouza, 2006; Ryan, 2006; Holsapple and Jones, 2005) and suggested that knowledge sharing poses security risks – this research has uncovered the opposite scenario where the ETI placing a greater focus on protection measures had hindered and restricted its knowledge sharing and dissemination. Eisenhardt (1989) argues that an essential feature of theory building is comparison of the emergent concepts or theory from the data with existing literature. During this comparison, "cases which confirm emergent relationships enhance confidence in the validity of the relationships. Cases which disconfirm the relationships often can provide an opportunity to refine and extend the theory" (Eisenhardt, 1989: 542). The findings of the current research have generated both cases and thus extend previous theory, creating a solid foundation for further research into the negative impact of information security practices on knowledge sharing, and subsequently the organisation – which needs attention from information security and knowledge management researchers.

The existing KM literature highlighted a lack of knowledge protection theories, frameworks, strategies and guidance for organisations, due to the lack of empirical research and the challenging nature of the conflict between knowledge sharing and security. This research provides empirical evidence of this conflict between knowledge sharing and information security and how it impacted this particular case study organisation and its employees, and based on this, offers theoretical, methodological and practical guidance for researchers and practitioners.

The conflict between knowledge 'sharing' and 'security' has mainly been categorised as a KM issue in previous literature and has been largely biased as it is guided by the aim to improve protection of knowledge, however, this research found that the issue arises in the intersection of the two practices. So, both practices need to be evaluated when researchers explore the occurrences of such conflicts and try to create a balance between them. Furthermore, unlike previous literature that also perceives 'knowledge protection' to be in the KM domain and separated from the concept of information security, the outcomes of this research make a strong case for a change in this perception. For example, having one set of efforts for protecting knowledge from a KM perspective, and on the one hand, having separate efforts for protecting information i.e. information security – which can also sometimes include 'knowledge' in the form of security awareness initiatives - is an inefficient and ineffective approach that can duplicate efforts and cause confusion. Moreover, one reason for the lack of balance between knowledge sharing and information security could be the way the two practices are typically perceived to be disconnected and managed separately in organisations. This makes the subsequently arising conflicts between them difficult to identify, and requires two separate sets of efforts for resolving the same conflict, which is a waste and duplication of organisational resources. Hence, a holistic and strategic approach to 'knowledge and information management' is proposed as a result of this research,

that encapsulates the management, sharing and protection of the organisational knowledge and information to help achieve organisational efficiency and create a harmonious relationship between knowledge sharing and security.

In the literature review, it was established that researchers typically recognise KM to consist of five processes, which based on a comprehensive analysis, Heisig (2009) summarises as the following: share, create, apply, store and identify knowledge. Consequently, knowledge protection has not received a great deal of attention in the discipline of KM, and, the role that information security plays in this and how it directly impacts KM has been overlooked. The findings of this research extend the framework of KM processes that Heisig (2009) presents and provides evidence that the protection of knowledge is not only a vital part of KM, but how not incorporating this in the KM strategy can cause issues for other processes, in particular knowledge sharing. Thus, this thesis extends existing theory and provides sound evidence for the need to incorporate a sixth process in knowledge management - knowledge protection - as depicted by the new model of KM presented in Figure 40.

Figure 40: Knowledge management processes

In information security literature and practice, it was identified in the literature review that the protection of tacit knowledge and the role of humanistic or 'softer' aspects such as human awareness and behaviour, are often overlooked. This research contributes to the literature in this discipline as the empirical findings highlight that 'knowledge' and 'information' are often intertwined, and the protection of knowledge, particularly tacit knowledge, is of equal, if not greater, importance for the case study organisation and its employees. It was also learned that the ETI had implemented different measures for these; to protect data and information, the organisation had various technical measures in place; to

protect knowledge, comprehensive legal and operational processes were in place, and the role of employee awareness was strongly connected to tacit and explicit knowledge protection. Further, it was also found that a lack of awareness about knowledge sharing or knowledge protection guidelines led to increased behaviours of knowledge protection at the ETI. This finding extends existing theory as it strongly refutes the information security literature in which the lack of guidelines or awareness amongst employees was primarily associated with a lack of compliance, risky behaviour and increased likelihood of security breaches (e.g. see D'Arcy et al, 2009; Von Solms and Von Solms, 2004; Bulgurcu et al, 2010). It also emphasises the need for information security literature and theories to take a broader approach that is open-minded to the different variations of impact information security measures and concepts can take, and suggests a vital need for information security approaches to incorporate both tacit and explicit knowledge, and 'softer' humanistic elements such as behaviour and tacit awareness.

In addition to the theoretical contribution to knowledge management and information security literature, this research also contributes to the body of literature on project teams, project-based organisations, as well as public-private partnerships, particularly in relation to their knowledge sharing and information security practices.

6.4.2 Practical

In terms of the practical contribution, through this research, it is evident that by focusing on the employees and their knowledge and experiences, an organisation can learn effectively about its specific knowledge sharing and information security practices, identify strengths and weaknesses and initiate informed change. The empirical research has received recognition for being an innovative and effective KM initiative in an organisation and has shown a successful and practical example of collaboration between academia and industry; it was selected as a finalist case study and awarded 'Certificate of merit' at the Management and Intellectual Capital Excellence Awards 2015 (see Appendix L).

The research enabled the ETI to learn about its knowledge sharing and information security practices, their associated strengths and weaknesses, and the nature of the relationship between the two conflicting practices. More importantly, the ETI learned about the impact of information security measures on knowledge sharing; being too cautious and overprotective of its knowledge had created knowledge sharing barriers that affected day-to-day activities of employees, resulted in missed opportunities for exploitation and consequently impacted the ETI's performance as a knowledge generating and disseminating organisation whose outputs are knowledge driven. Thus, the research has been fruitful for the ETI in becoming aware of the issues that employees experience, developing a distinctive and enriched view of where it was at that stage and initiating improvements to achieve more efficiency and effectiveness in its KM activities. Further, the involvement of employees throughout the

research and their buy-in strengthens the organisation's capability and forms a strong foundation from which to implement changes and improve the chances of their success. The contents of this thesis – particularly the eight overarching themes that have emerged from the analysis of the research findings - are also contributing significantly to a project the organisation is carrying out to reflect on and review what has been learned from operating the ETI for the last 10 years.

The research findings also present practical implications for knowledge-intensive organisations that are aiming to nurture effective knowledge sharing through their KM initiatives, whilst ensuring effective compliance to information security requirements; the two practices have conflicting aims, yet are typically managed and driven independently of each other. The most integral learning from this is the need for such organisations to take a holistic approach to KM that incorporates knowledge protection and aims to effectively manage the relationship between the sharing and protection of knowledge.

6.4.3 Methodological

For the KM field as a whole, this research has developed a methodological approach underpinned by action learning that has the ability to generate effective individual, team and organisational learning and change. By looking at organisational KM holistically and recognising the integral role employees, practices, processes and technologies play, the methodology was designed in a way that enabled the researcher to explore all of the relevant areas inclusively. The methodology was shared in the International Conference on Intellectual Capital and Knowledge Management (ICICKM 2014) in Sydney (see Appendix I) where it received considerable positive feedback and was awarded the prize for 'Best PhD paper and presentation' (see Appendix J).

For the action learning arena, a novel approach of using the action learning philosophy has been introduced that demonstrates how team action learning (i.e. using intact teams as opposed to conventional action learning) can be used to engage employees to share and combine their knowledge on real organisational issues, generate new learning and develop actions to initiate improvements in the organisation. The research methodology enabled reflection and learning at various levels – including individual, team, organisational, and the researcher level. The research has been a practical demonstration of a multi-faceted empirical research methodology that explored multiple subject areas, from employee, organisational and research perspectives, and that allowed the researcher to play a dynamic role i.e. as a researcher and an action learning facilitator. The model offers flexibility and transferability to be used in different contexts and organisations.

The action learning community has also received the research favourably. The research was shared in the Action Learning and Action Research Association (ALARA) conference Australia in November 2014 and also in a workshop run by the Action Learning for Facilitators (ALF) network in London in March

2015. Both audiences acknowledged the novelty of the approach and praised the innovative theoretical and practical application of action learning at the team level to address challenges and improve organisational practices. It was recognised that the team-based action learning approach has the potential to change mind-sets in the action learning community about the ways and settings in which action learning can be used. Subsequently, the ALF network has invited a further contribution from this research methodology and the presentation of a case study in a future workshop.

The research methodology received positive feedback from the research participants. During the second cycle of ALSs, two of the three participating teams expressed to the researcher that since their first ALS and engagement with this research, they had been reflecting on the organisational as well as their own team's practices, which was said to have improved their awareness and even triggered changes within their team to improve knowledge sharing. Following the ALSs, participants were invited to provide anonymous feedback via an online survey. The feedback provided is shown in Tables 25, 26, 27 and 28.

	STRONGLY DISAGREE	DISAGREE	NEITHER DISAGREE NOR AGREE	AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
The discussion topics were relevant to the ETI's current practices	0.0% 0	0.0% 0	20.0% 1	60.0% 3	20.0% 1	5	4.00
The discussion topics are important and affect me and my team in our work	0.0% 0	0.0% 0	0.0% 0	100.0% 5	0.0% 0	5	4.00

Table 25: Discussion topics

	STRONGLY DISAGREE	DISAGREE	NEITHER DISAGREE NOR AGREE	AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Participating has enabled me to reflect on my own experiences and activities	0.00% 0	0.00% 0	40.00% 2	60.00% 3	0.00% 0	5	3.60
I feel I could openly participate in the discussions/activities with ease	0.00% 0	0.00% 0	0.00% 0	80.00% 4	20.00% 1	5	4.20
I feel the team could discuss issues/problems openly and with ease	0.00% 0	0.00% 0	0.00% 0	100.00% 5	0.00% 0	5	4.00
Using this Action Learning could help to improve the ETI's practices	0.00% 0	0.00% 0	0.00% 0	80.00% 4	20.00% 1	5	4.20

Table 26: Action learning approach

	STRONGLY DISAGREE	DISAGREE	NEITHER DISAGREE NOR AGREE	AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Collectively understanding the strengths and weaknesses of knowledge sharing and knowledge protection, could improve the working practices of my team	0.00% 0	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00

Table 27: Research benefits

	STRONGLY DISAGREE	DISAGREE	NEITHER DISAGREE NOR AGREE	AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
The activities enabled effective team collaboration where everyone's views were taken into account and respected	0.00% 0	0.00% 0	0.00% 0	80.00% 4	20.00% 1	5	4.20

Table 28: ALS activities

6.4.4 Research impact and recognition

The current research has made an impact on the case study organisation, the ETI, by way of effective organisational learning about its practices, identifying challenges and areas of improvement, as well as incorporating learning in its KM strategy and initiating relevant changes to improve the balance between knowledge sharing and information security. In addition, this research has made impact beyond the ETI in various ways and received international recognition for its originality and effectiveness.

6.4.4.1 Conference papers

Conference: 15th European Conference on Knowledge Management (ECKM) 2014

Dates: 4-5 September 2014

Location: Polytechnic Institute of Santarém, Santarem, Portugal

Contribution: Paper 'Knowledge Sharing and Information Security: A Paradox?' (see Ahmed et al, 2014a)

Conference: 11th International Conference on Intellectual Capital, Knowledge Management & Organisational Learning (ICICKM) 2014

Dates: 6-7 November 2014

Location: The University of Sydney Business School, Sydney, Australia

Contribution: Paper 'Knowledge Sharing in Project Teams: A Research Model Underpinned by Action Learning' (see Ahmed et al, 2014b)*

**Awarded prize for best PhD paper and presentation* (see Appendix J).

6.4.4.2 Knowledge Management and Intellectual Capital Excellence Awards

Conference: Knowledge Management and Intellectual Capital Excellence Awards at the 16th European Conference on Knowledge Management (ECKM) 2015

Dates: 6-7 September 2015

Location: University of Udine, Udine, Italy

*Contribution: Case study 'Innovative Contribution to Organisational Knowledge Management Strategy: A Team Action Learning Initiative'***

**The case study was chosen by a panel of international experts from 70 case studies submitted to a competition for the Knowledge Management and Intellectual Capital Excellence Awards conducted by Academic Conferences and Publishing International. This case study, alongside seven others, was short listed as a finalist, invited to present at the conference and was awarded a certificate of merit (see Appendix L). The case study was subsequently published in a book.

6.4.4.3 Book chapter

After being shortlisted from 70 case study entries and awarded a certificate of merit at the 'Knowledge Management and Intellectual Capital Excellence Awards' at the 16th European Conference on Knowledge Management (ECKM 2015), the current research was published as a case study in the following book (i.e. Ahmed et al, 2015):

Knowledge Management and Intellectual Capital Excellence Awards 2015: An Anthology of Case Histories

6.4.4.4 Case study contribution

Conference: Action Learning and Action Research Association (ALARA 2014) Conference

Dates: 10-12 November 2014

Location: Bungendore, Australia

Contribution: Case Study for Pathways of Functional Reform, 'Knowledge Management: a novel methodology based on Action Learning'

6.4.4.5 Poster and image contribution

Conference: International Data and Information Management Conference (IDIMC) 2014

Date: 17 September 2014

Location: Loughborough University, UK

Contribution: Research poster

Conference: Loughborough Research Conference 2016 – 'Influence and Impact'

Date: 31 October 2016

Location: Loughborough University, UK

*Contribution: Research poster and image*** highlighting the influence and impact of this research*

***Awarded 'Highly Commended' prize for research image contribution

6.5 Reflections, limitations and future research

> *"…qualitative researchers should present a good story which is based on evidence but focused on meaning rather than measurement. In qualitative inquiry, the researchers' selves are involved, their experiences become a resource. Researchers cannot distance themselves from the other participants, although they cannot fully present their meaning and experience." (Holloway and Biley, 2011: 968)*

Taking a qualitative research approach has been both rewarding and challenging for the researcher. Being a qualitative researcher means a great deal of accountability to the research participants and readers, starting from the choice of methodology, data and the subsequent analysis and interpretations drawn from it (Holloway and Biley, 2011). In this research, accurately representing the participants' experiences and personal opinions, contextualising the findings from an organisational perspective, as well as contributing knowledge and experience of collaborating with the ETI – generating and presenting a fair and accurate amalgamation of three different perspectives, whilst maintaining integrity as a researcher, was a challenging task.

"The only source of knowledge is experience." Albert Einstein

From this PhD research experience, the researcher has gained insight into how dynamic and powerful qualitative research can be in exploring, identifying and interpreting complex organisational issues, particularly where humans play a role. Moreover, the aim of this research was to uncover organisational issues related to knowledge sharing and information practices. The role of the employee was central to this research.

Equally, unlike quantitative research, the in-depth and human-oriented nature of qualitative research inherently places the researcher into the research context. This requires the qualitative researcher to remain mindful of their role at all times so as to not become intrusive or try to influence the outcomes of the research. In addition to the development of skills, knowledge and experience as a researcher, the research journey has also led to personal growth and broadened the researcher's perspective.

Collaborating with the ETI for this research has been an extremely valuable research experience. The ETI's complex governance structure, dynamic and knowledge-intensive environment, and the nature of its innovative project work offered the researcher a rich, challenging and highly relevant case to explore. Further, the ETI's proactive and keen attitude towards learning and improving its knowledge management practices, as well as the voluntary participation of project teams and genuine honesty and openness in sharing their knowledge and experiences, facilitated and eased the research process. Towards the researcher's empirical and dynamic approach, the ETI was open-minded and provided all of the necessary support and access, whilst remaining ethical and not attempting to influence the process or outcomes.

The researcher experienced some logistical challenges during the data collection and analysis phases. Firstly, finding suitable slots for booking the ALSs with entire teams was difficult due to the busy schedules of the participants, and as a result, the gap between the first and second cycle of data collection was prolonged by a period of three to four months. Another challenge was the time-consuming process of transcribing and analysing the research data, as the researcher chose to transcribe and analyse the recordings of the ALSs manually to ensure accuracy. The researcher also experienced challenges with obtaining buy-in. The original aim of the methodology was to use a bottom-up approach where participants would develop actions in order to improve the organisation's knowledge sharing and information security practices, and subsequently change would be driven or championed by the participating teams. Although there was slight hesitation from a couple of participants in taking ownership of the actions their teams developed, the majority of the participants embraced the possibility of championing change in their organisation positively. However, the proposed bottom-up approach was not entirely successful and it is realised that management support is integral in such an initiative in order to fully implement an action learning framework and drive change in an organisation. This is particularly important for a partnership organisation that operates in a complex governance structure.

6.5.1 Limitations and future research

Although the research provided strong empirical validation of the conflict between knowledge sharing and information security, which contributes to the existing, largely conceptual, research on knowledge protection, it has the following limitations and subsequent recommendations for future research.

Given the complex nature of the conflict between knowledge sharing and information security practices, future research should take an inclusive approach that does not only focus on knowledge protection, but impartially explores the broader context that includes knowledge sharing and information security practices to develop a deeper and more accurate understanding. As this is a single organisation case study, the research approach was limited in only representing a single business within a specific industry context, thus, further research is required to understand how this clash manifests itself in different organisational contexts and in different industries. However, this research can be generalised in terms of the issues that have been explored, as well as the novel and effective methodological approach that has been developed. Although this research contributes to the body of knowledge about the conflict of interest between knowledge sharing and security, and provides empirical validation to the largely conceptual discussions as well as uncovering new issues, there is a vital need for further empirical research into the conflict to further expand the understanding. Another avenue emerging from this research that future research can build upon is the negative impact of information security measures on an organisation's knowledge sharing practices, and subsequently its performance.

Due to the limited scope and time of this research, only two action learning cycles were completed as part of the methodology. The aim behind action learning is continuous reflection, learning and change - through an on-going cyclic action learning approach, thus future application of the methodology may need to be extended over a longer period of time to achieve on-going learning benefits and to drive and manage organisation change through the approach. Application of this research methodology to empirically explore other similar issues or organisational contexts is also a recommended extension.

6.6 Concluding comments

The motivation behind this research was to empirically explore the conflict between knowledge sharing and security, to develop an in-depth and holistic understanding of how the issue manifests itself in a real organisational setting, and, to contribute to the limited - and mainly abstract - previous literature on this subject. Thus, the research aimed to investigate the relationship between the practices of knowledge sharing and information security, and, design recommendations for informing organisational strategy for balancing the relationship between the two practices.

When looking at the practices of knowledge sharing and information security independently at the ETI, it was clear that there were proactive and conscious efforts towards achieving the goals of each practice. Knowledge was recognised as the ETI's core product and its effective dissemination was key for the organisation's success which is why there was a keen attitude towards improving knowledge sharing internally and externally. On the other hand, a great deal of importance was given to protecting valuable knowledge and maintaining stakeholders' confidentiality, thus there were good systems, access controls, and information restrictions in place. In addition, strict legal and approval processes to protect information value and accuracy were implemented. However, when both practices were compared from a broader perspective, evidence of issues arising from their conflicting nature was clear. Moreover, operating in a complex governance structure with various expectations and contractual agreements with stakeholders regarding confidentiality, had created a protective culture in the organisation surrounding its knowledge, which hindered formal and informal knowledge sharing (including both, tacit and explicit forms) and made identifying opportunities for fully exploiting knowledge and Intellectual Property an operational challenge.

The research process facilitated the achievement of effective learning at individual, team and organisational level for the ETI about its practices, identification of challenges and areas of improvement, incorporating learning and recommendations into its KM strategy alongside existing activities to improve knowledge sharing. This research offers the first holistic and in-depth empirical case study approach into the combined practices of knowledge sharing and information security, and more importantly, the nature of their relationship and subsequent practical conflicts. Moreover, the findings about the conflicts – particularly those highlighting the negative impact of information security on knowledge sharing – offer a fresh perspective and the somewhat opposing conclusions drawn from previous literature. The findings highlight the need for researchers and practitioners to avoid a tunnel vision approach when exploring the issue of knowledge protection - and instead take a broader view and implement a holistic strategy for knowledge and information management, as opposed to treating and managing knowledge sharing and information security practices separately within an organisation. Importantly, the research contributes to theory by presenting an evidenced-based case for expanding the existing model of KM to also incorporate 'knowledge protection' as a sixth process.

In addition to the contribution to knowledge sharing and information security literature, the research also developed a novel methodological approach underpinned by the philosophy of action learning which contributes to the discipline of action learning. The findings also address the complexity of knowledge management in a public-private partnership that operates in a complex governance structure and attempts to meet the various and sometimes conflicting requirements of stakeholders. Thus, the research has made theoretical, methodological and practical contributions to existing research.

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APPENDICES

Appendix A – Participant consent form

Action Learning Research Workshop

PARTICIPANT CONSENT FORM

(to be completed after Participant Information Sheet has been read)

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Loughborough University Ethics Approvals (Human Participants) Sub-Committee.

I have read and understood the information sheet and this consent form.

I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in the study.

I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing.

I understand that all the information I provide will be treated in strict confidence and will be kept anonymous and confidential to the researcher.

I agree to participate in this study.

Your name _____

Your signature _____

Signature of Investigator _____

Date

Appendix B – Participant information sheet

'Knowledge Sharing at the ETI' - Action Learning Research Workshop

Participant Information Sheet

Researcher:	Ghosia Ahmed	g.ahmed@lboro.ac.uk	07809447439
Supervisors:	Dr Gillian Ragsdell	g.ragsdell@lboro.ac.uk	01509 223082
	Ms Wendy Olphert	c.w.olphert@lboro.ac.uk	01509 225914

Centre for Information Management, School of Business and Economics, Loughborough University, Loughborough, Leicestershire, LE11 3TU

What is the purpose of the study?

The purpose of this research is to examine the current knowledge sharing and knowledge protection/security practices at the ETI, including, the nature of the relationship between them and how it impacts individuals in their work.

This will enable the researcher to identify the strengths, weaknesses and levels of awareness of the current knowledge sharing and knowledge protection/security practices and understand how the protection/security mechanisms affect knowledge sharing (i.e. does one practice hinder the other).

Who is doing this research and why?

This study is carried out by Ghosia Ahmed (supervised by Dr Gillian Ragsdell and Wendy Olphert) of the School of Business and Economics, Loughborough University. The study is a part of a PhD research project supported by Loughborough University and the ETI.

Are there any exclusion criteria?

No

What will I be asked to do?

You will be asked to attend two workshops that will be carried out at the ETI. The purpose of the workshops is to enable the team engage in reflection, discussions, sharing of knowledge, experiences and problems and learning about the current knowledge sharing and knowledge protection practices at the ETI.

During each workshop, the researcher will ask a set of questions to the whole team on particular topics. For some questions, you will be asked to firstly write down your personal response based on your own knowledge and experiences, and then share and explain this with the rest of the team. The responses will then be gathered together and the team will be asked to discuss these in light of their knowledge and experiences and mutually order these by importance.

At the end of the workshop, you will be requested to complete a brief questionnaire based on the topics discussed during the workshop.

Once I take part, can I change my mind?

Yes. After you have read this information and asked any questions you may have, you will be asked to complete a Participant Consent Form, however if at any time, before, during or after the sessions you

wish to withdraw from the study please just contact the main the researcher. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

How long will it take?

The duration of the Action Learning workshops will be up to 2 hours each.

What personal information will be required from me?

You will be asked to complete a consent form which requires your full name and signature and a brief questionnaire for which you will need to provide details such as your name, department, job role and length of employment with the company. However, this information will only be seen by the researcher and will not be shared or published in the research.

Will the workshop discussion be recorded?

Yes, with the consent of the participants, the session will be audio recorded and transcribed at a later time. The sole purpose of audio recording the session, instead of taking written notes, is to enable the researcher to focus on facilitating during the workshop. The audio recordings will be deleted at the end of the research project and the transcribed data will be anonymised in the research output.

Are there any risks in participating?

No

Is there anything I need to bring with me?

No

Will my taking part in this study be kept confidential?

Yes. In addition, any personal opinions that you share in the research will be de-identified and will remain anonymous in the research results. The information collected during the workshop and the audio recordings of the discussions will be transcribed and accessed by the researcher only. Any identifying information and the audio recordings will be destroyed at the completion of the PhD research.

I have some more questions; who should I contact?

If you have further questions, please contact the researcher during the session or using the contact details provided above after the session.

What will happen to the results of the study?

The findings of the study will form a part of the researcher's PhD thesis and may also be included in academic research papers.

What if I am not happy with how the research was conducted?

If you are not happy with how the research was conducted, please contact Mrs Zoe Stockdale, the Secretary for the University's Ethics Approvals (Human Participants) Sub-Committee:

Mrs Z Stockdale, Research Office, Rutland Building, Loughborough University, Epinal Way, Loughborough, LE11 3TU. Tel: 01509 222423. Email: Z.C.Stockdale@lboro.ac.uk

The University also has a policy relating to Research Misconduct and Whistle Blowing which is available online at http://www.lboro.ac.uk/admin/committees/ethical/Whistleblowing(2).htm.

Appendix C – Questionnaire about KS and IS practices

Knowledge Sharing and Knowledge Protection Questionnaire

Action Learning Research Workshop

Participant Details

Name:

Department:

Role:

Gender:

Length of employment with the ETI:

Questions

Please rate the effectiveness of the following based on your own experience of working at the ETI (1= ineffective and 10= extremely effective):

ETI's knowledge sharing with external stakeholders	1 2 3 4 5 6 7 8 9 10
Knowledge sharing between project/programme teams at the ETI	1 2 3 4 5 6 7 8 9 10
Knowledge sharing between departments at the ETI	1 2 3 4 5 6 7 8 9 10
Knowledge sharing within your team	1 2 3 4 5 6 7 8 9 10
The role of the ETI's governance/management in nurturing knowledge sharing	1 2 3 4 5 6 7 8 9 10
The role of the ETI's culture in nurturing knowledge sharing	1 2 3 4 5 6 7 8 9 10
The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	1 2 3 4 5 6 7 8 9 10
Confidentiality policies/controls for sharing knowledge/information internally	1 2 3 4 5 6 7 8 9 10
Confidentiality policies/controls for sharing knowledge/information externally	1 2 3 4 5 6 7 8 9 10
The role of the ETI's governance/management in protecting knowledge/information.	1 2 3 4 5 6 7 8 9 10

Thank you for participating in this research. Your contribution is hugely valuable and appreciated.

Appendix D – Feedback questionnaire – SurveyMonkey

Research Workshop - Feedback

1. Discussion topics

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
The discussion topics are important and affect me and my team in our work	○	○	○	○	○
The discussion topics were relevant to the ETI's current practices	○	○	○	○	○

2. Action Learning workshop approach

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
Participating in the workshop has enabled me to reflect on my own experiences and activities	○	○	○	○	○
I feel I was able to openly participate and contribute in the discussions/activities with ease	○	○	○	○	○
I feel the team were able to discuss issues/problems openly and with ease	○	○	○	○	○
Using an Action Learning approach (i.e. teams discussing important issues, in a time and space away from their usual work environment) could help to initiate improvements in the ETI's practices	○	○	○	○	○

3. Learning and awareness

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
The workshop has improved my understanding and awareness of the knowledge sharing and knowledge protection practices at the ETI	○	○	○	○	○
I feel I could apply what I learned in the workshop to future activities	○	○	○	○	○
Collectively understanding the strengths and weaknesses of knowledge sharing and knowledge protection, could improve the working practices of my team	○	○	○	○	○
If all of the programme teams at the ETI were involved in this research, this could improve the knowledge sharing (and knowledge protection) practices between the teams	○	○	○	○	○

4. Logistics

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
The layout of the room was suitable for the nature of the workshop and activities	○	○	○	○	○
There was enough time provided for each activity	○	○	○	○	○
Length of workshop was sufficient	○	○	○	○	○
The size of group was appropriate for this type of workshop and its activities	○	○	○	○	○
The PowerPoint slides were useful aids and easy to follow	○	○	○	○	○
The activities (using post-it notes and the charts) enabled effective team collaboration where everyone's views were taken into account and respected	○	○	○	○	○

5. About the researcher

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
The researcher was organised	○	○	○	○	○
The researcher had good knowledge about the discussion topics	○	○	○	○	○
The activities were explained clearly by the researcher	○	○	○	○	○
The researcher was friendly and approachable	○	○	○	○	○
The researcher was able to answer all my questions to my satisfaction	○	○	○	○	○

6. Were there any aspects of the workshop you thought were particularly useful?

7. Were there any areas in which you think the workshop could be improved?

8. Are there any topics you think would be useful to add into this workshop?

9. Are there any other comments or suggestions you would like to make?

Thank you for your feedback.

Done

Appendix E – ETI report – summary of findings ALS C1

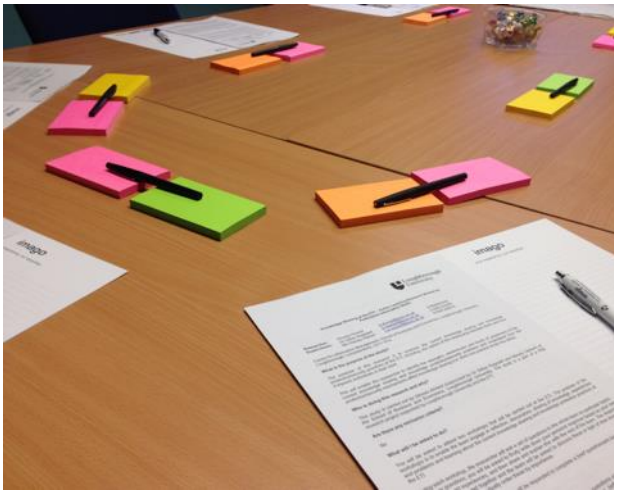
Summary of Cycle 1 Findings

1. Introduction

This report provides a summary of the findings from the first cycle of the research. This cycle consisted of three Action Learning Sets (ALS) with project teams at the ETI, which were carried out between June 2014 and August 2014.

2. Set-up of ALS

The ALSs took place in meeting rooms which were set-up in advance by the researcher i.e. with PowerPoint slides, a research information sheets, participant consent forms, post-it notes, pens and flip charts. The room was set-up with the aim to create an environment conducive for discussions and teamwork.



The duration of the first ALS was 2 hours, however, this proved insufficient to complete all of the activities, and thus the timing was increased to 3 hours for the subsequent two ALSs.

At the start of each ALS, the participants were requested to read the research information sheet, ask any questions, sign the consent forms if they're happy to proceed with the participation. All participants agreed to proceed with the participation. The researcher explained further about the research purpose, what Action Learning is and the structure of the ALS. The ALSs consisted of three themes. Including 'Knowledge & Information Sharing', 'The ETI Culture' and 'Protecting the ETI's Knowledge'. Each theme

consisted of 4-5 activities where all participants were able to contribute their opinions, have a discussion, constructively challenge each other's views and work together as a team to make decisions.

At the end of the end of the ALS, all participants were requested to complete a brief questionnaire (see Section 4 for results of the questionnaires). Following the ALS, a 'thank you' email was sent to each participant with a request to complete an anonymous online feedback questionnaire.

3. Summary of findings from first ALS cycle

Tables 1, 2, 3, 4 and 5 below provide a snapshot of some of the findings of the first cycle of ALSs.

1. Knowledge sharing externally	
Strengths: • SAGS (encourage external engagement, discussion of project outcomes) • Insights creation (expert staff able to explain project outcomes) • Member Portal (deliverables formally stored and organised, members access to project data, wide range of data and statistics available) • Knowledge (good engineering knowledge base, respected authority, well-reasoned and evidenced when sharing externally) • Strong knowledge creation management processes • Good access to external channels/partners • Evidence based output	**Weaknesses:** • Third parties (difficult to identify who might be interested, thus difficult to disseminate to them) • Confidentiality (restraints, fear of leakage/competition, cannot be specific about what we do due to confidentiality, what can/cannot be shared externally, confidentiality requirements slow things down) • Resource to publish technical data about ETI in journals / not communicating/publishing outputs on time • Weak at acting on feedback • Closed appearance of ETI (too protective, too corporate, ETI's external profile) • Intellectual property (too much obsession with IP, defensiveness around IP, Bureaucracy with external sharing with stakeholders)

Table 1: Knowledge sharing externally

2. Knowledge sharing between projects/programmes	
Strengths: • Good coordination of own team • Project workshops within project consortium/ETI organised • Presentations at team meetings • Lunch and learn sessions • Most people are keen to share • Small organisation size means people know each other • Governance and regular reviews • KS is encouraged • Good team sizes (closeness, information connections, team working) • Cross programme activities • Informal process related knowledge shared between project and programme teams	**Weaknesses:** • Between projects (programmes can be siloed, one team appears to be a remote company, don't feel "need" to share) • Weak internal knowledge sharing (small company approach, internal formal communication is poor) • Knowledge transfer/dissemination (lack of standardisation and best practice, some teams geographically disparate, no process of dissemination from meetings) • Lessons learned between projects • Lack of emphasis on identifying and communicating significance • Too much reliance on personal relationships • Timelines are tricky and often missed • Strategy insights creation not well understood by most • Lack of time to explore what other teams are doing • Communication lacking in programmes that have overlapping projects

Table 2: Knowledge sharing between projects/programmes

3. Cultural factors affecting knowledge sharing	
Motivating: • Exploitation work is getting individuals to think more about KM • Member value returns (publish to Member portal) • Staff are friendly and approachable for tacit knowledge sharing • Interest in wanting to make a difference • Work ethic (wanting to do a good job) • Personal/team benefits (like-minded people in the team, team working, sharing to learn, shared benefit/mutual interest) • 'Need'/requirement to do so • Promoting successes	**Hindering:** • Lack of clarity (ETI is a knowledge creating and communicating business but sees itself as an engineering organisation / lack of clear guidance for sharing, 'can't see wood for trees', not sure which party is interested, lack of experience of audiences) • Lack of summarised programme/project data available to everyone in the organisation, • Weak communication (continuous changes not communicated across teams, no regular top-down communication) • Geographic separation of one team • Mentality (lack of time, not part of my job, focus on project delivery) • Silos (org structure, incentives, data access) • Culture

Table 3: Cultural factors affecting knowledge sharing

4. Security/protection controls	
Strengths: • Good systems • Access controls on systems and restrictions on materials on the web • Legal protection (NDAs, good legal protection and procedures) • Document labelling for confidentiality • Effective management of knowledge sharing and control on member portal • Confidentiality requirements are strict and protect information	**Weaknesses**: • Complexity (legal licenses are complex, often include legal involvement) • Confidentiality/approval (weak procedure for reviewing presentation material • Lack of clarity on what confidentiality levels are or how much can be shared) • Lack of guidance leads to 'protecting' things just in case • Very bureaucratic and heavy handed legal approach to confidentiality • Causes delays in processing/providing information • External communications

Table 4: Security/protection controls

5. Security related challenges created by the governance structure
• Ensuring trust between commercial competitors • "Highest common denominators" syndrome i.e. need to meet security culture of all stakeholders • Lack of independent ETI voice (ETI position as a potential reputational risk' for members, no clarity on how to deal with this other than taciturnity) • Entirely protects value for members • Conflict of interest by Board members • Missed opportunities for sharing knowledge - confused the ETI about exploitation • Lack of trust • Competition law compliance

Table 5: Security related challenges created by the governance structure

4. Questionnaire results

At the end of the ALS, each participant was asked to complete a brief questionnaire about the knowledge sharing and knowledge protection practices at the ETI. Table 6 below shows the ranges and the average ratings from each team.

	Team 1		Team 2		Team 3	
	Rating range	Average rating for team	Rating range	Average rating for team	Rating range	Average rating for team
1. ETI's knowledge sharing with external stakeholders	Ranges between 5 and 7	**6.33**	Ranges between 3 and 7	**5.14**	Ranges between 3 and 6	**4.60**
2. Knowledge sharing between project/programme teams at the ETI	All participants rated 6	**6.00**	Ranges between 2 and 7	**4.57**	Ranges between 4 and 7	**6.00**
3. Knowledge sharing between departments at the ETI	Ranges between 3 and 5	**4.33**	Ranges between 2 and 5	**3.29**	Ranges between 4 and 7	**5.20**
4. Knowledge sharing within your team	Ranges between 6 and 8	**6.67**	Ranges between 8 and 10	**8.86**	All participants rated 7	**7.00**
5. The role of the ETI's governance/management in nurturing knowledge sharing	Ranges between 2 and 6	**4.33**	Ranges between 2 and 8	**4.71**	Ranges between 1 and 6	**4.00**
6. The role of the ETI's culture in nurturing knowledge sharing	Ranges between 2 and 7	**4.33**	Ranges between 3 and 7	**5.43**	Ranges between 1 and 5	**3.20**
7. The technical controls for protecting the ETI's knowledge/information (e.g. systems, access controls, electronic sharing tools	Ranges between 6 and 8	**7.00**	Ranges between 6 and 9	**7.00**	Ranges between 4 and 8	**6.80**
8. Confidentiality policies/controls for sharing knowledge/information internally	Ranges between 3 and 7	**5.33**	Ranges between 3 and 9	**6.71**	Ranges between 2 and 8	**5.20**
9. Confidentiality policies/controls for sharing knowledge/information externally	Ranges between 4 and 9	**6.33**	Ranges between 0 and 9	**5.29**	Ranges between 1 and 5	**3.80**
10. The role of the ETI's governance/management in protecting knowledge/information.	Ranges between 4 and 6	**5.33**	Ranges between 4 and 8	**5.14**	Ranges between 3 and 7	**4.00**
Participants were asked to rate the effectiveness of the following subjects based on their own experience of working at the ETI (1= ineffective and 10= extremely effective):						

Table 6: Questionnaire results

5. Plan for second ALS cycle

Currently, the researcher is analysing and reflecting on the first set of ALSs, including the relevance of the discussion themes, the outcomes of each individual ALS and effectiveness of the approach used. The analysis includes identification of strengths and weaknesses of existing practices, as well as gaps between current and desired practices. A comparison between the outcomes of the three teams will also be created.

Based on the analysis and findings of each team's first ALS, the next phase of the research is being designed. The next phase of the research consists of a follow-up ALS, focusing on particular areas of the ALS themes as identified from the outcomes of the first ALS.

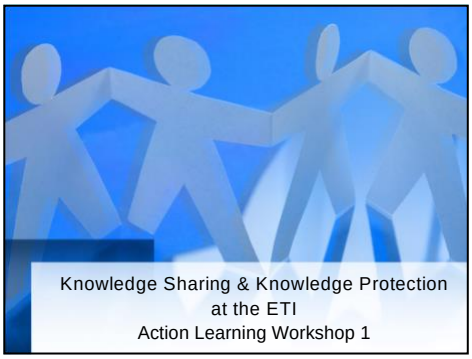
The aim of the second ALS will be to:

- Share the findings of the first ALS to each team
- Draw the team's focus towards the weak areas that they identified and reflect on these
- Engage the team in advanced discussions about those particular areas and explore matters in greater depth
- Involve the team in devising a plan of action that should be taken by the ETI in order to improve the relevant aspects of their knowledge sharing and knowledge protection practices

The second ALS will be carried out approximately 3-6 months after the first ALS (between November and December 2014) to ensure that the project teams have had sufficient time to reflect on the first ALS.

Appendix F – ALS 1 sample slides

03/12/2016



About the researcher

- Ghosia Ahmed
- PhD research student - School of Business and Economics, Loughborough University
- Knowledge Audit project at the ETI in 2012
  - Experience the working practices of the ETI
  - Develop an understanding of the current state of knowledge
  - Knowledge gaps and bottlenecks
  - Overall organisational culture

Purpose of this research

1. To understand the current **knowledge sharing** and **knowledge protection/security** practices
   - Strengths, weaknesses and level of awareness about each practice
   - The relationship between them and its impact on individuals in their work (e.g. does one practice hinder/compromise the other?)
2. Identify ways of improving knowledge sharing and knowledge protection practices

Research method: Action Learning

Action = experience, practice, process, way of doing something or problem etc.

- Process for reflective thinking and problem solving
- Time and conditions deliberately carved for reflection, listening and discussing
- Team works together on 'real' business problems/practices and produces solutions

Research process

Research process

- Today's workshop
  1. Three discussion themes, each with a set of questions
     - The team discusses together
     - Step 1 - researcher asks question
     - Step 2 - each participant writes their own response in **keywords** on post-it note
     - Step 3 - everyone shares their post-it(s) with the team
     - Step 4 - team discusses and collectively puts the post-its in order of importance on the chart
  2. Brief questionnaire at the end of session

Appendix G – ALS 2 sample slides

03/12/2016

Purpose of this research

1. To understand the current **knowledge sharing** and **knowledge protection/security** practices
   - Strengths, weaknesses and level of awareness about each practice
   - The relationship between them and its impact on individuals in their work (e.g. does one practice hinder/compromise the other?)
2. To identify ways of improving these practices (i.e. by devising appropriate solutions and actions)

Research process

Today's workshop

- Aims:
  1. Share the findings of the first workshop with you
  2. Draw your focus towards areas of improvement identified and encourage reflection on these
  3. Devise a set of actions/solutions to improve the relevant aspects of knowledge sharing and knowledge protection

Developing actions

- To address biggest issues as identified by your team
- Actions can be at organisational level or team level
- For each action, aim to identify:
  1. What needs to be done?
  2. What should it ultimately achieve?
  3. Who needs to do it?
  4. What can we do as a team to support it?
  5. How can we take ownership and track its progress?

Questionnaire results

		Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Average for team
1	The role of the ETI's culture in nurturing knowledge sharing	1	5	2	4	4	3.20
2	Confidentiality policies/controls for sharing knowledge/information	5	3	1	5	5	3.80
3	The role of the ETI's governance/management in nurturing knowledge sharing	1	6	3	4	6	4.00
4	The role of the ETI's governance/management in protecting knowledge/information.	3	3	3	7	4	4.00
5	ETI's knowledge sharing with external stakeholders	3	5	4	5	6	4.60
6	Knowledge sharing between departments at the ETI	6	5	4	4	7	5.20
7	Confidentiality policies/controls for sharing knowledge/information internally	5	6	2	8	5	5.20
8	Knowledge sharing between project/programme teams at the ETI	7	6	4	7	6	6.00
9	The technical controls for protecting the ETI's knowledge/information e.g. systems, access controls, electronic sharing tools	7	7	4	8	8	6.80
10	Knowledge sharing within your team	7	7	7	7	7	7.00

Participants were asked to rate the effectiveness of the following subjects based on their own experience of working at the ETI (1 = ineffective and 10 = extremely effective):

Appendix H – ECKM 2014 conference paper

Knowledge Sharing and Information Security: A Paradox?

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Abstract: This paper presents the findings of a knowledge sharing and information security literature review and identifies an interesting research gap in the intersection of the two practices.

In a fast changing environment where there is increasing need to understand customers' demands and competitors' strategies (Lin et al, 2012), knowledge sharing is recognised as an essential activity for organisational success (Wasko and Faraj, 2005; Renzl, 2008). Organisations continuously aim to exploit existing knowledge, seek new ways to improve and increase knowledge sharing activities, as well as to identify and reduce possible knowledge sharing barriers. However, albeit the integral role and benefits of knowledge sharing having been widely recognised, the security or protection of knowledge has not received the same level of attention. Although the importance of protecting knowledge has been stressed by some researchers (e.g. Gold et al, 2001; Desouza and Awazu, 2004; Desouza 2006; Ryan, 2006), research into the 'softer' or the human behaviour aspects of knowledge protection is scarce.

Information security is another field that has grown tremendously and is now a globally recognised discipline (Gifford, 2009) receiving attention from academics and practitioners (Wiant, 2005). Information security measures aim to prevent the loss or leakage of an organisation's valuable information and manage the resulting cost of any loss. Despite organisations' investments in prevention measures, information security breaches are still common where humans are often seen as the weakest link and 'incorrect' human behaviour as the most common point of failure. However, much of the research carried out to prevent information security breaches focuses on technical facets (Gordon and Loeb, 2006; Coles-Kemp, 2009).

From the literature review, it is evident that knowledge sharing and information security have become well-established concepts in academia and within organisations. However, the middle ground between these two equally important, and adjacent, practices, has received inadequate attention. Knowledge sharing aims to encourage individuals to share knowledge with colleagues, organisational partners and suppliers; on the other hand, information security initiatives aim to apply controls and restrictions to the knowledge that can be shared and how it is shared.

This paper draws attention to the perceived paradoxical nature of knowledge sharing and information security and raises awareness of the potential conflict that could compromise the protection of knowledge, or alternatively, reduce the openness of knowledge sharing.

Keywords: Knowledge sharing, information security, knowledge protection, literature review

1. Introduction

Organisations pay particular attention to knowledge management as knowledge forms an integral intangible asset facilitating organisational success and competitive advantage (Mueller, 2012). Advancing tremendously, knowledge management research has focused primarily on recognising, capturing, and the sharing of knowledge for improvement and innovation (Ryan, 2006). Knowledge sharing underpins the success of knowledge management initiatives (Wang and Noe, 2010) and has been recognised as a vital activity for organisational success (e.g. see Wasko and Faraj, 2005; Renzl, 2008).

However, whilst focusing on exploiting and maximising the value of knowledge, research into knowledge protection has been lacking (Desouza, 2006).

Information security has also now become a globally recognised discipline (Gifford, 2009) within organisations and academia. Affecting individuals in organisations on a daily basis (Albrechtsen, 2007), information security measures aim to manage the loss of information and the subsequent cost of that loss (Winkler, 2011) by protecting the confidentiality, integrity and availability or accessibility of information (Grama, 2010; Gifford, 2009; Kim and Solomon, 2010). Despite the fundamental role of human awareness and behaviour in making information security practices successful being acknowledged by various researchers (e.g. Coles-Kemp, 2009; Albrechtsen, 2007; Bishop, 2006; Stanton et al, 2005), literature has mainly focused on technical or formal aspects such as technologies, access controls and policies (Coles-Kemp, 2009).

Albeit the widespread recognition and implementation of the two practices, the middle ground between knowledge sharing and information security is an area that has been overlooked. Furthermore, there could be a paradox between knowledge sharing and information security practices (Desouza, 2006; Ryan, 2006) as one practice aims to encourage sharing of knowledge whereas the other tries to control the sharing through security measures. The following two sections comprise a literature review of knowledge sharing and information security, including a discussion of definitions, purposes and factors affecting each practice. Following this, we identify the middle ground between the two practices where a potential conflict of interest may exist and, finally, present the research gap.

2. Knowledge sharing

Christensen (2007) defines knowledge sharing as a process that exploits existing knowledge by identifying, transferring and applying it to solve tasks better, faster and cheaper. It is the essential mechanism through which employees apply their knowledge and contribute to an organisation's innovation (Jackson et al, 2006), but happens at the willingness of the individual (Gibbert and Krause, 2002). Huysman and De Wit (2002) claim that knowledge sharing is the foundation for organisational learning yet Hendriks (1999: 92) argues that "in a strict sense, knowledge cannot be shared" as it is entwined with a knowing subject, thus, certain prior knowledge is required to reconstruct and acquire knowledge.

Terms such as 'knowledge transfer' and 'knowledge exchange' are also sometimes used for referring to knowledge sharing (Foss et al, 2010) and bring ambiguity e.g. O'Dell and Grayson (1998), Inkpen and Tsang (2005), and Wasko and Faraj (2005) Cabrera et al (2006), Christensen (2007) and Haas and Hansen (2007).

Though these definitions and perspectives of knowledge sharing vary in many respects, they do share similar core concepts such as, using existing knowledge within the organisation to solve problems, generating new learning, and empowering the organisation for innovation.

2.1 Important factors in knowledge sharing

Knowledge sharing is a behaviour of choice (Ajzen, 1991; Gagné, 2009), thus, there are factors discussed by researchers (e.g. Hendriks, 1999; Bock and Kim, 2002; Lin, 2007; Gagné, 2009; Wang and Noe, 2010) that can motivate or hinder this behaviour. Alternatively, Riege (2005) has reviewed extensive knowledge sharing literature and identified three categories of barriers to knowledge sharing, including, individual factors (e.g. lack of trust and fear of loss of power,), organisational factors (e.g. lack of leadership and lack of appropriate reward systems), and technological factors (e.g. inappropriate systems and lack of training).

This literature review also highlights three categories of factors affecting knowledge sharing; human factors, technological factors and organisational factors.

2.1.1 Human factors

According to Reagans and McEvily (2003), *social connection* with the knowledge receiver is likely to motivate the knowledge owner to share knowledge. However, a study by Thomas-Hunt et al (2003) found that socially isolated members made greater contributions than socially connected members, and, their contributions were better acknowledged by others. Phillips et al (2004) also found positive congruence between social connections and effective group performance, but this was not the case in larger groups as it led to divisions and formation of sub-groups.

Trust between individuals is a fundamental principle of an effective social exchange (Blau, 1964), thus, trust improves an individual's motivation to supply useful knowledge (Tsai and Ghoshal, 1998), and accept the knowledge given by others (Mayer et al, 1995). Contrariwise, Bakker et al (2006) argue that, while the presence of high levels of trust does not necessarily increase knowledge sharing, a lack of trust may inhibit individuals' knowledge sharing motivation.

Cabrera et al (2006) explain that individuals may share knowledge by the perceived *rewards* associated with it, and according to Yao et al (2007), a lack of incentives can be a knowledge sharing barrier. Opposing arguments claim that extrinsic reward schemes can become a knowledge sharing barrier and have a counter-effect on existing intrinsic practices and motivations (Huber, 2001; Robertson and Swan, 2003).

The concepts of '*knowledge hiding*' and '*knowledge hoarding*' have also been highlighted as possible barriers to knowledge sharing. Knowledge hiding, according to Connelly et al (2011: 65), is "an intentional attempt by an individual to withhold or conceal knowledge that has been requested by another person". 'Knowledge hoarding' on the other hand, is when an individual accumulates knowledge that may or may not be shared in the future (Hislop, 2003) and can be caused by competition (Hansen et al, 2005). Both concepts can be characterised as a category of possible knowledge withholding behaviours (Connelly et al, 2011).

2.1.2 Technological factors

Ruddy (2000) asserts that technology combined with cultural or behavioural awareness is essential for effectively sharing knowledge. Knowledge Management Systems (KMS) are specifically implemented for documenting, distributing and transferring of knowledge between employees (Voelpel et al, 2005). However, research on knowledge sharing technologies has mainly focused on explicit and formal types of knowledge (Oshri et al, 2008), whereas a significant amount of organisational knowledge is shared informally and sometimes requires informal systems (Davison et al, 2013).

Despite the benefits of such technologies, knowledge sharing can become challenging for people if there is a lack of integration of technological systems and processes, shortage of technical support, a gap between what individuals require and what the systems provide, and a lack of familiarity and training on systems (Riege, 2005). Further, unrealistic expectations of employees in relation to the technology's capability (Riege, 2005) or the technology being too complex (Babcock, 2004) also have a negative impact on knowledge sharing.

2.1.3 Organisational factors

Martiny (1998) claims that change must be driven by management in the form of clear support and employees will share knowledge if they feel that it is desirable and expected by management. This argument is supported by studies such as Connelly and Kelloway (2003) and Cabrera et al (2006). A lack of support and direction from management can inhibit knowledge sharing (Riege, 2005), however, Mueller (2012) argues that, since knowledge sharing is not recognised as a formal activity, management should not interfere with informal processes and leave this responsibility for employees.

3. Information security

Information security has become a globally recognised discipline (Gifford, 2009) and is one of the various requirements of an employee's working day (Albrechtsen, 2007). According to Winkler (2011), information security is concerned with managing the loss of information and the subsequent cost of that loss, yet a more common definition is about protecting the confidentiality, integrity and availability or

accessibility of information (Gordon and Loeb, 2006; Grama, 2010; Gifford, 2009; Kim and Solomon, 2010).

Information security cannot be achieved by technologies alone, thus, policies and procedures play an important role (Von Solms, 2001; Bishop, 2006; Coles-Kemp, 2009; Klaic and Hadjina, 2011). Although, in order to make them work, a human perspective on information security is fundamental (Coles-Kemp, 2009; Albrechtsen, 2007; Stanton et al, 2005). Where correct and constructive human behaviour can enhance the effectiveness of information security, incorrect and negative behaviour could inhibit it (Stanton et al, 2005).

3.1 Information security threats and measures

Despite organisations implementing prevention measures, information security breaches are common (Gordon and Loeb, 2006). PricewaterhouseCoopers (2013), stated 93% of large and 87% of smaller organisations reported facing security breaches. Gordon and Loeb (2006) stress that organisations must have the ability to detect and rectify information security breaches, however, in reality, even well established organisations that have disaster response measures in place, still suffer significantly from such breaches (Anderson, 2003).

Information is exposed to technologies, people and processes (Posthumus and Von Solms, 2004), which is why, unsurprisingly, the majority of serious information security breaches take place due to failure from a combination of these (PricewaterhouseCoopers, 2013). Technologies can never be resistant to attack so information security needs to be a multi-layered approach (Smith, 2013). Yet majority of the research carried out to prevent information security breaches focuses on mainly technical measures (Gordon and Loeb, 2006) despite the widespread acknowledgement of humans being the weakest link in information security (e.g. Stajano and Wilson, 2011; Spears and Barki, 2010).

3.1.1 Human related threats and prevention measures

Marks and Rezgui (2009) assert that most security managers focus primarily on technical facets and solutions, yet research strongly suggests that non-technical aspects are equally as important (Siponen and Oinas-Kukkonen, 2007; Dhillon and Torkzadeh, 2006). Further, according to KPMG's (2012-2013) security survey, the most common point of failure in information security is human behaviour - despite the recognition of human input being essential in the success of information security initiatives (e.g. Albrechtsen, 2007; Bulgurcu et al, 2010).

Dhillon and Backhouse (2000) claim that most security breaches are caused by existing employees, possibly due to a lack of employee integrity, whereas Shropshire (2009) believes it could be due to personal hardships or vengeance. However, in many cases the breaches are not planned with malicious intent, but are rather unintentional, accidental or out of the involved party's control (Shropshire, 2009). Stajano and Wilson (2011: 70) argue that "security engineers only thought about their way of protecting the system, not about how real users would react to maliciously crafted stimuli".

Siponen (2001) argues that information security awareness should form an integral part of the general knowledge of individuals - where anyone who sees information as an important asset, should also be aware of the potential threats. Awareness and education should be designed to respond to the cultural variations within organisations (Coles-Kemp, 2009) so that employees focus on working for, or with security, rather than against it (Furnell and Thomson, 2009).

3.1.2 Technology related threats and prevention measures

Despite being protected by intricate safeguards, systems are frequently vulnerable to attack (Stajano and Wilson, 2011). Deloitte (2013) reports that, although new technologies provide powerful capabilities to organisations, the risks introduced by these technologies are evolving at an overwhelming pace. In particular, Internet related security attacks such as viruses and hacking are immense and increasing (Herley, 2009), yet, PricewaterhouseCoopers (2013) found that 83% of large and approximately 75% of small organisations have stored 'confidential' or 'highly confidential' data on the Internet. Additionally, many organisations allow their employees to use personal devices to access organisational systems,

emails and data under the 'Bring Your Own Device' trend, despite the growing security risks posed by it (Deloitte, 2013).

Siponen and Oinas-Kukkonen (2007) claim that anti-virus software aims to guarantee the requirements of confidentiality, integrity and availability are satisfied, however, this alone is insufficient even if organisations feel 'protected' through it (Smith, 2013). Technological information security solutions impact and frame the users' behaviour and act as a "foolproof security mechanism" when they use a system (Albrechtsen, 2007: 277). Such mechanisms may automatically and unnoticeably prevent users from performing a potentially unsafe action, but it does raise questions about the level of security awareness and understanding the users of such systems have.

3.1.3 Policy related threats and prevention measures

Ernst & Young (2012) reports that, since 2006, organisations have been forced to implement new security policies that incorporate the risks arising from new technologies being used in the workplace. According to PricewaterhouseCoopers (2013), 93% of organisations where a security policy existed but was poorly understood by the employees, had employee related breaches, whereas in the organisations where the policy was understood, 47% still experienced staff related breaches. Thus, having information security policies in place does not guarantee such policies being followed by employees and the effectiveness of the implementation of these policies becomes disputable.

Information security policy compliance is currently one of the biggest challenges and concerns for organisations (Al-Omari et al, 2012). Further, an employee's attitude towards compliance of security policies may be determined by possible consequences of their experiences, for example, the time and effort required if they comply or the punishment if they do not (Bulgurcu et al, 2010). Al-Omari et al (2012) argue that compliance with security policies is influenced by quality of information, facilitating conditions and habits of employees, whereas Knapp et al (2006) believe it is top management support that is most influential.

4. Middle ground between knowledge sharing and information security

In section 2, we discussed the importance of knowledge sharing in order for organisations to gain advantage from their most valuable asset – their knowledge. However, the field of knowledge management has mostly focused on maximising the value of and exploiting knowledge. Subsequently, research into protection of knowledge has been lacking (Desouza, 2006). Although, some researchers have highlighted concerns and aimed to explore the area of knowledge protection (e.g. De Faria and Sofka, 2010; Desouza, 2006; Ryan, 2006; Holsapple and Jones, 2005; Desouza and Awazu, 2004; Gold et al, 2001), the research on this topic remains sparse.

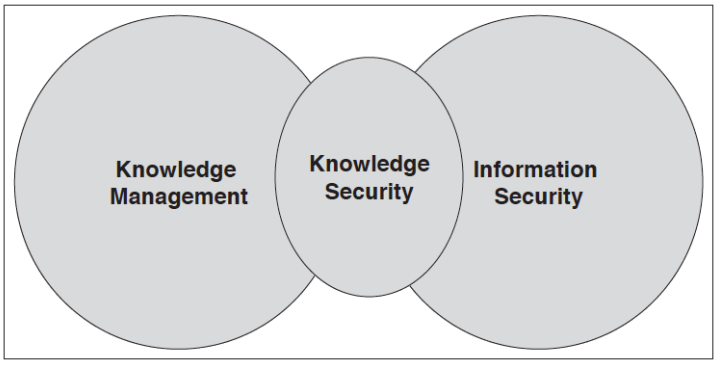

Figure 1: Knowledge security (Desouza, 2006: 2)

In section 3 we discussed how and why organisations implement information security measures to prevent and manage the loss of their valuable information. It is essential for organisations to secure knowledge, should they wish to make it a 'truly competitive resource' (Desouza, 2006), however, much of the literature on information security has focused on technical aspects (Coles-Kemp, 2009) – albeit

the integral role of human awareness and behaviour being acknowledged by various researchers (e.g. Coles-Kemp, 2009; Albrechtsen, 2007; Bishop, 2006; Stanton et al, 2005).

Despite the widespread recognition and implementation of the two practices, there could be a paradox between knowledge sharing and information security (Desouza, 2006; Ryan, 2006). Ryan (2006) discusses the security needs of knowledge management and proposes further research to help organisations effectively manage the tension between knowledge sharing and knowledge protection. Ryan (2006: 45) claims that the cause of this conflict is the "intersection of the nature of innovation and the rewards of innovation", since innovation requires novel ideas and concepts to be imagined and shared, but on the other hand, there are needs to protect intellectual capital. Similarly, Desouza (2006) draws attention to a research space that he calls, 'Knowledge Security' (see Figure 1), existing between knowledge management and information security (Desouza, 2006; Desouza and Awazu, 2004).

Achieving knowledge security is not easy and has various challenges associated with it. Desouza (2006) argues that, unlike information, knowledge is difficult to visualise and capture, in particular tacit knowledge that resides in people's heads, and if this knowledge cannot be visualised, how can it be managed? There are additional, perhaps greater, challenges that have not been raised by Desouza (2006) or Ryan (2006). For example, when looking at the possible conflict between the practices of knowledge sharing and information security, how can organisations find evidence of this clash existing in practice? Another challenge is identifying the level of knowledge security awareness amongst individuals and how this affects their knowledge sharing behaviour in the workplace, which would be a critical early step in identifying how serious an issue, if at all, knowledge security is.

5. Research gap

From our review of the literature, we argue that the research gap of 'knowledge security' exists in the middle ground between the practices of knowledge sharing, rather than the knowledge management discipline as a whole, as argued by Desouza (2006), and information security. The possible conflict between knowledge sharing and information security is an area that needs vital exploration before moving onto the next step of attempting to achieve knowledge security.

Although Desouza (2006) and Ryan (2006) have discussed the existence of this clash and other researchers (e.g. De Faria and Sofka, 2010; Ryan, 2006; Holsapple and Jones, 2005; Gold et al, 2001) have stressed the importance of 'knowledge protection', evidence of this problem in practice has not yet been presented. Further, from a practical perspective, little research has been carried out to understand an employee's behaviour and whether they experience a paradox when attempting to share knowledge whilst simultaneously abiding by the security expectations. If a paradox exists, does it make individuals careless when sharing knowledge and compromise on security, or, does their knowledge sharing become inhibited? This would be a good starting point for further research in this enticing research area.

6. Conclusion

By conducting this literature review, it has become evident that the research in these areas has grown tremendously, primarily driven by globalisation, advancements in information and communication technologies and the Internet. These factors have already changed, and continue to change, the way organisations operate and the way people work. However, the practices of knowledge sharing and information security could be in conflict due to their intrinsic opposing natures. The possibility of a conflict has not been widely recognised in academia or in organisations, and thus, requires further research to explore and understand the scale and seriousness of the problem and its impact on the knowledge sharing behaviour of individuals.

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Appendix I – ICICKM 2014 conference paper

Knowledge Sharing in Project Teams: A Research Model Underpinned by Action Learning

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Abstract: Project environments are highly knowledge-intensive as project teams are intentionally formed with a diverse range of members with specialist knowledge, skillsets and experiences in order to collaborate and produce a unique product or service. Due to their specialist expertise, individually, project team members do not have all of the knowledge a project requires and must acquire this knowledge from their peers in order to accomplish their work. So, effective knowledge sharing by team members is a fundamental component in projects that leads to better performance.

Essential learning from each project is vital in order for the team to develop and can be acquired from sharing of tacit knowledge, for example, post-project reviews or sharing of lessons learned which typically take place after project completion. Learning is 'cradled in the task' and occurs through reflection on the experience. However, reflection does not occur easily or naturally, as it requires a space in which individuals are able to stand back and relax their presuppositions. This is a greater challenge in team environments where efforts to generate reflection often fail.

Action learning (AL) takes place in a mutually supportive team where individuals can openly share experiences and problems, which enables a team to learn, develop, and make decisions on appropriate courses of action during the project lifecycle. Thus, in AL teams, reflection occurs naturally and continuously because of the time and conditions that are deliberately carved for reflection and listening. In addition to the learning that is generated, action learning also provides benefits such as team building, increasing learning capacity, empowering employees and transforming organisational culture.

However, from an extensive literature review it has become evident that there is a lack of a 'standard' definition of or approach to action learning. Despite the wide variety of action learning applications and approaches, it is primarily being used as a pragmatic instrument in research where its philosophical roots are often overlooked. Thus, in this paper, we propose a novel qualitative research approach, philosophically underpinned by AL, which will enable effective knowledge sharing, reflection and learning in cross-functional project teams.

Keywords: Knowledge sharing, action learning, reflection, project teams, qualitative research model

1. Introduction

The importance of knowledge is particularly recognised and valued in project environments where, for example, often contractor staff, consultants and third party suppliers is hired because of their specialist knowledge and skills. Sharing such diverse knowledge and experiences between the project team members can improve performance and lead to the development of innovative products and services for the organisation.

Sharing project knowledge, experiences, problems and best practices often takes place at the completion stage of the project in processes such as post-project reviews or lessons learned, which precludes the opportunity to learn and reflect during the project lifecycle. Learning and reflection are activities that go hand-in-hand, therefore learning requires reflection. However, reflection can be a

difficult and unnatural exercise, and attempts to reflect in team environments, often fail (Marquardt, 2011).

Using the philosophy of AL, in which learning takes place by a team of individuals reflecting on actions and experiences in a mutually supporting environment, reflection, and the subsequent learning, can be stimulated and supported for the project team. In addition to the reflective learning, the project team can also obtain several other benefits from an AL approach.

In this paper, we propose a fresh qualitative research approach, philosophically underpinned by AL that will facilitate effective knowledge sharing, reflection and learning in cross-functional project teams.

2. Project teams

A team is a group of individuals with a common aim where the roles and skillsets of the each member complement those of the other team members (Adair, 2011). Modern organisations continuously face new demands and are required to be innovative, which subsequently makes cooperative work in teams vital to achieve central organisational tasks (West, 2012).

West (2012: 16) claims that organisations are now moving away from the conventional and rigid hierarchical structures as "the team rather than the individual is increasingly considered the basic building block of organisations". Within the area of projects in particular, the role of teams is recognised as a key determinant of project outcome, and, Gido and Clements (2008: 332) argue that the level of effectiveness of the project team can make the difference between project success and failure.

Project teams are used in many industries and are formed to deliver industry-defined products to outside customers or to manage change and deliver value within the organisation (Chiocchio and Essiembre, 2009). Project teams can be 'traditional' where a group of co-located people work interdependently face-to-face to accomplish a project objective (Gido and Clements, 2008), or 'virtual' where a group of people who are distributed geographically, organisationally or by time differences, collaborate to work on a project via computer-mediated technologies (Powell et al, 2004). There is a greater level of heterogeneity between project team members, as compared to other organisational teams. For example, there is greater diversity in terms of geographic, cultural, religious, educational, experience levels, skillsets and communication level differences. With these added levels of complexities, it is important to understand how effective project teams can be nurtured.

Project environments are highly knowledge-intensive as project teams are intentionally formed with a diverse range of members with specialist knowledge, skillsets and experiences in order to collaborate and produce a unique product or service. Thus, due to their specialist areas of expertise, individually, project team members do not have all of the knowledge a project requires and must acquire this knowledge from their peers in order to accomplish their work (Wang and Ko, 2012). Further, project team members can have specific roles based on their specialist skillsets or be flexible where their skillsets can be utilised in a variety of ways (Camilleri, 2011). Very often these specialist skills that are not available within the organisation, thus, the employment of third-party firms or individuals, such as contractors, suppliers or vendors, are required to work with or as part of the project team (Camilleri, 2011).

2.1 Knowledge sharing in project teams

The specialist knowledge and skills of individuals in the project team, have led to the importance of knowledge being particularly recognised and valued in project environments. Hong et al (2008) found that project team members' knowledge, tacit knowledge or know-how in particular, and the ability to communicate effectively leads to positive project performance. Similarly, Deeter-Schmelz and Ramsey (2003) stress that for better individual and group level performance, sharing and combining knowledge is crucial amongst team members. Thus, effective knowledge sharing by team members is a fundamental component in projects that leads to better performance and project success (Deeter-Schmelz and Ramsey, 2003; Hong et al, 2008).

Project scope can change unexpectedly which subsequently has an impact on the team performance and can create stressful situations (Wang and Ko, 2012). In such situations, Wang and Ko (2012: 423) suggest that "undesired consequences may occur if the knowledge cannot be effectively shared among the team", for example, reduced efficiency in work, higher chances of failure and delays in deliverables. On the other hand, according to Hsu et al (2007), teams which display better interaction and knowledge sharing, are more likely to reduce uncertainties and perform better.

2.2 Learning and reflection in project teams

For a team to develop, essential learning from each project is vital (Ochieng and Price, 2010). This can be acquired from sharing of tacit knowledge, for example, and sharing of lessons learned (Goffin and Koners, 2011). According to Sharp et al (2003), sharing of lessons learned can help to avoid duplication of work and ensure knowledge is reused across projects. Further, in a lessons learned log, project team members capture the knowledge and learning they gain from the project, typically done when a project reaches completion or a particular milestone is achieved, and is then added into the project documentation (Newell et al, 2006) or shared in post-project reviews (Goffin and Koners, 2011). Furthermore, some examples of lessons learned that are linked closely to the tacit knowledge of project team members are, "dealing with project budgets, problem solving, coping with time schedules, and coping with changes in product specifications" (Goffin and Koners, 2011: 300). However, this reflective excercise usually takes place after the completion of a project and, by then, the potential benefits of learning from this valuable knowledge, for the current project, are missed.

Other researchers have also stressed the importance of reflection as being an integral part of effective learning. Hammer and Stanton (2009) suggest that various failures faced by organisations and teams all share one underlying cause – failing to reflect. According to Marquardt (2011) reflection is about individuals recalling, thinking about, pulling apart, making sense, and attempting to understand. Pedler (2011: xxi) argues that learning is 'cradled in the task' and occurs through reflection on the experience of taking action. Reflection has played a central role in many learning approaches. For example, in the field of experiential learning, Kolb (1984) and Schön (1983), who have both had extensive impact on management education (Reynolds and Vince, 2004), emphasise the importance of reflection in learning

However, the challenge is that reflection does not come easily or naturally to individuals as reflective inquiry occurs when people are given space to stand back and relax their presuppositions and assumptions (Marquardt, 2011). This becomes even more difficult in team environments where efforts to generate reflection often fail (Marquardt, 2011).

3. Action learning

"There can be no learning without action, and no action without learning" (Revans, 2011: 85).

The practice of 'action learning' was originated by Reginald Revans (1907-2003) in the 1940s (Smith and O'Neil, 2003). Revans recommended that managers should be encouraged to "learn with and from each other using the team review to find solutions to their immediate problems" (Revans, 1982: 64). Although the practice of AL was conceived in the 1940s, between 1945 and 1975, it received little favourable attention in the management literature (Revans, 1982). In the 1980s AL began to attract growing interest, primarily due to its revival by Revans (e.g. Revans, 1982) and then gained further interest in the 1990s (Dilworth, 1998).

Pedler (2011: xxi) claims that AL is "a pragmatic and moral philosophy based on a deeply humanistic view of human potential that commits us, via experiential learning, to address the intractable problems of organizations and societies". According to McGill and Beaty (2001:11), it is a "continuous process of learning and reflection, supported by colleagues, with an intention of getting things done". AL can be associated with organisational learning and the creation of a learning organisation, as well as being a vital instrument for transforming organisational culture, increasing learning capacity and empowering employees (Dilworth, 1998).

Often carried out using an AL set (ALS), which is a small learning group (Smith and O'Neil, 2003), AL provides various advantages to organisations such as building trust, professional development, enabling action taking, increasing self-awareness of individuals and organisational thinking (Haith and Whittingham, 2012). Weinstein (1999: 236) reports four key benefits of AL highlighted by practitioners and participants as being (i) resolving real business problems, (ii) improving social processes, (iii) empowering people and (iv) improving leadership qualities. Similarly, in addition to leadership development and professional learning, Marquardt (2011) argues that AL allows problem solving, team building and leads to organisational change.

There are various perceptions of AL by different researchers and thus it becomes difficult to accurately define it because it means different things to different people. Dilworth (2010) argues that, although Revans did not expect all AL approaches to be identical to his own approach, he did hope for certain basic elements to remain present. These include, empowering the learners, minimal interferences in the process by external expert facilitators, using real life problems that are of genuine difficulty and urgency, getting individuals out of their comfort zones by having them operate in unfamiliar settings and deal with unfamiliar problems, and reflecting throughout on these experiences and the assumptions behind their actions, including their implementation of solutions to the real problem addressed (Dilworth, 2010: 3). However, Dilworth (2010) raises the concern that much of the AL that takes place currently does not adopt these basic principles that Revans had hoped for, and neither has the growth of AL, in general, given a great deal of acclaim to Revans.

3.1 Reflection in action learning

In Section 2, we discussed the importance of reflection in achieving effective learning, as well as the challenges associated with it. In the case of AL, however, reflection occurs naturally and continuously because of the time and conditions that are deliberately carved for reflection and listening (Marquardt, 2011). To emphasise the importance of reflection in AL, Pedler (2011) draws our attention back to Reginald Revans', the founder of AL, original philosophy behind AL where it is argued that learning cannot take place without action, and vice versa. Revans' AL formula was, $L = P + Q$, "where learning is a combination of P (programmed knowledge, or the content of traditional instruction), and Q (questioning insight, derived from fresh questions and critical reflection)" (Pedler 2011: xxii). Similarly, Dilworth (1998) makes a strong argument that reflection is equally as important as the action itself, thus, what AL offers is high levels of judgement and understanding through the link of action and reflection.

Reflection is essential in order to convert tacit experiences into explicit knowledge (Raelin, 2001) and individuals tend to learn effectively when they reflect with like-minded colleagues on real problems arising in their organisation (Cho and Egan, 2009). Further, Cumming and Hall (2001) claim that, after an ALS activity has taken place, the set reflecting on the impact of changes that resulted from the activity will enable individuals to learn and benefit from each other as well as provide opportunities for transferring this learning to other parts of their work and life.

There appears to be a consensus amongst various researchers about the integral role of reflection in AL (e.g. Haith and Whittingham, 2012; Pedler 2011; Marquardt, 2011; Cho and Egan, 2009; McGill and Beaty, 2001; Cumming and Hall; 2001). According to Lee (1999), the fundamental difference between AL and other organised approaches of reflection is the fact that it takes place in a mutually supportive group and because it is facilitated by an appointed individual. Thus, through the reflection in AL, individuals get the opportunity to work on real issues that exist within their workplace, develop the skills to reflect upon their own and their colleagues' actions, learn from shared experiences and develop further courses of action and decisions accordingly.

4. Action learning research

4.1 Situations in which action learning has been used

Although the commonality between the definitions of AL discussed earlier (in Section 3) involves learning based on action and reflection, due to the flexibility that it offers, the application of AL has taken a variety of forms by different researchers and practitioners. In addition to the variety of approaches taken, there

is evidence of AL approaches being applied in a wide range of contexts – a few of which are discussed here.

Thornton and Yoong (2011) carried out a case study based on a blended AL approach (one that comprises of both face-to-face and online interaction) for leadership development. The particular areas of interest in this case study were the role of the facilitator in the context of blended AL, the way leadership learning is supported by blended AL, the ICT tools most appropriate in blended AL and the kind of the leadership journeys the participants took (Thornton and Yoong, 2011).

In another study, Coghlan and Coughlan (2008) used a combination of AL and action research (ALAR) to form a methodology of a research project that concentrated on collaborative improvement in a supply chain. The project, called CO-IMPROVE, aimed to formulate a business model that is supported by a web-based software system and an AL approach was taken to guide the implementation of the project via a collaborative improvement between partners in Extended Manufacturing Enterprises (EMEs). The partaking managers adopted an AL approach to accomplish their commercial objectives and whereas the academic researchers used action research researchers to consolidate the AL processes and to generate actionable knowledge (Coghlan and Coughlan, 2008). By using this combination, the researchers were able to commit to scientific rigour and combine technical elements, process and AL (Coghlan and Coughlan, 2008).

Higgins (2002) reports on another AL approach used as a participatory research process with mill workers in the Australian sugar industry. The model developed in this research, a novel integer-programming model, was underpinned by AL and consisted of a sequence of cycles including plan, action, reflect and revised plan. The model enabled the participating mills to overcome barriers and improved their infrastructure and transport efficiency. It is argued that without a participatory approach, the focus of the study would have been drawn towards academic science. Thus, by having equal participation from industry participants and researchers in the research process, combined with an equal level of interaction between the two, all participants achieved faster and better learning, and the researchers' ability to add value to industry processes was also improved.

To give an idea of the variety of its types and applications, Cho and Egan (2009: 446) in their review of AL literature, argue that examples include business-driven AL, interorganizational AL, critical AL, auto-action AL, self-managed AL, project AL, developmental AL, work-based learning, and Web-based AL. Although the examples provided above are only a few, they provide a solid evidence of the diverse application and flexible nature of AL that can be applied in different organisational settings.

4.2 Action learning based research models

A few research models have been identified where AL has been adopted to guide the research process.

Vince and Martin (1993) present a rational model of AL that is structured as a cycle consisting of five stages of reflecting on experiences, including, observation, provisional hypothesis, trial or experiment, audit and review. Vince and Martin (1993) claim that since learning is not achieved solely by intellectual or rational skills, psychological and political elements should also considered in AL, and thus propose two additional layers to this model of psychological and emotional elements that can promote or hinder AL. However, despite taking these 'softer' elements into consideration, the researchers continue to describe the AL model being of a "highly structured format" (Vince and Martin, 1993: 211), which overlooks the basic AL philosophy, e.g. focusing on learning and reflection with a flexible and non-rigid approach.

Zuber-Skerritt (2002) presents a generic model that combines AL and action research in an integrated approach. This cyclic model uses action research as a methodology for addressing organisational issues and consists of eight components of a systematised AL program, starting from the problem definition and needs analysis to program completion presentation and celebration. Zuber-Skerritt (2002) explains that all phases of the model contain an underlying cyclical process of the following: planning, taking, observing, reflecting, and revising. Integrating these five processes into each phase of the model by

Zuber-Skerritt (2002) provides the AL team the ability to follow an iterative and flexible method through which action, learning and reflection can take place at each stage.

Kuhn and Marsick (2005) have designed an AL model for initiating and empowering strategic innovation and sustained growth in mature organisations that are facing new competitive challenges. The core of this model is a set of refined cognitive capabilities including sensemaking, strategic thinking, critical thinking, malleable learning orientation, conceptual capacity and divergent thinking (Kuhn and Marsick, 2005). It is argued that individuals who are able to acquire these cognitive capabilities through AL will begin to think differently about their business, learn how to spot changing trends and develop the ability foresee the future. Subsequently, this provides challenge, opportunity and support for the organisation to overcome orthodoxies that can hinder innovation (Kuhn and Marsick, 2005). By drawing attention to the importance of cognitive dimensions, this model is underpinned by the core principles of AL. It integrates 'learning' and 'action', whilst taking into account the importance of reflection, questioning norms and collective learning. Thus, it brings 'learning' into the centre of the strategy for organisational success, without insisting on a linear approach or a set of rigid steps

Based on their extensive review of AL literature, Cho and Egan (2009) propose a conceptual framework of AL research and argue that this framework amplifies, tests and critically analyses the key characteristics of AL. This model represents the key dimensions of AL as highlighted in their literature review, including, relevant antecedents, process of AL, proximal and distal outcomes. Further, the model treats AL as a process consisting of four critical stages, i.e. the initiation of AL, AL intervention deployment, AL implementation, and AL evaluation (Cho and Egan, 2009). As compared to the models discussed prior to this, Cho and Egan's (2009) framework offers a more comprehensive and detailed approach to carrying out AL, by taking into account various characteristics that need to be considered about the methodology, tools, team, environment, learning, outcomes and the organisational impact (in the form of the success) achieved from the intervention.

The models discussed here have been designed with the aim of following the philosophy of AL, follow a linear approach and are primarily being used as a pragmatic instrument in research. However, we have been unable to find a model that is philosophically underpinned by AL and aims to improve reflection, learning and knowledge sharing practices in diverse project teams. Further, the models discussed do not provide a way of operationalising the AL approach by measuring effectiveness, suitability or success of the outcomes. Although each model emphasises the participants' learning and reflection, the role or reflection of the researcher, which could bring additional benefits to an AL model, has not been considered.

5. Novel research model using action learning

5.1 Philosophical underpinning

A research philosophy is about the development of knowledge and the knowledge itself, and, contains the necessary assumptions about the researcher's view of the world (Saunders et al, 2009). Two main research philosophies have been identified in research, *positivism*, a scientific approach, and *interpretivism*, a social approach - also known as anti-positivism or post-positivism.

This research model will follow an *intepretivist* study approach, combined with the philosophy of AL which is that - learning cannot be achieved without action, and, action without learning. As discussed earlier in Section 3 of this paper, AL enables employees to collectively engage in a continuous process of learning and reflection, whilst tackling real organisational practices. In the AL process, individuals in the project team will have the ability to share their knowledge, experiences, issues and best practices from the project, reflect on these, and, as a result, generate learning and plan of action in a mutually supportive environment.

5.2 Proposed action learning research model

Underpinned by the philosophy of AL, a cyclic research model (see Figure 1) is proposed which consists of four phases containing AL sub-cycles. Each phase follows an 'action-reflection-learning-planning'

cycle. In addition to the reflection and learning of the participants, at each phase of the model, the researcher will be able to reflect on the process and contents of the ALS. A cyclical approach will provide the flexibility to design and adapt each subsequent research phase based on the outcomes of the previous phase, to ensure that the approach used is relevant and the important areas receive the required attention.

The ALS will be a peer discussion group, facilitated by the researcher to create an atmosphere conducive to individuals focusing on discussing and reflecting on organisational practices and issues as per their experiences (Haith and Whittingham, 2012). Consisting of two ALS, the four phases of the proposed research model follow a design-implement-design-implement process. The four phases of the model and their stages are explained in the following sub-sections.

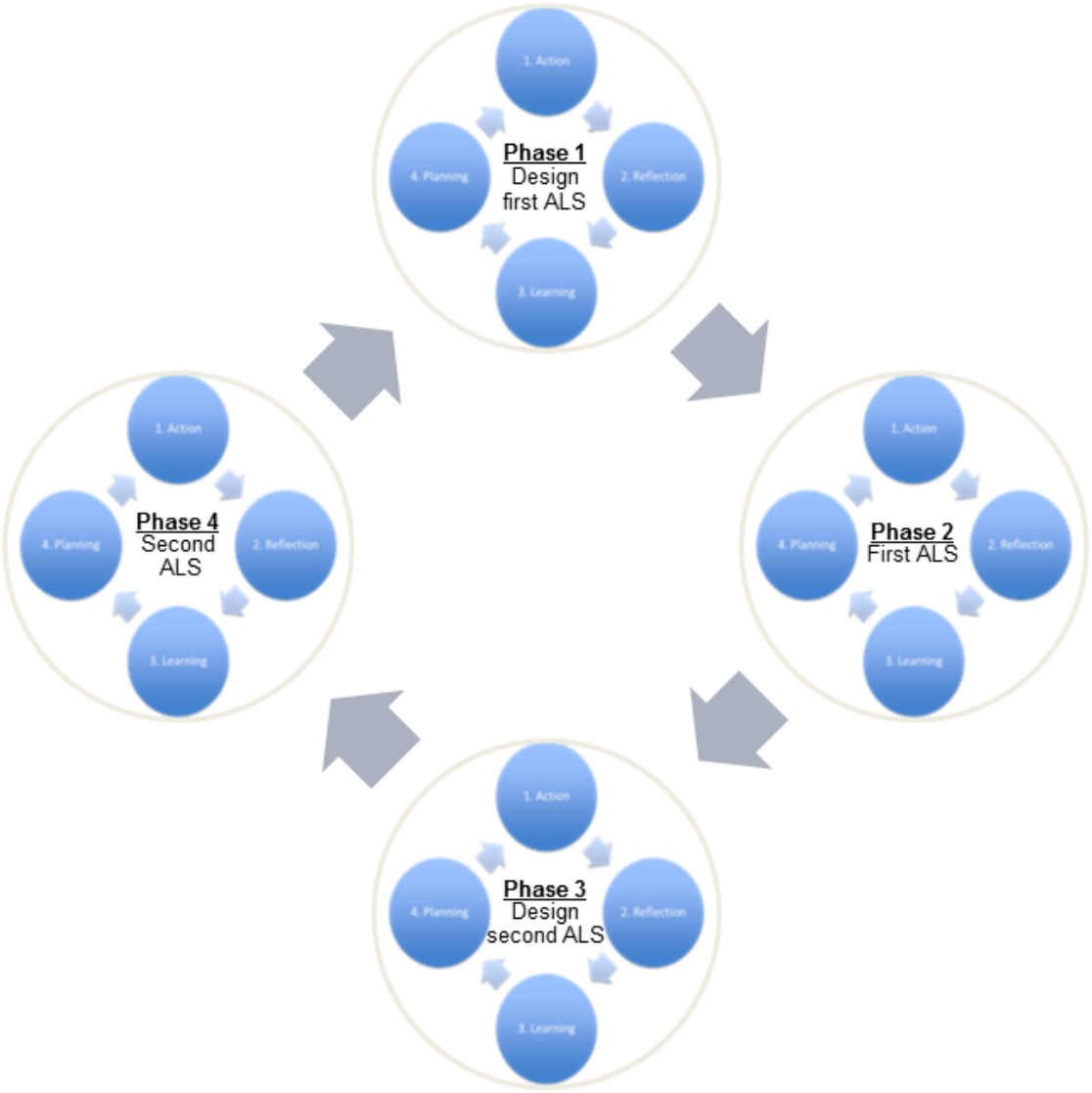

Figure 1: Research model underpinned by action learning

5.2.1 Phase 1 – Designing the first ALS

The focus of this phase is on the researcher's reflection before the study starts, in order to design and plan the first ALS.

1. *Action*: Initiate the AL process

2. *Reflection*: The researcher reflects on their own experiences and learning and the existing organisational and project team practices
3. *Learning*: Based on the reflection, identify a set of practices which are in need of attention to formulate ALS themes
4. *Planning*: Develop a set of discussion themes consisting of a set of questions, choose the project team to participate in the research and plan the first ALS

During this phase, sufficient time and consideration should be invested in developing the ALS themes and the questions that are posed to the participants to ensure that the project team and the wider organisation can benefit from relevant and productive discussions and the subsequent courses of actions. For example, an ALS theme in this context could be about the practice of 'knowledge sharing between projects', and questions related to this could focus on the strengths and weaknesses of current practices, effectiveness, bottlenecks and how improvements can be made. To ensure that the themes selected are relevant and important, input from the project manager of the participating project team may be useful.

5.2.2 Phase 2 – First ALS

The second phase of the research is the first ALS. The aim of this phase will be to initiate the reflection and learning process using the discussion themes with the chosen project team.

1. *Action*: Run the ALS with the chosen project team.
2. *Reflection*: From the discussion themes, a reflection process is triggered in the participants, enabling them to reflect on their experiences and share these with the team.
3. *Learning:* By sharing experiences, reflecting and discussing together, participants learn from one another and recognise the current practices and the associated issues.
4. *Planning*: Based on the discussions and the important matters that arise, the project team decide on courses of action for improving current practices.

5.2.3 Phase 3 – Designing the second ALS

During this phase of the AL model, the researcher is able to analyse and reflect on the outcomes of the first ALS.

1. *Action*: The researcher transcribes and analyses the outcomes of the first ALS.
2. *Reflection*: The researcher reflects on the first ALS outcomes and the effectiveness of the approach.
3. *Learning*: Insights are developed about the approach used and relevance and effectiveness of the discussion themes as experienced and discussed by the chosen project team. Strengths, weaknesses of existing practices, as well as gaps between current and desired practices, are identified.
4. *Planning*: Using the learning from the first ALS outcomes, necessary changes are made to the ALS themes (e.g. focussing, modifying, eliminating or adding discussion points) and the second ALS is designed and planned.

5.2.4 Phase 4 – Second ALS

This phase of the research model consists of a follow-up ALS, focussing on particular areas of the ALS themes as identified from the outcomes of the first ALS. This ALS should be carried out approximately 3-6 months after the first ALS to ensure that the project team have had sufficient time to reflect and apply changes to their behaviours and practices.

1. *Action*: Run the ALS with the same project team.
2. *Reflection*: From the experience and learning of the first ALS and the current discussion themes, a reflection and knowledge sharing process is triggered in the participants.
3. *Learning:* By reflecting on the previous ALS discussions and outcomes, the participants will have greater awareness and form a mature understanding of the ALS themes, be able to recognise

the changes that have resulted from those outcomes and be in a position to engage in advanced discussions and explore matters in greater depth.

4. Planning: Based on this deeper understanding and awareness developed about the ALS themes, participants in the project team are in a position to develop personal and team level plans of action to further improve their current practices.

5.3 Operationalising action learning for knowledge sharing, reflection and learning

The aim of our proposed model is to use the philosophy of AL to facilitate effective knowledge sharing, reflection and learning in cross-functional project teams. In order to operationalise this model, it is important to firstly identify the characteristics of AL, knowledge sharing, reflection and learning behaviour leading to this effectiveness. Based on our analysis of the relevant literature (see Sections 2 and 3) numerous characteristics of knowledge sharing, reflection and learning have been identified, from which we suggest the following thirteen key characteristics based on the imperative role they play in project teams:

1. Sharing of tacit knowledge and experiences (Hong et al, 2008).
2. Converting tacit experiences into explicit knowledge (Raelin, 2001).
3. The team combining the knowledge that is shared by individuals (Deeter-Schmetz and Ramsey, 2003).
4. Sharing of problems and lessons learned (Goffin and Koners, 2011).
5. Reflection on experience of taking action (Pedler, 2011; Dilworth, 1998; Marquardt, 2011).
6. Addressing the intractable problems of the organisation (Pedler, 2011; Dilworth, 1998).
7. Questioning insight and assumptions (Pedler, 2011).
8. Transforming organisational culture (Dilworth, 1998).
9. Increasing self-awareness and building trust (Haith and Whittingham, 2012).
10. Enabling action taking (Haith and Whittingham, 2012).
11. Resolving real business problems (Weinstein, 1999).
12. Improving social processes (Weinstein, 1999).
13. Empowering people (Weinstein, 1999; Dilworth, 1998).

These characteristics, collectively, constitute this research model and emphasise its core purpose. Thus, after the four phases of the proposed research model are complete and the outcomes of both ALS are compared and analysed, this list of key characteristics can be used as a tool to measure the success and effectiveness of the overall outcomes of this AL model.

6. Conclusion

Knowledge sharing is a vital activity for success in cross-functional project teams, which consist of various individuals with diverse backgrounds, knowledge, skills and expertise. Sharing of such knowledge improves project effectiveness, increases the chances of project success and provides a learning and development opportunity for the team members. However, reflective learning cannot take place without reflection, and reflection is a challenging activity, the attempts to which often fail in project environments.

Using the philosophy of AL, this reflection and the subsequent learning can be achieved amongst the project team. However, by reviewing relevant AL literature and exploring its various applications and models, it is noticeable that, not only the approaches vary to a great degree, but the core philosophy behind AL is often overlooked. Further, an AL model that can be applied to solve the problem of learning and reflection in project teams via knowledge sharing does not previously exist.

Thus, the proposed model is the first of its type, underpinned by the philosophy of AL, that aims to nurture effective knowledge sharing, reflection and learning in project teams – during the project lifecycle as opposed to after project completion, as typically happens. This model also emphasises on the reflection of the researcher before, during and after the AL process to ensure flexibility and accuracy

in the approach, as well as providing practical guidance on measuring the effectiveness of the approach, as well as operationalising the characteristics of each concept involved in the model.

Another element that distinguishes this model from other AL models is that it consists of two separate ALS (but with the same project team) to ensure learning and reflection takes place as continuous process, supported by colleagues (McGill and Beaty 2001). As a result, this facilitates the team to reflect during, after and between the two ALS which enables them recognise the impact of changes, learn from one another and transfer the learning to other parts of their work and life (Cumming and Hall, 2001).

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Appendix J – ICICKM 2014 conference prize certificate

Appendix K – ECKM 2015 Excellence Awards case study

Innovative Contribution to Organisational Knowledge Management Strategy: A Team Action Learning Initiative

Abstract

The paradoxical requirements of knowledge sharing and information security bring various knowledge management (KM) issues that affect both individuals' day-to-day work and the overall organisation's performance. This was the basis of a case study tackled by a team from Loughborough University.

The Energy Technologies Institute (ETI) is an organisation that combines knowledge and expertise from partnerships with academia, industry and the UK government, in order to deliver innovative low carbon solutions. Operating within a complex governance structure, the organisation works to meet the expectations of various stakeholders, comply with legal parameters of its membership model (to protect its unique knowledge and arising intellectual property), deliver innovative solutions many of which are of a competitive nature, and, disseminate this knowledge effectively and on time. Thus, the management of both, 'knowledge sharing' and 'information security', is an operational challenge for the ETI.

The aim of the KM initiative was to (i) understand the current knowledge sharing and information security practices at the ETI and (ii) identify ways of improving knowledge sharing within and beyond the organisation.

The KM initiative consisted of the development of an innovative and creative Action Learning (AL) approach through which ETI project teams combined their knowledge and experiences to identify their organisation's current knowledge sharing and information security practices and collectively devised practical solutions. Thus, through the combined effort of its project teams, the ETI was able to learn effectively and efficiently as an organisation about its challenges and the subsequent changes required, incorporate these in its KM strategy and initiate relevant changes to improve its KM. In addition to the value and benefits it has brought for the ETI, this innovative initiative has made methodological, theoretical and practical contributions to and received excellent feedback from international KM and AL communities.

1. **Introduction to the nature of the Knowledge Management and/or Intellectual Capital initiative and its specific objectives**

Knowledge sharing is recognised as an essential activity for organisational success, hence organisations continuously aim to exploit existing knowledge, seek new ways to improve and increase knowledge sharing activities, as well as to identify and reduce possible knowledge sharing barriers. Similarly, protecting their valuable knowledge and intellectual property (IP) through information security measures is equally important for organisations. Information security measures aim to prevent the loss or leakage of an organisation's valuable information and manage the resulting cost of any loss. So, on the one hand knowledge sharing aims to encourage individuals to share knowledge with colleagues, organisational partners and suppliers, and on the other hand, information security initiatives aim to apply controls and restrictions to the knowledge that can be shared and how it is shared.

The intrinsically paradoxical requirements of knowledge sharing and information security (see Figure 1) bring various challenges that affect both individuals' day-to-day work and the overall organisation's performance. These challenges formed the basis of a case study tackled by a team from Loughborough University.

The case study was carried out with the Energy Technologies Institute (ETI) – a UK-based organisation that is a public-private partnership set-up by the UK government and global energy and engineering companies - BP, Caterpillar, EDF Energy, Rolls-Royce and Shell. By combining the knowledge and expertise from partnerships with academia, industry and the UK government, the ETI researches,

develops and delivers innovation in low carbon energy solutions that will help the UK address its long term emissions reductions targets. Operating within a complex governance structure, the ETI works to meet the expectations of various stakeholders, comply with legal parameters of its membership model (to protect its unique knowledge and arising IP), deliver innovative solutions (many of which are of a competitive nature) and, disseminate this knowledge effectively and on time. Thus, the management of both, 'knowledge sharing' and 'information security', is an operational challenge for the ETI.

Figure 1: The conflict of interest between knowledge sharing and information security

1.1 Objectives of the Knowledge Management initiative

In order to identify ways in which the ETI can improve its knowledge sharing by effectively managing the relationship between its knowledge sharing and information security practices, understanding the current state of the two practices was vital. Therefore, the objectives of the KM initiative were to:

I. understand the current knowledge sharing and information security practices at the ETI, and,
II. identify ways of improving knowledge sharing within and beyond the organisation.

Using an Action Learning (AL) approach, central to the KM initiative design was the input from employees. The employees involved in the initiative not only participated by sharing their knowledge and experiences of the two practices and identifying the current issues, but they also became more empowered as teams to develop appropriate solutions that informed the organisation's KM strategy and initiated effective organisational change.

This case history discusses the infrastructure of the KM initiative and how an innovative and successful team AL approach was developed (section 2), the challenges that were encountered, how they developed and were overcome (section 3), as well as, how the initiative was received by the users or participants (section 4). How the efficiency and effectiveness outcomes were achieved and how they were measured (section 5) will also be discussed, followed by how the initiative was taken forward and what its contribution to the KM and AL communities is (section 6).

2. The infrastructure i.e. people, systems, hardware, software etc. required to launch the initiative

2.1 Role of people

Knowledge sharing is an activity that happens intentionally and voluntarily, and much of it in an organisation occurs between *individuals*. Equally, although information security measures are typically implemented and governed by dedicated individuals or teams in the organisation (such as IT), their impact in practice can only really be assessed through understanding the employees' day-to-day experiences of information security.

By taking into account the integral role of employees in the current practices, it was recognised that the KM initiative would need to be designed with the knowledge and experiences of the employees at its core. To elicit individual's knowledge and experiences and develop a snapshot of the knowledge sharing and information security practices, any qualitative data collection method, such as one-to-one interviews, questionnaires or focus groups, would have been sufficient. However, the aim of this initiative was more than understanding the current practices; the intention was to develop ways of improving practice, which would subsequently lead to improved organisational effectiveness and efficiency. Therefore, it was critical that the employees were engaged and become an active part of the initiative that would drive organisational change. With that in mind, a creative and novel AL approach was developed.

2.2 Approach and steps used to launch the initiative

"The end of learning is action, not knowledge" -Peter Honey

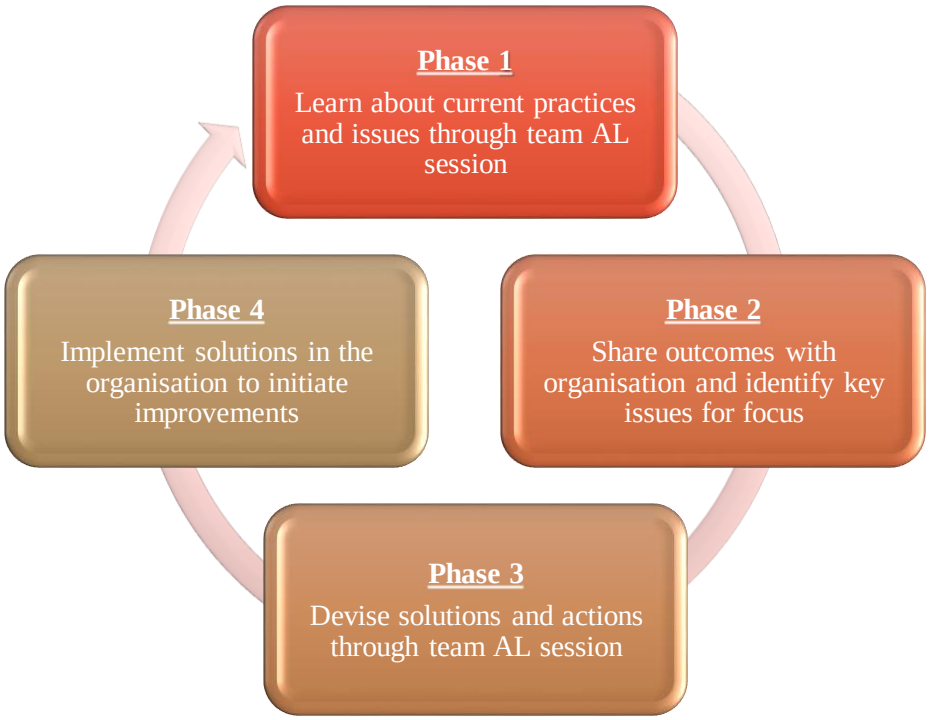

Figure 2: Design of the KM initiative

AL is a process of reflection and learning to address and solve real organisation problems. The AL environment is specifically designed to be conducive to reflection, openness, knowledge sharing and learning. Additional to the learning that is generated by and for the employees involved in AL, the process can also facilitate organisational learning and be a powerful tool for transforming organisation culture, increasing learning capacity and empowering employees.

In conventional AL, a set of individuals are brought together for the purpose of AL, as opposed to using an intact team e.g. a departmental team or project team because of the additional complexities and group dynamics of an intact team such as relationships, hierarchy and the challenges of sticking to the AL principles e.g. confidentiality. However, for this initiative a novel and creative AL approach was developed where intact *project teams* at the ETI were specifically selected for participation in the AL sessions. The relationship between knowledge sharing and information security becomes even more

important to explore in project environments as both practices are equally important to ensure that a novel product or service is achieved from the project (through the collective knowledge sharing of the team), yet it should give the organisation advantage over its competitors by protecting the knowledge which leads to that product or service being generated.

The KM initiative consisted of a cyclic AL approach with three project teams at the ETI.

Phase 1

The aim of Phase 1 was to learn about the current knowledge sharing and information security practices. Three team AL sessions were set-up (with a duration of three hours each), all consisting of the following discussion themes.

- Theme 1: Knowledge sharing (i.e. strengths and weaknesses, level of awareness and the challenges).
- Theme 2: The organisational culture (i.e. what motivates people culturally to share knowledge and the role of management in supporting and nurturing knowledge sharing).
- Theme 3: Information security (i.e. strengths and weaknesses, level of awareness and the challenges).

Each theme consisted of a set of questions, encouraging participants to reflect on and share relevant experiences. For example, one of the questions in Theme 1 was '*What do you think the strengths and weaknesses are of knowledge sharing externally for the ETI?*'. By sharing their knowledge and experiences, the team engaged in deep discussions and reflection, and collectively developed a hierarchy of the key strengths and weaknesses of the ETI's knowledge sharing and information security practices.

Participants were also asked to complete a brief questionnaire by rating the effectiveness of various aspects of knowledge sharing and information security at the ETI.

Phase 2

Phase 2 of the initiative consisted of the analysis of the findings from Phase 1, a summary report for the ETI and a meeting with the ETI to share the findings and progress. Next, based on the Phase 1 findings, the second set of AL workshops were designed.

Phase 3

Phase 3 consisted of the second set of AL sessions (duration of three hours each) with the three project teams. During each session, the team's respective findings from Phase 1 were shared, focusing particularly on the issues identified, which led to deeper discussions and the development of appropriate actions and solutions to help the ETI overcome these issues and improve its knowledge sharing.

Phase 4

In Phase 4, the outcomes of Phase 3 were analysed and the actions and solutions that the teams devised were shared with the ETI. The actions and solutions were then mapped against the existing KM activities to identify where they would be best aligned. Engagement took place with the project managers from each of the participating teams to help initiate the implementation of the KM initiative.

2.3 Role of technology

Since the initiative's purpose was to identify current knowledge sharing and information security problems and improve knowledge sharing throughout and beyond the organisation, the focus was on the social dimensions (such as the employees' knowledge, experiences and organisational processes), rather than technological dimensions. However, technology does play an important role in both knowledge sharing and information security, and therefore a number of technology related areas were

specifically explored under each of the three themes discussed in section 2.2 (e.g. systems, electronic sharing tools and technical access controls).

3. The challenges that were encountered, how they developed and how they were overcome

Although the KM initiative was overall successful, a number of challenges were faced along the way that can be expected from an initiative that intends to drive organisational level change.

During Phase 1, a major challenge was obtaining buy-in from the three participating teams. During the session, some individuals questioned whether there was value for them in participating, what significance their involvement held and how they would benefit from it. This challenge was overcome by explaining the integral role of the participants in the initiative and how their collective reflection, knowledge and experience sharing would enable the ETI to learn about its current practices and the associated issues. Further, it was also explained that the findings from this phase of the initiative (in particular the problems identified) would inform the subsequent phases and the team would use this learning and have the authority to develop suitable actions and solutions.

Another challenge faced during the first phase of the initiative was to get the participants in the project teams to focus on their experiences of the current practices '*as they are'*, as opposed to how they '*should be'* (in theory). Thus, the participants had to be regularly reminded of this throughout the sessions.

During the second session (Phase 3) the teams were reminded of the outcomes of the first session and the issues they identified, and were asked to devise appropriate solutions and actions. It was challenging to shift the team's mindset from focusing on the problems to developing solutions. Some resistance was experienced from some of the participants in taking ownership of the solutions and actions they were devising. However, this was overcome once it was clarified that the solutions and actions being developed were not the sole responsibility of the team to implement and drive, but more so for them to champion the organisational level changes that will occur. Once the teams understood the value of the initiative and their role in driving organisational change, they became proactively engaged in developing the solutions and actions and took responsibility for championing the subsequent changes.

A logistical challenge faced was finding a suitable timeslot to set-up each of the sessions due to the busy schedules of the teams. After experiencing some difficulty with this in Phase 1, the subsequent sessions were planned and set-up well in advance.

4. How the initiative was received by the users or participants

For the KM initiative, three project teams were invited to voluntarily participate and each team responded positively. At the start, each participant was informed about the process of the initiative and what will be required from him or her in the form of participation, following which a consent form was completed. The participants were also briefed and assured of anonymity of their participation which helped to develop confidence and enabled them to participate without hesitation.

As discussed in section 3 earlier, during the initial stage of the initiative, buy-in from all of the participants was challenging and required further explanation of the aims and benefits. Once this was clear, the participants engaged enthusiastically and shared their knowledge, experiences and problems openly and honestly.

Further, in the second session (in Phase 3), despite the initial struggle, the participants in each of three project teams acted as a community and collectively devised solutions to the ETI's knowledge sharing and information security problems. The approach each of the teams took to devise the solutions and take ownership of championing the actions strongly suggested that the participants felt a sense of empowerment and responsibility in improving the organisation's practices through the KM initiative.

5. The efficiency, effectiveness or competitive advantage outcomes that were achieved and how they were measured and evaluated

The KM initiative enabled the ETI to learn about its current knowledge sharing and information security practices, their associated strengths and weaknesses, and the nature of the relationship between the

two conflicting practices. More importantly, the ETI learned about the impact of information security measures on knowledge sharing. Being too cautious and overprotective of its knowledge and IP had previously created knowledge sharing barriers that affected day-to-day activities of employees, resulted in missed opportunities for timely exploitation of project outcomes and consequently impacted the organisation's performance as a knowledge generating and disseminating organisation whose outputs are knowledge driven. Becoming aware of the issues that employees experience and receiving proposed solutions by those employees, provided the ETI with a distinctive and enriched view of where it was at that stage and which changes needed to be initiated to improve the efficiency and effectiveness of its KM.

The effectiveness and efficiency of the KM initiative were evaluated through the outputs achieved. Through the initiative, the ETI generated individual, team and organisational level learning as well as a new capacity to initiate organisational change through the engagement, trust and empowerment of its employees. Thus, the KM initiative has been important for initiating thoughtful and inclusive change. The learning and solutions developed throughout the KM initiative were incorporated in the ETI's KM strategy and aligned with relevant activities to improve knowledge sharing within and beyond the organisation.

6. Plans to further develop the initiative

The KM initiative was a part of a PhD research in collaboration with the ETI. The initiative has not only been fruitful for the ETI in initiating improvements to achieve more efficiency and effectiveness in its KM activities, but has also had international impact and brought methodological, theoretical and practical benefits for the KM and AL communities.

For the KM arena, this initiative has introduced a fresh and powerful methodological approach underpinned by AL that can drive effective organisational change. Very often, the focus of KM initiatives is on technological interventions or solutions, despite the employees, practices and processes playing an integral role in an organisation's KM. In terms of the practical benefits, through this initiative, it is evident that by focusing on and empowering employees, an organisation can learn about its specific KM related practices, identify the strengths and weaknesses and develop informed solutions. Further, the involvement of employees throughout the initiative and their buy-in strengthens the organisation's capability and forms a strong foundation from which to implement KM changes and improves the chances of their success. The methodology of this initiative was shared in the International Conference on Intellectual Capital and Knowledge Management (ICICKM 2014) in Sydney where it received considerable positive feedback and was awarded the prize for 'Best PhD paper and presentation'.

The AL community has received this KM initiative extremely favorably. The case study was shared in the Action Learning and Action Research Association (ALARA) conference Australia in November 2014 and also in a workshop run by the Action Learning for Facilitators (ALF) network in London in March 2015. Both audiences acknowledged the novelty of the approach and praised the innovative theoretical and practical application of AL at the team level to address and improve organisational practices. It was recognised that the team-based approach has the potential to change mindsets in the AL community about the ways and settings in which AL can be used. Subsequently, the ALF network has invited further contribution and enlightenment on this KM initiative in a workshop in December 2015.

The Knowledge Management Case Study Team

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Appendix L – ECKM 2015 Excellence Awards merit certificate

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Knowledge Management and
Intellectual Capital Excellence Awards

September 2015

Certificate of Merit

awarded at the University of Udine
for the case history:

Innovative Contribution to Organisational Knowledge Management Strategy: A Team Action Learning Initiative

By

Ghosia Ahmed, Gillian Ragsdell, Wendy Olphert, and Mike Colechin

Sue Nugus, Conference Director
Academic Conferences & Publishing International

Dr Maurizio Massaro
For the
Competition Judging Committee

Appendix M – Research Image

Appendix N – Loughborough Research Conference prize certificate

Loughborough University

This is to certify that

GHOSIA AHMED

has been awarded

Highly Commended Image Competition

Loughborough University Research Conference 2016

Congratulations!

Professor Andrew Dainty
Director of the Graduate School

31st October 2016

Appendix O – Research poster

KNOWLEDGE SHARING & INFORMATION SECURITY: A CONFLICT OF INTEREST?

PhD Research by Ghosia Ahmed (School of Business and Economics, Loughborough University)
Academic Supervisor: Dr Gillian Ragsdell (School of Business and Economics, Loughborough University) | Industrial Supervisor: Dr Mike Colechin (The Energy Technologies Institute)

1. WHAT?

Knowledge sharing:

- Essential activity for organisational success
- Aims to encourage effective knowledge sharing with colleagues & stakeholders
- Organisations seek to exploit existing knowledge & improve internal & external knowledge sharing

Information security:

- Measures aim to prevent the loss or leakage of organisation's valuable information
- Applies controls & restrictions to the knowledge that can be shared & how it is shared
- Measures involve technologies, people & processes

2. WHY?

- Both practices have inherently conflicting interests - so how do they affect each other?
- The paradoxical requirements of knowledge sharing & information security bring various knowledge management (KM) issues that affect both individuals' day-to-day work & the overall organisation's performance
- The aim of this PhD is to: (i) understand the current knowledge sharing & information security practices at the ETI & (ii) identify ways of improving knowledge sharing within & beyond the organisation

3. HOW?

Case study at the Energy Technologies Institute (ETI):

- Public-private partnership
- Combines knowledge & expertise from partnerships (academia, industry & UK government)
- Develops & delivers innovative low carbon solutions

Development of an innovative & creative Action Learning (AL) approach through which ETI project teams:

- Combine their knowledge & experiences to identify important aspects of the organisation's current knowledge sharing & information security practices
- Identify key areas for improvement
- Collectively devise practical actions

4. RESULTS

Knowledge sharing:

- Knowledge is ETI's core product & effective dissemination is key for success
- ETI has unique position in energy industry
- Keen attitude towards improving knowledge sharing internally & externally

Information security:

- Good systems, access controls & information restrictions in place
- Strict legal & approval processes to protect information value & accuracy
- Importance given to protecting valuable knowledge & maintaining confidentiality of stakeholders

Challenges identified:

- Protective culture surrounding its knowledge
- Complex governance structure (ETI is a membership organisation)
- Identifying best opportunities for fully exploiting knowledge and Intellectual Property

Outcomes achieved:

- Learning at individual, team & organisational level
- Devised solutions to incorporate in KM strategy alongside existing activities
- Voluntary input & engagement from employees

5. INFLUENCE & IMPACT

For the ETI:

- Effective organisational learning about practices
- Identifying challenges & areas of improvement
- Incorporating learning in Knowledge Management strategy & initiating relevant changes to improve knowledge sharing

Recognition:

Awarded prize for 'Best PhD Paper and Presentation' | 11th International Conference on Intellectual Capital, Knowledge Management (ICICKM 2014) | The University of Sydney, Australia

Finalist and awarded 'Certificate of Merit' | Knowledge Management and Intellectual Capital Excellence Awards at the 16th European Conference on Knowledge Management (ECKM 2015) | University of Udine, Italy

Conference papers & presentations:

'Knowledge Sharing and Information Security: A Paradox?' | 15th European Conference on Knowledge Management (ECKM 2014) | 4-5 September 2014 | Polytechnic Institute of Santarém, Portugal | Paper:

'Knowledge Sharing in Project Teams: A Research Model Underpinned by Action Learning' | 11th International Conference on Intellectual Capital, Knowledge Management & Organisational Learning (ICICKM 2014) | 6-7 November 2014 | The University of Sydney, Australia

Book chapter:

'Innovative Contribution to Organisational Knowledge Management Strategy: A Team Action Learning Initiative', in 'Knowledge Management and Intellectual Capital Excellence Awards 2015: An Anthology of Case Histories'

Theoretical, Practical & Methodological contribution

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