Knowledge in Collectives of Experts
Exposing the Role of Social Processes in Developing and Sustaining Expert Knowledge

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Abstract

This doctoral thesis explores *development and sustainability of knowledge* within *expert collectives*, as an outcome of a dynamic *social phenomenon*. The rationale of this research is the observation that collectives of experts are a classic example of knowledge based social structures, where a group of specialists jointly learn and share their knowledge to achieve a common goal or to fulfil a shared interest. Therefore, the social processes within these communities are worthy of investigation, in particular, as to how they contribute to the collective cultivation and renewal of expert knowledge.

A qualitative inquiry of case study analysis is employed to investigate the research problem. In doing so, two case studies representing two different alternatives of expert collectives are explored in this research. The findings reveal that the development and sustainability of knowledge in expert communities is an evolving cycle of collective learning and sharing facilitated through a complex and unique set of social processes.

From a theoretical perspective, this thesis makes a novel contribution to theory by introducing the collectives of experts' perspective of knowledge. By doing so, it reveals how the notion of collectives of experts can be used to inform the knowledge refinement and revision in specialist groups more broadly. Secondly, this research broadens the traditional understanding of knowledge by elaborating its sociological importance.

From the practical perspective, this thesis contributes to improve the managerial practice, by informing managers the significance of social interactions and relationships between employees, to effectively leverage their specialist knowledge. In doing so, the findings of this research inform managers how they could foster social dynamics conducive for the advancement and renewal of the specialist knowledge in their organisations.

Declaration of Originality

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Definitions

Collectives of experts	Groupings of uniquely skilled individuals, continuously learning and sharing their specialist knowledge to achieve a common goal or to fulfil a shared interest.
External expert collectives	Groups of uniquely skilled individuals with shared personal interests, operating for the *benefit of the individuals* that constitute them.
Expert knowledge	The resultant knowledge of performing a particular task or set of activities, over and over again, to reach full professional competence.
Internal expert collectives	Groups of specialists bound by formal organisational agendas, operating for the *benefit of the organisations* that control them.
Knowledge development	The advancement of knowledge through continuous activities of learning, knowledge sharing and new idea generation.
Knowledge sustainability	The renewal of knowledge through continuous processes of relearning, extrapolation and interpolation under changing circumstances.
Social processes	The activities and actions that are a result of interactions and relationships between members in a group.

Chapter 1

Introduction

1.1 Background of the Thesis

This research explores *social processes* within *collectives of experts* that facilitate *knowledge development and sustainability*. Collectives of experts (CoE) are groupings of uniquely skilled individuals, collaborating to fulfil a common goal or a shared interest. The significance of these collectives lies within their ability to create value through effectively leveraging specialist knowledge. Thus, CoE help us to understand how a collective approach can be used to cultivate and renew specialist knowledge. However, researchers in organisational science have not yet fully recognised the significance of the collectives of experts' perspective of knowledge. To address this gap, this doctoral thesis investigates knowledge in expert collectives. In doing so, it explores development and sustainability of knowledge within these communities, as an outcome of a dynamic social phenomenon.

The rationale of this research is the observation that CoE are a classic example of knowledge based social structures, where a group of specialists jointly learn and share their knowledge to achieve a common goal or to fulfil a shared interest. Therefore, the social processes within these communities are worthy of investigation, in particular, as to how they

contribute to the collective development and sustainability of expert knowledge.

1.2 Significance of the Research Problem

The research problem to be addressed is: *How do social processes within collectives of experts facilitate knowledge development and sustainability?* It concentrates on three key issues: (1) knowledge development and sustainability, (2) collectives of experts, and (3) social processes. In this section, the contemporary importance of the research problem is discussed and justified through each of these key issues.

1.2.1 Knowledge Development and Sustainability

The first research issue explores *knowledge development and sustainability* in expert collectives. Knowledge is dynamic in nature and can be used differently, under changing circumstances, to solve new problems as they arise. Consequently, it has now become one of the most valuable resources, providing contemporary organisations with strategic advantage and success over their competitors (Bollinger & Smith 2001; Wickramasinghe 2006). The rapid growth in knowledge based economies has also made businesses realise the power of knowledge. In fact, recognition of knowledge as a key strategic resource has resulted in

organisations looking into various means of exploiting and harnessing their organisational knowledge in order to create value.

This growing interest on organisational knowledge has fuelled extensive research on the topic of knowledge since the early 1990s to this date. As a result, some of the most influential research articles on knowledge by authors such as Nonaka (1994); Grant (1996); Davenport and Prusak (2000); Brown and Duguid (2001) have been published since the 1990s. However, what we must note here is that the main focus of much contemporary knowledge research has been on effective the *management of knowledge* through its successful capturing, using, distributing and storing (Davenport 1994). This indicates that the areas of (1) knowledge development and (2) knowledge sustainability have received very little attention.

Both development and sustainability of knowledge are equally important in providing organisations with sustainable strategic advantage through enhancing quality, creativity and efficiency (Davenport & Prusak 2000). Yet, only a few studies have provided empirical insights into cultivation of knowledge. Similarly, the significance of knowledge renewal is rarely acknowledged by the existing literature. So, this tells us that there is a significant gap in the literature that needs to be addressed. Following from this recognition, this research explores knowledge development and sustainability, from the perspective of knowledge in expert collectives, an area that is yet to be fully explored.

1.2.1.1 Knowledge Development

Activities of learning, knowledge sharing and new idea generation were identified as the key components of knowledge cultivation, in the preliminary readings of the literature. So, for the purpose of this research, knowledge development is defined as the advancement of knowledge through continuous learning, sharing and gaining of new insights.

Given the fast changing and unpredictable nature of the environments contemporary businesses operate in, they continuously face new problems and challenges that need to be addressed through effective cultivation and advancement of their knowledge. This justifies why it is vital for all modern-day organisations to ensure continuous expansion of their organisational knowledge. However, knowledge development still remains an area that has not been research extensively. In addressing this gap, the issue of knowledge development is explored in this thesis, from the perspective of knowledge in expert collectives.

1.2.1.2 Knowledge Sustainability

The term knowledge sustainability is defined here as the renewal of knowledge through continuous processes of relearning, extrapolation and interpolation under changing circumstances. The concept of sustainability came into the limelight with the publication of the Brundtland Report in 1987 by the United Nations, where it emphasised the need for us to focus

on economic, social and environmental sustainability to ensure the sustainable development of the societies. Following from this recognition, in recent years, heavy emphasis has also been placed on ensuring the sustainability of corporations, through efficient economic, environmental and social performances (Bos-Brouwers 2010).

Research on economic sustainability, in particular, is rooted in ensuring the long-term survival of organisations through sustaining their economic capital. Importantly, knowledge has been recognised as a key component of a firms' intangible economic capital (Dyllick & Hockerts 2002). Therefore, promoting continuous evolution, development and update of knowledge can help organisations to create new strategic growth alternatives (Ambosini & Bowman 2009). This is important because it demonstrates how activities of knowledge renewal and update can help in organisational value creation.

Secondly, activities of knowledge renewal and recombination are significant for organisations because they can have a direct impact on creating dynamic capabilities (Cepeda & Vera 2007; Easterby-Smith & Prieto 2008; Nielsen 2006; Verona & Ravasi 2003). These dynamic capabilities in turn determine an organisation's ability to remain competitive in fast changing and complex environments. This indicates that survival of an organisation depends upon its' capacity to renew knowledge as a key organisational resource. Even so, existing literature on knowledge provides very little insights into understanding the issue of knowledge renewal. This shows us that there is a significant gap in the

literature. To address this gap, this thesis explores knowledge sustainability, with regard to expert collectives.

1.2.2 Collectives of Experts

The second research issue explores the notion of *collectives of experts*. For the purpose of this research, collectives of experts are recognised as groupings of uniquely skilled individuals, continuously learning and sharing their specialist knowledge to achieve a common goal or to fulfil a shared interest. Such collectives can be 'internal' to formal organisational[1] agendas or 'external' and independent by nature.

1.2.2.1 External vs. Internal Collectives

External collectives of experts (see Table 1), like guilds, communities of practice, professional societies and trade associations are either organically developed or deliberately created by a group of people to fulfil their shared personal interests. They can operate both inside and outside of formal organisations. For example: communities of practice as external collectives can be found both inside and outside of organisations. External communities have an individual oriented agenda and operate *for the benefit*

[1]Formal organisations are corporate actors/ institutions that receive their resources-ranging from the most tangible, such as monetary wealth, to the most intangible, such as the right to control one's time or speech-ultimately from natural persons, although some resources may come from other corporate actors. These resources can be invested or disinvested, at the discretion of the persons or other corporate actors who control them.(Coleman cited in Kieser 1989, p.34)

of the individuals that constitute them. Therefore, they can be seen as examples of socially constructed knowledge structures that facilitate effective transfer and advancement of specialist knowledge.

Internal collectives of experts (see Table 1) are identified here as groupings of specialists such as knowledge hubs, product development teams and high performance R&D teams, operating inside of formal organisations. They are deliberately formed by organisations to carry out specific tasks and to solve complex organisational problems (Ranney & Deck 1995). The internal collectives are bound by formal organisational agendas and operate *for the benefit of the organisations that control them*. As a result, the activities of these communities are driven by specific corporate or commercial operational directives.

Table 1. Characteristics of External and Internal Collectives

External collectives	Internal collectives
• Can operate both inside and outside of organisations.	• Operate within formal organisations.
• Organically developed or deliberately created by individuals.	• Deliberately created by organisations.
• Fulfil shared personal interests.	• Carry out specific organisational tasks.
• Driven by individual oriented agendas.	• Driven by formal organisational agendas.
• Operating for the benefit of the individuals that constitute them.	• Operating for the benefit of the organisation that controls them.

1.2.2.2 Expert Knowledge in Collectives

In this thesis, expert knowledge is defined as the resultant knowledge of performing a particular task or set of activities, over and over again, to reach full professional competence. The uniqueness of expert knowledge is derived from the fact that the experts do not rely on rules or guidelines to solve problems. Instead, they intuitively grasp situations through their deep tacit understanding and only use analytical approaches in problem solving (Cheetham & Chivers 2005). Hence, their knowledge is 'a necessary component in the analysis of any complex decision problem' (Keeney & von Winterfeldt 1991 cited in McBride & Burgman 2012, p. 32). Therefore, expert knowledge can be of great value for the modern-day organisations operating in highly competitive and dynamic environments, where they have to continuously provide cutting edge solutions to address new situations and problems.

Having understood the significance of expert knowledge for contemporary organisations, this thesis argues that expert collectives can provide us with valuable insights into understanding the cultivation and renewal of specialist knowledge. This is because the skilled individuals within these groups effectively (and deliberately) capitalise their knowledge through collective efforts. However, the significance of expert collectives on leveraging specialist knowledge has largely been ignored. Therefore, to address this gap in the literature, the issues of development and sustainability of specialist knowledge are investigated in this doctoral thesis through the collectives of expert perspective.

1.2.3 Social Processes

The third research issue explores *social processes* within collectives of experts. The term social processes is used here to describe the activities and actions that are a result of interactions and relationships between members in a group. This section examines the underlying relationship between the social dynamics and collective knowledge. By doing so, it illustrates the significance of exploring the issue of social processes in understanding knowledge advancement and renewal in collectives.

1.2.3.1 Social Processes and Knowledge

Knowledge is a product of human reflection and experience, because it is constructed by people as they interact in a social context (De Long & Fahey 2000; Hemetsberger & Reinhardt 2006). Social interactions help individuals to develop strong interpersonal relationships and it increases their willingness to share what they know with others in the group to create new knowledge (McFadyen & Cannella jr. 2004). This exemplifies the dynamic and socially constructed nature of knowledge. Thus, we can argue that social dynamics are likely to play a vital role in enabling successful cultivation and renewal of knowledge in expert communities.

Despite the inherent connection between social interactions, relationships and knowledge, the significance of social processes in facilitating knowledge advancement and renewal is yet to be fully explored. In fact,

organisational science research often tends to overlook ‘the human-side' of knowledge which involves exploring knowledge as a product of people interacting, sharing and reflecting upon their ideas and experiences (Adams & Freeman 2000). This deficit highlights the need for research to look into the role of social processes, when seeking ways to understand how collectives go about developing and sustaining knowledge.

1.2.3.2 Social Processes and Collectives

Exploring knowledge in collectives can help us view knowledge as something that is actively constructed in a social setting (Adams & Freeman 2000). Collectives of experts thrive through constructive social interactions and connections. Therefore, the most logical argument is that these social dynamics play a vital role in determining the effectiveness of learning and knowledge sharing opportunities in these communities.

The activities of learning and knowledge sharing were identified as the key components of knowledge development and sustainability, during the preliminary readings of the literature (Nonaka, Toyama & Nagata 2000; Nonaka, von Krogh & Voelpel 2006). So, we can argue that social interactions and connections are likely to promote the overall knowledge advancement in expert communities. Yet, empirical studies have not fully explored this inherent relationship between social processes and collective knowledge. This research is significant because it addresses this gap by

exploring the role of social processes with respect to the development and sustainability of knowledge in expert collectives.

1.3 Research Questions

Three questions were developed to guide the literature review and so to reveal how current research can address the key issues that inform the research problem. The remainder of this section introduces those research questions and provides a brief overview of the areas of literature explored under each question.

1.3.1 Research Question 1

How is collective knowledge developed and sustained?

This research question addresses the first key issue; *knowledge development and sustainability*. During the preliminary readings of the literature; activities of learning, knowledge sharing and new idea generation were identified as the key contributors of knowledge cultivation and renewal. Consequently, literature on these three areas is explored to address the first research question.

1.3.1.1 Collective Knowledge Development

Continuous learning, sharing and shifting of knowledge result in creation of new knowledge (Nonaka, Toyama & Nagata 2000). Learning is the problem-solving process triggered by gaps in potential performance (Capello1999; Pisano 1994). It is explored here as a cohesive experiential activity that can take place at both individual and collective levels.

Individual learning is when a person acquires knowledge through his or her personal activities and experiences. Collective learning, however, is a dynamic, interactive social process, which allows individuals to coordinate their actions in search of solutions to problems (Capello 1999; Kirat & Lung 1999). This tells us that a collective approach to learning can be particularly useful in helping individuals to exchange as well as to reflect upon their knowledge, ideas and experiences. Therefore, knowledge sharing is enabled through participation in complex social learning systems (Wenger 2000).

Collective sharing activities give rise to creative thinking, which then leads to gaining new insights (Rothaermel & Hess 2007). Hence, a continuous inter-play between learning and exchange of knowledge helps us develop new ideas (Liao 2006). These are important issues when we consider that businesses are required to constantly come up with new ideas to address business challenges and to exploit emerging market opportunities. Moreover, new ideas are important as they later develop into innovations; creating new contexts and new views of world, thus giving rise to new

knowledge (Nonaka, von Krogh & Voelpel 2006). Following from this recognition, this research explores theoretical foundations of learning, knowledge sharing and new idea generation to address the issue of collective knowledge development.

1.3.1.2 Collective Knowledge Sustainability

Activities of learning and knowledge sharing are important in understanding collective knowledge sustainability. Learning is a continuous reconstruction of experience that reconciles new experience with old ones (Beckman & Barry 2007). In particular, shared learning involves joint problem solving and reflection (Berkes 2009). Such a collaborative approach to learning is important in allowing participants to update their existing knowledge through relearning and considering alternative view points. Therefore, we can argue that collective learning activities help people to renew and revise their current understandings. This indicates that sustainability of knowledge can be promoted through shared learning experiences.

Collective learning activities also result in participants sharing their existing knowledge, ideas and experiences with others. Such sharing can help members not only to deepen the richness of their thinking but also to update their knowledge by building on each others' ideas (McDermott 1998). This demonstrates how collective learning and sharing activities can

help participants to extend their knowledge through extrapolation, exploitation and adaptation.

Consequently, to address the issue of collective knowledge sustainability, this research explores the literature on (1) learning and 2) knowledge sharing.

1.3.2 Research Question 2

What Constitutes a Collective of Experts?

This second research question aims at establishing the notion of *collectives of experts.* By doing so, it explores literature on: (1) guilds, (2) communities of practice and (3) high performance R&D teams. Firstly, guilds are recognised as historical examples of external collectives that are deliberately created and operate outside of formal organisations. Secondly, communities of practice are explored as examples of contemporary examples of external collectives developed organically that can operate both within and outside of organisations. Finally, high performance R&D teams are explored as internal expert collectives that are deliberately created and operate for the benefit of the organisation that controls them.

1.3.2.1 Guilds

Guilds are recognised as one of the early forms of knowledge based expert collectives, because they have been in existence since medieval times (Wenger, McDermott & Snyder 2002; Lesser & Storck 2001; Krause 1996). Medieval guilds were formed by craftsmen and tradesmen to facilitate the transfer and refinement of their specialist knowledge through apprenticeships and training (Epstein 1998, p. 682). By doing so, they ensured the continuity and standards of various trades and crafts through guilds such as Barbers & Surgeons Guild, Bakers Guild, Weavers Guild and Armourers Guild for centuries (City of London 2013). This is important because it tells us that in medieval guilds, the members were driven by their shared personal motivation to promote and protect their individual knowledge about a particular craft or a trade.

Entire economies rested on medieval guilds because they were able to facilitate economic gains by successfully mediating interactions between interdependent tradesmen, and masters, journeymen and novices of crafts (Ouchi 1980). Masters of these guilds passed on their expertise to the novices who worked under them. Once the novices completed their apprenticeship by gaining full proficiency of the craft, they then became journeymen, travelling across various towns and cities, working for other masters. This concept of journeymen is particularly interesting, because it reveals how medieval guilds encouraged their members to celebrate the 'journey of learning' through which they gained new knowledge about the craft/or the practice.

Guilds members collaboratively learned and shared their expertise to ensure the continuation of the craft, trade or a practice. They acquired knowledge about making specific things or undertaking specialist tasks and activities; relative to their guild, based on the cumulative experience of the collective and its' members (eds Epstein & Prak 2008). This reveals how guilds were able to effectively improve and update their specialist knowledge through social ties and professional interactions. Therefore, in this research, guilds are recognised as examples of historical external collectives, created deliberately and operate outside of formal organisations to fulfil the shared personal interest of members.

1.3.2.2 Communities of Practice

Communities of practice (CoP) are a group of people informally bound together by their shared expertise and passion for a joint enterprise (Wenger & Snyder 2000). The concept of CoP was first introduced by Lave and Wenger in 1991 as a novel approach to understanding learning outcomes of informal social interactions. Communities of practice are often organically developed and can exist both within or outside of formal organisational boundaries (Wenger 1998; Iverson & McPhee 2002).

What's unique about communities of practice operating within greater organisational unites is that they usually exist as informal associations of employees, yet, they operate free from institutional pressures and

administrative frameworks (Wenger & Snyder 2000; Wenger 1998). On the other hand, communities operating outside of organisational boundaries take the form of independent networks of professionals and practitioners such as those found in professional associations of accountants, architects or engineers.

In communities of practice, members are bound by their shared interest to further expertise and knowledge about a particular practice (Wenger & Snyder 2000). Consequently, they are motivated to learn and share knowledge as a collective. In doing so, they take time to collectively reflect on their experiences and to build on each other's ideas (Cook & Yanow, 1993; De Laat & Simons 2002). This collective approach to learning and knowledge sharing helps community members to deepen the richness of their thinking and to develop a shared meaning that would in turn lead to collective knowledge building (Hara 2001; Wenger, McDermott & Snyder 2002; McDermott 1998). Due to these reasons, communities of practice provides a contemporary example of external collectives that are organically developed to fulfil the shared personal interest of the members and can exist both within and outside of organisations.

1.3.2.3 High Performance R &D Teams

High Performance R&D teams (HPR&D teams) consist of experts working together in a challenging business environment that require them to provide

dynamic solutions to address complex problems and situations (Daniel & Davis 2009; Ranney & Deck 1995). They are deliberately formed by R&D organisations to solve problems through collaborative learning and knowledge sharing. As a result these teams utilise specialist knowledge of their members to make those critical advances and technological leaps that will give their company's products a significant competitive advantage in the marketplace (Katz 1994).

Members in high performance R&D teams place heavy emphasis on stimulating growth of their expertise through innovation and intellectual advancement. In doing so, they engage in collective development, refinement and renewal of their expert knowledge. The collective nature of high performance R&D teams is demonstrated through their spirit of collaboration, commitment and sense of community and communication, all of which are considered as key factors contributing to the success of these teams (Ehlen 1994; Daniel & Davis 2009). This suggests that successful R&D teams are those in which team members collectively brainstorm, experiment and test new ideas to generate cutting edge innovations to solve complex problems. Thus, high performance R&D teams can be considered as suitable examples of internal collectives of experts that are deliberately created and specifically directed to achieve formal organisational agendas.

1.3.2.4 The Notion of Collectives of Experts

By exploring literature on guilds, communities of practice and high performance R&D teams, this thesis outlines the commonalities between expert collectives operating in different contexts. In doing so, for the purposes of this research, a collective of experts is defined as a *group of uniquely skilled people, collectively sharing and cultivating knowledge to achieve a common goal or a shared interest.* This definition of collectives of experts introduced here is not limited to the examples discussed above. In fact, it can be used more broadly to include other forms of knowledge groups such as knowledge hubs, product teams and task forces that create value through social cultivation and renewal of specialist knowledge.

1.3.3 Research Question 3

How do Social Interactions and Relationships within CoE Influence the Development and Sustainability of Collective Knowledge?

The third research question is regarding the next issue; *social processes*. It explores the literature on social capital. Social capital factors such as social ties, trust, interactions, shared language and vision are important determinants of the quality of learning and knowledge transfer (Chiu, Hsu

& Wang 2006; Swart & Kinnie 2003). Activities of learning and knowledge sharing in turn facilitate the advancement and revision of knowledge. Hence, it can be argued that collective knowledge development and sustainability is likely to be influenced by the social processes within expert communities. So, to answer the third research question, this thesis explores the three dimensions of social capital (Tsai & Ghoshal 1998) that include: social interactions of *structural capital*, social connections of *relational capital* and shared artefacts and objectives of *cognitive capital.*

1.3.3.1 Social Interactions and Connections of Structural Capital

The nature of social interactions and connections between individuals are explored here through structural social capital (Tsai & Ghoshal 1998). Social interactions are recognised as the fundamental determinant of the degree and quality of knowledge transfer as they enhance the free exchange of ideas, knowledge and experiences (Argote, McEvily & Reagans 2003; Hildrum 2009; Taminiau, Smit & de Lange 2009). However, for social interactions to promote effective sharing of knowledge, they have to be both frequent and meaningful (Liao 2006).

Frequent interactions are useful in facilitating a continuous dialog between members in a group, and would help them share and discuss their ideas and experiences on a regular basis. The quality of social interactions ensure what is shared between the participants are in fact useful and conducive to

the overall advancement of their knowledge. Consequently, here in this research, it is argued that frequent and quality interactions of structural capital can lead to greater knowledge development and sustainability opportunities within collectives of experts.

1.3.3.2 Social Connections of Relational Capital

The relational social capital is examined here to help understand the nature of the social connections (Nahapiet & Ghoshal 1998). In doing so, factors such as trust, mutual understanding and commitment are identified as the key determinants of the quality of relational capital (Kimble & Hildreth 2005; Lesser & Prusak 1999). The presence of these factors positively contributes towards cultivating strong relationships between individuals (Cohen & Prusak 2001).

Trust is identified as a vital component in cultivating strong relationships (Marsick & Volpe 1999). Such trust-based relationships make individuals feel safe, hence, motivate them to open up and share their personal knowledge and experiences. This indicates the value of strong trust based relationships in promoting the sharing of tacit knowledge that is deeply rooted in personal experiences and values. Moreover, according to Dhanaraj and Parkhe (2006) the strength of a relationship between two individuals dictates what is learnt and how well it is being learned. This is important because it illustrates the significance of relational social capital in facilitating collective cultivation and renewal of knowledge.

1.3.3.3 Shared Artefacts, Interests and Objectives of Cognitive Capital

Shared artefacts, interests, objectives and interpretations of cognitive social capital are worthy of investigation because they foster opportunities for frequent interactions and help individuals to develop strong relationships with others in their group. According to Allee (2000) the accumulated knowledge of groups is embodied within shared artefacts such as stories, symbols and vocabularies. Thus, they serve as valuable tools for future learning.

Having shared objectives and similar interests can also help members in a collective to better understand and interact with each other (Tsai & Ghoshal 1998; Nahapiet & Ghoshal 1998). This is because they allow people to develop a sense of empathy around common trials and tribulations and provide them with a point of reference when it comes to sharing and developing new knowledge (Iverson & McPhee 2002; Lesser & Storck 2001; Wenger 1998).

Based on the above analysis, it can be argued that shared artefacts, interests and objectives of cognitive social capital are useful in fostering conditions necessary to establish strong social relationships of relational capital and frequent interactions of structural capital. Further, we can state that there is an inherent relationship between the three dimensions of social capital as each of these dimensions are needed to support existence and to stimulate the growth of others. Consequently, this research explores the three dimensions of social capital to understand knowledge in expert collectives.

1.4 Methodological Stance

This research employs a qualitative approach to explore the significance of social processes in facilitating collective knowledge development and sustainability. Given the nature of this social phenomenon to be explored, a qualitative approach is the most appropriate (Morgan & Smircich 1980; Denzin & Lincoln 2005; Firestone 1987) to investigate the research issues.

Using a case study methodology (Neuman 2006; Denzin & Lincoln 2005), this research conducts an in-depth analysis of knowledge in collectives of experts. By doing so, it investigates two case studies that represent two clear alternatives of collectives of experts. Case 1 representing external collectives explores two contemporary craft guilds as sub-cases while Case 2 of internal collectives investigates three medical research teams as sub-cases. In doing so, this doctoral thesis conducts a comparative assessment of knowledge development and sustainability processes in external and internal collectives. This in turn allows richer theory building as well as more robust outcomes to be derived in addressing the research problem.

To collect case evidence, this research uses a two-staged interview process. Stage 1 interviews are informal and conversational in nature with a low degree of structure while Stage 2 interviews are semi-structured. The first round of interviews aims to identify the issues that the interviewees think to be of relevant and significant in addressing the research problem. Next, Stage 2 semi-structured interviews allow the interviewer to discuss these

key issues in detail. Therefore, the nature of the interviews used in this thesis help maximise the depth and richness of the evidence gathered.

Finally, this project uses a five step thematic coding process to analyse the interview material. In doing so, it first transcribes the interviews and then establishes main themes consistent with the key issues outlined in the research problem. This is then followed by the coding of the interviews. The analysis of the interviews involves a within case comparison between the sub-cases to establish results for each major case and then a cross-case comparison between the major cases. Finally, the case results are interpreted to inform the propositions and discussed for the purpose of inductive theory building. This process concludes once the new concepts and findings reach theoretical saturation.

1.5 Expected Outcomes and Contributions of This Thesis

Expected outcomes of this doctoral thesis include informing theory by identifying a proactive approach to nurturing and maintaining knowledge in collectives of experts. In doing so, it highlights the importance of cultivation and renewal of expert knowledge. In addition, this thesis makes a novel contribution to theory by introducing the notion of collectives of experts. It reveals how the collectives of experts' perspective of knowledge can be used to inform the effective advancement and refinement of knowledge in specialist groups more broadly. Another significant

contribution of this research is that it further extends our current understanding on the role of social processes facilitating expert knowledge development and sustainability. In doing so, this thesis broadens the traditional understanding of knowledge by elaborating its sociological importance.

Key managerial implications arising from this doctoral investigation include informing managers about the value of cultivating knowledge as well as sustaining knowledge within the specialist groups in their organisations. By doing so, it argues that it is necessary for managers to pay equal attention to both of these areas. In particular, this thesis suggests that there should be proper systems in place, not only to manage organisational knowledge, but also to ensure its cultivation and renewal where groups of experts are integral to its advancement.

Next, this research helps mangers to recognise the significance of the collectives of expert perspective of knowledge, particularly, when it comes to refining and renewing unique or specialist knowledge areas. Finally, it draws managers' attention into the importance of fostering necessary conditions to promote social interactions and relationships between members of their organisations, to harness collective reflection and effective sharing of the organisational knowledge.

1.6 Structure of the Thesis

This thesis is divided into six chapters. In the first chapter, the background of the research project, along with the research objectives and questions are discussed. The second chapter provides a comprehensive review of literature and develops the propositions and the theoretical framework for the doctoral investigation. The third chapter explains and discusses the projects methodology. The fourth chapter presents the empirical work through the analysis of the case evidence. The interpretation and discussion of the empirical findings is presented in chapter five with consideration to the research propositions and the theoretical framework. Finally, chapter six concludes this thesis by providing an overview of the key findings, considering theoretical and practical contributions, and then suggesting areas for future research.

Chapter 2

Literature Review

2.1 Introduction

In this second chapter, a collection of management theories and perspectives are presented from the literature to inform the research problem: *How do social processes within collectives of experts facilitate knowledge development and sustainability*? By doing so, this literature review reveals the current thoughts on the collectives of expert perspective of knowledge.

Expert collectives such as guilds, communities of practice and high performance R&D teams have been recognised as catalysts for learning, sharing and cultivating specialist knowledge. These collectives implicitly rely on and are informed through social ties and interactions (Belfanti 2004; Wenger, McDermott & Snyder 2002; McDermott 1998; Ehlen 1994; Chen, Chang & Hung 2008). Following from this recognition, we can argue that in a collective of experts, the refinement and renewal of knowledge is an outcome of joint efforts of its members. However, research acknowledging the importance of expert collectives in leveraging specialist knowledge is rare. This gap in the literature manifested the need for exploring the research issues of *social processes* in facilitating *knowledge development and sustainability* in *collectives of experts*; thus the foundation for this

thesis was laid. These research issues are used as a point of reference for the exploration of literature, and for the subsequent development of research questions in this thesis.

Literature presented in this chapter aims to demonstrate that social processes fostering the development and sustainability of expert knowledge can be best understood by exploring knowledge groupings of experts such as those found in guilds, communities of practice and high performance R&D teams. In doing so, collections of literature corresponding to each of these research issues (as outlined in Table 2) are being explored here to address the research problem.

Table 2. Research Issues and Corresponding areas of Literature Explored

Research Issues	Areas of Literature Explored
Knowledge development and sustainability	Learning Knowledge sharing New idea generation
Collectives of experts	Guilds Communities of practice High performance R&D teams
Social processes	Social capital - Relational, structural and cognitive dimensions

This chapter is structured around three research questions, designed to address each research issue. A diagram illustrating the link between the

research problem, research questions and the areas of literature explored under each of these questions is presented in Figure 1.

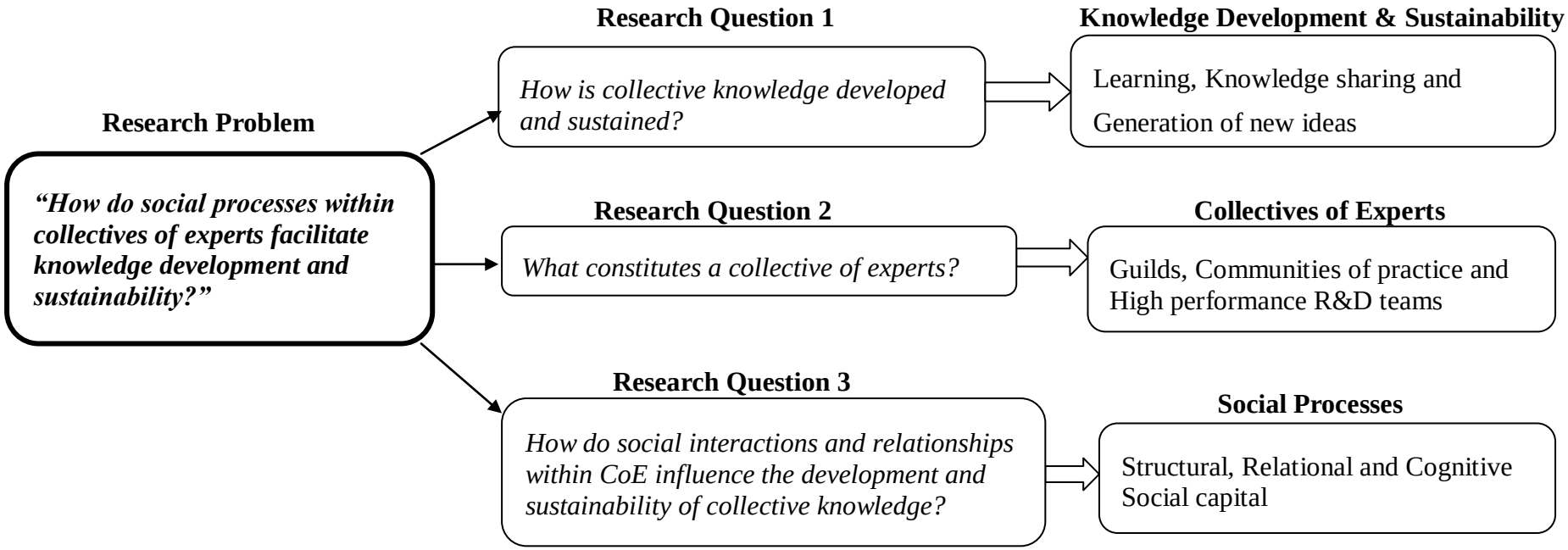
The first section of the chapter is guided by the research question: *How is collective knowledge developed and sustained?* It addresses the issues of *knowledge development and sustainability* by exploring a collection of literature on learning, knowledge sharing and new idea generation. In doing so, the following theoretical foundations are discussed: collective and individual learning, formal and informal learning, experiential and trial and error learning, explicit and tacit knowledge sharing, new idea generation, creativity and innovation.

In the second section of the chapter, the issue of *collectives of experts* is addressed through the research question: *What constitutes a collective of experts?* It explores various forms of social task groups such as guilds, communities of practice and high performance R&D teams to construct the notion of collective of experts.

The third section of the chapter informs the issue of *social processes*, by asking the question: *How do interactions and relationships within collectives of experts influence the development and sustainability of collective knowledge?* By doing so, it explores literature on social capital and discusses social interactions and connections of structural capital, social relationships of relational capital and shared goals and artefacts of cognitive capital.

Following the consolidation of these literature perspectives and theoretical interpretations, three research propositions and a supporting theoretical framework are developed to operationalise the research issues, and so to inform the empirical investigation. The propositions and the theoretical framework for this research are presented in the final section of this chapter. In doing so, it explains how and why the theoretical positions developed from the review of literature help us understand the value of social processes in facilitating knowledge development and sustainability within collectives of experts.

Figure 1. Areas of Literature Representing Collections of Management Theories and Perspectives Relevant for Each Key Issue to Inform the Research Questions that address the Research Problem



2.2 Knowledge Development and Sustainability

Knowledge development is an outcome of learning, knowledge sharing and new idea generation. Continuous learning and knowledge sharing lead to new idea generation and these new ideas later develop into innovations, thus enabling the advancement of knowledge (Liao 2006; Nonaka, von Krogh & Voelpel 2006). Activities of learning and knowledge sharing are also important in ensuring the sustainability of knowledge. This is because knowledge and skills are iteratively refined, updated and re-applied through the involvement in learning and sharing activities. Following from this recognition, literature on learning, knowledge sharing and new idea generation (see Table 3) is explored here to address the research question: *How is collective knowledge developed and sustained?*

Table 3. Knowledge Development and Sustainability: Areas of Literature, Theoretical Foundations, Corresponding Key Authors and their Contributions/ Arguments

Areas of Literature	Theoretical Foundations	Key Authors	Main Contributions/Arguments of the Key Authors
Learning	Individual & collective learning Formal & informal learning	Svensson, Ellström and Åberg 2004	Introduce a model for workplace learning by integrating formal and informal learning at individual and organisational level.
		Berkes 2009	Highlights the role of social learning in knowledge generation.
Knowledge sharing	Explicit & tacit knowledge sharing	Nonaka 1994	Argues that organisational knowledge is created through a continuous dialogue between tacit and explicit knowledge.
		Polanyi 1966	Discusses the crucial part tacit know-how plays in scientific knowledge.
		Nonaka and von Krogh 2009	Discuss organisational knowledge creation theory.
New idea generation	Generation of new ideas, Creativity and Innovation	Paulus and Yang 2000	Sharing and generating ideas in groups enhance creativity and innovation
		Popadiuk and Choo 2006	Examine the relationship between innovation and knowledge creation.
		Amabile and Pillemer 2012	Discuss social psychology of creativity. Suggest that collective sharing and problem solving could promote individual creativity.

2.2.1 Learning

Learning is an ongoing process (Marsick & Volpe 1999) which occurs at both individual and collective (group or organisational) levels as a result of involvement in various types of activities to acquire knowledge, information, insights and understandings. Various forms of learning activities including individual and collective learning, formal and informal learning, and trial and error learning are explored and discussed here to reveal the importance of learning activities in facilitating collective cultivation and update of knowledge.

2.2.1.1 Individual and Collective Learning

Individual learning is when a person acquires knowledge through his or her own personal experiences and activities. On the other hand, collective learning is a collaborative action with great social significance, because it involves learning from others, in a group or an organisation. However, it is important for us to understand that the presence of learning at the individual level does not guarantee that learning will also take place at the group level (Svensson, Ellström & Åberg 2004). This is because interactions among group members need to be fostered to enable collective learning.

Collective learning is an interactive social process of cumulative knowledge, based on a set of shared rules and procedures which allow

individuals to coordinate their actions in search of solutions to problems (Capello 1999; Kirat & Lung 1999). Consequently, when members of an organisation take part in group learning activities, they collectively share, discuss and reflect upon their ideas, experiences and knowledge, which then result in them gaining new insights (Armstrong & Mahmud 2008; Larsson et al. 1998; Salomon & Perkins 1998).

Importantly, successful implementation of these new ideas generated during collective learning activities results in innovations which later develop into new knowledge. This tells us that collective learning activities are in fact a stepping stone towards the cultivation of knowledge. Having recognised this, we can argue that collaborative learning activities play a significant role in facilitating collective knowledge development.

According to Berkes (2009) collective learning happens most efficiently through joint problem solving and reflection, with the individuals sharing their knowledge, experiences and ideas. Such collective sharing and reflection is useful in allowing group members to consider alternative view points, to relearn and to engage in critical appraisal of their ideas. These are all important attributes of group learning activities as they help participants to collectively refresh and update their knowledge.

Secondly, problem solving through collective learning activities involves continuous reconstruction of experiences. This is because joint learning provides participants an opportunity to reconcile new experiences with old ones (Beckman & Barry 2007). In particular, it makes them realize how

they could use their existing knowledge in new and creative ways to successfully address future challenges. This reveals the significance of joint learning activities to promote relearning, renewal and update of current understanding of group members. Based on the analysis, we can state that collective learning activities are also useful in promoting sustainability of knowledge.

With regard to fostering knowledge advancement and revision through collective learning, it is important for us to note that mere participation in collaborative activities does not guarantee learning outcomes. This is because learning itself; i.e. understanding and interpreting the meaning of the ideas, experiences and knowledge shared is still performed at the individual level (Gherardi & Nicolini 2000). Consequently, collective activities need to be seen as '*learning platforms'* that provide individuals with opportunities to learn from each other.

Based on the above analysis, it can be concluded that in the case of joint learning activities, individual learning is inseparable from the collective learning experience (Brown & Duguid 1991). Understanding this reciprocal relationship between individual and collective learning is important, as it tells us that for effective cultivation and renewal of knowledge in collectives, learning should take place both at individual and group levels.

2.2.1.2 Formal and Informal Learning

Learning activities can be either formal or informal (see Table 4). Formal learning involves deliberately organised activities such as workshops, tutorials and seminars. They are highly structured and often class-room based, thus, formal learning activities can be more suitable for sharing theoretical or explicit knowledge about a particular topic or a practice. On the other hand, informal learning is an everyday activity that takes place often without the person being aware of it. It is unstructured, incidental and frequently happens as a result of individuals taking part in some other activity such as casual conversations, storytelling, and trial and error experimentation (Marsick & Watkins 2001).

Table 4. Characteristics of Formal and Informal Learning

Formal Learning	Informal Learning
• Deliberately organised • Typically institutionally sponsored • Highly structured • Often class-room based • Help develop explicit (theoretical) knowledge.	• Unplanned and implicit • Unintended and opportunistic • Unstructured • Invisible. Often incidental, experiential and a result of trial and error experimentation. • Resultant knowledge is often tacit (practical) knowledge.

(References: Marsick & Watkins 2001; Eraut 2004; Svensson, Ellström & Åberg 2004)

Informal learning is often invisible and experiential. Trial and error experimentation, in particular, helps participants to better understand their

practice through the testing of different methods and techniques (Sanchez & Heene 1997; Sommer & Loch 2004). Involvement in such experiential learning activities results in individuals gaining a wealth of tacit know-how, because tacit knowledge is acquired overtime unintentionally through action, practice, and reflection (Armstrong & Mahmud 2008; Nonaka & von Krogh 2009). Consequently, the resultant knowledge of informal learning activities such as trial and error experimentation is considered often to be rather implicit (or tacit) in nature.

Given the value of informal learning activities in transferring tacit knowledge, contemporary organisations have placed high importance in fostering informal learning opportunities within their organisations (Marsick & Volpe 1999). However, we must note that often the 'conceptual tools and explicit knowledge about a task' is not shared during informal learning activities (Svensson, Ellström & Åberg 2004, p.480).

The coded and documented explicit knowledge is significant in providing the necessary background to carry out a particular task. Therefore, formal learning activities such as well-structured training programs, lectures, seminars and workshops are necessary to build that common base. This tells us that having a continuous inter-play between formal and informal learning activities is crucial to facilitate effective sharing of both explicit and tacit knowledge.

2.2.2 Knowledge Sharing

Knowledge can be either explicit (codified) or tacit (implicit) in nature. A continual dialogue between tacit and explicit knowledge create new ideas that would later stimulate innovation (Nonaka 1994; Wang & Wang 2012). This indicates that organisational member's ability to effectively exchange their knowledge is a crucial element in enhancing the innovative capabilities of organisations (Smith, Collins & Clak 2005; Saenz, Aramburu & Rivera 2009). Thus, it can be argued that sharing of both explicit and tacit knowledge is equally important for organisations to solve problems and achieve goals (Smith 2001). This section explores literature on explicit and tacit knowledge transfer, to understand how participation in sharing activities can help advancement and renewal of knowledge in collectives.

Explicit knowledge involves the theoretical (know-what) knowledge that can be expressed using words and numbers (Krogh, Ichijo & Nonaka 2000; Nonaka 1994). Such knowledge is easy to share through print, electronic and formal learning methods (Smith 2001). Moreover, it can be documented and stored in books, data bases, work manuals and written protocols, for reuse in future to solve similar type of problems. In fact, it is common for many organisations to have effective systems in place to share explicit knowledge such as market data, contact details of suppliers and protocols by documenting and storing them in a shared company data base, thus; making it accessible to their employees. This implies that

organisations can capture, store and transfer their explicit knowledge easily though formalised knowledge sharing systems and activities.

Unlike the explicit knowledge, tacit know-how is not easy to share; hence, it often gets lost and goes unrecorded. This is because tacit knowledge is highly personal knowledge that is deeply rooted in personal beliefs, experiences and action (Brown & Duguid 2000; Keeble & Wilkinson 1999; ed. Nonaka 2005; Polanyi 1966). This makes it difficult to communicate through formalised knowledge sharing activities. As a result, personal know-how of individuals is generally shared unintentionally through casual conversations, stories and mentoring. This is important because it demonstrates that fostering opportunities for members to interact in a social setting can promote tacit knowledge sharing.

2.2.2.1 Collective Knowledge Sharing for Knowledge Development

New knowledge is created when individual participants share what they know with each other, and then internalise and apply what they have learned from others in new ways to solve problems (Wah, cited in Smith 2001, p.319). This tells us that for new knowledge to be created, individual participants need to have the ability to understand and interpret what they have learned through collective sharing. Following from this recognition, we can argue that individual members' ability to interpret and understand the shared knowledge is determined by their background knowledge and experiences.

Firstly, having some background understanding or prior knowledge about the practice or the topic being discussed is important because it helps participants to internalise the new information they have acquired during collective learning activities. Consequently, we need to realise the significance of participants having some background knowledge to ensure effective communication, acceptance and interpretation of knowledge which is being shared during collective activities.

Secondly, personal experiences of individual participants (shaped by their observations, values, thoughts and feelings) can also influence their ability to understand the knowledge shared during collective activities. This is particularly the case with tacit knowledge (Bushe 2009) because it is highly personal and often found in the form of undocumented ideas, insights and know-how. Such knowledge is deeply rooted in personal experiences and beliefs thus understanding it would require both the receiver and sharer (of knowledge) to have shared experience (Nonaka & Toyama 2003). This tells us that personal experiences of individual participants can also affect their ability to understand the knowledge shared during collective activities.

The above discussion reveals the significance of background knowledge and experience of individual participants in determining their ability to interpret and understand the knowledge shared. Capacity to understand the acquired knowledge is crucial because then only one can develop new ideas and new knowledge. Due to these reasons, in this thesis, it is argued that background knowledge and experiences of individual participants is likely

to influence the knowledge development in collectives of experts. Therefore, the **first proposition** of this research is:

> ***P1.*** *In CoE, the background knowledge and experiences of individual participants is likely to influence collective knowledge development.*

2.2.2.2 Collective Knowledge Sharing for Knowledge Sustainability

In this doctoral investigation, the idea of knowledge sustainability is presented as the renewal of knowledge through continuous processes of relearning, extrapolation and interpolation under changing circumstances. In doing so, it recognises the significant role played by ongoing collective knowledge sharing activities to ensure the revision and update of knowledge. Collective sharing of knowledge is important in making individual participants realize how they could use their existing knowledge in new and creative ways to successfully address future challenges. This can be achieved in two ways.

Firstly, individuals are more likely to use knowledge sharing as an opportunity to deepen their own understanding (Wang & Noe 2010). So, knowledge sharing itself is a learning experience for the sharer. Secondly, continuous sharing of individually acquired knowledge with others in the group facilitates its revision and renewal. This is because when members in a community take time to collectively reflect on their experiences, it

allows them to build on each other's ideas. Importantly, this in turn helps them deepen the richness of their thinking and insights (McDermott 1998). Therefore, it is apparent that collective sharing activities promote sustainability of knowledge.

What is important to note here is that to facilitate the strategic renewal of knowledge, individuals need to iteratively refine and re-apply their knowledge through participating in continuous knowledge sharing activities (Crossan, Lane & White 1999). This tells us that successful extrapolation and interpolation of knowledge under changing circumstances can be achieved through the involvement in ongoing collaborative learning and sharing activities. Therefore, it can be argued that in expert collectives knowledge is likely to be sustained through ongoing collective sharing activities, so the **second proposition** of this research is:

> ***P2.*** *The collective sharing of knowledge and ideas in CoE is likely to be key to the sustainability of their knowledge.*

2.2.3 Generation of New Ideas

New idea generation is important for the cultivation of new knowledge because it helps generate knowledge by stimulating innovation. Existing literature identifies generation of new ideas as an outcome of collective learning and knowledge sharing (Lawson & Lorenz 1999; Rothaermel & Hess 2007; Paulus & Yang 2000; Gilsing 2005).

Learning activities help members share their ideas and experiences with others. This result in individuals learning from each other and then understanding and interpreting what they have learned based on their individual capacities. Importantly, it is this individual level learning that enhances individual level creativity and helps members to engage in creative exploitation of acquired knowledge (Amabile & Pillemer 2012). This indicates that creativity is needed to stimulate one's ability to reflect, interpolate and extrapolate knowledge to generate new ideas (Chen, Chang & Hung 2008; Nahapiet & Ghoshal 1998; Harada 2003). In most cases the biggest challenge is not generating more ideas, but how to take the really good ideas and make them actually happen by integrating them into practice (Denning 2005; Hargadon & Sutton 2000). Therefore, only those new ideas that can be successfully implemented to solve problems are considered as innovations.

Innovation is a process that involves generation, adaptation, implementation and incorporation of new ideas (Van de Ven, Angle & Poole 1989). Consequently, generation of new ideas and their successful implementation into a new product, a process or a technique is recognised as the key to innovation (Brown & Duguid 1991; Popadiuk & Choo 2006). Importantly, successful innovations create new contexts and new view of world, and as a consequence, give rise to new knowledge (Keeble & Wilkinson 1999; Nonaka, von Krogh & Voelpel 2006). This is useful information as it informs us that collective cultivation of knowledge is an outcome of innovation.

Once new knowledge is developed to solve problems, it is then shared through collective learning and sharing activities to generate new ideas which will in turn stimulate future innovations. This shows us that development of knowledge can also be the course of innovation (Taminiau, Smit & de Lange 2009). Following from this recognition, we can argue that collective development of knowledge is not only an outcome of innovation but also is the cause of innovation itself, hence, the development of expert knowledge and innovation are interrelated (McAdam 2000; Popadiuk & Choo 2006; Waters 2000).

2.2.4 The Process of Collective Knowledge Development and Sustainability

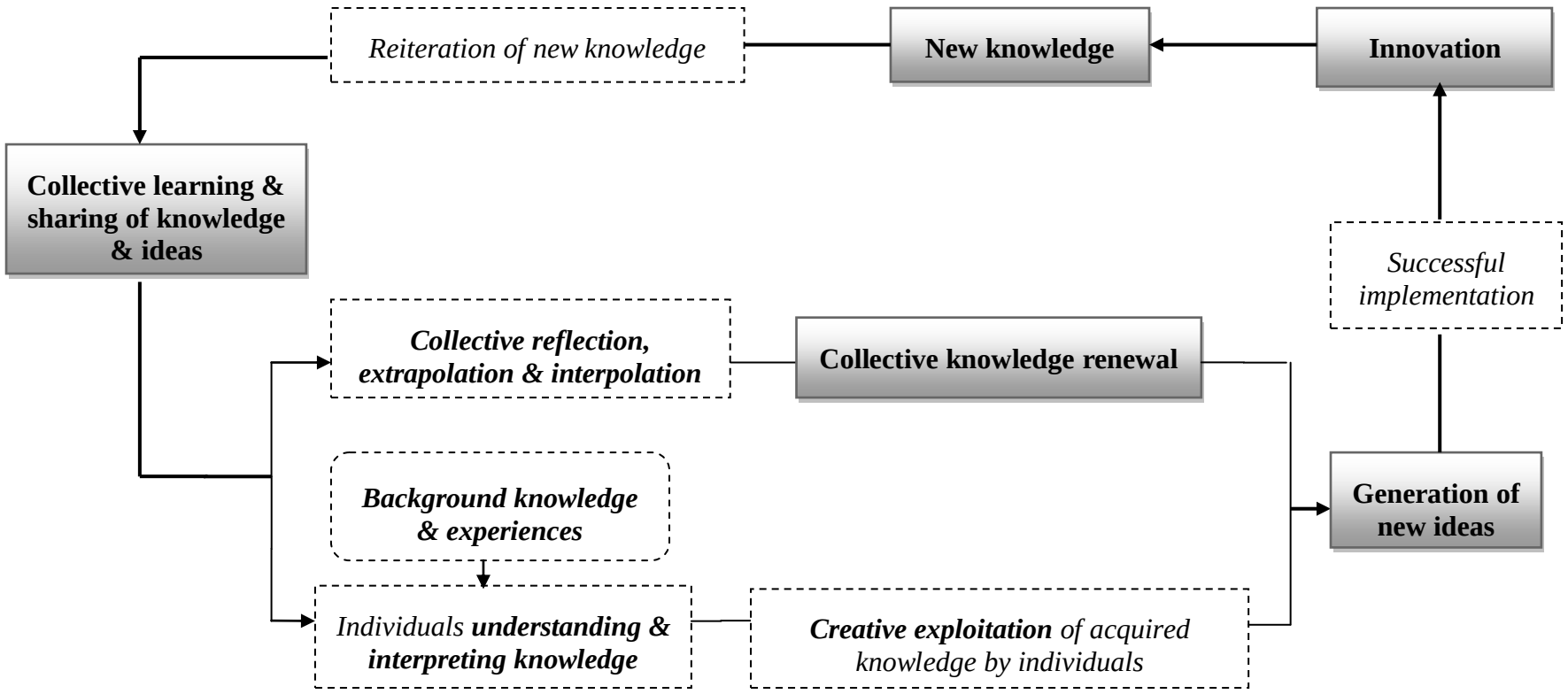
A theoretical framework has been developed in conjunction with the literature review (see Figure 2) to illustrate the process of collective knowledge development and sustainability as a cyclical process of collaborative learning, knowledge sharing and new idea generation. Firstly, participation in group learning activities leads to collective sharing of knowledge, experiences and ideas. Next, the individual participants try to understand and interpret what they have learned through collective sharing based on their background knowledge and personal experiences. Once the individual participants acquire the shared knowledge based on

their individual capacities, they then engage in creative exploitation of this individually acquired knowledge, which results in new idea generation.

Collective learning and knowledge sharing activities can also stimulate new idea generation by allowing participants to collectively reflect, interpolate and extrapolate their existing knowledge. Such collective renewal and revision of existing knowledge can lead to generation of new ideas as members realise new ways of using what they already know. This is important because it shows us how collective sustainability of knowledge can also contribute to the development of collective knowledge.

Successful implementation of new ideas to improve products, processes and work methods result in innovation. These innovations give rise to new contexts and new view of the world, thus they become new knowledge over time. New knowledge is then shared through collective learning and sharing activities, so that it can be used to solve similar problems that might arise in the future.

Figure 2. The Process of Collective Knowledge Development and Sustainability



2.3 Collectives of Experts

This section explores the notion of *Collectives of Experts* (CoE), as a mechanism for enabling expert knowledge development and sustainability. The literature informing this research issue is derived from areas of guilds, communities of practice (CoP) and high performance R&D teams (HPR&D teams) (see Table 5).

Firstly, guilds are discussed here as historic examples of external collectives operating outside of formal organisations. Next, CoPs are explored as contemporary external collectives that can exist both inside and outside of organisations. Finally, this section investigates HPR&D teams as long–established examples of internal collective. Collectively, these theoretical areas contribute to an understanding of the notion of collectives of experts and inform the second research question: *What constitutes a collective of experts?*

Table 5. Collectives of Experts: Areas of Literature, Corresponding Key Authors and their Contributions/ Arguments

Areas of Literature Explored	Key Authors	Main Contributions/Arguments of the Key Authors
Guilds	Ogilvie 2007	Provides a critical appraisal of pre-modern craft guilds as economic institutions.
	Epstein 1998	Argues that medieval guilds played a leading role in preindustrial European economy through their apprenticeships and technological inventions.
	Belfanti 2004	Discusses how craft guilds helped transfer technical knowledge during the early modern age.
Communities of practice	Lesser and Prusak 1999	Argue that CoP contribute to the development of social capital within organisations and by doing so, they enable effective sharing and creation of knowledge.
	Allee 2000	Explains how OD practitioners can promote knowledge sharing and creation through CoP.
	Wenger and Snyder 2000	Introduce CoP as a new organisational form emerging in companies that thrive on knowledge.
High performance R&D teams	Ehlen 1994	Explains how shared responsibility and common goals can make HP teams successful.
	Daniel and Davis 2009	Argues that having a sense of commitment and community help HPR&D teams excel.

2.3.1 Guilds

A Guild is 'an association formed by a group of people who regard themselves as sharing some common characteristics and wish to pursue some common purpose' (Ogilvie 2007, p.1). The history of the guilds can be traced back to medieval times (Wenger, McDermott & Snyder 2002; Lesser & Storck 2001; Krause 1996). These medieval guilds were primarily formed to enable the transfer of skills through apprenticeship and training (Epstein 1998, p. 682). In doing so, they ensured the continuity and standards of trades and crafts.

Even though the significance of medieval guilds as economic contributors declined over time, it is evident that they laid the foundation for the modern apprenticeship system of industrial training (Fukuyama 1995; Richardson & McBride 2009). Interestingly, some of these guilds continued to grow around certain professions and trades acting as knowledge sharing platforms (e.g. the pharmacy guild). This illustrates the enduring significance of guilds as catalysts for promoting specialist knowledge related to unique crafts and trades.

Medieval guilds were formed intentionally by specialised artisans and tradesmen (Epstein 1998, p. 685) to protect the knowledge and ensure the continuation of various crafts, trades and practices; e.g. the Barber-Surgeons Guild, circa 14thcentury (Ellis 2002), Bakers Guild, Weavers Guild and Armourers Guild (City of London 2013). So this tells us that in guilds, members were driven by their shared personal motivation, to ensure

the continuation of expertise in the craft or the trade. This means that the activities of guilds had a personal agenda. Therefore, we can consider guilds as examples of external expert collectives, driven by shared personal motivation of their members.

Guilds were able to effectively mediate interactions between interdependent tradesmen, as well as the masters, journeymen and novices of crafts (Ouchi 1980). According to Braverman (1974), guild members shared knowledge about tools, materials and processes of their practice (which tradition, training and experience have given them) by constantly interacting and collaborating with each other. For example, upon joining the guild, novices were first trained under the guild masters. After completing their apprenticeship, they then travelledas journeymen from town to town working for different masters, to further improve their skills and techniques (Wiesner 1989).

The role of journeymen is particularly interesting because, firstly, it tells us that guilds encouraged member's to celebrate the journey of learning, through which they gained new knowledge about the craft / or the practice, as well as refining their own. Secondly, it shows us that collaborative open learning and knowledge sharing activities were used by guilds to ensure the advancement and continuation of their expert knowledge.

The collective sharing activities within guilds were prompted by the shared interests, norms and values of guild members. In fact, Belfanti (2004) argues that guild members' ability to collaborate with others for a common

purpose allowed them to effectively share and leverage their specialist knowledge. This is important because it indicates that having a common understanding helped guild members to trust one another, and facilitated coordination and cooperation among them for mutual benefit (Putnam 1995; Fukuyama 1995).

Based on the above review of literature, we can conclude that in guilds, members were bound by shared norms and values, and they engaged in collaborative learning and knowledge sharing to ensure the prolongation of knowledge and standards of their crafts, trades and professions. Thus, for the purpose of this research guilds are explored as historic examples of external collectives of experts.

2.3.2 Communities of Practice

Communities of practice (CoP) are another example of experts working together sharing their knowledge. Liedtka (1999) suggests CoP evolve over time as a result of groups of likeminded practitioners[2] coming together to develop a shared meaning by collectively learning and sharing their knowledge (Hara 2001; Wenger, McDermott & Snyder 2002; Allee 2000). Lave & Wenger first introduced the concept of communities of practice in 1991, as a novel approach to understanding learning outcomes of informal and situated social interactions. Wenger (1998) defines communities of

[2]Practitioners are "amateurs in the sense that they dwell in a practice and experience an intellectual pleasure that they share with others" (Gherardi 2009, p.538)

practice as a unique combination of three fundamental elements: domain, community and practice.

- **Domain:** organizing around the domain of knowledge that gives members a sense of *joint enterprise* and brings them together through shared understanding of their situation

- **Community:** members function as a community through relationships of *mutual engagement* that bind members together into a social entity and interact regularly by engaging in joint activities that build relationship and trust.

- **Practice:** building capability in its practice by developing a *shared repertoire* and resources such as tools, documents, routines, vocabulary, symbols, artefacts, that embody the accumulated knowledge and future learning of the community.

Communities develop organically and can exist within or outside of formal organisational boundaries (Wenger & Snyder 2000; Wenger 1998; Lesser & Prusak 1999). CoPs that are outside to organisational boundaries, operate in forms of networks of professionals and practitioners such as professional associations of accountants or architects (Wenger 1998; Iverson & McPhee 2002). According to Roberts (2006) obtaining membership in these communities can be beneficial to certain individuals working in the current accelerated business environment. This is because it would give them a chance to acquire and refine their specialist knowledge

and increase their ability to deliver innovative solutions to address critical issues faced by businesses and societies.

Communities within formal organisations, operate as informal collectives of people, who continually negotiate, communicate and coordinate with each other directly as they share a passion for a joint enterprise (Wasko & Faraj 2005; Wenger & Snyder 2000; Wenger 1998). For example: the Community of Practice for Teaching and Learning in the Professions Faculty at the University of Adelaide. These communities can develop within as well as across different organisational divisions, attracting members with a diverse range of competences (Wenger & Snyder 2000; Ruuska & Vartiainen 2003). This is further illustrated in the above example where academics and administrative staff from Schools as diverse as architecture, law, business and education come together to share ideas on teaching and learning.

Communities of practice are generally more informal in their activities than work groups or business units (Allee 2000; Peltonen & Lamsa 2004). So the community members operating freely from directive institutional pressures rather adopt a level of self-determination in their undertakings. This is important because it tells us that even though communities of practice can develop within formal organisations, they still operate free from organisational directives.

The term *community* highlights the personal basis upon which relationships are formed. On the other hand, *practice* can be defined as a dynamic

process through which individuals learn by actually performing the task and interacting with others performing similar tasks (Lesser & Prusak 1999). As a result, communities of practice tend to develop organically, in response to the contributions and interests of members. Moreover, the significance of these communities lies within their ability to provide a 'shared forum' for experimentation and creativity (Roberts 2006; Nätti & Still 2007). By doing so, community members create, share and apply knowledge as a collective, about a topic or a practice they are mutually interested in. This tells us that in communities of practice, members associate because they have a shared interest in furthering their expertise and knowledge about a particular topic or a practice.

Members in communities of practice learn collectively by sharing experiences and knowledge with each other, in free-flowing and creative ways (Storberg-Walker 2008; Kasper, Mühlbacher & Müller 2008; Kimble & Hildreth 2005; Wenger & Snyder 2000). It tells us that community members engage in collective learning and sharing knowledge to fulfil their shared interests. This is why communities of practice are often recognised as powerful vehicles for sharing knowledge, in particularly, through the means of social interactions (Allee 2000; Ardichvili et al. 2006; Peltonen & Lamsa 2004). Consequently, we can conclude that communities of practice are examples of external expert collectives, with a contemporary approach to collective knowledge sharing that can exist both inside and outside of formal organisations.

2.3.3 High Performance R&D Teams

A team is a small group of people with a shared goal and a common purpose, who are mutually accountable for creating a work product (McDermott 1999). Organisations have been using teams for a long time, to carry out specific tasks and organisational activities. High performance R&D teams, in particular, consist of groups of well trained technical and scientific experts from diverse sources working collectively on complex technological projects, in intensely challenging environments. These teams are deliberately formed by organisations operating in highly competitive industries (such as high-tech and bio-tech), to meet the demands of rapid new product development (Daniel & Davis 2009).

According to Kokavcova and Malá (2009), organisations form high performance R&D teams act firstly, to create a space that support learning and exchange of ideas among people; and secondly, to support the creation of new knowledge that will help them solve problems and remain competitive. Consequently, members in R&D teams are driven by their shared commitment for generating results that will in turn help them fulfil the goals of their organisations (Kodama 2007; Lesser & Prusak 1999). Importantly, this has made them act upon the best interest of their mission along with others who are also committed to help each other to achieve mutual goals (Ehlen 1994). So, it tells us that in high performance R&D teams members associate for the purpose of fulfilling the responsibilities they have towards their assigned organisational unit.

Generally, high performance R&D teams consist of technical and scientific experts from diverse fields. These diverse expertise and knowledge of team members are seen as both a source and a barrier to their ability to innovate and create new scientific knowledge (Carlile 2002). Following from this recognition, it can be argued that the effectiveness of HPR&D teams lies within the members' ability to excel at collaboration (Newman 2009). So, the spirit of collaboration, commitment and a sense of community are all considered as key factors contributing to the success of these teams (Ehlen 1994; Daniel & Davis 2009). However, to co-operate their divergent viewpoints, team members may have to develop boundary objects (e.g. shared goals, methods and repositories) that are 'both adaptable to different viewpoints and robust enough to maintain identity across them' (Star & Griesemer 1989, p. 387).

Driven by their shared commitment for results, team member's work together to develop new products through brainstorming, experimenting, testing and presenting new ideas. In fact, it is through these collective activities that they address complex problems and generate rapid innovative solutions (Ranney & Deck 1995). This is important because it tells us that the activities of R&D teams involve members collaboratively learning and sharing their expert knowledge, to solve complex organisational problems. Thus, we can conclude that high performance R&D teams are examples of internal expert collectives, operating within formal organisational directives and agendas.

2.3.4 What Constitutes a Collective of Experts?

The previous sections explored guilds, communities of practice and high performance R&D teams as examples of collectives of experts. Based on the above reviews of literature, this section points out some of the most significant differences and parallels between these three expert collectives (see Table 6); with regard to their type of association, purpose of association, activities agenda and type of development.

The literature informed us that the purpose of association for those in guilds and communities of practice is different from those found in high performance R&D teams. Members of guilds and communities of practice associate because they have a shared *personal* motivation or interest on a particular craft or a practice. As a result, the learning and sharing activities of these two types of communities are directed towards the benefit of the individual members that constitute them. So, they are examples of *external* collectives. In contrast, team members associate as they are being assigned to the same organisational unit, thus; have a shared commitment towards generating results to help achieve *organisational* goals. This meant that the activities of teams are designed for the benefit of the organisation that controls them. Hence, R&D teams are examples of *internal* expert collectives. This tells us that the purpose of association for guilds and communities of practice are personally directed where as in R&D teams it is driven by the contractual obligations, team members have towards their assigned organisational unit.

With regard to the issue of typical development, both guilds and R&D teams are created deliberately, however, for two distinct purposes. Guilds are deliberately created by craftsmen and tradesmen who are driven by their shared personal motivation to ensure the continuity of their craft or the trade. Similarly, R&D teams are also intentionally created, however, by formal organisations to fulfil their organisational goals and agendas. Consequently, the R&D teams operate *inside* formal institutions, while the guilds exist *outside* of these organisations. So, guilds and R&D teams provide two clear alternatives of expert collectives that are deliberately created, to fulfil shared personal and organisational agendas respectively.

Interestingly, the typical development of communities of practice differs from both guilds and teams in two aspects: firstly, communities are developed organically and are not generally deliberately created although they may be post-rationalised as intentional. Secondly, unlike the guilds and R&D teams, the communities of practice can develop both *inside* and *outside* of formal organisations.

Based on the above analysis we can conclude that while guilds and R&D teams are similar in the dimension of typical development, they differ with regard to their purpose of association and the direction of their activities agenda. Secondly, guilds and communities of practice are similar in their purpose of association as well as how their activities are shaped, yet, different on the dimension of typical development. Finally, when comparing communities of practice with R&D teams, they do not share any similarities in terms of either of these dimensions.

Despite their differences in terms of purpose of association and typical development, we can draw a couple of significant parallels across guilds, communities of practice and R&D teams, with regard to their type of association and activities carried out with the collective. Firstly, all three collectives are groupings of uniquely skilled individuals or specialists. Secondly, members in all three collectives engage in collaborative learning and knowledge sharing activities to fulfil a shared interest, or to achieve a common goal. Due to these reasons, it is clear that a *collective of experts is constituted when a group of uniquely skilled individuals associate to collaborate, learn and share their knowledge to achieve a common goal or to fulfil a shared interest.* Thus for the purposes of this research a CoE is recognised as such a group and will be used to describe all the collectives that follow.

Table 6. Characteristics of Various Forms of Collectives of Experts

	Guilds *External collectives*	**Communities of Practice** *External collectives*	**High Performance R&D Teams** *Internal collectives*
Type of Association	• Groups of uniquely skilled artisans and tradesmen.	• A group of people with similar expertise and interests.	• A collective of technical or scientific experts.
Purpose of Association	• To fulfil shared *personal* motivation to excel in a craft or a trade.	• To fulfil shared *personal* interests on a particular topic or a practice	• To fulfil the responsibilities towards the assigned *organisational* unit.
Activities Agenda	• Learn and share knowledge about a particular craft or a trade, for their *individual* benefit.	• Learn and share knowledge to further their *individual* expertise.	• Learn and share specialist knowledge to solve complex problems, for the benefit of the *organisation* that controls them.
Typical Development	• Deliberately created • Exist *outside* of formal organisations.	• Organically developed • Exist either *inside or outside* of organisations.	• Deliberately created • Operate *inside* of formal organisations.

2.4 Social Processes

This section explores *social processes* that facilitate knowledge development and sustainability in collectives of experts. The literature informing the issue of social processes is presented here through the *three dimensions of social capital*: structural, relational and cognitive capital (Tsai & Ghoshal 1998).

Social capital refers 'to the features of social organizations that facilitate coordination and cooperation for mutual benefit' (Putnam 1995, p.67). The features of social capital include: social ties, trust, interactions, relationships, shared language, vision and norms (Lesser & Storck 2001; Du Plessis 2008; Lesser & Prusak 1999).These social features are recognised as key determinants of collaborative learning and knowledge sharing opportunities (Swart & Kinnie 2003; Chiu, Hsu & Wang 2006).

The previous sections of this chapter discussed activities of learning and knowledge sharing as key components of knowledge cultivation and renewal. So, it can be argued that there is an inherent relationship between social capital and collective knowledge cultivation and renewal. Consequently, this section explores literature on social capital to understand its impact on knowledge in expert collectives (see Table 7).

Table 7. Social Processes: Areas of Literature, Theoretical Foundations, Corresponding Key Authors and their Main Contributions/ Arguments

Areas of Literature Explored	Theoretical Foundations Discussed	Key Authors	Main Contributions/Arguments of the Key Authors
Social Capital	Social interactions of structural capital, Social connections of relational capital & Shared artefacts, interests and objectives of cognitive capital	Tsai and Ghoshal 1998	Examine the relationship between structural, relational and cognitive social capital to explain how they can enhance organisational value creation.
		Nahapiet and Ghoshal 1998	Examine the three dimensions of social capital to explain how they facilitate the creation and exchange of knowledge.
		Coleman 1988	Introduces the concept of social capital
		Cohen and Prusak 2001	Argue that social capital is key to knowledge sharing, innovation and high productivity in organisations.
		Portes 1998	Provides a critical review of the origins and various definitions of social capital.
		McFadyen and Cannellajr. 2004	Discuss the link between social capital and knowledge creation. Argues that for knowledge creation, the strength of interpersonal relationships is more important than the number of relationships.

Building from the position of Tsai and Ghoshal (1998) the three dimensions of social capital includes: social interactions of structural capital, social connections of relational capital and shared artefacts, interests and objectives of cognitive capital. Collectively, these three dimensions of social capital contribute to the understanding of the interactions and relationships that facilitate collective development and sustainability of knowledge and address the third research question*: How do social interactions and relationships within CoE influence the development and sustainability of collective knowledge?*

2.4.1 Social Interactions of Structural Social Capital

The structural dimension of social capital is concerned with the social interactions between individuals (Tsai & Ghoshal 1998). They are important issues in understanding collective advancement and revision of knowledge because it is through these interactions that knowledge is shared and transferred (Portes 1998). Following from this recognition, this thesis explores how social interactions of structural capital influence collective knowledge development and sustainability by enhancing knowledge sharing opportunities within expert collectives.

According to Liao (2006) effectiveness of knowledge sharing depends on both the frequency and quality of social interactions. Regular interactions between members in a group allow them to collectively reflect on their experiences, build on each other's ideas and so to deepen the richness of

their thinking. This demonstrates how continuous dialogue between organisational members can help them share ideas and discuss problems to foster collective creativity and innovation. This is important because new knowledge is created when individuals continuously share what they know with others, internalise it and apply what they learned (eds Epstein & Prak 2008; Wah, cited in Smith 2001, p.319).

The informal nature of interactions between individuals encourages the free exchange of ideas, knowledge and collective innovation (Taminiau, Smit & de Lange 2009). Informal interactions frequently take place along the office corridors, during common breaks and meals like breakfast or lunch. These everyday informal interactions between organisational members are a useful means of sharing some of the most valuable and personal knowledge with each other (Brown & Duguid 2000; Cross et al. 2001; Iverson & Mcphee 2002). This is because face to face casual conversations and storytelling that takes place on social settings create a relaxed and a non threatening environment for individuals to share their personal experiences, ideas and viewpoints with others (Swap et al. 2001).

Frequent informal interactions help cultivate mutual understanding, trust and reciprocity (Van den Hooff & Huysman 2009; Holste & Fields 2010). These are significant issues in developing, maintaining and strengthening relationships among members in a collective (Kimble & Hildreth 2005; Kokavcova & Malá 2009; Lesser & Prusak 1999). Importantly, people share their valuable personal know-how only with those who they have strong trusting relationships with them. Due to these reasons, regular

informal interactions help sharing the tacit know-how embedded in the minds of individuals (Argote, McEvily & Reagans 2003; Hildrum 2009; Ranft 2006; Scarso, Bolisani & Salvador 2009; Kasper, Mühlbacher & Müller 2008).

It is also important to note that the frequent interactions between members in a collective need to be quality interactions, if they are to facilitate collective cultivation and renewal of knowledge. Quality of social interactions can be determined by their ability to enable sharing of valuable information, ideas and experiences among the participants. Therefore, they help individual participants to learn new things and build on each other's knowledge (Bushe 2009; D'Andrea-O'Brien & Buono1996; Senge 1991).

Quality interactions between senior members and juniors are useful because they help newcomers learn the practice in concrete terms while existing members gain new insights by reflecting upon their own ideas through the process of teaching the practice (Simon 1991; Ardichvili et al. 2006). According to Mayfield (2010) and Swap et al. (2001) mentoring is an effective way of allowing senior members to directly transmit their tacit know-how and experiences to the novices. Senior members often possess a back-log of experiences which are considered as a valuable part of their tacit knowledge. Therefore, it can be argued that quality interactions between senior members and novices offer an effective means of sharing tacit-knowledge.

To sum up, the above discussion revealed that there is an inherent necessity for social interactions as the framework for knowledge sharing in collectives. This is important because it indicates how regular and meaningful interactions of structural social capital can contribute to the improvement and updating of knowledge by facilitating effective knowledge sharing. Therefore, we can conclude that social interactions and connections of structural social capital can influence the development and sustainability of knowledge in expert collectives.

2.4.2 Social Connections of Relational Social Capital

Relational social capital is about the nature of the relationships within a social entity (Nahapiet & Ghoshal 1998). It includes factors such as trust mutuality, shared interests, desire and motivation (Lesser & Prusak 1999). These factors are significant because they hold members in a group together and positively influence the development of strong interpersonal relationships between them (Cohen & Prusak 2001). However, what we must note here is that friendships do not readily pass from one person to another (Nahapiet & Ghoshal 1998). This suggests that relational capital within a collective can either increase or decrease over time, if not managed properly (Agndal, Chetty & Wilson 2008). This is useful information as it tells us that developing and maintaining social relationships can be a both rewarding and a challenging task.

Strong interpersonal relationships are important when understanding collective knowledge cultivation and renewal. This is because they contribute to effective sharing of knowledge by increasing shared experiences, common language and bonds of friendship (McFadyen & Cannellajr. 2004). However, the value of these relational factors has been overlooked because it is not easy to identify and explain them due to their intangible nature (Coleman 1988). Therefore, this section explores social relationships and the idea of relational social capital to reveal how significant they are in facilitating collective knowledge development and sustainability.

Strong friendships and interpersonal relationships are generally built upon trust. Trust-based relationships are important since they can increase individuals' willingness to share what they know with others (Holste & Fields 2010; Huang 2009; Chen et al. 2011). The presence of trust and safety within teams enable members to collectively reflect on their experiences, build on each other's ideas to solve business and technical problems (McDermott 1999; Liao 2006).

Trust plays a vital role in promoting the dissemination of tacit knowledge, which is often context specific and derived through personal experiences (Dyer & Nobeoka 2000). It makes individuals feel safe enough to share their beliefs and ideas that are deeply rooted in their personal experiences and values (McDermott 1998). So, people learn and share knowledge more easily in a culture of collaboration and trust (Marsick & Volpe 1999; Dhanaraj & Parkhe 2006). For example mutual trust between members in

R&D teams has a significant impact on creativity because it encourages members to open up and share their ideas and knowledge with others (Chen, Chang & Hung 2008; Andrews & Delahaye 2000). This is important in informing us the value of strong trust-based relationships in facilitating successful knowledge cultivation and update among members in collectives.

In sum, the literature on relational social capital informs us that strong relationships are useful in facilitating effective sharing of knowledge and learning between individuals. Such collective sharing activities are important because they in turn help people advance and update their current understanding. Therefore, based on the above review of literature it can be concluded that relational social capital within expert collectives is likely to influence the collective development and sustainability of knowledge.

2.4.3 Shared Artefacts, Interests and Objectives of Cognitive Social Capital

Cognitive capital refers to 'the shared representations, interpretations and systems of meaning among parities' (Nahapiet & Ghoshal 1998, p. 244). This section discusses the significance of cognitive capital in terms of shared artefacts, interests and objectives. In doing so, it reveals how these issues influence collective knowledge refinement and renewal by promoting effective sharing of knowledge while fostering structural and relational dimensions of social capital.

Shared artefacts serve as foundations for future learning and ensure effective transfer of knowledge among members in a group (Allee 2000; Collins & Smith 2006). They accumulate over time through shared experiences, stories, routines, codes and symbols (Preece 2004; Lesser & Prusak 1999). It is within these artefacts that the accumulated knowledge in collectives is embodied. For example, Brown and Duguid (2000) state that in communities of practice stories and narratives are often used by members as a means of transferring socially constructed tacit-know how. Consequently, we can argue that shared artefacts of cognitive capital promote knowledge sharing; thus they can be considered as useful issues in understanding the cultivation and renewal of knowledge in collectives.

Shared interests and objectives have a significant influence in collective learning and knowledge sharing. This is because they help people develop a sense of empathy around common trials and tribulations and provide them with a point of reference when it comes to sharing their knowledge with others (Iverson & McPhee 2002; Lesser & Storck 2001; Koliba & Gajda 2009). For example, according to Tsai and Ghoshal (1998) shared interests and passion among members in communities of practice motivate them to share what they know with others. Similarly, as stated by Bakker et al. (2006) in teams, knowledge sharing is driven by members' obligation towards fulfilling their shared organisational goals. Due to these reasons, we can state that common elements such as shared objectives, interests and goals motivate individuals to share what they know with others in their collectives.

Finally, shared interests and objectives can also help individuals to better understand and interact with each other. Hence, it has been argued that these elements of cognitive capital have a direct impact on fostering interactions and relationships between individuals (Tsai & Ghoshal 1998; Nahapiet & Ghoshal 1998). For example, communities of practice develop as a result of individuals with a shared interest interacting to share what they know with others (Allee 2000; Wenger, McDermott & Snyder 2002; Duguid 2005). This demonstrates how cognitive capital can foster social interactions of structural capital and connections of relational capital. So, we can argue that there is an inherent relationship between the three dimensions of social capital.

In conclusion, the literature reveals that shared artefacts, interests and objectives of cognitive social capital can influence collective knowledge refinement and renewal in two ways: firstly, by facilitating collective knowledge sharing opportunities and secondly, by positively influencing social interactions and relationships between individuals. Thus, it is clear that cognitive dimension of social capital provides us with valuable insights into understanding collective knowledge development and sustainability in expert collectives.

2.4.4 Social Processes as Enablers of Collective Knowledge

The above review of literature on structural, relational and cognitive social capital revealed the important role played by social processes in facilitating

successful advancement and revision of collective knowledge. Based on the above analysis, it is apparent that the quality of social interactions and relationships between members has a direct impact on fostering joint leaning and knowledge sharing opportunities within a collective. Moreover, learning and knowledge sharing are the key components of knowledge cultivation and renewal. Consequently, we can state that the quality of social interactions and relationships is likely to determine knowledge development and sustainability opportunities within expert collectives. Therefore, the literature examined in the preceding section of the review supports the development of the **third proposition**:

> ***P3***. *The quality of social interactions and relationships determine knowledge development and sustainability opportunities in CoE.*

2.5 Propositions and the Theoretical Framework

Literature in this chapter was examined to reveal current thinking on the research issues of knowledge development and sustainability, collectives of experts and social processes. From each of these research issues, a research question was developed to aid the consideration and extrapolation of the relevant theoretical foundations, and so to help inform the main research problem: *How do social processes within collectives of experts facilitate knowledge development and sustainability?* Literature in each section was considered in exploration of the research issues and contributed to

developing three propositions which will be used to examine the empirical evidence of this research. Figure 3 illustrates this research design path.

A theoretical framework (see Figure 4) was developed in conjunction with the three propositions. The theoretical framework provides insights into the collective development and sustainability of knowledge by assembling current theory into an explanatory frame. In doing so, the development and sustainability of knowledge in collectives of experts is revealed here as likely to be an iterative process of collective learning, sharing and generation of new ideas, which is affected by the social interactions and relationships among members.

It is also apparent from the literature that background knowledge and the personal experiences of members influence their capacity to understand knowledge that is being shared within their collective. Further, the literature suggests that once the new knowledge is created, it is then likely to be shared through collective learning activities thus contributing to its continuation and to help solve similar types of problems in the future. The remainder of this thesis will explore whether these theoretical premises are supported and informed by the knowledge sharing activities of external and internal collectives of experts as exemplified by contemporary craft guilds and medical research teams.

Figure 3. Research Issues and Underlying Areas of Literature that Inform the Research Propositions as they have developed to address the research problem.

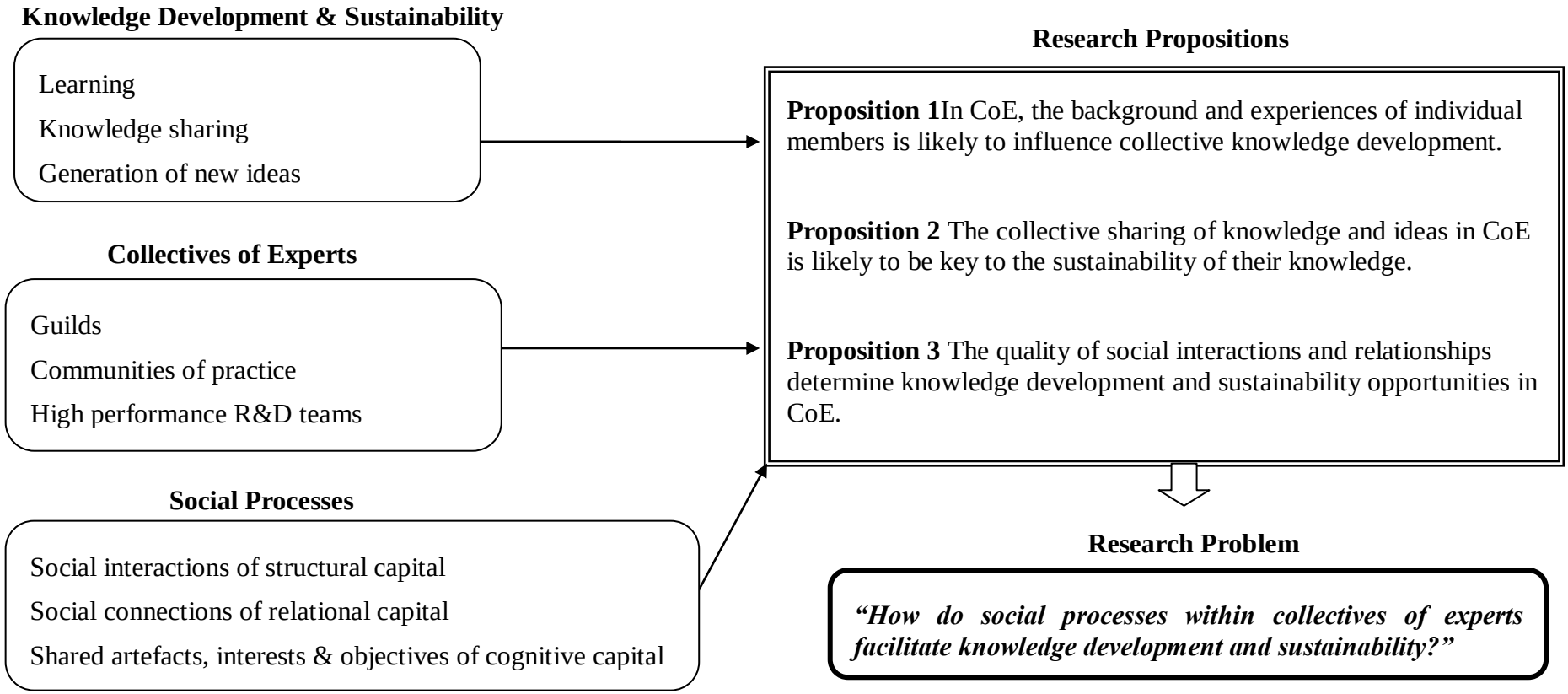
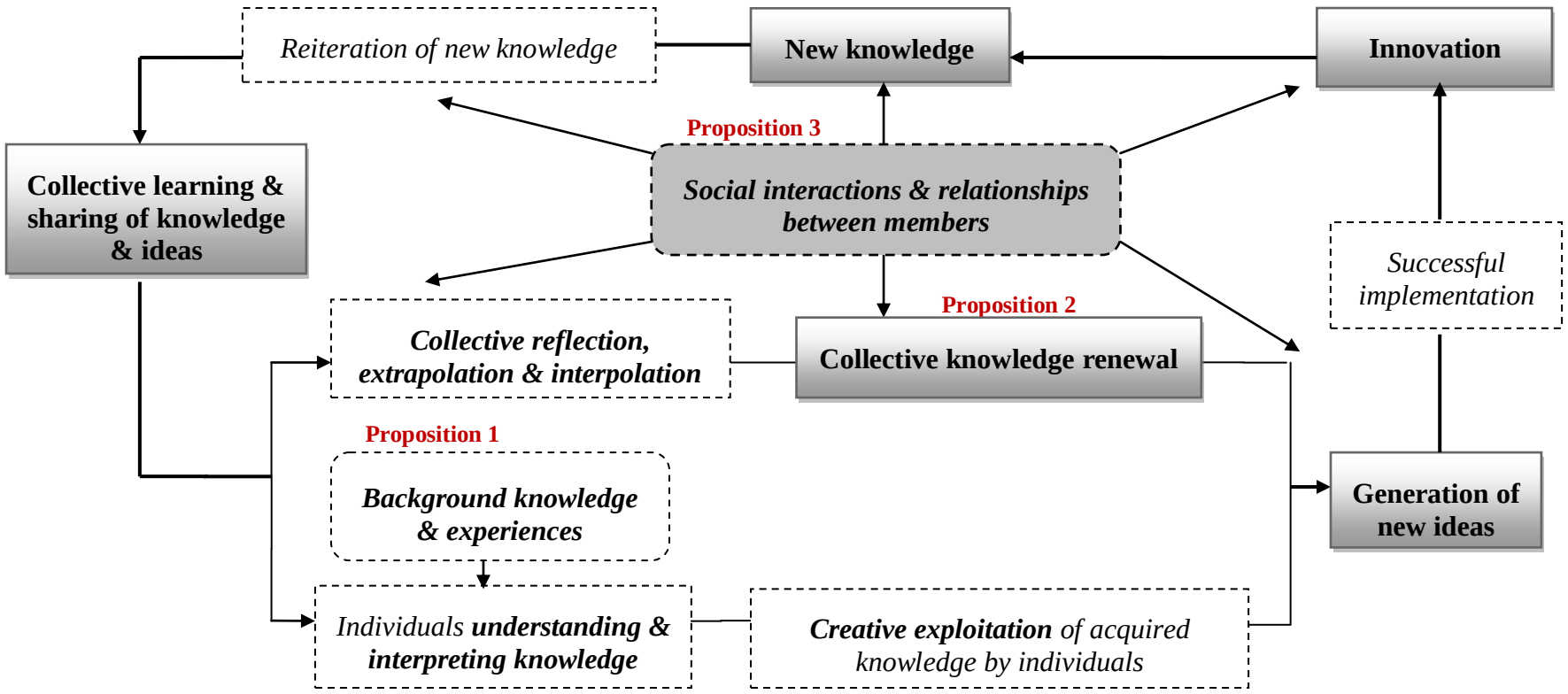


Figure 4. Theoretical Framework Illustrating the Process of Collective Knowledge Development and Sustainability influenced by Social Interactions and Relationships



Chapter 3

Methodology

3.1 Introduction

The purpose of this chapter is to explain and justify the methodology for this doctoral investigation. First, it provides an overview of the ontological and epistemological perspectives of the research project. This is followed by a discussion of the chosen research methodology and its compatibility with the research problem. In doing so, this chapter examines the appropriateness of the case study approach for exploring the research issues. The third section introduces the two cases through which the empirical investigation was undertaken in this thesis. The penultimate section outlines the research design and the empirical approach and discusses how case evidence was collected and analysed. Finally, the chapter concludes with a discussion about the trustworthiness, rigor and generalizability of the chosen methodology for examining the research problem.

3.2 Ontological and Epistemological Assumptions

This doctoral investigation is shaped by the ontological and epistemological perceptions of realism[3]. The paradigm of realism is supportive of the inductive theory building research (Perry 1998) being used here to explore how social interactions and relationships within expert collectives facilitate knowledge development and sustainability. Blaikie (1991, p.121) claims that in realism research, 'social world is viewed as an objective, material structure of relations which is not accessible to direct observation'. Consequently, for this research, realism provided a useful and appropriate approach for examining the social processes (including those implicit and embedded within the behaviours of individuals), that influence knowledge activities in collectives of experts.

The *modified objectivist*[4]position is developed as the epistemological guide in this research. According to Healy and Perry (2000, p.119) epistemology defines 'the relationship between the reality (ontological reality) and the researcher'. Identifying the epistemological position of a research is important in understanding 'the relationship between the knower (the research participant) and would-be-knower (the researcher)' (Ponterotto 2005, p.127).

[3] Ontological perspective of realism assumes that the research is dealing with complex social phenomena involving reflective people. Realist researchers are 'value aware' and accept that there is a real world to discover even if it is only imperfectly and probabilistically apprehensible (Healy & Perry 2000, p.121 - 123).

[4] Realism is characterised by researcher objectivity. It holds that there is an external reality (Tsoukas 1989) although the complexity of that reality and the limitations of a researcher's mental capacity makes triangulation of data essential to refine feasible observations of that reality (Perry 1998, p. 787).

The modified objectivist position used in this thesis considers that the findings are probably true because the real world is imperfectly apprehensible. In doing so, it recognises the value of multiple perceptions about a single reality. Thus it requires triangulation of multiple perceptions from several data sources (Healy & Perry 2000). Consistent with the modified objectivist position, the views of numerous members from various collectives of experts were collected to help understand the role of social processes in fostering collective advancement and renewal of knowledge.

3.3 Research Methodology

A qualitative inquiry of case study analysis (Neuman 2006; Denzin & Lincoln 2005) was employed to conduct an in-depth investigation of the key research issues informing the research problem. The appropriateness of the case study approach in addressing the key issues of this research can be justified through the following reasons.

Firstly, social interactions and relationships cannot be easily quantified, as they rely on researchers' discernment and interpretation, so their analysis requires an inductive, but not a deductive approach. Therefore, considering the nature of this social phenomenon to be explored, a qualitative approach was chosen as the most appropriate to investigate the research issues of this thesis (Morgan & Smircich 1980; Denzin & Lincoln 2005; Firestone 1987).

Secondly, the case study approach is compatible with the chosen philosophical approach of realism. Case study research collects perceptions of the unobservable external world (Perry 1998) for the purpose of theory generation (Patton & Appelbaum 2003). Likewise, in the paradigm of realism, the emphasis is laid on the 'meaning' rather than on the 'measurement' to facilitate theory building. Therefore, case study analysis is often used as the preferred methodology for the realism paradigm (Perry 1998; Healy & Perry 2000). This further justifies the appropriateness of the case study methodology for investigating the research issues in this doctoral thesis.

3.4 Case Studies

Two case studies were undertaken in this research to provide a substantial comparative assessment of different expert collectives. The case studies were purposefully selected considering their theoretical appropriateness, in terms of how they could extend the theory (Eisenhardt1989; Patton & Appelbaum 2003). The first case was an example of external collectives of experts i.e. motivated by personal direction, while the second case study was an example of internal expert collectives i.e. motivated by organisational direction. The purpose of this section is to provide an overview of the chosen cases, and then to discuss why they were considered as theoretically useful cases for this project.

3.4.1 Case 1: External Collectives of Experts

Case 1 included two sub-cases of different contemporary craft guilds, as external collectives of experts. Both guilds were deliberately created associations of crafts people. They were organised in such a way that they had expectations of their members with respect to their conduct and standards. Furthermore, each guild consisted of members with formal roles, positions and tasks such as the guild president, secretary and organising committee members. This is interesting because it tells us that with regard to their typical development, these two guilds, to some extent, can be recognised as organisations (in their own right). Yet, their activities and purpose of association were developed around a more socially negotiated agenda and personal motivations.

The membership into the guilds was voluntary, required a financial subscription and was driven by guild members' shared personal motivation to develop their skills as well as to promote and protect their craft. This meant that the guild members had an individual oriented agenda as far as the development and application of their expertise and this established the nature of their interactions with others in the guild. Due to these reasons, the two craft guilds were recognised as suitable examples of expert collectives operating for the benefit of the individual that constitute them and were explored as two sub-cases within the major case study of external collectives of experts.

Sub-case one explored the Knife-makers Guild (KG), while sub-case two examined the Spinners and Weavers Guild (SWG). The contribution of these cases to the broader case of external collectives of experts was enhanced due to the fundamental differences in their membership. In the case of knife-makers, membership was largely comprised of middle aged/ older men and significantly the members were geographically dispersed rather than being a locally aggregated collective.

On the contrary, SWG had a predominantly female membership, with members being in close enough proximity to each other to be able to associate frequently. Therefore, within the case of external collectives of experts, Knife-makers Guild and Spinners and Weavers Guild were polar examples because of the fundamentally contrast in gender and location dimensions. These differences contributed to the uniqueness of each guild, thus making them divergent cases that offered rich insights into addressing the research problem. The remainder of this section present the background information about each guild, in terms of their relevance and appropriateness to this research.

3.4.1.1 Sub Case A: Knife-makers Guild

The Knife-makers Guild (KG) is a 'not for profit' guild formed by a group of knife-makers in 1984. The guild has a president, a secretary and a panel of senior members as the organising committee. At the time of this research the purpose of the guild was given as follows:

The group is dedicated to promote, preserve and develop the craft of knife-making and all its various disciplines to the highest standard possible.

For the purposes of this research its pertinent to note that there were various levels of membership within the Knife-makers Guild including: full members, probationary members, associate members (artisans, collectors and overseas members), corporate members (museums and private institutions) and suppliers of wood and metal.

To obtain the full membership of the guild, members had to go through a 12 month probation period and to develop some proficiency in the fundamental techniques of knife-making. At the end of their probation, members had to present three knives before a panel of expert knife-makers. Full membership was awarded only to those who demonstrated an acceptable standard of proficiency in knife-making and agreed to uphold the aims and values of the guild. So, the significance of fulfilling the technical expectations as well as upholding to their common aims and vales was apparent in the rituals of the Knife-makers Guild.

Knife-makers joined the guild for two main reasons. Firstly, it was to gain recognition for being a member of the guild that represented the knife-makers in the Australia. Being part of the guild was seen to convey legitimacy to their practice, improve their reputation as a craftsperson and to enhance the esteem with which their work was viewed. This was mainly the case with those members who were also entrepreneurs, as they were frequently selling their creations in both local and foreign markets.

Another reason for joining the guild was to gain access to valuable technical knowledge and associated specialist information about the craft, by meeting and interacting with fellow knife-makers in the country. This shared motivation and association of the knife-makers illustrated that they are indeed a collective of experts.

Due to the geographic dispersion of the guild's membership, the Annual Knife Show was the only formally organised event that brought all the knife-makers from different states and cities across Australia together. However, regional workshops and open days were organised by the guild throughout the year targeting members from different states. It was also apparent that knife-makers met and interacted, informally and socially to discuss and to practice the craft outside the organised guild activities.

Those who lived in close proximity to each other frequently met to work with each other, while the interactions between members living interstate was mainly facilitated through telephone, email and the guild website. This tells us that despite the geographical dispersion of its membership, members of the KG constantly interacted and communicated with each other and practiced the craft together. This is significant as it shows of knife-makers valued the interacting with fellow members.

In conclusion, the Knife-makers' Guild was a dispersed group of Australian knife-makers formed by the shared personal motivation of the members, to promote and protect the craft of knife-making through collaborative learning and knowledge sharing activities. Thus, it fulfilled the

requirements of an external collective of experts for the purposes of the empirical investigation for this research. Consequently, Knife-makers Guild was chosen as an appropriate sub-case for the broader case of external collectives.

3.4.1.2 Sub Case B: Spinners and Weavers Guild

The Spinners and Weavers Guild (SWG) has been in existence for more than 30 years, with their purpose being described as follows:

> *We help maintain skills and techniques that have been passed down for generations and encourage the development of new techniques and ideas that make our crafts more relevant to modern lifestyles. Our aim is to promote the growth of spinning, weaving, and associated crafts, which are a part of the heritage of the world.*

Members of the Spinners and Weavers Guild were geographically localised, with many of its' members being residents of neighbouring suburbs. There were no prerequisites to join the guild; rather, the guild membership was open to anyone interested in practicing or learning spinning and weaving. Thus, for the majority of the guild members spinning and weaving was their hobby. The motivation of many of the spinners and weavers who had joined the guild was mainly for the enjoyment and improvement of their skills and understanding of the craft. Therefore, the members of the Spinners and Weavers Guild were clearly

bound by their shared interest in the techniques and processes of spinning and weaving.

Similar to the Knife-makers, the SWG also had the common roles of president, secretary and treasurer as well as other office bearers to help with the running of guild activities. The activities of the spinners and weavers guild were coordinated and organised by the guild leadership and other senior members of their organising committee. SWG met twice a month in a community hall. The first Thursday of the month was a monthly meeting, organised to discuss guild activities for the coming month. The third Thursday of the month was a spinning and weaving workshop specifically planned to help members learn new techniques associated with the craft or its unique materials and tools.

Aside from these two regular events, other guild activities included social events such as 'garden spinning days' and more craft oriented events such as the annual open day. These regular guild activities were organised by spinners and weavers to propose their craft through social engagement and teaching techniques.

Finally to sum up, the Spinners and Weavers Guild was a group of individuals with a personal shared interest in improving their understanding and capabilities of this traditional craft. The guild gave them the opportunity to associate collaboratively learn and collectively share knowledge to enhance their unique expertise. Therefore, it can be

considered as an example of external collectives of experts which was appropriate for this research.

3.4.2 Case 2: Internal Collectives of Experts

The case of internal collectives of experts was investigated through three sub-cases of different medical research teams. All three teams were part of a collaborative research centre which operated through alliances with the local university, state government and a large public hospital. They were all involved in cancer research, with each team having a unique cancer research agenda.

The medical research teams explored as the sub-cases of the Case 2 of were very similar in nature. They operated within the same faculty of the local university, and their areas of research were closely related. Each team had multiple inter-dependent research projects going on; all of which linked to the main research agenda of their overarching research group.

Each team was a discrete collective of medical scientists with a shared repertoire of skills and knowledge of their specific area of cancer research, which was the foundation of the teams' common research agenda. They were deliberately established as a strategic research unit and consequently were operating according to the directives and agendas of the formal organisational entity. So the three medical research teams qualified as

internal communities and were appropriate sub-cases for the major case of internal collectives of experts.

The team members had varying levels of seniority, expertise and shared a diversity of organisational positions. In each team, membership consisted of a team leader, senior scientists acting as supervisors, post-doctoral researchers and junior researchers such as doctoral and Honours students, research assistants and technical staff. They were mostly employees of the local university, with each having a designated position in the university's hierarchical structure, depending on their level of seniority, expertise and experience.

Entry into the teams was possible only by employment into vacant positions. The minimum requirement for joining the team was to have completed at least a bachelor's level degree in Sciences. Most team members came from the same field of the medical sciences, however, with different levels of expertise, seniority and niche specialities. This is interesting because it tells us that these research teams consisted of experts with various levels of expertise and specialities, working together to achieve the research goals of their particular team.

All three teams had their own laboratory. So in each case the teams of researchers were located in their own common work space. Working in close proximity to each other enabled frequent face to face communication among the members of the team in each case. Formal weekly meetings were held within the teams to discuss their research progress. Moreover,

seminars and workshops were also frequently organised, in collaboration with other research groups from different universities and research institutions. This demonstrated that the activities of the three research teams were directed towards enhancing collaborative learning and sharing of their expert knowledge in order to fulfil the organisational agendas.

In conclusion, the three medical research team sub-cases explored within the major case of internal collectives of experts were significantly similar with regard to their typical development, type of association, purpose of association and their agenda of activities. These similarities among the three sub-cases here enabled them to be consolidated into a sound aggregate case and contributed to the generalisability of the case of internal collectives of experts.

3.5 Research Design and Empirical Approach

The two major case studies chosen for this project represented two clear alternative contexts of collectives of experts. Selection of such theoretically useful case studies allowed richer theory building and to deliver more robust research outcomes through a comparative cross-case analysis. Case evidence was collected using various interview techniques e.g. informal, semi-structured, and in-depth. These interviews were then analysed using a thematic coding process.

First, the evidence gathered for each sub-case was examined independently. Next, a sub-case-comparison was conducted to synthesise the sub-case results and to compile evidence for each major case. A cross-case analysis was then conducted between the major cases to reveal their commonalities and differences. Finally, the consolidated case results were interpreted and discussed with compared to the existing theory to inform the propositions. This analysis process was concluded once it was deemed to have reached theoretical saturation.

The research design and analysis process is illustrated in Figure 5. The subsequent parts of this section provide a detailed discussion of how the case evidence was collected for this doctoral research and analysed to inform the propositions towards inductive theory building.

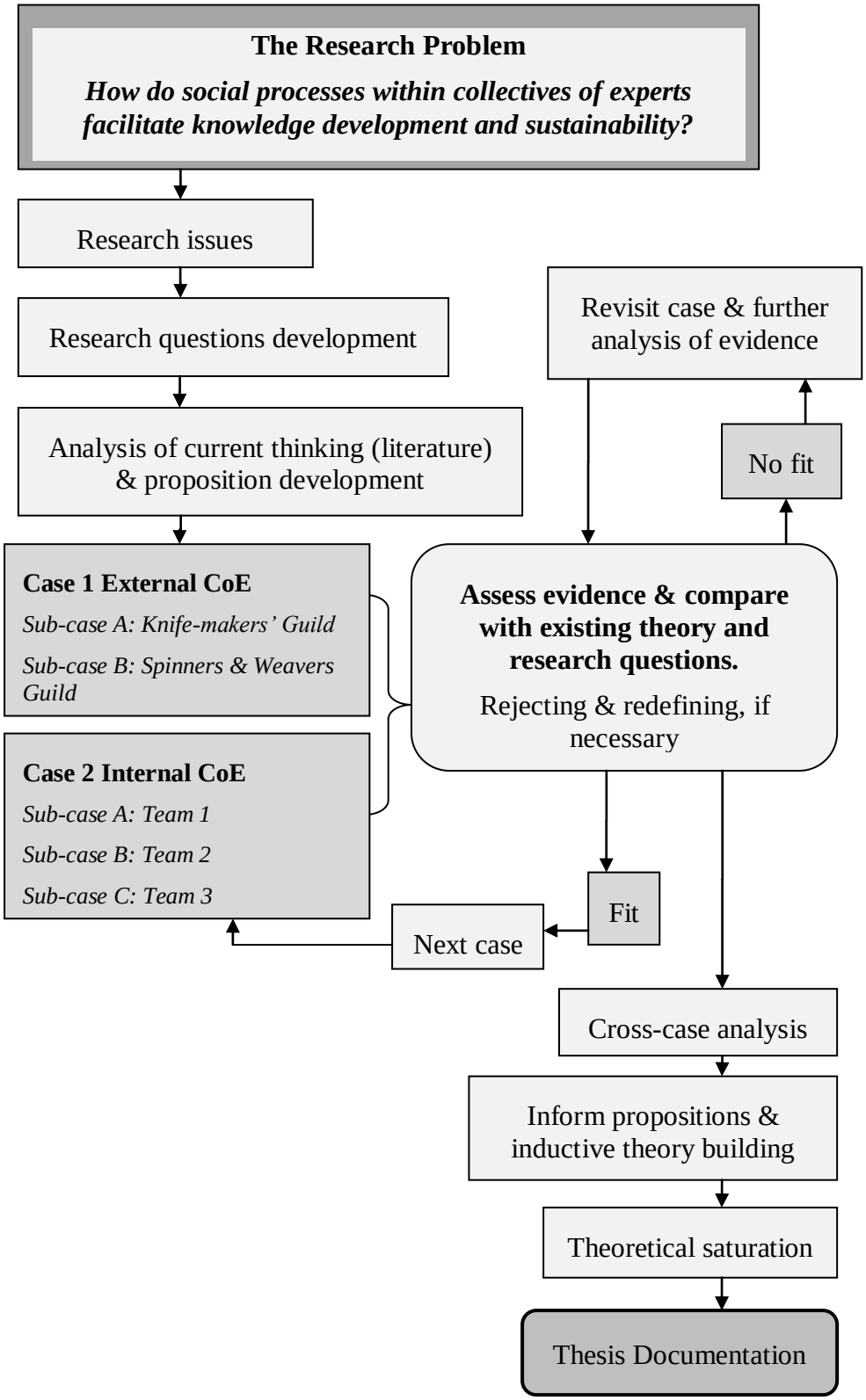


Figure 5. Research Design Showing Sequential Case Analysis and Iterative Theory Testing, Plus Cross Case Analysis and Inductive Theory Building.

3.5.1 The Interviews

Consistent with the case study methodology, face to face interviews were used to collect evidence for this research (Eisenhardt 1989; Yin 2009). They were useful in exploring the views and perceptions of the participants about the role of social processes in facilitating knowledge cultivation and renewal within their collectives. In this way, interviews as the preferred choice of data collection method provided a deeper understanding about this social phenomenon to be explored.

A total of 55 individuals were interviewed across both cases. With regard to Case 1 external collectives, 34 interviews were conducted in total across the two sub-cases. In Case 2 internal collectives, a total of 21 interviews were conducted across the three sub-cases. This section, first discusses how participants were selected for the interviews and then it provides a detailed description of the interview procedures.

3.5.1.1 Participant Selection

Participants for the interviews were deliberately selected, firstly to include members who played an active role in organising the activities of their guilds and teams, and secondly, to represent the diverse positions they held within their respective collective. This purposeful sampling helped the researcher to select individuals who could provide 'information rich' interviews (Patton 2002).

Case 1 External Collectives

Case 1 explored two craft guilds (i.e. the Knife-makers' Guild and the Spinners and Weavers Guild) as sub-cases. Presidents of both guilds were initially contacted and met, to explain the research project and to introduce them to the researcher. They were then provided with an outline of the research and their guild was invited to participate.

Guild members who were actively involved in guild activities were selected as suitable participants for the interviews. This was because they were able to provide relevant and insightful information about the social dynamics within their collective which would help to address the key issues of this research. As a result, senior members and members holding positions in the guild committees were frequently identified as the most suitable participants for the interviews.

Participants were interviewed to discuss their perceptions of how member behaviours and interactions influenced collective development and knowledge sustainability of knowledge within their guilds. Fifteen semi-structured interviews were conducted with the members of the Knife-makers' Guild, during their annual knife show. Conducting interviews at the knife show was particularly useful, as it gave the interviewer an opportunity to meet and talk with members from different states and countries who had various levels of expertise and specialisations. Importantly, this increased the richness of the evidence collected from the Knife-makers' Guild. With regard to the Spinners and Weavers Guild, a

total of nineteen interviews were conducted. The interviews were held on the guild site, during their monthly get-togethers.

A total of thirty four interviews were conducted across both guilds (see Table 8). These interviews contributed to this research by providing a comprehensive study of the feelings, beliefs and attitudes of members with respect to the advancement and refinement of knowledge within their respective groups as external collectives of experts.

Table 8.Case 1 External Collectives of Experts' Interviewee Details

Case	Total Number of Interviewees
Sub-Case A: Knife-makers Guild	**15**
Sub-Case B: Spinners & Weavers Guild	**19**

Case 2 Internal Collectives

The second case study of internal expert collectives explored three sub-cases of medical research teams as expert groups, operating in accordance with formal organisational directives and agendas. In a process similar to that of the first major case, the team leaders were first contacted and met with the researcher, to introduce the research project and the researcher to them. Following that, introduction letters explaining the research in more

detail were sent to them outlining the issues to be addressed during in the interviews.

In each of these research groups, every team member played a unique role in organising and conducting various research activities, relating to the main research agenda of their teams. As a result of their diverse roles and avenues of involvement, the participants were chosen across the diverse positions, including senior research scientists, post-doctoral scientists, doctoral and Honours students and research assistants (see Table 9). This ensured that every interviewee was able to provide unique insights into how they collectively developed and sustained knowledge within their research team.

A total of twenty one interviews were conducted across the three research teams. All the interviews were held at the respective offices of the teams. Team members were interviewed to discuss how their team dynamics, member behaviours and interactions influenced their ability to refine and renew knowledge. Hence, these interviews contributed to this research by providing a study of knowledge development and sustainability within the groups of these experts, as informed by the formal organisational directives and agendas of their research.

Table 9. Case 2 Internal Collectives of Experts' Interviewee Details

Case	No. of Interviewees	Interviewee Positions
Team 1	7	2x Doctoral Students 1x Post-doc Scientist 1x Head of the Laboratory 1x Senior Research Scientist 1x Honours Student 1x Research Assistant
Team 2	5	2x Research Assistants 1x Head of the Laboratory 1x Senior Research Scientist 1x Doctoral Student
Team 3	9	3x Honours Students 2x Research Assistants 1x Post-doc Scientist 1x Doctoral Students 1x Head of the Laboratory 1x Senior Research Scientist

3.5.1.2 The Interview Process

A two-staged interview process was employed to collect case evidence for this research and the consent of the University of Adelaide's Ethics Committee was granted to conduct these interviews. The first round of the interviews was informal and conversational in nature while the interviews conducted at the second stage were semi-structured. A total of 25 informal

interviews and 30 semi-structured interviews, collectively involving 55 participants, provided approximately 22 hours of interview materials for analysis (see Table 10).

Table 10. Stage 1 and 2 Interview Details

	Case 1	**Case 2**	**Total no of Interviews**
Stage 1 Informal interviews (Approx. 15 minutes each)	KG x 10 SWG x 15 Total of 6.25 hrs	-	**25**
Stage 2 Semi-structured interviews (Approx. 30 minutes each)	KG x 5 SWG x 4 Total of 4.5 hrs	Team 1 x 7 Team 2 x 5 Team 3 x 9 Total of 10.5 hrs	**30**
No of interviews per case	**34** ***Total of 10.75 hrs***	**21** ***Total of 10.5 hrs***	**55**

Stage 1 Interviews

The interview process started with the researcher conducting a total of 25 informal interviews across the two guilds in Case 1 (see table 10). Each

interview lasted for approximately for 15 minutes. In total, stage 1 interviews provided 6.25 hours of interview content. The purpose of conducting the informal interviews was to view the research topic from the perspective of the interviewees and to identify the key issues and areas significant for further investigation in informing the research problem.

Stage 1 interviews were conducted during the interviewers' visits to the guild sites. They were conversational in nature and had a low degree of structure. This allowed participants to freely discuss and reveal their thoughts about those issues and areas that they thought as significant, in helping the researcher to understand the social dynamics influencing knowledge development and sustainability within their respective collectives. Moreover, general questions about the main research issues were prepared in case the interviewee did not raise them during the interviews. The questions usually started with 'how' and included questions such as 'How do you feel about becoming a full member? and 'Can you tell me about your experience of attending the workshops?'

Given their casual and spontaneous nature, the informal interviews were not –recorded. However, brief notes were made during and immediately after the interviews to note all the important and relevant issues raised during the interviews. The evidence gathered during stage 1 interviews not only gave the researcher useful background information about the two guilds, but also provided guidance as to how stage 2 interview questions should subsequently be designed. Therefore, the first round of the

interviews was valuable because they laid the foundation for developing and conducting more structured interviews at the second stage.

Stage 2 Interviews

During the second stage of the interview process, a total of 30 semi-structured interviews were conducted across both major cases (see Table 10). This included nine interviews from the guilds in Case 1 and 21 interviews from the research teams in Case 2. Each interview conducted at the second stage of the interview process lasted for approximately half an hour. Thus, they provided 15 hours of interview material in total.

The purpose of conducting semi-structured interviews was to give the interviewer the flexibility to discuss key issues identified during Stage 1 interviews in greater detail and so to obtain rich and detailed information (Riege 2003). Moreover, the second round of the interviews also helped the interviewer to gather deep and rich insights in a targeted and deliberate way, within the limited time period available in the doctoral candidature (Rowley 2002; Patton 2002). The issues identified during the first round of the interviews, as well as the three research propositions were taken into consideration when developing the stage 2 interview questions. So the questions were designed to cover the following research themes: learning strategies, knowledge sharing, organisation and communication, membership, change and creativity.

The semi-structured interviews included some specific questions such as 'Are there any conflicts of interest among members?' and 'What motivates you to share what you know with others in your group?' (see Appendix A). The interviews were digitally recorded with the consent of interviewee. The ability to digitally record the interviews allowed the interviewer to concentrate fully on asking questions and responding to the interviewees answers. Recordings were then transcribed to enable data analysis.

3.5.2 Analysis of the Interviews

The interviews were analysed using a thematic coding process facilitated through the NVivo qualitative software program. Thematic analysis involves 'identifying, analysing and reporting patterns or themes' within the interviews (Braun & Clarke 2006, p.6). It is a widely used qualitative analytic method, yet there is no one agreed way of conducting a thematic analysis. The thematic analysis process used for the purpose of this research (see Figure 6) involved five main steps: transcription of interviews, theme establishment, coding of the transcribed interviews into key themes, analysis of the case evidence, and then interpretation and discussion of the empirical findings to inform the propositions and for inductive theory building.

3.5.2.1 Step 1: Transcription

Digitally recorded interviews were transcribed into text and each was given a unique code. Line numbers and page numbers were also included to assist with relocating key quotes within the context of the interviews (see Appendix B). After that, the transcribed interviews were uploaded on to a computer to begin the coding process using Nvivo .

3.5.2.2 Step 2: Theme Establishment

To begin the coding process, the following three themes were established a priori, consistent with the key issues identified as crucial to the research problem: (1) knowledge development, (2) knowledge sustainability and (3) social interactions and relationships. Consequently, corresponding nodes were then set up in NVivo. Sub-themes and subsequent nodes were created by identifying related themes and issues pertinent to the researcher through the coding process, as they were revealed in the interviews.

3.5.2.3 Step 3: Coding

Coding describes the process used to collate evidence into key themes. It involves sorting the statements and comments made by the participating interviewees into groups as they inform different elements of the investigation. Interviews were first coded broadly into the main thematic nodes: knowledge development, knowledge sustainability and social

processes. Then, the evidence under these main nodes was coded again into sub/child nodes. For example, the evidence under the main node knowledge development was coded into sub/child nodes on collective learning, knowledge sharing and background knowledge. Moreover, the emergent, surprising or unexpected issues (such as: power dynamics, personal motivation, organisational agendas and bureaucracies) that didn't fit into the recognised themes were coded into independent/free nodes.

Each quote that was sorted through this coding process was assigned a code which included: an interview code, a page number and a line number (see Appendix C). This enabled transparency by allowing the source of the quote to be easily traced (Miles & Huberman 1984).

3.5.2.4 Step 4: Analysis

The first stage of the analysis process involved going through the evidence for each separate sub-case, in order to identify the themes and issues with a particular significance in informing the propositions. Then, a comparison between the sub-cases within each major case was conducted. This resulted in establishment of an aggregate set of case evidence for each major case. Once the analysis of individual case evidence was completed, a cross-case analysis was conducted to highlight the similarities and differences between the two major cases.

3.5.2.5 Step 5: Interpretation and Discussion

Interpretation of the consolidated empirical occurred once the analysis process was completed. It involved first, evaluating the themes and issues and then determining what collectively the interviewees were saying about knowledge development and sustainability in their collectives. This involved discerning an understanding of the implications and associated meanings of the issues and themes that were raised as relevant or important. Doing so required looking beyond the evidence and asking'What is all this evidence in the theme actually telling me about this issue?' and 'Why is this important?' This resulted in interpretation of case evidence through insights, synthesis and reflection to inform the three research propositions.

Finally, during the discussion the researcher was able to draw meaning and insights about the research problem from the accumulated case evidence. In doing so, the implications and associated meanings of their activities, interactions and relationships were considered, compared and contrasted to generate a consolidated synthesis of the empirical findings informing the research problem of this thesis. This process was concluded once the evidence informing the new concepts and findings was exhausted and thus the analysis had reached theoretical saturation.

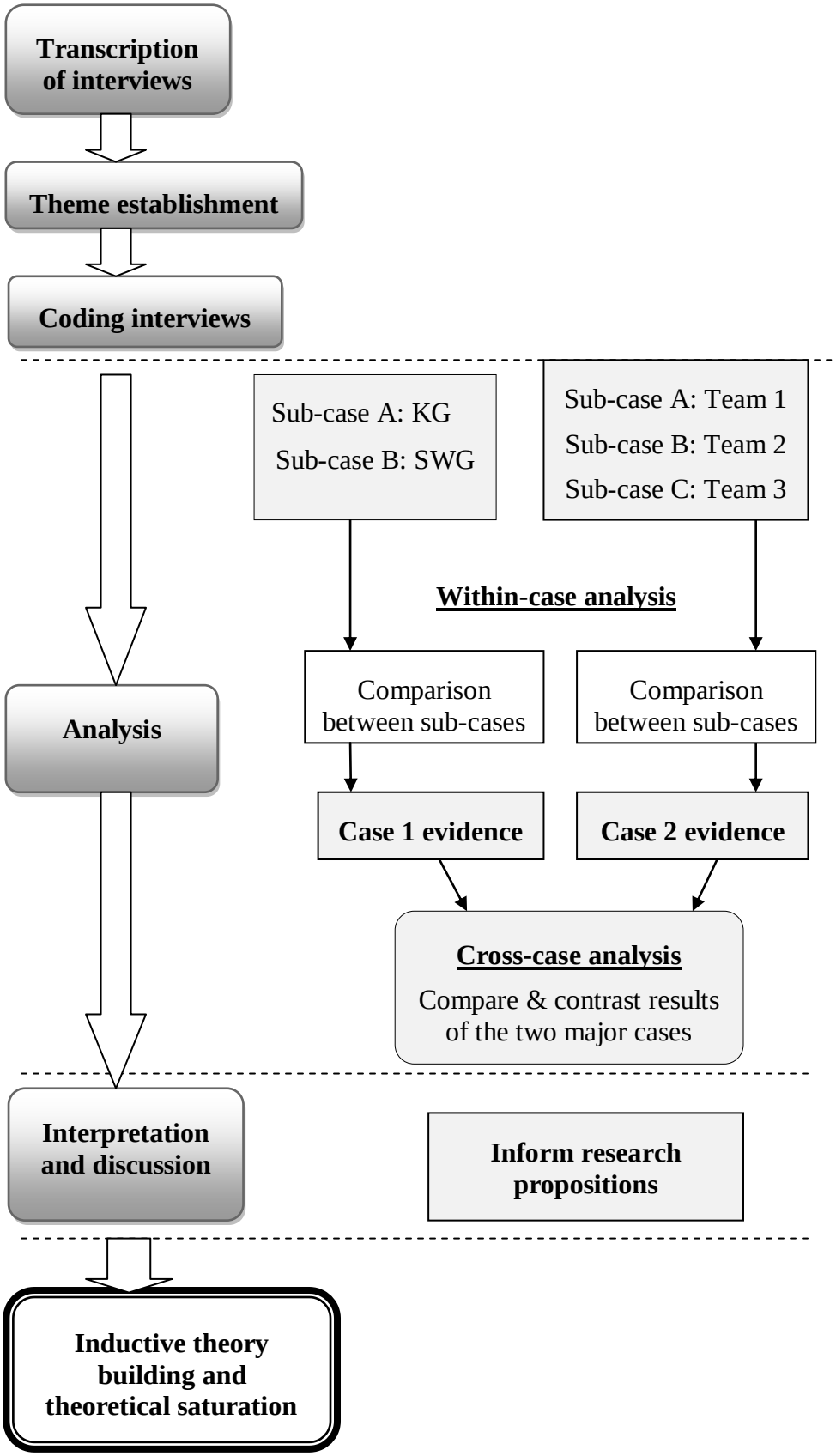


Figure 6. The Thematic Coding Process

3.6 Methodological Trustworthiness, Rigor and Generalisability

The quality in qualitative research within the realism paradigm can be assessed by methodological trustworthiness, rigor and generalisability (Healy & Perry 2000). Methodological trustworthiness[5]demonstrates that the inquiry's findings are 'worth paying attention to' (Lincoln & Guba 1985, p.290). In this research a rigorous data collection and analysis process was employed that included multiple cases, within case comparisons and cross-case analysis to ensure the methodological trustworthiness.

Firstly, case studies representing two alternative categories of collectives of experts were chosen for the purpose of this research. This contextual diversity of the major case samples facilitated robust research outcomes through a comparative cross-case assessment of diverse informative cases. Thus, it allowed richer theory building. Secondly, multiple case studies were explored within each major case. In particular, polar type sub-cases were used within the major case of external collectives. This contribution of divergent sub-cases facilitated a rich within case analysis; thus supporting the methodological trustworthiness of this research.

[5]In qualitative research the concepts of credibility, dependability and transferability have been used to describe various aspects of trustworthiness. This involves how well data and process of analysis address the intended focus and the transferability is the extent to which findings can be transferred to other settings or groups (Polit & Hungler, cited in Graneheim & Lundman 2004, p.109-110).

A rigorous data collection and analysis process was used to ensure the soundness of the results for this project. In doing so, multiple interviews were conducted to gather diverse perceptions about the key issues related to the research problem. Moreover, the interviews were recorded and then coded using a five step thematic analysis process to ensure the transparency of the data analysis process. These are significant factors as they demonstrate the methodological rigor of this research and address the soundness and quality criteria for the results produced for this doctoral thesis.

Finally, in order to have practical implications for managers and theoretical contributions for understanding knowledge in expert collectives, the results of this research need to be generalisable. According to Seale et al. (eds 2004) generalisability of results depends upon the cases selected and studied. In this research, theoretically useful cases were selected to help extend the theory, and to enable the generalisability of the results. In fact, cases were purposefully selected to include sound alternatives of collectives of experts.

Multiple sub-cases were explored within each of these major cases. In particular, the three research teams operating within similar contexts were explored as sub-cases of Case 2 internal collectives. This was important because it provided an opportunity for findings to be confirmed within each type of expert collectives. Confirmability is another soundness criteria used to assess rigor and validity in qualitative research (Guba 1981).

Therefore, the results of this project should be able to be generalised to similar forms of collectives of experts.

3.7 Conclusion

This chapter detailed out the case study methodology adopted for this thesis. In summary, consistent with the realism paradigm, purposeful case selection was used to choose theoretically useful cases to understand the significance of social processes facilitating knowledge development and sustainability within collectives of experts. Case evidence was gathered through a two-staged interview process. Interviews were then analysed using a thematic coding process. Once the coding of interviews was completed, a within case comparison between the sub-cases was conducted. This was then followed by cross-case analysis of those two major cases. Subsequently, the consolidated case results were interpreted and discussed to support the propositions and also for inductive theory building. Those results are the subject of the next chapter.

Chapter 4

Case Evidence

4.1 Introduction

The empirical work of this doctoral thesis is presented in this chapter. In doing so, the evidence from the two case studies is analysed here to identify the themes and issues with a particular significance to informing the role of social processes in developing and sustaining collective knowledge.

Case 1 explored external collectives of experts, bound by their shared personal motivation and interest. Case 2 examined internal expert collectives driven by formal organisational agendas and directives. These fundamental differences between the chosen cases served to address the research problem comprehensively by considering two clear alternatives of expert communities. So, the evidence from the two cases presented here tells us how these external and internal groups of specialists are able to cultivate and renew their knowledge through collective efforts.

This chapter is divided into four main sections. The first two sections presents evidence and concepts from Case 1and 2 respectively. Case 1 external collectives explored the Knife-makers Guild and the Spinners and Weavers Guild as sub-cases. On the other hand, Case 2 internal collectives investigated three medical research teams as sub-cases. With respect to the

analysis of each major case, first, the evidence from the sub-cases is analysed independently, outlining the themes and issues with a particular significance to informing their knowledge development and sustainability. Then, the sub-case results are analysed collectively to inform a consolidated case perspective.

Following the analysis of the evidence for each major case in its own right, a cross-case analysis is conducted to compare and contrast the results of the two consolidated case studies. This helped to illustrate the similarities and differences between external and internal expert communities, with regard to their approach towards the advancement and revision of collective knowledge. The cross-case analysis is presented in the penultimate section of this chapter. Finally, a summary of the case result is provided in the chapter conclusion.

4.2 Case 1: External Collectives of Experts

In this thesis, external collectives of experts are recognised as those groups of uniquely skilled individuals with shared personal interests. The significance of these collectives lies within their ability to leverage their shared specialist knowledge for the benefit of the individuals that constitute them. Yet, how these communities develop and sustain knowledge through collective efforts is not yet clearly understood. In addressing this gap, the empirical evidence presented here reveals the activities and processes of

knowledge cultivation and renewal in external collectives, exemplified through two contemporary craft guilds.

4.2.1 Sub-Case Evidence

Two sub-cases informed the study of external collectives of experts. Sub-case one explored a national knife-makers' guild, while sub-case two investigated a regional spinners and weavers' guild. The knife-makers were predominantly male and geographically dispersed. On the other hand, the membership of the spinners and weavers guild was largely female and locally aggregated. Thus, the two guilds provided divergent examples of external communities, with regard to the dimensions of gender and distribution of their membership. This comparative basis offered rich empirical insights to address the research problem.

This section analyses the evidence from the two guilds independently. The themes and issues identified through the analysis of interviews for the guilds, as informing their collective knowledge cultivation and renewal were grouped into eight thematic categories (see Table 11). These thematic categories are presented for each guild in the remainder of this section.

Table 11. Case 1: Sub-Cases and Thematic Categories

Sub-Cases	Thematic Categories
Knife-makers' Guild ***&*** ***Spinners and Weavers' Guild***	• Collective learning • Knowledge sharing • Background knowledge and experiential learning • Personal motivation • Willingness to change • Social interactions • Shared interests and collective identity • Shared resources

4.2.1.1 Sub-Case 1: Knife-Makers' Guild

The Knife-Makers' Guild is the first sub-case explored under the major case study of external collectives of experts.

Collective Learning

It was evident that the opportunity to learn as a collective was clearly valuable for the knife-makers because it helped them to *"better"* and *"further"* their expertise by *"learning new things"* from each other. The annual knife show, regional guild workshops and open days were examples of formally organised learning activities of the Knife-makers' Guild. The workshops and open days were carefully planned and structured to ensure that they are suitable not only for members who *"don't have lot of experiences"* but also *"for those who have been doing it (knife-making) for a reasonable amount of time"*. This meant that the formally organised

guild activities provided learning opportunities for both novices and masters by creating *"a forum"* where they could *"all congregate and talk"* about their experiences and ideas. Therefore, taking part in guild activities was described as indispensable by the knife-makers' for their personal and collective knowledge advancement.

According to the interviewees of the Knife-makers Guild, regular informal catch-ups and work days that took place outside of guild activities were also valuable in *"getting you the knowledge"* about the craft. It appeared that those members who lived within a close proximity would *"visit each others' sheds"* quite regularly to *"work with each other"* and to *"show each other what they've been doing".* Such informal work days gave the participants an opportunity *"to talk, trade ideas"* and to *"learn off each other"*. So, these informal learning experiences were also identified as significant for the knife-makers ability to expand and renew their knowledge and so to develop their expertise.

Knowledge Sharing

Given the geographic dispersion of the membership, knife-makers shared their knowledge through both face to face and electronically aided (e.g. telephone and email) communication. The evidence collective from the interviews suggested that although the knife-makers shared their explicit knowledge *"quite willingly"* with each other, they did not *"pass on too much information about the secrets"* they have *"learnt over the period of time"*. They felt that such personal knowledge cannot be easily shared with

others but rather needed to be developed overtime *"by your own personal experiences"*. This tells us that even though the knife-makers generously shared their explicit knowledge, they were not so able to share their tacit know-how (e.g.: *"I've got 15 years of experience and I can't just tell you all of that in 10 minutes.")*. So, the evidence collected in the interviews revealed that sharing of explicit knowledge was more important for the knife-makers to develop their collective knowledge.

The continuous sharing of explicit knowledge about various techniques, raw materials and tools, not only gave members *"more insights into ways of how to do things"* but also *"to pick up on where they're going wrong"*. This helped them to refine and improve their personal expertise by discovering new ways of doing things. These new ideas later developed into new styles and techniques and subsequently shared with other craftsmen through the involvement in guild activities (e.g. *"if someone comes up with something new or different, most people would get to see it at one of the shows"*). This opportunity to see and discuss novel creations of fellow guild members motivated knife-makers to *"make better knives and to try new things"*. Hence, the ongoing sharing activities within the Knife-makers' Guild clearly created an evolving cycle of knowledge cultivation.

The engagement in collective sharing activities also resulted in guild members *"bouncing ideas back and forth"*. This made them realise that they *"could be doing a technique in a slightly different way to make a better product"*. So, the collective sharing of ideas and knowledge helped

members to revise and update their craftsmanship by *"trying different styles, but using the basic techniques"*. Consequently, the evidence from the Knife-makers' Guild tells us that iterative knowledge sharing had a significant influence on the sustainability of their collective knowledge.

Background Knowledge and Experiential Learning

In the case of Knife-makers' Guild, members' ability to understand and interpret the shared knowledge appeared to depend upon their background knowledge and experiential learning activities. Having recognised this, the guild required its members to have some basic understanding about the craft when joining the guild. Furthermore, the members' had to go through *"a twelve months probationary period"* before they were entitled for full membership. This implies the importance of a sound knowledge base and experiential foundation for the knife-makers.

The full guild membership was granted to only those who demonstrated some proficiency and understanding about the *"the basic techniques"* of knife-making. This suggested that knife-makers considered being familiar with the fundamental techniques of the craft to be an important attribute for their ability to contribute, by understanding and interpreting the knowledge shared during the guild activities. Given the very nature of the Guild was to refine and inform the craft of knife-making, this requirement directly confirms that the shared motivation of the members was about developing their expertise. Thus, background knowledge was clearly significant for the collective development of knowledge within the knife-makers' guild.

Secondly, experiential learning was also crucial for the knife-makers ability to internalise the shared knowledge. It appeared, that after taking part in guild activities the members would *"take and 'better' the ideas"* they have just heard through their *"own sort of trial and error"* experimentation. This gave them an opportunity to understand how to use a particular technique by *"actually trying it"*. These individually directed experiential learning activities were seen as *"the best way"* for them to personalise the explicit knowledge that was shared, for their own unique purpose. Importantly, personalisation of shared knowledge helped members to develop their own styles and methods. This makes it apparent that the experiential learning had a significant impact on the collective knowledge expansion of the knife-makers.

Personal Motivation

According to majority of the interviewees from the knife-makers guild, it is *"your imagination, your skills and your learning"* that helps you to develop your *"own style and little niche"*. So, the members' ability to develop new styles, techniques and methods depended upon their personal motivation to learn and to engage in creative exploitation of their knife-making knowledge. Importantly, the unique styles and methods developed by the individual members were then shared with others, through the involvement in guild activities such as the Annual knife show and open days. This in turn contributed to the collective development of knowledge because seeing these new creations inspired knife-makers to think differently and so to develop their own style. Hence, the personal

motivation of members to improve their skills and expertise was clearly significant for the collective knowledge advancement of the Knife-makers Guild.

Willingness to Change

Majority of the interviewees from the Knife-makers Guild stated that they are quite willing *"to try different and better ways to do things",* but these changes should *"come very slowly"* for them to be *"more acceptable"*. Interestingly, it appeared that the novices had *"a lot less trouble about changing things"* with compared to those senior members that had achieved a level of mastery.

This may be due to the fact that the masters have tried and tested many different techniques and alternative methods over time and through that they have established a foundation of expertise which serves as a conservative reference. Novices, in contrast were likely to be keen to develop that knowledge foundation. So, they were more willing to try new things and learn from those experiences. These findings tell us that knife-makers willingness to change varied according to their level of experiences and level of mastery. Nevertheless, all of the interviewees acknowledged that they have *"to change with time"*, if they *"want to see the guild progress"*. Thus, the results from this guild clearly demonstrate that members' willingness to change had a significant influence on their ability to develop knowledge as a collective.

Social Interactions

It was evident that the knife-makers who lived within close proximity would often *"catch up, to find out what everybody else has been doing".* These informal get-togethers and visits, that took place *"once or twice a week"* allowed knife-makers to *"look at each other's knives, pick up little tips and to steal a few ideas".* Moreover, the interviewees stated that they *"talked regularly on the phone"* with others who lived in different states. This meant that regardless of the geographic spread of the membership, knife-makers talked and interacted with fellow members *"several times a week".* These regular interactions helped them to *"gain more knowledge"* by learning and exchanging ideas and information with each other.

The knife-makers also felt that interacting with all members regardless of their seniority was important because *"there is always something to learn off from everybody".* For example, it was evident that the novices often inspired the masters of the guild to think differently and to try out new ways of doing things. This was clearly illustrated in the following comment made by one interviewee: *"some new member will come in, he has only been doing this for a year and their work is unbelievable. It shakes a lot of the older guys up, gets them out of their comfort zone".* So, the frequent interactions between the novices and masters were seen as significant in providing mutual benefits for both parties. Thus, the findings from the Knife-makers' Guild clearly illustrated the value of frequent and quality social interactions among members in promoting the refinement and renewal of their collective knowledge.

Shared Interests and Collective Identity

The knife-makers described their guild as a *"group of like-minded hobbyists"* because they all shared a *"big interest in knives"* and wanted to improve themselves as knife-makers. This shared interest not only motivated them *"to be around people that make knives"* but also gave them a sense of collective identity by making them all feel as *"part of the group"*. This collective context was important for their commitment to learn and share knowledge as a community of uniquely skilled craftsmen. Therefore, the shared interest and collective identity were seen as important in helping knife-makers to develop and sustain their collective knowledge.

Shared Resources

Finally, the shared resources of the guild such as the library and the monthly newsletter helped knife-makers to collectively share and advance their knowledge. The interviewees suggested that they frequently borrowed books and DVDs from the library to learn about various aspects of the craft. On the other hand, the monthly newsletter provided an effective means of knowledge transfer. The newsletter not only helped members to share valuable knowledge such as the contact information of suppliers but also allowed them to get to know fellow members, especially the ones who are living in different states of Australia by providing *"the contact information and the speciality of the knife-makers who are willing to help"*. Hence, the evidence tells us that even their humble guild newsletter was a valuable resource for promoting knowledge advancement within the guild as it helped to share valuable information.

4.2.1.2 Sub-Case 2: Spinners and Weavers Guild

The Spinners and Weavers Guild was the second sub-case investigated in the major case of external collectives of experts.

Collective Learning

Shared learning within the Spinners and Weavers Guild was mainly facilitated through formally organised guild activities such as garden spinning days, open days and monthly meetings and workshops. These guild activities provided members with *"excellent"* opportunities to interact, share ideas and learn off each other. This makes it apparent that formal mechanisms (such as monthly guild meetings and workshops) were intrinsic for organising group interactions within the spinners and weavers guild and thus, creating a collective learning environment for knowledge advancement.

It was also evident that the deliberately organised learning activities of the Spinners and Weavers' Guild were *"fairly open"* and *"relaxed"* in nature. According to the interviewees, having a *"friendly"* atmosphere not only made them *"enjoy doing the workshops"* but also *"helped to make learning a bit easier"*. Thus, the findings revealed that the informal nature of the guild activities created engaging 'open learning' environments which were conducive for the spinners and weavers to learn as a group.

Knowledge Sharing

The geographically localised guild membership made it possible for the spinners and weavers to meet regularly to share their knowledge, ideas and experiences with one another. The guild met twice a month for their monthly meeting and workshop. Events such as open days and garden spinning days were also held several times a year. It was evident that the participants shared their knowledge *"very generously"* during these events, with one interviewee stating that *"I was just amazed at the amount of knowledge that women brought and shared."* This continuous sharing of knowledge and ideas *"inspired"* the individual participants to think differently and so to create new knowledge through discovering new styles and techniques.

Importantly, evidence suggested that the spinners and weavers *"shared their knowledge once they've created it"* through participating in collective sharing activities. This was significant in stimulating the creative thinking of fellow guild members. Therefore, it was apparent that the ongoing collective sharing created a cyclical process of knowledge cultivation within the spinners and weavers guild.

Collective sharing also helped members to discover new and improved ways of using materials and techniques. This was clearly evident in the following comment made by one interviewee: *"the fabrics are softer and people are using a better quality wool fleece and that has got a lot do with us being educated".* The guild leader also commented that she had

"noticed the change" in terms of members coming up with new and different ways of doing things. She felt that this was a result of members sharing and discussing their ideas and experiences with each other on a regular basis. Thus, it is clear that collective sharing of knowledge was significant for the spinners and weavers ability to refine and renew their expertise as a collective.

Background Knowledge and Experiential Learning

Despite the fact that background knowledge was not a prerequisite to obtain the membership of the Spinners and Weavers Guild, majority of the interviewees stated that they were familiar with the basic techniques of the craft when they joined the guild. In fact, there were some members who had practiced the craft as a hobby for years before joining the guild. This meant that the spinners and weavers did have some fundamental understanding about the basic techniques and methods of their craft, which would have undoubtedly helped them to understand and interpret the knowledge shared during the guild activities. Therefore, it can be inferred from the interviews that having some basic understanding about the craft was useful for the members' ability to improve their knowledge.

According to the interviewees, the personalisation of shared knowledge through experiential learning was also important for their ability to cultivate new knowledge. They stated that hands-on learning helped them fully grasp the techniques and methods they learned from others (e.g. *"it is 'doing' knowledge so you have to 'do' it")*. So, the spinners and weavers

often *"developed something new"* by *"applying the things they have learnt"* from the fellow guild members into their own work. Therefore, members' ability to internalise the shared knowledge through experiential learning was significant for the cultivation of collective knowledge in the Spinners and weavers' Guild.

Personal Motivation

The interviews revealed that the members of the Spinners and Weavers' Guild were motivated by the sense of pride they had in developing various styles and methods that are unique to themselves. In fact, it appeared that they always tried to do things *"a bit differently"*, with one interviewee stating that: *"I don't want to do the one that you've done because I feel a little bit up there with what I have learnt".* This encouraged them to be creative and to think of new and different ways of using various techniques, materials and patterns. Hence, the evidence from the interviews suggested that the personal motivation of spinners and weavers to unleash their creativity influenced the advancement and renewal of their collective knowledge.

Willingness to Change

It was evident that spinners and weavers willingness to change encouraged them to constantly experiment and discover new ways of doing things, with one senior guild member commenting that: *"I always tell them (new members) there is 101 different ways to spinning, so not to worry about the fact that it doesn't look like someone else's".* Importantly, spinning and

weaving was described as a *"very creative sort of craft"* by the interviewees. So, they felt that they *"have to be quite creative"* in terms of experimenting with different techniques and materials. This willingness to change was crucial for their ability to excel in the craft because it meant that they were open to learn, adopt and experiment with new techniques. Thus, it is clear that members' willingness to change had a significant impact on the refinement and renewal of knowledge in this guild.

Social Interactions

Given that the spinners and weavers met regularly as a guild, social interactions among the guild members mostly took place during and after these guild activities. In fact, the *"informal"* and *"relaxed"* nature of the guild activities encouraged guild members to talk and interact with each other freely. According to the interviewees, they often learned and shared a great deal of knowledge during these informal chit-chats. So, the spinners and weavers felt that frequent social interactions helped *"move the guild forward"*.

Majority of the interviewees stated that interacting with *"different personalities who have way out ideas"* often *"inspired"* them to think differently. They felt that having different personalities as part of their community would help stimulate the creativity of fellow members. This suggested that the spinners and weavers appreciated the differences in personalities.

The evidence also revealed that in the Spinners and Weavers Guild, there were constant interactions between the learners and those more experienced. When a new comer with little experience joined the guild, a more senior member *"would usually take that person under their wing"* to teach various techniques and methods. This meant that in the case of spinners and weavers, the interactions between junior and senior members often took place in form of mentoring. Such constant interactions provided newcomers with regular learning and knowledge sharing opportunities, thus, contributed towards the overall progression of the guild.

Shared Interests and Collective Identity

Spinners and weavers were bound by the shared interest they had towards learning and practicing the craft. Importantly, this shared interest motivated them to come together to form the guild, with the guild leader stating that: *"there were several of us who were enjoying spinning and thought, where do we go from here and it sort of worked itself into the guild".* This tells us that the shared interest gave spinners and weavers a sense of collective identity and brought them *"together"* to learn and share knowledge with each other. So, there is no doubt that the collective context created through the shared interest and identity was fundamental in spinners and weavers ability to refine and renew their expertise as a craft guild.

Shared Resources

The interviews revealed that the members of Spinners and Weavers Guild shared resources such as books and magazines with each other. In fact, the members brought in various books and magazines to share with fellow members. This resulted in formation of the guild library. The comments made by the interviewees revealed that they often gained new insights and *"little hints"* about various ways of using techniques by referring to these books and magazines in their library. This suggested that the guild library played significant role in stimulating the creative thinking and innovation among spinners and weavers and so contributed towards their collective knowledge advancement.

4.2.2 Within-Case Analysis

Evidence from the two sub-cases of the first major case was analysed independently in the previous two sections to reveal how external collectives develop and sustain their knowledge. In this following section, a within-case analysis is conducted to synthesise these two bodies of sub-case evidence into the major case of external collectives of experts. In doing so, here the results from the two guilds are compared and discussed to reveal how each guild informs the eight thematic categories identified as significant in addressing the research problem.

4.2.2.1 Collective Learning

Collective learning experiences were significant for the cultivation and renewal of knowledge in both guilds because they enabled members to further their expertise through exchanging ideas and learning from each other. The evidence revealed that formal organisational mechanisms (such as meetings, workshops and open days) as well as informal discussions and work days created shared learning platforms within the two craft guilds. However, there were some significant differences between the knife-makers, and spinners and weavers in terms of their approach towards organising collective learning activities.

The knife-makers preferred to have their learning activities well planned and structured to cater for the learning needs of all its members. On the other hand, the spinners and weavers emphasised on having an informal and relaxed atmosphere during their guild activities. This could be due to the gender differences of the guild membership. However, exploring the impact of gender differences in collective learning activities was beyond the scope of this research.

4.2.2.2 Knowledge Sharing

The evidence from the two craft guilds revealed the importance of collective sharing of knowledge and ideas for their ability to develop and sustain their expertise. Firstly, sharing their knowledge about various

methods, techniques and tools helped members to gain new perspectives and so to discover new and better ways of doing things. Secondly, collective sharing gave guild members an opportunity to discuss and reflect upon their ideas and experiences. This helped them to revise and renew their techniques to develop new styles. These issues were common across both guilds. However, it appeared that each guild had a unique approach to knowledge sharing.

Given the geographic dispersion of the membership, the knife-makers shared knowledge and ideas during and outside of guild activities as well as through electronically aided communication (e.g. telephone and email). On the other hand, the spinners and weavers with their locally aggregated guild membership mainly shared their knowledge during monthly guild meetings and workshops.

The evidence also suggested that, compared with the spinners and weavers, the knife-makers were somewhat reluctant to share their personal knowledge. So, it appeared that the collective sharing of explicit knowledge was more important for the knife-makers. This different approach to knowledge sharing can be attributed to their difference in gender and location dimensions. However, exploring the influences of these issues in collective development and sustainability of knowledge was beyond the scope of this research.

4.2.2.3 Background Knowledge and Experiential Learning

It appeared that background knowledge and experiential learning was significant for the collective development of knowledge in both craft guilds because these two factors determined guild members' ability to internalise the shared knowledge. Firstly, having some basic understanding about the fundamental techniques of their craft helped guild members to refine their expertise by understanding and interpreting the shared knowledge. On the other hand, experiential learning was conducive for the guild members to develop their own styles and techniques by personalising the shared knowledge.

The new styles and methods developed through personalising the shared knowledge were in turn shared with fellow members through the involvement in guild activities such as the Knife-show and open days. So, background knowledge and experiential learning appeared to be significant for the collective advancement of knowledge in guilds. However, compared with the spinners and weavers, the importance of having a sound knowledge base and experiential foundation was more explicitly stated in the case of Knife-makers' Guild, through their membership prerequisites and 12 months probationary period.

4.2.2.4 Personal Motivation

In the case of knife-makers, individual members' motivation to discover and experiment with various methods, tools and materials lead to the development of new styles. On the other hand, the spinners and weavers were constantly motivated by their need to create styles and patterns that are unique to themselves. Importantly, the evidence from both cases suggested that this personal motivation to learn and unleash their creativity not only helped guild members to further their individual expertise but also contributed towards their overall knowledge progression.

4.2.2.5 Willingness to Change

The results from both guilds clearly demonstrated that members' willingness to change techniques and methods was significant for their collective knowledge advancement. However, in the case of the knife-makers, the reluctance of more experienced members to adopt new techniques and their preference towards incremental change were key factors determining the degree of change within their guild. However, these issues were not evident in the case of the Spinners and Weavers Guild. So, it appeared that, compared to the knife-makers, spinners and weavers had less trouble in changing and adopting new techniques.

4.2.2.6 Social Interactions

Social interactions between knife-makers took place outside of guild activities and were a result of members regularly catching-up or visiting each others' sheds. On the other hand, the interactions between the spinners and weavers mainly took place during and after their monthly guild meetings and workshops. Nevertheless, in the case of both guilds, these social engagements helped members to share valuable knowledge and information with each other. Thus, it was evident that regular social interactions between members were fundamental in creating an effective passage of knowledge within the two craft guilds explored in Case 1.

The results from the two guilds also made it very clear that the frequent interactions must take place across all levels of membership, regardless of their level of expertise. This was because interacting with different personalities inspired guild members to think differently and so contributed towards the collective refinement and renewal of their knowledge.

The evidence from the Knife-makers' Guild revealed that interactions between the novices and masters were important in providing mutual learning opportunities for both parties. However, with regard to the spinners and weavers, interactions between the junior and senior members were for the purpose of providing the newcomers with guidance and support they needed. So, compared with the knife-makers, the spinners and weavers' motives for interacting with novices were more altruistic. This

difference in their motives may be attributed to the gender difference of the guild memberships, but that issue has not been examined in this research.

4.2.2.7 Shared Interests and Collective Identity

The members of both craft guilds were bound by the shared interests they had towards learning and practicing their crafts. Importantly, this shared interest created a collective identity among guild members and in turn motivated them to interact, learn and share knowledge as a group. So, the results from the two guilds clearly illustrated that the social foundation created through shared interests and collective identity was a key to the guilds members' ability to develop and sustain knowledge as expert communities.

4.2.2.8 Shared Resources

Shared resources such as libraries and newsletters were important in facilitating knowledge sharing and creative thinking among the guild members. So, shared resources were significant for the cultivation and revision of collective knowledge in guilds. In the case of spinners and weavers, the guild library helped stimulate the creative thinking of the members. On the other hand, the shared resources such as the guild library and the monthly newsletter of the Knife-makers' Guild enabled effective knowledge transfer and so helped members to further their expertise.

However, compared with the spinners and weavers, the knife-makers were much more heavily relied upon their shared resources (e.g. the newsletter) to get to know fellow members and to share valuable craft related information such as the contact information of suppliers and masters of knife-making.

4.2.3 External Collectives Major Case Summary

The two craft guilds explored as the sub-cases of major Case 1 identified eight thematic categories as significant in understanding the collective knowledge development and sustainability in external collectives (see Table 12).

Firstly, the findings suggested that collective learning and sharing experiences facilitated through formal mechanisms such as meetings, workshops and seminars as well as informal catch-ups, telephone and email conversations were significant for the guild members' ability to refine and renew their collective knowledge. Yet, how the members of these two guilds went about learning and sharing knowledge varied according to their unique context. For example: the Knife-makers' Guild, with their predominantly male and geographically dispersed membership had their guild activities well planned and structured, and emphasised on sharing explicit knowledge through face to face and electronically aided communication. On the other hand, spinners and weavers with their female and locally aggregated membership not only wanted their guild activities to

be informal and relaxed in nature but also shared both explicit and personal knowledge generously through face to face, personal communication.

Secondly, the evidence from craft guilds revealed that having a sound knowledge base and experiential foundation was significant for their overall knowledge progress because these issues determined members' ability to understand and interpret the shared knowledge. The evidence collected from the craft guilds also suggested that members' willingness to change as well as their motivation to learn and discover new styles and methods were all important issues informing the collective advancement and renewal of expert knowledge in guilds.

Finally, it was clearly evident that the social foundation within each guild played a crucial role in facilitating collective learning and sharing among its members. Regular social interactions between guild members was seen as key to sharing knowledge, while the shared interests and collective identity of the members were identified as fundamental for their ability to further their expertise through collaborative efforts. Use of shared resources such as the libraries and newsletters also enriched the knowledge transfer and communication among the guild members. In conclusion, the evidence revealed that the development and sustainability of collective knowledge in craft guilds, as examples of external communities was an evolving cycle of collective learning and sharing facilitated through unique social processes.

Table 12. A Summary of Thematic Categories and their Level of Importance as Evident in Each Sub-Case of Major Case 1

Theme/Issue	Sub-case 1 Knife-makers' Guild	Sub-case 2 Spinners & Weavers' Guild
Collective learning	**Significant** • Formal mechanisms (e.g. shows, workshops, open days)	
	• Well planned and structured	• Informal in nature
Knowledge sharing	**Significant** • Face-to-face and electronically aided • Reluctant to share personal knowledge • Emphasis of explicit knowledge sharing	**Significant** • Face-to-face and personal • Generous sharing of both implicit and explicit knowledge
Background knowledge and experiential learning	**Significant** • Background knowledge a prerequisite • Probationary period for experiential learning	**Significant** **(**Importance of these issues was implicitly stated.)
Personal motivation	**Significant** • To learn and discover new things	**Significant** • To do things differently and to develop unique styles
Willingness to change	**Significant** • Incremental change • Depended upon the level of mastery and experiences	**Significant** • Crucial for the guilds' progress
Social interactions	**Significant** • Face-to-face and electronically aided. • For the mutual benefit	**Significant** • Regular face-to-face. • Altruistic interactions between seniors and juniors
Shared interests and collective identity	**Significant** • Aided learning, sharing and interactions	
Shared resources	**Significant** • E.g. library & news letter • Crucial for knowledge transfer and getting to know fellow members	**Significant** • E.g. the Guild library • Stimulated creative thinking

4.3 Case 2: Internal Collectives of Experts

Internal collectives of experts are groups of specialists driven by formal organisational agendas. So, they operate for the benefit of the organisations that control them. Internal expert groups are significant because they solve complex organisational problems by effectively leveraging the specialist and unique knowledge of their members. Yet, how these groups develop and sustain their expert knowledge as a collective is not widely explored. This section presents evidence from three medical research teams as examples of internal collectives and informs us about the cultivation and renewal of knowledge within these groups as an outcome of a dynamic social phenomenon.

4.3.1 Sub-Case Evidence

Three sub-cases of research teams informed the study of internal collectives of experts. All three teams were employed within the same collaborative research centre, although each group worked on different research programs. Thus, the three sub-cases of this major case were similar in terms of their typical contextual development, purpose of association and activities agenda. This presents an interesting parallel when considering the individual differences of each sub-case.

Evidence from the three sub-cases is presented in this section sequentially, one sub-case at a time. In doing so, the common themes and issues

identified in the interviews as significant in informing the collective development and sustainability of knowledge were grouped into eight thematic categories (see Table 13). These themes are used to bring consistency and to facilitate comparative opportunities across the presentation of results for the three research teams here.

Table 13. Case 2: Sub-Cases and Thematic Categories

Sub-cases	Thematic categories
Team A ***Team B*** ***&*** ***Team C***	• Collective learning • Knowledge sharing • Background knowledge and experiential learning • Organisational agendas and bureaucracies • Social interactions • Key relationships and power dynamics • Common goals and collective identity • Shared resources

4.3.1.1 Sub-Case 1: Team A

Team A is the first sub-case explored under the major case of internal collectives of experts.

Collective Learning

In the case of Team A, the interviewees revealed that the opportunity to *"learn as a group"* was *"absolutely essential"* for them *"to develop"* as a team. This meant that shared learning experiences were significant not

only for the members' to develop technical abilities but also to sustain their knowledge as a cutting edge research collective. So, laboratory meetings and seminars were organised regularly for the members to share their ideas, discuss problems and to critically and intellectually analyse their results.

Interestingly, the evidence suggested that the team leader thought of formal learning mechanisms to be fundamental for member learning, while the two supervisors beneath him felt that *"striking a balance between formal meetings and informal discussions"* was more effective in promoting group learning. Nonetheless, the rest of the team members believed that they mostly learned through informal *"group talk"* and ad-hoc group discussions. In fact, many interviewees stated that it was *"easier"* for them to learn, if it was *"a bit informal"*.

These are all important findings because firstly, they reveal that the mechanisms used by the team leader to promote group learning differed from those that were actually preferred by the team members. Secondly, the evidence tells us that the informal group discussions and activities created effective learning environments which were conducive for the team members' ability to develop collective knowledge.

Knowledge Sharing

Members of Team A saw knowledge sharing as the *"key to learning new things"*. They felt that *"you have to share"* what you know with each other because it is *"very important for the overall progress"* of the team. Firstly,

hearing the ideas and experiences of others helped team members to *"come up with new insights into the techniques that they're using"*. Moreover, sharing their experiences and project challenges allowed members to solve problems with the help of others, with one interviewee stating that: *"someone else's eyes could look over it and figure out the problem straight away"*. This meant that knowledge sharing was important not only for the members *"to improve"* as researchers, but also to *"provide input to the group as a whole"* in terms of developing new knowledge.

Secondly, it was evident that ongoing knowledge sharing activities got *"everyone's brain flowing"* and resulted in members having *"little discussions and debates"* about *"what is the best way to do"* the laboratory techniques. These discussions made them realise that *"there is always more than one way to do a particular experiment"* and helped them to *"adapt"* their knowledge about various techniques to suit the current needs. Thus, the results from this team clearly demonstrate that collective sharing of knowledge and ideas was an effective way of renewing their current knowledge.

Background Knowledge and Experiential Learning

Having some fundamental understanding about the lab techniques was a prerequisite to join Team A. Majority of the interviewees stated that a considerable amount of *"foundation knowledge is necessary to understand why you're doing certain things in your techniques"*. This meant that having some *"basic understanding"* about the techniques was crucial for

them to interpret the shared knowledge and so to refine their expertise. Therefore, it can be inferred from the evidence that background knowledge was significant for the knowledge expansion of Team A.

To fully comprehend the shared knowledge about various lab techniques, the members had to *"do it practically in the lab"*. As stated by the interviewees, *"there is only so much you can translate through words"*. So, *"the best way to learn"* a particular technique was to do it using one's own hands. Evidently, it was this *"experience"* they gained through hands-on learning that helped them to internalise the shared knowledge by *"thinking about it in their own way"*. This personalisation of knowledge was crucial for the researchers to *"come up with new ideas"*. Hence, the evidence revealed that experiential learning activities of individual members contributed towards the collective knowledge development of this team.

Organisational Agendas and Bureaucracies

Given that *"things change all the time"* in the field of medical sciences, the organisational agendas of the collaborative research centre demanded team members *"to continuously come up with new things to improve what they're doing"*. This meant that the team members were under continuous pressure *"to innovate and to develop new technologies"* that could give their group *"an edge"* in terms of creating new knowledge. Therefore, it was apparent from the interviews that knowledge cultivation within Team

A was driven by the organisational agendas of the collaborative research centre.

While the organisational agenda worked in favour of the teams overall knowledge cultivation, the organisational bureaucracies such as deadlines, limited funding and resources restricted members' ability to improve their knowledge (e.g.: *"you get all the support to actually develop new things but they will have a short existence if they don't get the money").* In fact, majority of the interviewees complained that they *"don't have lot of opportunity to experiment"* because they were often restricted by the project deadlines and lack of *"research funding"*. So, the members had to always try and *"strike a balance"* between the creativity and practicality in their new ideas to ensure that these ideas can be implemented using the resources that are available for them. This shows us that the members' ability to create and refine their knowledge was limited by the organisational bureaucracies.

Social Interactions

Social interactions that took place during the morning tea break, lunch outs and after work drinks were seen as vital in promoting effective transfer of knowledge within Team A. It was during these social interactions that members would often *"chat"* about their work, *"hear other people's ideas"* and *"get feedback"* from others. Interestingly, it appeared that members preferred to share their ideas during these *"informal conversations"* than presenting them *"formally"* at the weekly lab

meetings. This tells us that social interactions between the members were indispensable for the knowledge transfer within Team A and so to the overall improvement of their collective knowledge. Yet, it appeared that the team leader was not so keen on encouraging social interactions, with the interviewees revealing that he *"did not have lot of influence in the social interactions"* and seldom took part in the social activities.

This lack of support from the team leadership may have affected the quality of social interactions within Team A because many of the senior researchers felt that their lab didn't *"socialise as much as other labs"*. While the team leader did not particularly see social interactions as an effective means of knowledge sharing, majority of his team members including the two supervisors felt that they could always *"learn a new skill"* by talking to others in their group. So they stated that *"it is important to interact with people in the group"* on a daily basis regardless of their level of seniority and organisational position. This open-mindness to ideas among team members appeared to be key to constructive knowledge sharing and refinement.

For example, it was evident that the senior researchers welcomed the *"opportunity"* to teach juniors because it helped them to *"refresh"* their knowledge, with one senior researcher stating that: *"all the newcomers bring something, even if it's just renewing your skills because you haven't done something in a while"*. This tells us that social interactions across all levels of membership helped members not only to learn, and share knowledge but also to renew their knowledge. So, there is no doubt that

the social interactions were crucial for the collective knowledge advancement and renewal in Team A.

Key Relationships and Power Dynamics

In the case of Team A, key relationships were evident between supervisors and research students as well as among those members who interacted with one another outside of work hours. Supervisor-student relationships were a result of senior researchers being held responsible for guiding junior research students. On the other hand, the personal relationships and friendship groups between certain members developed overtime as a result of them interacting with each other outside of work (e.g. going out for morning coffee and lunches).

It appeared that those with *"better personal relationships"* often preferred to exchange ideas and discuss research issues only among themselves and interacted less with those outside of their friendship group. This meant that the existence of key relationships was a barrier for the effective knowledge transfer and so it hindered the broader collective cultivation of knowledge in this team.

Existence of power dynamics also influenced the knowledge sharing within Team A. For example, the interviews revealed that some senior members were in a *"struggle for power"* and found it somewhat hard *"to compromise"*. On the other hand, the technical staff complained that they were *"not given as much opportunity to sit down and read widely about*

their area". As a result, they took *"less ownership of the intellectual knowledge behind what they are doing"* and were often reluctant to share their expertise with others in their team. Consequently, these power dynamics hindered knowledge transfer and members ability to work as a collective. So, these issues were seen as a constraint for the members' ability to develop and sustain their collective knowledge.

Common Goals and Collective Identity

Members of Team A had their individual projects, all designed to contribute towards the one big goal of their team. So, they were aware of the fact that the outcomes of their individual projects had a direct impact on the overall progress of their team, with one interviewee stating that: *"our goal together is to make a big story. So no one is more important than another."* This made them come together whenever it was needed regardless of their hierarchical positions because the members knew that *"your success comes from your lab. Without the lab you're no-one"*. Thus, having *"a common goal"* was clearly important for their ability to refine and renew their knowledge as a collective.

Having a common goal gave members a sense of collective identity and created a friendly culture where they all *"work together closely helping each other out"*. In fact, it was evident that this collective context created a mutual understanding among the team members, with one interviewee stating that: *"if someone's working on the techniques that I am familiar with I try my level best to help them. They would do the same for me"*.

This tells us that collective identity was the key to motivating members to interact, learn and share their knowledge with each other. So, it was important in understanding the development and sustainability of knowledge within Team A.

Shared Resources

Members of Team A worked in *"an open plan office"*. So they had the opportunity *"to talk"* to each other *"on an open door basis"*. This was useful in promoting effective communication and continuous knowledge transfer among the members. Moreover, it was evident from the interviews that the members used a *"shared server"* to store and share their data, so that *"anyone can see"* and access their information. This tells us that use of shared resources such as the office space and shared servers were significant not only for the team members' ability to interact but also to share valuable information. So, this would have undoubtedly contributed towards their collective knowledge development.

4.3.1.2 Sub-Case 2: Team B

Team B was the second sub-case explored for the major case of internal collectives.

Collective Learning

In the case of Team B, weekly lab meetings, monthly workshops and seminars as well as informal group discussions were all valuable *"learning opportunities"* that helped them improve their knowledge as a group. For example: seminars and workshops provided *"a forum"* where members could *"share ideas"* and learn *"new techniques"* while the informal group discussions were useful for them to learn by *"just talking and sharing ideas"* with each other. So, both formal mechanisms and informal group talk as collective learning experiences were significant for the members' ability to gain *"new understanding and new knowledge"*.

The uniqueness about the formal learning mechanisms of Team B was that the team leadership deliberately made them *"semi-formal"*, to help his team members *"learn off each other"* more easily. This is interesting because it clearly demonstrates that informal nature of group activities was conducive for the collective learning within the Team B.

Knowledge Sharing

Members of Team B shared their knowledge and ideas *"very generously"* with each other because they thought it to be important for their ability *"to be innovative"* and so to *"grow"* as a team. This generous sharing of

knowledge helped them *"see things differently"* and to come up with new ideas by getting out of their *"comfort zone"*. These new ideas later *"expanded into new protocols"* and facilitated the development of *"new and more advanced techniques"*. Thus, it was apparent from the interviews that ongoing knowledge sharing was significant for the collective knowledge development of Team B.

Collective sharing of ideas and knowledge also helped team members to *"evolve"* as a collective by *"expanding"* their way of thinking. Constant sharing involved members *"discussing"* and reflecting on their results as a group. This made them realise how they could *"adopt existing protocols to suit the current needs"*. So, the evidence collected from the interviews suggested that collective sharing activities of Team B were crucial for the update and renewal of their collective knowledge.

Background Knowledge and Experiential Learning

Having some background knowledge in biomedical sciences was a prerequisite to join the team. So, all members of Team B had completed at least an Honours level degree and knew the *"background theory"* behind the lab techniques. This not only helped them to perform the techniques *"properly"* but also to have *"an intellectual understanding about what they are doing"*. Thus, it can be inferred from the evidence that background knowledge played a significant role in team members' ability to understand and interpret the shared knowledge.

Experiential learning activities also helped members to internalise the shared knowledge. In fact, the interviewees stated that *"there is no substitute"* for doing a technique *"by yourself"* because it helped them to understand all the *"little bits and pieces"* of knowledge involved in that technique correctly. This personalisation of knowledge allowed members to discover new and improved ways of doing laboratory techniques. Therefore, the interviews revealed that experiential learning activities of individual members were significant for the knowledge expansion of Team B.

Organisational Agendas and Bureaucracies

Research activities of Team B were shaped by the organisational agendas of the main research centre which focused on conducting cutting edge research in the field of Bio-medical sciences. So, the team members were responsible for creating *"new knowledge"* to deliver ground breaking solutions for the health problems of the modern society. This meant that they had to constantly come up with *"new ideas"* in order to be *"innovative"* and to *"move forward"* as a group. Thus, the results from Team B reveal that the organisational agendas had a significant influence over their collective knowledge cultivation and renewal.

Despite the support from the organisational agendas in fostering knowledge development, it appeared that organisational bureaucracies (e.g. project deadlines and limited funding) hindered the team members' ability to develop new knowledge. According to the majority of interviewees, it was important for them to make sure that the new ideas are *"feasible"* in terms

of their compatibility with the time and resource availability. So, they were faced with the challenging task of being *"able to show that it is not only a good idea but you can actually do it"* using the resources that are available to them. This meant that these organisational factors often limited the innovation within Team B and thus, influenced the quality of their knowledge advancement.

Social Interactions

Regular social interactions among team members took place as a result of them *"catching up after work"* and *"going out for morning coffee"*. The interviews revealed that *"a lot of casual conversations about work"* took place during these social outings. This meant that frequent social interactions were an *"important"* means of promoting knowledge transfer between the team members. Having recognised this, the team leader encouraged members to frequently organise social activities and to interact with one another outside of working hours. In fact, he felt that it is crucial for members of all levels to interact on a regular basis because it would enrich their knowledge sharing expertise.

Firstly, talking to members with a variety of backgrounds and expertise was seen as a valuable opportunity to access specialist knowledge within their group. Secondly, exchange of alternative perspectives among members from backgrounds and experiences *"raised everybody's level of awareness of new ideas"*. This meant that frequent social interactions across all levels of membership not only fostered learning and knowledge sharing but also stimulated new idea generation. So, there is no doubt that social

interactions were crucial for this teams' ability to improve and renew their collective knowledge.

Key Relationships and Power Dynamics

In the case of Team B, key relationships and power dynamics were not evident among its members. According to the interviewees, they had *"a good team environment"* where *"everyone got along with each other"*. The team leader deliberately tried to minimize the power dynamics within his team because he felt that *"it is important to break down those (hierarchical) barriers to foster the ease of communication"* between the members. So, it was evident that the members of Team B *"talk to each other as equals"* and tried not to *"alienate anyone by pulling rank on them".*

This appeared to be significant in *"encouraging learning"* and promoting the overall knowledge transfer by allowing everyone to contribute during group discussions. Hence, it can be inferred from the evidence that the absence of key relationships and power dynamics fostered learning and knowledge sharing within Team B and was significant for their ability to develop and sustain knowledge as a collective.

Common Goals and Collective Identity

In Team B, the members were all working *"together as a group"* to achieve a common goal. This made them *"constantly move forward"* by *"collaborating as a team to achieve the end result"*. Having a common

goal gave team members a sense of collective identity. This was important as it allowed team members to be *"very open and transparent"* with their knowledge. So, it appeared that the collective context created through shared goals and identity was important for the development of collective knowledge in Team B.

Shared Resources

The interviews revealed that the members of Team B, including the leader and the supervisors, all worked in the *"same office"*. This resulted in there being *"a lot of cross-communication"* between members and so it helped them to constantly exchange information and ideas while working. It was also evident that members used a protocol book to record the procedures of conducting various lab techniques. This shared book was seen as a useful means of sharing and preserving the valuable knowledge for communal use, with one interviewee stating that: *"if you need reminding (about a technique) there is a book with all the information in it".* Therefore, it is apparent from the interviews that the shared resources such as the office space and protocol books were important for the advancement of knowledge in Team B, as these promoted knowledge transfer within the team.

4.3.1.3 Sub-Case 3: Team C

Team C is the third sub-case explored under the major case of internal collectives of experts.

Collective Learning

Learning within Team C was a result of members taking part in weekly lab meetings, monthly seminars, workshops as well as *"lots of little informal meetings"*. Collectively, these shared experiences helped members to *"learn new techniques"* and to *"engage in discussions"* about how to overcome the research challenges and problems. So, it was apparent from the results that both formal learning mechanisms as well as informal discussions were significant for the team members' ability to improve and renew their knowledge as a group through collective learning.

It was also evident that the learning activities of Team C (e.g. the weekly meetings and monthly seminars) were conducted in a *"very informal sort of way"*. This was seen as *"quite important to their learning"* because the *"relaxed"* and *"informal"* nature encouraged members to open up and to *"share what they have been doing"* with others in their team. This tells us that in the case of Team C, the informal nature of the group activities created an environment conducive for learning.

Knowledge Sharing

According to the interviewees of Team C, making sure that there was *"a passage of knowledge throughout the team"* was very important for their

ability to grow as a team. So, there was *"no holding back of information"* among team members. It was evident that they even shared *"little hints and techniques"* they have learned overtime with fellow members *"very generously"*. This is interesting because it tells us that researchers of Team C shared their explicit knowledge as well as the personal know-how with each other quite willingly on a regular basis.

Collective sharing of knowledge and ideas helped members *"to gather other people's perspectives"* and so to come up with novel solutions to address the *"difficulties in experiments*". This in turn helped them to move forward as a team by *"getting better results"*. So, according to the interviewees, collective knowledge sharing was a key not only to *"improve yourself technically, theoretically and intellectually"* but also to ensure the overall progress of their team.

Collective sharing also resulted in team members *"critically and intellectually"* analysing and discussing their ideas. It was evident that *"ideas were being thrown back and forth"* among them during these *"vigorous discussions"*. So, collective sharing helped team members to *"evolve"* by coming up with *"some really fantastic ideas"* about how they could use their knowledge in different ways to solve new problems. Consequently, sharing of knowledge and ideas resulted in team members collectively revising and renewing their collective expertise.

Background Knowledge and Experiential Learning

In the case of Team C, background knowledge and experiential learning were seen as essential for the individual members' ability to understand and interpret the shared knowledge. Firstly, having completed at least a Bachelors level degree in sciences was a prerequisite to join this team. Therefore, all members had some basic understanding about theory behind the techniques they used in the lab. According to the interviewees *"having background knowledge"* made *"it easier"* for them to understand the shared knowledge and so to develop their expertise. Hence, it can be inferred from the evidence that background knowledge of the individual members was significant for the knowledge expansion in Team C.

Secondly, experiential learning was seen as *"priceless"* in helping members to internalise the shared knowledge, with one interviewee stating that: *"I know this because I have done it with my own hands"*. Importantly, it appeared that *"trying out"* the techniques *"to see if it works in your own hands"* gave them an opportunity to personalize what they learned from others. This often resulted in members discovering new and improved methods of doing lab experiments. So, there is no doubt that the experiential learning experiences of individual members played a significant role in promoting the overall knowledge advancement of Team C.

Organisational Agendas and Bureaucracies

Organisational agendas of the collaborative research centre imposed *"continuous pressure"* on the researchers to create new knowledge that could make significant contributions to the research excellence of the organisation. This meant that it was *"absolutely important"* for Team C to help their organisation *"move forward"* by *"coming up with new ideas"* that could develop ground breaking solutions to medical issues. This tells us that the organisational agendas played a significant role in encouraging the overall knowledge advancement of Team C. Yet, it appeared that their ability to develop new knowledge was often limited by the limited availability of resources.

Lack of *"funding"* often made it *"very difficult"* for the researchers to implement new ideas, while the established industry standards and university protocols restricted changing existing techniques and lab protocols. As a result, the team members sometimes had to compromise the creativity of their ideas in order to make them *"logical and practical"*. Thus, it is clear from the interviews that the organisational bureaucracies hindered the scope of innovation within this team and thus was a barrier for their collective knowledge enhancement.

Social Interactions

According to the interviewees of Team C, it was always *"good to go out and catch up outside of work"* because *"you can always learn something new"* from the *"laid back and casual chats"* that took place during these

social activities(such as morning coffee, lunches and after work drinks). The *"informal"* and *"relaxed"* atmosphere of the social activities made members feel comfortable and helped them share their knowledge and ideas without any reservations (e.g.: *"what you can discuss in a coffee shop, you can't do in the office"*). So, the evidence collected from the interviews of Team C clearly revealed that social interactions *"definitely help in the sharing of knowledge"* among their members. Moreover, it appeared that *"talking about different ways of doing techniques during social hours"* offered members *"fresh perspectives"* about how they could improve their techniques and methods. So, the frequent social interactions were also valuable in promoting refinement and renewal of collective knowledge in this team.

Having recognized the significance of social interactions in transferring valuable knowledge, the team leader and the supervisors not only took part in social activities but also encouraged members to interact with one another *"on a day to day basis"*. Since everyone in the group had *"knowledge and experiences in different pieces of equipment and areas"*, talking to people regardless of their organisational position was crucial for members to improve themselves as researchers. For example, the junior members found it to be really useful to talk to their supervisors as well as to the technical staff to learn the lab techniques. This tells us that frequent and quality social interactions were conducive for the collective development and sustainability of knowledge in Team C.

Key Relationships and Power Dynamics

Even though the members of Team C *"all got along well with each other"*, existence of key relationships within the team was clearly evident from the interviews. In fact, it appeared that some members had *"better"* personal relationships with certain members. This resulted in these members sharing ideas and discussing research issues only among themselves. So, it can infer from the results that the existence of key relationships was a barrier for collective sharing. This would have undoubtedly affected the knowledge enhancement of Team C.

Power dynamics' within this team was a result of differences in levels of experience and position within the organisational hierarchy. This meant that some members were reluctant to consider the ideas and opinions of those who are beneath them. For example: it appeared that the *"more experienced"* members sometimes got *"a bit defensive"* about changing their techniques. Nonetheless, majority of the interviewees felt that it is *"healthy"* to have some minor conflicts of opinion because it made them *"critically analyse"* the techniques before deciding which one is better. This had a constructive influence on the overall knowledge development process of Team C.

Common Goals and Collective Identity

According to the interviewees of Team C, they were *"all working under the umbrella of the big common goal"* of their team. This meant that the actions of each member had a direct impact on the overall progress of their

team. Importantly, this common goal made them all come together and learn as a group because *"the common goal is more important than their individual egos"*. In fact, the *"drive towards the same goal"* gave them a collective identity and created a *"quite friendly and accommodating environment"* within their team. This collective context made it *"easy"* for them to *"learn together"* and to *"work hard"* by *"helping each other out"*. Hence, the common goal and the collective identity were significant for Team Cs' ability to *"grow"* as a research group by refining and renewing their collective knowledge.

Shared Resources

Being in the same office resulted in lots of informal conversations taking place among the researchers. This helped them to share ideas and learn from each other. Shared protocol books were also seen as a useful way of recording, storing and sharing valuable information about how to conduct various laboratory experiments. Thus, it appeared that shared resources such the *"common office space"* and *"shared protocol books"* facilitated communication and knowledge transfer among the members and was constructive for this teams' ability to develop and sustain their collective knowledge.

4.3.2 Within-Case Analysis

Evidence from the three sub-cases of the second major case just presented is examined collectively in this section. In doing so, a within-case analysis is conducted here, to provide a soundly informed generalised view of how research teams, as examples of internal collectives of experts, develop and sustain their knowledge through collective efforts.

4.3.2.1 Collective Learning

Collective learning experiences facilitated through the lab meetings, workshops and seminars as well as informal discussions and group talk were identified as significant for the development and sustainability of collective knowledge in all three research teams. Moreover, the informal nature of team activities was conducive in promoting joint learning opportunities. This was common across all three teams. Yet, it appeared that only the leaders of Team B and C recognised this and conducted their group meetings in an informal and relaxed manner, to promote effective learning outcomes.

4.3.2.2 Knowledge Sharing

The evidence from all three teams revealed that the members shared their knowledge generously during weekly meetings and informal ad-hoc group discussions. This collective sharing of knowledge and ideas resulted in

members gaining new insights and so advancing their knowledge as a collective. Moreover, collective sharing helped team members to constantly update and revise their expertise by critically analysing and reflecting upon the techniques they used in laboratory experiments. Therefore, the mechanisms that promoted collective sharing of knowledge, both social and organisational, were intrinsic to the collective development and sustainability of knowledge in all three research teams.

4.3.2.3 Background Knowledge and Experiential Learning

Background knowledge in Biomedical Sciences was a prerequisite to join the research teams. The evidence collected from all three teams revealed that a sound knowledge base is crucial for the team members' ability to understand and interpret the shared knowledge, and so to contribute during the group discussions. Secondly, experimental learning also enabled members to further themselves as scientists by personalising the shared knowledge. So, these results clearly illustrates that the background knowledge and experiential learning were significant issues for the development of collective knowledge in research teams explored here as examples of internal collectives

4.3.2.4 Organisational Agendas and Bureaucracies

Organisational agendas and bureaucracies were identified in the evidence from the research teams as key factors for determining their ability to innovate and create new knowledge. Each of these teams operated as an independent research community within the same collaborative research centre. So, they were all driven by the organisational agendas of the research centre, which emphasised on developing new knowledge to address the medical problems of the modern society. So, the cultivation of collective knowledge in these three research teams were encouraged by the innovation oriented organisational agendas of the research centre.

Being under the organisational umbrella of the research centre demanded the research teams not only to comply with the supra-organisational agendas, beyond those of their own program group, but also to be within the budgets, timelines and protocols of the organisation. This was seen as a key issue limiting the scope of innovation in these research teams. As a result, it was evident that the team members' ability to advance and improve their collective knowledge was hindered by the operational ramifications of organisational bureaucracies.

4.3.2.5 Social Interactions

The importance of social interactions for collective development of knowledge was clearly evident across all three research teams. It appeared

that team members shared valuable knowledge, ideas and information by talking to each other casually during the coffee breaks, lunch outs and after work drinks. So, the evidence from the research teams emphasised on the importance of frequent interactions taking place across all levels of membership (regardless of their organisational positions and the level of experiences) for the intellectual progress of the team. Yet, it appeared that only the leaders of Team B and C recognised this and encouraged organising social activities (e.g. morning teas and lunches) to promote interactions among their team members.

The evidence revealed that the leader of Team A did not recognise the significant role played by the social engagements in fostering knowledge development opportunities in his team. So, it appeared that the members of Team A did not interact as much as the other research groups. This lack of social interactions among Team A members did not explicitly influence their collective knowledge sharing. However, it was apparent that, compared to the other two teams, the social dynamics within Team A was significantly influenced by the existence of key relationships and power dynamics among members which in turn hindered knowledge sharing within the team.

4.3.2.6 Key Relationships and Power Dynamics

The quality of collective knowledge cultivation and renewal within research teams appeared to be influenced by the key relationships and

internal power dynamics. Firstly, the existence of key relationships hindered knowledge sharing within both Team A and C, with there being members who interacted only with those in their friendship groups. Moreover, these two teams were also affected by wider organisational hierarchies and internal power dynamics which gave rise to conflicting opinions among members. Yet, unlike in Team A, the power dynamics among the members of Team C appeared to have a constructive influence over their knowledge advancement. This was because the conflicts caused by internal power dynamics resulted in them critically appraising the ideas of all members before deciding on which idea is better.

Secondly, in the case of Team B, key relationships and power dynamics were not evident because the team leadership took active measures to minimize the hierarchical barriers within his team, by giving everyone an equal opportunity to contribute to and take part in group discussions. This lack of internal power dynamics and key relationships enriched their knowledge exchanges and so was seen as conducive for Team Bs' ability to learn and share knowledge as a collective.

Overall, it appeared that compared to Teams B and C, the key relationships and power dynamics within Team A had a significantly negative influence over the quality of their collective knowledge advancement. This may be because the members of Team A (as discussed above) did not interacted as much as the other two teams and received less support from the leadership in organising social activities.

4.3.2.7 Common Goals and Collective Identity

Members of the three research teams were collectively working towards the common goal of their respective teams. Importantly, this meant that each team member played a unique role in achieving the shared goal of their team. So, the actions of each member had a significant influence over the overall progress of their team. As a result, having a common goal was fundamental for the team members' ability to work together to find solutions for the medical problems of the modern society. In fact, it gave them a sense of collective identity and so motivated them to interact, learn and share their knowledge and ideas as a collective. These issues were common across all three cases. Thus, common goals and collective identity were identified as key factors influencing members' ability to develop and sustain collective knowledge in research teams.

4.3.2.8 Shared Resources

In all three research teams, members worked in a shared office. This helped them to constantly interact, learn and share ideas with each other while they are at work. Shared servers and protocol books were other examples of shared resources used by team members to record and share valuable knowledge and information with others in their team. So, the evidence from all three cases revealed that shared resources enabled effective communication and knowledge transfer among team members. So, shared

resources were significant for the development and sustainability of collective knowledge in research teams.

4.3.3 Internal Collectives Major Case Summary

Eight thematic categories were identified as important in informing the collective cultivation and renewal of collective knowledge in research teams explored as examples of internal collectives of experts (see Table 14). The evidence revealed that cultivation and renewal of collective knowledge within research teams was a cycle process of collective learning and sharing activities facilitated through a unique set of social dynamics and contextual nuances.

Firstly, it was evident that the members of these internal collectives learned and shared their knowledge regularly through both formal mechanisms (e.g. meetings and seminars) as well as informal discussions. Importantly, it was apparent that background knowledge and experiential learning activities were crucial for the team members' ability to understand and interpret the shared knowledge. As a result of having a sound knowledge base was a prerequisite for joining these research teams.

Secondly, the results for research teams explored here as internal collectives revealed that the organisational agendas encouraged the overall knowledge advancement within these teams. Yet, the organisational bureaucracies such as limited resources, industry standards and deadlines

hindered the quality of knowledge development and sustainability within these collectives.

Regular social interactions among members' facilitated through morning teas, lunches and after work drinks created an effective passage of knowledge within these teams. In fact, the results from all three teams suggested that members shared some of the most valuable personal knowledge, information and ideas during these social engagements. Furthermore, it was revealed that social interactions needed to be stimulated through the support and encouragement from the team leadership.

Having a common goal and collective identity appeared to be fundamental for the team members ability to cultivate and renew their knowledge as a collective. Use of shared resources such as the shared office space, servers and protocol books also helped research team members to communicate and exchange knowledge. Collectively, all these issues were significant in creating social foundations that enriched team members' ability to share and enhance their collective knowledge. However, the existence of key relationships (such as friendship groups) and internal power dynamics between members of the research teams hindered the quality of social interactions and relationships. In conclusion, the evidence of this research revealed that the quality of social processes had a significant influence over team members' ability to cultivate and refine their collective expertise as internal specialist groups.

Table 14. Thematic Categories and their Level of Importance as Evident in Sub-Cases of Major Case 2

<table>
<tr><th>Theme/Issue</th><th>Sub-case 1
Team A</th><th>Sub-case 2
Team B</th><th>Sub-case 3
Team C</th></tr>
<tr><td rowspan="2">Collective learning</td><td colspan="3">Significant
• Formal mechanisms (e.g. group meetings and seminars) and informal group discussions</td></tr>
<tr><td></td><td colspan="2">• Informal atmosphere in team activities to promote learning</td></tr>
<tr><td>Knowledge sharing</td><td colspan="3">Significant
• Face to face and regular</td></tr>
<tr><td>Background knowledge and experiential learning</td><td colspan="3">Significant
• To understand and interpret the shared knowledge
• Background knowledge as a prerequisite to join the teams</td></tr>
<tr><td rowspan="2">Organisational agendas

Organisational bureaucracies</td><td colspan="3">Significant
• Encouraged innovation and cultivation of collective knowledge</td></tr>
<tr><td colspan="3">Significant
• E.g. deadlines, limited funding, industry standards and protocols
• Barrier for innovation
• Hindered development of collective knowledge</td></tr>
<tr><td rowspan="2">Social interactions</td><td colspan="3">Significant
• Enabled collective learning, sharing and new idea generation
• Across all levels of members, regardless of their organisational positions</td></tr>
<tr><td>• Less interactions
• Lacked support from the leader</td><td colspan="2">• Received encouragement and support from the leaders to engage in social interactions</td></tr>
<tr><td rowspan="2">Key relationships

power dynamics</td><td rowspan="2">Significant
• Hindered knowledge sharing</td><td rowspan="2">Inconsequential</td><td>Significant
• Hindered knowledge sharing</td></tr>
<tr><td>• Had a constructive influence on knowledge advancement.</td></tr>
<tr><td>Common goals and collective identity</td><td colspan="3">Significant
• Helped members to collaborate, learn and share knowledge as a group</td></tr>
<tr><td>Shared resources</td><td colspan="3">Significant
• E.g. shared office, servers and protocol books
• Facilitated communication and knowledge sharing</td></tr>
</table>

4.4 External vs. Internal Collectives: A Cross- Case Analysis

The two major case studies undertaken for this doctoral thesis explored external and internal collectives of experts through craft guilds and research teams respectively. A comparative assessment of the case results is provided in this section to highlight the similarities and differences between these two communities in their approach towards the development and sustainability of collective knowledge.

4.4.1 Similarities between External and Internal Collectives

Six common themes and issues (see Table 15) were identified across the two major case studies. These common themes are discussed below to outline the similarities between external and internal expert communities, in terms of their approach towards collective cultivation and renewal of specialist knowledge.

Table 15. Themes and Issues Common across the Major Cases

Major Case	Common Themes/Issues
Case 1 External collectives ***&*** ***Case 2 Internal Collectives***	• Collective learning • Knowledge sharing • Background knowledge and experiential learning • Social interactions • Collective identity • Shared resources

4.4.1.1 Collective Learning

The evidence revealed that in both cases the opportunity to learn as a group was fundamental for the members' ability to further their collective expertise. It appeared that formal mechanisms (e.g. meetings, seminars and workshops) as well as informal discussions were intrinsic in proving shared learning experiences in both guilds and research teams. This is interesting because it reveals that formal mechanisms were instrumental in promoting learning not only within internal research teams, but also for those expert groupings such as guilds, operating independent of formal organisational agendas.

Further, the findings went on to reveal that the informal nature of group activities was valuable in creating environments that are conducive for learning where participants could easily share their thoughts and ideas. Interestingly, this was more strongly emphasised in the evidence for research teams of Case 2 internal collectives. This means that regardless of operating within formal organisational hierarchies, the members of internal specialist groups preferred an informal and relaxed approach to learning and sharing their knowledge with others.

4.4.1.2 Knowledge Sharing

It was clearly evident across both major cases that taking part in knowledge sharing activities not only helped individual members to refine their

understanding and skills but also to enhance the overall progress of their collective. Collective sharing also enabled members to revise their current understandings through collective discussion and reflection. This gave them an opportunity to discover new and improved ways of doing things. These issues were common across both the guilds and research teams. So, collective sharing of knowledge and ideas was seen as significant for the members of both communities ability to improve and revise their collective expertise.

4.4.1.3 Background knowledge and Experiential Learning

Results from the two major cases revealed that background knowledge and experiential learning were important for the members' ability to internalise the shared knowledge, and so to come up with new ideas which later developed into new knowledge. However, the need for having a sound knowledge base and experiential foundation was emphasised much more strongly in research teams of Case 2 internal collectives. This may be because individual members' ability to internalise the shared information had a direct impact on the overall progress of internal collectives, as each member played a unique role in achieving the common goal. However, in craft guilds as external collectives, the actions of individual members did not have such a direct impact on the immediate progress of their group.

4.4.1.4 Social Interactions

It was evident that the frequent social interactions that took place across all levels of membership were crucial for the cultivation and renewal of collective knowledge in guilds and research teams. In fact, the members of both collectives shared some of their most valuable knowledge through engaging in frequent social interactions with others in their groups.

Interestingly, the case results revealed that social engagements among the members of research teams were facilitated through formally organised social activities such as morning teas, lunch outs and after work drinks. On the contrary, interactions between guild members of external collectives took place naturally. This was because involvement in the guild itself was regarded as a social activity by the members of these external expert groups.

4.4.1.5 Collective Identity

Collective identity was clearly important for the members of both guilds and research teams. It gave them a sense of belonging and by doing so, motivated members to interact, learn and share their knowledge as a group. The collective identity in guilds was a result of members having a shared personal interest, while in the case of research teams; it was created through their common goals. Nonetheless, this collective identity appeared to be the glue that binds members of these collectives together. So, it had a

significant influence over the collective knowledge advancement in both cases.

4.4.1.6 Shared Resources

Shared resources were useful in mediating effective communication and transfer of knowledge between group members. This was common across both major cases. In the case of guilds as external specialist groups' shared resources such as libraries and newsletters helped members communicate and share their knowledge, where as in research teams as examples of internal communities, shared office space, shared servers and protocol books appeared to be valuable resources in promoting knowledge transfer. Thus, use of shared resources appeared to be useful for members in expert communities to share knowledge and so to enhance and update their collective expertise.

4.4.2 Differences between External and Internal Collectives

The themes and issues identified as unique to each major case (see Table 16) are discussed in this section. In doing so, the key differences between guilds as external collectives and research teams as internal expert communities are outlined here, with regard to their approach to collective development and sustainability of knowledge.

Table 16. Themes and Issues Unique to Each Major Case

Major Case 1 ***External Collectives***	**Major Case 2** ***Internal Collectives***
• Personal motivation • Willingness to change • Shared interests	• Organisational agendas and bureaucracies • Key relationships and power dynamics • Common goals

4.4.2.1 Personal Motivation and Willingness to Change

Personal motivation and willingness to change appeared to be significant for the collective knowledge development and sustainability of guilds in Case 1 external collectives. In guilds, individual member's motivation to learn and discover new ways of doing things as well as their enthusiasm to change and experiment with various techniques resulted in members developing and improving their craftsmanship. This in turn contributed towards the overall knowledge improvement of these guilds. These issues were unique to the craft guilds of Case 1 external collectives and were inconsequential in the research teams of Case 2 internal collectives.

4.4.2.2 Organisational Agendas and Bureaucracies

Organisational agendas and bureaucracies were identified as themes unique to the research teams explored in Case 2 as internal collectives. Given that

these internal specialist groups were deliberately created by a collaborative research centre to carry out specific tasks, they had to operate within the innovation oriented agendas and organisational bureaucracies of this institution that controlled them. So, the case results revealed that organisational agendas constantly encouraged team members to be innovative in their thinking and so they had a positive influence over the development and sustainability of collective knowledge in research teams.

On the contrary, organisational bureaucracies (e.g. limited availability of funding, time and protocols) hindered the knowledge enhancement and renewal within these research teams by limiting their scope of innovation. So, the case results tell us that compared with the guilds of Case 1, members of research groups in Case 2 had less scope to exploit their creativity. This was because these research teams as internal communities were limited by their organisational bureaucracies and so had to seek the approval of their governing organisation before implementing new ideas.

4.4.2.3 Key Relationships and Power Dynamics

Existence of key relationships and power dynamics were evident only in research teams of Case 2 internal collectives. The key relationships existed in the form of friendship groups within the research teams appeared to be a barrier for their knowledge sharing. On the other hand, the internal power dynamics were a result of organisational hierarchies and they too hindered collective knowledge cultivation in research teams. These issues were

unique to the research teams explored as internal collectives. So, the case results revealed that key relationships and power dynamics were context specific and negatively influenced the cultivation and renewal of collective knowledge in the research teams of Case 2.

4.4.2.4 Shared Interests and Common Goals

Guild members of Case 1 external collectives were bound by their shared interests, while those in research teams of Case 2 internal collectives were bound by their common goals. In Case 1, shared interests were conducive in encouraging guild members to learn and share knowledge as a collective, so that these craftsmen could enhance and refine their personal knowledge. On the other hand, the research team members of Case 2 collectively learned and shared their knowledge to achieve their common goals. So, it was evident that the shared personal interests of guild members encouraged them to refine their expertise as a collective for the individual benefit, where as the common goals of research teams' motivated members to develop knowledge for the benefit of the organisation that controls them.

4.4.3 Summary of the Cross-Case Analysis

The cross-case comparison above identified some significant parallels and differences between craft guilds as external collectives and research teams as internal collectives of experts. A total of 12 thematic categories were

identified, as important in understanding knowledge in these collectives of experts. This included six common themes and three unique themes for each of these cases (see Table 17).

Firstly, the cross-case analysis revealed that collective learning and knowledge sharing facilitated through social interactions, collective identity and shared resources were significant for the cultivation and renewal of collective knowledge in both external and internal communities explored here through craft guilds and research teams respectively. Moreover, it appeared that having background knowledge and experiential foundation was conducive for the development of collective knowledge in both these specialist groups. However, it appeared that having a sound knowledge base was more important for the research team members of internal collectives.

In the case of external collectives such as those explored through the two craft guilds, the cultivation and renewal of their collective expertise were significantly influenced by guild members' willingness to change and shared personal motivation. So, it was clear from the evidence that the social engagements within craft guilds as external collectives were primarily driven by the shared interests of the members that constitutes them.

On the other hand, in the case of those research teams explored in Case 2 as examples of internal collectives revealed that their ability to enhance knowledge was mainly determined by the common goals, organisational

agendas and bureaucracies. Moreover, the quality of social processes in these internal groups had to be promoted not only through formally organised social activities such as morning teas and lunches, but also by taking active measures to minimise the existence of key relationships and internal power dynamics.

Collectively, the results of this empirical investigation revealed that in the development and sustainability of collective knowledge in expert communities was a result of collective learning and sharing activities facilitated through a complex and unique set of social processes. Importantly, it was evident that these social dynamics varied according to the contextual nuances of these expert collectives.

Table 17. Thematic Categories and their Level of Importance as Evident in Each Major Case

Themes/Issues	Major Case 1 External Collectives	Major Case 2 Internal Collectives
Collective learning	**Significant** • Through formal mechanisms (e.g. meetings, workshops, seminars) and informal discussions	
		• Informal atmosphere to promote learning
Knowledge sharing	**Significant** • Resulted in new ideas and knowledge renewal	
Background knowledge and experiential learning	**Significant** • Helped understand and interpret the shared knowledge	
		• Emphasised on having background knowledge.
Social interactions	**Significant** • Frequent and across all levels of membership. • Helped knowledge sharing and new idea generation.	
	• Took place naturally, during and outside of guild activities	• Facilitated through deliberately organised social activities (e.g. morning teas, lunches and after work drinks)
Collective identity	**Significant** • Fostered interaction, learning and knowledge sharing	
Shared resources	**Significant** • Enabled effective communication and knowledge sharing	
Personal motivation	**Significant** • Encouraged learning and new ideas generation	**Inconsequential**
Willingness to change	**Significant** • Fostered innovation.	**Inconsequential**
Shared interests	**Significant** • Promoted learning and sharing for the individual benefit.	**Inconsequential**
Organisational agendas Organisational bureaucracies	**Inconsequential**	**Significant** • Organisational **agendas promoted** knowledge cultivation • **Bureaucracies hindered** knowledge advancement**.**
Key relationships and power dynamics	**Inconsequential**	**Significant** • Hindered knowledge transfer.
Common goals	**Inconsequential**	**Significant** • Encouraged learning and sharing for the benefit of the organisation.

4.5 Conclusion

Evidence from the two case studies undertaken in this doctoral thesis was presented in this chapter. The first half of the chapter analysed the evidence for Case 1 external collectives while the second half analysed the results for Case 2 internal collectives of experts. In doing so, eight thematic categories were identified as significant in understanding their knowledge development and sustainability in each major case. Next, a cross case analysis was conducted to draw out the similarities and differences between the two case studies and so to synthesise the case evidence. How those consolidated results inform the propositions and address the theoretical premises of this research is the subject of the next chapter.

Chapter 5

Interpretation and Discussion

5.1 Introduction

This chapter presents an integrated discussion and interpretation of the case results. By doing so, it discusses the implications and associated meanings of the themes and issues identified through the empirical investigation, as important in understanding the development and sustainability of knowledge in collectives of experts, with reference to the research propositions and the theoretical premises of this research.

Three research propositions were developed from the theoretical platform presented in Chapter 2, to guide the empirical investigation of case evidence. Drawn from existing theory, the propositions suggest what we would expect to find, based on the research undertaken and carried out to date. In doing so, these provide a basis to examine whether the issues of background knowledge and experiences, collective sharing of knowledge, and social interactions and relationships are significant in facilitating the cultivation and renewal of knowledge in expert collectives. This chapter interprets the consolidated evidence from external and internal collectives of experts explored through craft guilds and research teams respectively, to inform these three propositions.

This chapter is divided into four main sections. The first section discusses and interprets the consolidated results with respect to the issue of collective knowledge development and sustainability. In doing so, it explains how the findings of this empirical investigation support the first two research propositions.

In the second section, the themes and issues identified from the case studies, as significant in understanding the role of social processes for collective knowledge is discussed with reference to the existing literature and interpreted to inform the third research proposition.

Following the discussion and interpretation of the results, an empirical model is developed to operationalise the findings of this doctoral investigation. This empirical model illustrating knowledge in collectives of experts is presented in the penultimate section of this chapter. Finally, the chapter concludes with a synthesis of the empirical findings to reveal how these address the research problem and objectives of this study.

5.2 Collective Knowledge Development and Sustainability

The results from the case studies presented in this thesis reveal that development and sustainability of collective knowledge is an evolving cycle of collective learning and knowledge sharing that leads to new idea generation, which is consistent with the work of Liao (2006) and Nonaka,

von Krogh & Voelpel (2006). In fact, the case evidence suggest that collective learning and knowledge sharing experiences in craft guilds and research teams as examples of CoE help members to gain new perspectives and so to come up with new ideas by internalising and then assimilating that knowledge into the context of their own work. Furthermore, the evidence suggests that formal mechanisms (such as seminars, workshops and meetings) as well as informal group talk and discussions are intrinsic to the collective learning and sharing within these specialist groups.

The findings also reveal that having an informal and relaxed atmosphere in formally organised group activities (e.g. seminars, workshops and weekly group meetings) is significant in creating environments conducive for collective learning and sharing, particularly in research teams as examples of internal collectives. Thus, the case evidence of this study shows that despite operating within formal organisational hierarchies, members of internal specialist groups prefer an informal approach to their collective knowledge advancement. This evidence goes beyond those discussed by relevant literature, and so contributes to existing knowledge in the area of knowledge in internal collectives of experts.

Secondly, the results in this research indicate that background knowledge and experiential learning of individual members is crucial for their ability to internalise the shared knowledge in order to discover new ways of doing things. For example: having a sound knowledge base helped members of guilds and research teams to understand and interpret the knowledge and ideas shared during their group activities. On the other hand, experiential

learning activities allowed members to personalise the shared knowledge about various techniques, tools and methods and so to develop their own ways of doing things. These findings are consistent with the literature, which states that new knowledge is created when individual participants share what they know with each other, and then internalise and apply what they have learned from others in new ways (Wah, cited in Smith 2001, p.319). So, the collective case results of this research indicate that in collectives of experts, background knowledge and experiential learning activities of individual members are significant for the development of collective knowledge, thus supporting proposition 1.

Proposition 1. *In CoE, the background knowledge and experiences of individual members is likely to influence collective knowledge development.*

Interestingly, compared to the craft guilds, the value of foundation knowledge, to the ability of the group to understand and advance upon is emphasised much more strongly in research teams. Consequently, proposition 1 is more strongly upheld in the case of research teams in internal collectives of experts. This may be because in research teams, members' ability to internalise the shared knowledge has a direct influence over the collective progress, as each member plays a unique role in achieving the common goal of their team. On the contrary, in craft guilds, as examples of external collectives, members' ability to internalise the shared knowledge do not have a direct influence over the immediate progress of their guild.

The results of this research also illustrate that collective sharing of knowledge and ideas is the key to the sustainability of the expertise of members in craft guilds and research teams. For example: in craft guilds, collective sharing of knowledge and ideas about various methods, tools and materials help members to refine and renew their techniques and so to develop new styles and patterns. On the other hand, in the case of research teams, collective sharing give members an opportunity to update and revise their technical expertise by critically analysing the techniques they used in laboratory experiments. So, the consolidated case evidence of this study clearly reveals that collective sharing of knowledge and ideas is the key to the sustainability of their collective knowledge, thus supports and informs proposition 2.

> ***Proposition 2.*** *The collective sharing of knowledge and ideas in CoE is likely to be key to the sustainability of their knowledge.*

Consistent with the literature, empirical evidence of this thesis suggests that collective sharing and reflection help members to build on each other's ideas and so to refine and renew their knowledge by deepening the richness of their thinking and insights (McDermott 1998; Crossan, Lane & White 1999). This iterative process of knowledge renewal allows members in expert communities to discover new and better ways of using their existing knowledge to solve problems. As suggested by the literature, successful implementation of new ideas, creates new processes and techniques and as a consequence, gives rise to new knowledge (Brown & Duguid, 1991;

Popadiuk & Choo, 2006). So, the results of this study show that renewal and revision of the existing knowledge in turn contributes to the overall knowledge advancement of collectives of experts and provides a sustainable evolving knowledge resource.

Finally, the case results reveal that there are some fundamental differences between craft guilds (as external collectives) and research teams (as internal collectives) with regard to their collective development and sustainability of knowledge. Firstly, the results tell us that individual members' willingness to change techniques as well as their personal motivation to learn and develop new styles play a significant role in promoting knowledge advancement in craft guilds as external collectives of experts. This information fills a gap, as the literature has not comprehensively addressed the issue of knowledge development and sustainability in the context of external specialist groups, operating for the benefit of the individuals that constitute the group.

In the case of research teams as examples of internal collectives of experts, the evidence shows that organisational agendas and bureaucracies are significant factors influencing their ability to refine and renew collective expertise. This is because the organisational agendas encourage team members to constantly advance their collective knowledge, while the organisational bureaucracies (e.g. project deadlines, limited resources and protocols) hinder this process by limiting their scope of innovation. This evidence contributes to the literature which addresses the issue of

knowledge development and sustainability in internal specialist groups such as those found in research teams very poorly.

5.3 Social Interactions and Relationships for Collective Knowledge

The evidence from this research clearly illustrates that the quality of social processes has a significant influence over the knowledge development and sustainability within collectives of experts. Consistent with the literature, the case studies presented in this thesis reveal that frequent social interactions of structural social capital across all levels of membership are avenues fostering knowledge transfer and are significant for the collective development and sustainability of knowledge (Portes 1998; Liao, 2006). However, the empirical results suggest that there are some significant differences between external and internal collectives in terms of how they promote social interactions within their respective communities. These issues are previously not recognised by the literature.

Firstly, the case study results show that, compared to research teams of internal collectives, the social interactions within craft guilds as external communities' take place spontaneously and naturally as part of their group activities. Secondly, the results of this thesis proposes that the social interactions within internal collectives such as research teams, not only requires constant support and encouragement from the leadership but also needs to be promoted through formally organised social activities such as

morning teas and lunch. This is significant because it signals the managers who are relying on CoE knowledge that they need to actively promote and facilitate social interactions to enrich the knowledge transfer among members of these internal specialist groups.

It is also apparent from the investigation of this thesis that having a sense of collective identity is important for the improvement and updating of knowledge in collectives of experts. For example: in research teams knowledge cultivation is driven by members' commitment towards achieving a common goal for the benefit of their collective as well as the organisation that control them. This result is consistent with existing literature, which suggest that members of internal collectives such as R&D teams are committed to help each other to achieve mutual goals and so they act upon the best interest of their mission (Ehlen 1994).

In the case of craft guilds, members are bound by shared interests. So, they interact, learn and share knowledge as a collective for their individual benefit. Furthermore, the results show that the shared interests and common goals helped members develop a sense of collective identity in guilds and research teams respectively. This is consistent with the existing literature, which suggests that shared interests and objectives of cognitive social capital help people to develop a sense of empathy around common trials and tribulations and provide them with a point of reference when it comes to sharing their knowledge with others (Iverson & McPhee 2002; Lesser & Storck 2001; Koliba & Gajda 2009).

Another interesting finding is that the use of shared resources such as shared office space and servers in research teams, and libraries and news-letters in guilds not only foster communication between members but also create an effective passage of knowledge within their communities. So the evidence of this study clearly acknowledges the value of shared resources when improving the quality of social interactions as well as the knowledge sharing in collectives of experts.

Finally, the literature suggests that strong interpersonal relationships of relational social capital increase shared experiences, and common language; thus, contribute to effective sharing of knowledge (McFadyen & Cannellajr 2004). While the evidence present in this thesis confirms this, it reveals that the existence of key relationships (e.g. friendship groups) among members of research teams in particular, hinder their collective knowledge sharing.

Case evidence also demonstrates that internal power dynamics, which is a result of organisational hierarchies, can also exist within these internal specialist groups. These power dynamics cause conflicts among team members and so negatively influence the social dynamics within research teams. So, the findings reveal that wider organisational hierarchies and internal power dynamics hinder the ability of research teams to share knowledge and so to refine and renew their knowledge as internal collective. The results of this study show that these issues are unique to internal collectives explored through research teams and have not been discussed in literature, in relation to knowledge development and

sustainability in the context of knowledge cultivation in internal collectives of experts.

Collectively, the issues discussed above illustrate the significance of social foundations such as structural, relational and cognitive capital for craft guilds' and research teams' ability to renew and refine their expertise through collective learning and sharing. By doing so, the empirical evidence from external and internal collectives explored in this study show that the quality of social interactions and relationships determined knowledge development and sustainability opportunities within collectives of experts. Thus, proposition 3 is well informed and supported by the case evidence.

Proposition 3. *The quality of social interactions and relationships determine knowledge development and sustainability opportunities in CoE*

5.4 Knowledge in Collectives of Experts: An Empirical Model

An empirical model (see Figure 7) has been developed to reflect the findings discussed in the previous two sections. The findings of this study not only support all three research propositions and extend the information from the literature but also reveal some themes and issues which are beyond the scope of initial propositions and that have not been excessively

discussed by the relevant literature. The empirical model here encompasses all these themes and issues identified from the case study investigation and provide insights into the development and sustainability of knowledge in collectives of experts. In doing so, the empirical model illustrates knowledge development and sustainability in expert collectives as an evolving process of collective learning and sharing facilitated through unique social processes.

Firstly, participation in collective learning and knowledge sharing activities result in individual participants understanding and interpreting the shared knowledge through their background knowledge and experiential learning activities. Once the individual participants acquire the shared knowledge based on their individual capacities, they then engage in creative exploitation of this individually acquired knowledge, which results in new idea generation.

Collective learning and knowledge sharing experiences can also stimulate new idea generation by allowing participants to collectively discuss and reflect upon the techniques and methods they use. Such collective renewal and revision of existing knowledge lead to generation of new ideas as members realise new ways of using what they already know. So, the collective sustainability of knowledge in turn contributes to the collective knowledge advancement in expert communities.

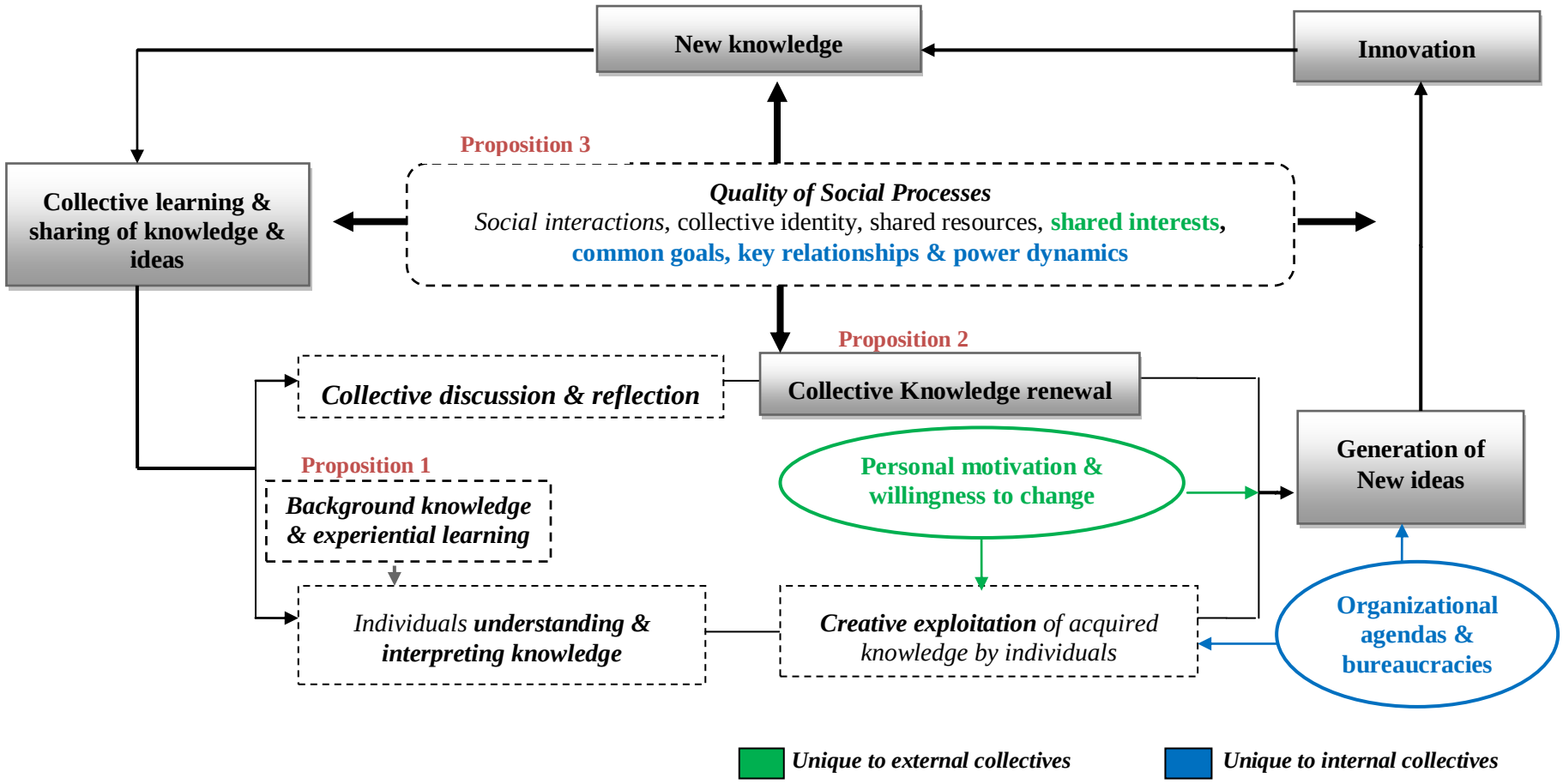
Generation of new ideas in external collectives such as those found in craft guilds is influenced by individual members' personal motivation to learn

and to be creative as well as the willingness to change their techniques. On the other hand, the new idea generation in internal specialist groups such as research teams, is significantly influenced by the agendas and bureaucracies of the organisation that controls them.

In collectives of experts, successful implementation of new ideas result in innovation and these innovations give rise to new contexts and new view of the world, thus they become new knowledge with time. New knowledge is then shared through the involvement in collective learning and sharing activities, so that it can be used to solve similar problems that might arise in the future.

Finally, this process of collective knowledge development and sustainability is significantly influenced by the quality of social processes within collectives of experts. Issues such as social interactions, collective identity and shared resources are key to understanding the social dynamics within expert communities. Moreover, shared interest is a unique attribute of external collectives which determine the quality of their social processes. On the other hand, factors such as common goals, key relationships and power dynamics influence the social foundation within internal collectives of experts.

Figure 7. The Empirical Model Illustrating the Process of Knowledge Development and Sustainability in Collectives of Experts



5.5 A Synthesis of the Empirical Findings

This section presents a synthesis of empirical findings to illustrate how they address the research problem and the objectives of this thesis. One of the main objectives of this research was to explore the issue of collective knowledge development and sustainability. Both the issues of knowledge development and sustainability are significant in providing organisations with strategic advantage (Davenport & Prusak, 2000), yet they have received little attention. In addressing this gap, the empirical evidence of this doctoral investigation tells us that the knowledge cultivation and renewal within collectives of experts is a cyclical process of collective learning and sharing activities facilitated through unique social dynamics.

The results of this study also tell us that the background knowledge and experiential learning have a significant influence over the cultivation of knowledge in expert collectives. This is because these issues help members to contribute in group discussions and to come up with new ideas by internalising the shared knowledge. Furthermore, this evidence shows that collective renewal of knowledge which is a result of members sharing, discussing and reflecting upon their expertise, help them discover new ways of doing things and so contribute to the overall advancement of collective knowledge in expert communities.

The second research objective of this thesis was to understand the relationship between social processes and collective knowledge. The relationship between the social dynamics and collective knowledge

development and sustainability is an area that has not been widely explored in the literature. The results of this thesis help address this gap, by revealing that the process of cultivation and renewal of knowledge in expert communities relies on frequent social interactions, shared resources, common goals and mutual ambition of members to learn and advance their personal and collective knowledge pools. These issues are important and have not been disclosed before with regard to the knowledge cultivation and revision in collectives of experts.

The empirical evidence of this study also informs us that there are some significant differences between external and internal collectives of experts, with regard to their approach towards collective knowledge advancement. In doing so, the evidence of this research shows us that, external communities like craft guilds are bound by shared personal interests of their members. So, the refinement and renewal of knowledge in these groups is influenced by members' personal motivation and willingness to change. On the contrary, this study tells us that the internal expert collectives such as medical research teams are driven by common goals and their ability to advance knowledge is influenced by organisational agendas, bureaucracies, key relationships and internal power dynamics. The theoretical and practical implications and outcomes arising from these findings will be discussed in the next chapter.

Chapter 6

Conclusion

6.1 Introduction

This doctoral thesis was set out to explore collectives of experts' perspective of knowledge and so to understand *how social processes within these expert communities facilitate knowledge development and sustainability.* In doing so, this thesis argued that collectives of experts are a classic example of knowledge based social structures, where specialist knowledge is effectively leveraged through collective efforts; thus, the social dynamics within these communities are worthy of investigation, particularly, as to how they contribute to the collective development and sustainability of expert knowledge. Consequently, this research is important to contemporary organisations in a knowledge economy that rely on specialist groups to develop knowledge as a locus of competitive advantage because it informs how members of expert collectives refine and renew their expertise through collective efforts.

The purpose of this chapter is to provide an overall conclusion to the research problem. In doing so, it first outlines the key findings of this research. This is followed by a discussion of the theoretical contributions and managerial implications of this research project. The penultimate section outlines the limitations of this research and suggests areas for future

research. Finally, the chapter ends with a synopsis of the major conclusions arising from this doctoral investigation.

6.2 Key Findings

The key findings of this study reveal that knowledge development and sustainability in collectives of experts is an evolving process of collective learning and sharing facilitated through a unique social phenomenon.

Secondly, the empirical findings show that the background knowledge and experiential learning of individual members influence the collective knowledge development. In doing so, this research reveal that individual members ability to understand, interpret and personalise the shared knowledge help them to discover new ways of doing things and so to contribute back to the knowledge advancement of their expert collectives.

The results of this study also reveal that collective sharing and reflection of knowledge and ideas is the key to the sustainability of collective knowledge because it help participants to discover new ways of doing things by revising and renewing their existing knowledge. As a result, the empirical investigation of this research tells us that renewal of knowledge in turn contribute to the overall knowledge advancement in collectives of experts.

Another significant finding of this research is that social interactions, collective identity and shared resources are important issues in

understanding the quality of social processes that facilitate the knowledge advancement and revision in collectives of experts. In doing so, it illustrates the value of social foundation in promoting collective learning and sharing experiences in expert collectives.

Finally, the findings show us about some of the unique attributes of external and internal collectives, with regard to their collective knowledge development and sustainability. For example: the results shows that shared interests, personal motivation and willingness to change are issues unique to understanding knowledge cultivation and renewal in external collectives like craft guilds. On the contrary, organisational agendas, bureaucracies, common goals and existence of key relationships and internal power dynamics are unique issues contributing to the knowledge in internal collectives of experts.

6.3 Contributions to Knowledge

The original contribution to knowledge by this thesis is the introduction of the collective of experts' perspective of knowledge. By doing so, this thesis reveals how collectives of experts' perspective of knowledge can be used to understand the advancement and refinement of knowledge in specialist groups more broadly.

The topic 'knowledge' has been discussed by the literature to a great extent. However, the main focus of much contemporary knowledge research has

been on effective management of knowledge. This research extends that focus to include the development and sustainability of expert knowledge; an area that has previously not been recognised by the literature. Consequently, the results of this thesis make a novel contribution to knowledge not only by introducing the concepts of development and sustainability of knowledge but also by highlighting the interrelationship between these two areas.

Another significant contribution of this research is that it illustrates that the social and contextual nuances are unique to the way each collective of experts engages to develop and sustain their knowledge as a collective. In doing so, this empirical investigation contributes to knowledge by informing researchers how specialist groups driven by both individual oriented agendas and formal organisational agendas to refine and renew their expertise.

Finally, this research further extends our current understanding of the significance of social processes in facilitating the collective development and sustainability of expert knowledge. Despite the intrinsic relationship between social processes and knowledge which is a product of human interaction (De Long & Fahey 2000; Hemetsberger & Reinhardt 2006), the role of social dynamics in cultivating knowledge has not been fully explored. This thesis exemplifies the significance of social processes in fostering the collective cultivation and refinement of expert knowledge. By doing so, it broadens the traditional understanding of knowledge by elaborating its sociological importance.

6.4 Implications for Management and Practice

There are a number of practical managerial implications arising from this research. The empirical evidence of this thesis suggests that the advancement and renewal of knowledge in specialist groups (including those internal communities such as research teams, operating within formal organisations) are significantly influenced by the quality of their social processes. In fact, these social processes play a key role in harnessing collective learning, reflection as well as effective sharing of the organisational knowledge. Therefore, the main practical implication arising from this research can be drawn from the value of recognising the significance of the collectives, particularly, when it comes to refining and renewing unique or specialist knowledge areas.

Activities of knowledge renewal and recombination are seen as significant for organisations' ability to create dynamic capabilities (Cepeda & Vera 2007; Easterby-Smith & Prieto 2008; Nielsen 2006; Verona & Ravasi 2003). By recognising the importance of social interactions and relationships to refine expert knowledge, the findings of this thesis inform managers how social foundations can help cultivate dynamic capabilities as well as new strategic growth alternatives through effective development and sustainability of specialist knowledge.

Based on the results of this thesis, managers could also implement a range of inter-personal activities to foster social dynamics conducive for the advancement and renewal of the specialist knowledge in their

organisations. For example: managers could try and make the atmosphere of weekly meetings, seminars and workshops informal and relaxed to promote collective learning and sharing of ideas and knowledge among the organisational members.

Secondly, to harness social interactions, managers could encourage and support the organisation of frequent social activities such as morning teas and lunches. Moreover, they could also use shared resources such as open office spaces, common rooms, newsletters and shared servers to enable effective communication and knowledge transfer among the members of their organisations and departments.

Finally, to improve the overall quality of the social processes within their organisations, managers should take necessary actions to minimise the existence of internal power dynamics. For example: this can be done by giving equal opportunity for all members to take part in and contribute to group discussions. So, that it will help to improve the overall knowledge advancement of their organisations.

6.5 Limitations and Areas for Future Research

This research explored knowledge in collectives of experts and has unveiled the unique social mechanisms used by these collectives to develop and sustain their specialist knowledge. However, future research could seek to further verify these relationships and influences, possibly using

different methods to gather evidence and also by assessing alternative contexts.

Face-to-face interviews used in this research gave participants a chance to discuss and reveal the issues and areas they thought as significant in understanding the social dynamics influencing development and sustainability of knowledge in their collectives. Yet, the interviews alone made it challenging to capture the full richness of the social phenomena explored in this study. So, future research could use alternative methods such as participant observation and ethnography to explore these issues more comprehensively.

This study explored knowledge in external and internal collectives through craft guilds and medical research teams respectively. So, it is limited to the understanding of knowledge activities of specialist groups operating in these two contexts. For example: the medical research teams explored here as internal collectives presented a valuable comparison for this research project. Yet, they represented only one type of research team that is more homogenous than other types of R&D teams. Therefore, future research could explore other expert communities in different contexts and industries, including R&D teams with heterogeneous memberships operating in diverse R&D contexts (e.g. new product development), virtual expert groups and external collectives of experts in various trades and professions (e.g. Accountants, Architects and Engineers)

Empirical evidence of this research also suggests a number of specific directions that future research on knowledge in collectives of experts could take. The findings revealed that collective learning and sharing experiences in expert communities, particularly within those craft guilds as external collectives of experts, is affected by gender differences and geographic dispersion of the membership. However, exploring the impact of these issues on the cultivation and renewal of collective knowledge was beyond the scope of this research. Hence, future research could elaborate on this study to develop a comprehensive framework of these issues. For example, to understand the gender differences in collective cultivation of expert knowledge, future research could explore learning styles and knowledge sharing within specialist groups operating in predominantly male or female dominated areas/ occupations such as midwifery and fire fighting.

6.6 Conclusion

The main objective of this research was to explore the dynamic processes of knowledge development and sustainability in collectives of experts. Despite the growing focus on knowledge as a valuable resource providing organisations with strategic advantage, the topic of expert knowledge development and sustainability has not been widely explored. In fact, the significance of expert collectives in leveraging specialist knowledge has largely been ignored. So, this research was set out to explore how expert

communities develop and sustain their specialist knowledge through collective efforts; an objective that was achieved.

This research informs researchers as well as business practitioners how knowledge is cultivated and renewed in expert collectives. By doing so, this research informs them about the unique ability of expert communities to effectively leverage specialist knowledge through collective efforts. This empirical investigation also highlights the inherent relationship between the social processes and collective knowledge advancement. So, the research outcomes of this doctoral investigation provide both academic and managerial contributions by exploring the dynamic processes of knowledge development and sustainability in collectives of experts and highlighting key attributes essential for improving the value of social processes in fostering the collective development and sustainability of specialist knowledge.

Appendices

Appendix A: Stage 2 Interview Guide

Case 1 External Collectives

History

- Historical background of the guild?

Membership

- How many members were there initially? And how many members are there now?
- How to become a member of the guild?
- Do you advertise or promote the guild to increase membership or is it the word of mouth?
- Why did you join this guild?
- What were the expected benefits of joining the guild?

Purpose

- What is the main purpose of guild?
- Why do you think people join the guild?

Organization and Communication

- How do members communicate with each other?
- How are activities coordinated by the guild?

Learning Strategies

- How does the guild encourage learning among members?
- Are there any workshops or meetings? If so, how often do the members meet each other?
- Do you see the workshops or meetings as important part of the learning process?
- How often do you meet the other guild members?
- How do you think the guild can encourage or facilitate learning of new techniques?

Knowledge Sharing

- Do you still use the techniques used in the past?
- How do you share traditional and new techniques among members?
- Is the continuity of knowledge a key agenda for the guild?
- How do workshops and shows help to share knowledge?
- Do you use the website and online forums?
- Are you satisfied with the existing knowledge sharing processes or do you think there should be more workshops, new letters or meetings to share knowledge and new techniques?

Innovation, Change and Creativity

- Are there any conflicts of interest (traditional vs. innovation) among members?

- How do you manage change? How do members react to new techniques? Do they adopt them easily?
- Do you think preservation of techniques is a barrier to embrace new techniques within the guild?
- What sort of learning methods promotes innovation activities?

Case 2 Internal Collectives

Membership

- How long have you been with this research team?
- How would you describe your role in the team?
- When you first joined, how long did it take you to feel like part of the team?

Purpose and Leadership

- Do you see your research group as a unique group with a common goal?
- Do you think the team leader plays an important role in this group?
- What sort of leadership do you think is required within this team?

Organisation and Communication

- How do members of your team communicate with each other (e.g. formal or informal meetings)?
- Do you talk with other members of the team frequently about your work/ part of the project?
- Do you think it's important to be able to discuss about your work with others in the team?
- Do you do anything outside of work with your colleagues (e.g. going out for lunch or coffee)? If so, how important are these informal interactions for your ability to maintain a good working relationship with them?

Learning Strategies

- What sort of learning happens within the team? Is it more practical, theoretical or a combination of both?
- Are there any weekly meetings or workshops?
- Do you see the seminars organised by the University as an important part of the learning process?
- Do you feel you learn from other members of your team?
- Do you think that these learning opportunities are important for you?

Knowledge Sharing

- Do you think knowledge sharing is important to this group?
- How do you think knowledge is shared among the members of your group?
- If you come up with a new idea, are you comfortable about telling it to others in your group? If so, when and where would you share it (e.g. during formal meetings or informal chit-chat)?

- What motivates you to share what you know with others in your group?
- Do you think trust plays a significant role in knowledge sharing?

Innovation, Change and Creativity

- Do you think innovation is important to this research team?
- How do you feel about accepting new ideas and changing the way you do things?
- Do you see any sort of conflicts happening within your team?
- What do you think enables your team to achieve success? Do you see learning, knowledge sharing and innovation as key success factors?
- Can you think of anything else that would help me to understand about learning, knowledge sharing and innovation within this team?

Appendix B: Example of an Interview Transcript

KG_Interview#10005 p1 of 4

Thank you very much for agreeing to do an interview.

No worries.

The first three questions are basically on membership. How did you get to know about the guild?

I'd met some knife makers and they were members of the guild and they told me about it.

Okay, so how long have you been a member?

I'm still a probationary member. I'm not a full member yet. I joined three years ago. I should've become a member last year but I didn't come to the show last year and I didn't submit my three knives to be judged, I guess, for full membership, so that was happening this year.

Okay. So, what was the main purpose of you joining this guild? What did you expect to gain out of the membership?

To meet all the rest of the knife makers and to obviously then be able to get knowledge off them. And to be able to show my knives at the show, and to help as then becoming a member of the guild and helping to promote knife making.

So it's basically three things: to learn new things and then to sell your knives and promote your knives, and then to attract new members, so help new members to learn about knife making.

Yep.

How do you communicate with other members in the guild, for example members from your state and interstates?

Either, well email, phone, go and visit them.

So do you do that frequently?

Not so much. I mean the other guys in the guild all live quite a distance from me. And because I'm more interested in forging the knives, I tend to communicate more with the people over this side of the country, because there's more over here doing the forging.

How do you think this guild encourages members to learn new things?

Well the shows certainly help because we compete against each other, I guess. I mean everyone wants to win – everyone likes to win the awards – the best knife in each class, sort of thing, so that encourages them to make a better knife and to try new things, better yourself, further yourself.

Do you use the website, the online forums and the newsletter to learn new things?

Yes. Definitely. Our newsletter could be better. There's not a lot of learning stuff in the newsletter. That's something that we need to look at.

So you think there should be more articles about new techniques and ways of making?

Yeah.

How do you think the guild promotes new techniques or innovative ways of making knives? Do you think it's happening?

No, no. I don't think it is. I think...

Do you think they should promote it?

Yeah, yeah, they should. I mean at the moment the only thing is when we get together for a show, and someone will have something new or "How did you do that?" you know, and they'll tell you how they did it. So, I mean there are no secrets. Some people might think there is but generally there's no secrets amongst us, we're all doing the same thing. So the guild, I guess...

Do you think there should be more open days or workshops?

Yes, which is something that's being talked about anyway at the moment.

Do you still use the old techniques, the techniques you have used in the past, or you are flexible to adapt for new techniques?

Oh no, I'm flexible. You've got to be flexible, you've got to be flexible, otherwise you just – I mean if there's an easier way of doing something out there, well you're mad if you don't do it.

So you're more than happy to adapt for a new technique or innovative machinery?

Yes.

When it comes to sharing knowledge, do you think the guild facilitates you to share knowledge, or whether you can learn something from other members? Is it easy; does the guild facilitate it?

Do they facilitate it?

Yes.

Um ... Up to a point. Because they run the shows like this, that gets everyone together, sort of thing. So it does give us a forum, sort of thing, or an area. It does give us somewhere where we can all congregate and talk about what we do, so then you learn new things, yeah.

You said that obviously you read the newsletter and do you use the online forums of other websites?

Yes, I do. I participate in five different forums.

Do you go to other shows like gun shows and… apart from knife shows?

No, in ....go to the .....Arms and Armourers Fair, and I also go to – I'm not going this year but last year I did – went to the Blade Show, to that show.

Do you think that using old techniques acts as a barrier to be innovative in knife making for you?

No. There's no reason why you shouldn't or can't change the way you're doing anything. I mean obviously I think we need to... get out there in the public and show a lot of the old ways of doing things to promote it more as an art-form that just knife making, because there's that many people getting stabbed and knives being used these days that they say, "Oh, you're a knife maker," and "Oooooh". But if you're doing it as an art-form and promoting it as an art-form, which is something the guild needs to do now, I think, then it should be more socially acceptable and we should get more people then becoming interested in it, for that side of it. You're not just making a knife, you know, it's a piece of art.

So you think that in order to increase the membership and attract new members you have to change that attitude about making knives, to promote it rather as an art or the way of showing your creativity?

Yeah. And the historical aspect of it as well. This is how it was done 200 years ago and this is how we still do it.

In your opinion how do you think this guild could improve – attract members or help new members to learn new things and preserve the knowledge that all the members already have?

The members that we've got at the moment, I think, need to in their each individual states get out there and...

Promote the guild?

Yeah. And promote knife making as an art-form, and that will then attract people to the guild. And I think we need to do it very soon.

So you think that members from different states, they should organise activities within their states?

Yes.

That's about it. Thank you for your time.

No worries.

Appendix C: Example of an NVIVO Coding Report

Name: (MEANS) Collective learning opportunities

<Internals\\Group 1\\HM_Group 1 13_7_AL> - § 2 references coded [2.91% Coverage]
Reference 1 - 1.73% Coverage
Seminars, because we're a bone field, so seminars on bones, and symposiums on bones, conferences on bones that we all go to, workshops on how to write better journal papers, how to write grants, how to do better statistical analysis, all these things are ... that we go to, to better ourselves.
Reference 2 - 1.18% Coverage
Sometimes things go in one and out the other. But sometimes they do, so I guess it really depends. When I went to the writing workshop, for example, it really helped me because my weakness is writing.

<Internals\\Group 1\\HM_Group 1 13_7_AT> - § 4 references coded [6.33% Coverage]
Reference 1 - 2.96% Coverage
Yeah there is a weekly seminar in the institute so a visiting academic from overseas or somewhere else in Australia tends to visit and talk about their particular of research, which is sometimes relevant to what we do and sometimes not. And then there's annual conferences which we try to attend if there is money available, they are more useful to go and see, to see and meet the range of scientists who have similar interests. That just depends on money.
Reference 2 - 0.62% Coverage
Yep, you definitely gain new insights when you go to a conference and see other people's research.
Reference 3 - 1.44% Coverage
the Institute does organise the some seminars and workshops for various technical aspects such as … microscopy would be the next one. But then there is lots of collaboration with the universities

<Internals\\Group 1\\HM_Group 1 13_7_HM> - § 4 references coded [5.28% Coverage]
Reference 1 - 1.36% Coverage
we have individuals going to them, not necessarily on a weekly basis, but on a more irregular basis, but somehow something's come up, it's within a conference, and it's attached to a conference, and so they'll go to that. And that might only be one person going, and then it's the responsibility of that person to impart the knowledge to the rest of the group.
Reference 2 - 2.30% Coverage
And when I say theoretical, we'll have not necessarily technique-oriented seminars, but we have, well we have a weekly scientific seminar within the Institute, and I try, I urge our staff and students to attend those. They're ... I think my, I have to put pressure on them to go and to attend those, because they're not immediately related to their own work, so therefore I would like them to attend because I'd like them to try and extract

experiences and knowledge from other fields in medical research and address it to their problems, and think, is this applicable and what does that mean for us?
Reference 3 - 0.43% Coverage
But when there is a seminar or a technology report that is very relevant, then they'll seek that out quite readily.

<Internals\\Group 1\\HM_Group 1 13_7_MS> - § 2 references coded [4.18% Coverage]
Reference 1 - 2.37% Coverage
we have seminars in terms of other people presenting their work, but workshops that help ... like apart from the lab meetings which provides each and every one of the lab member a good idea of how they can measure different things or, yeah, use different techniques, I think that's a pretty good opportunity to learn new things

<Internals\\Group 1\\HM_Group 1 13_7_NL> - § 5 references coded [3.85% Coverage]
Reference 1 - 0.88% Coverage
Also for the School, we have a weekly seminar of the school. And I guess PhD students are expected to come, but sometimes I'm very busy, so I can't ... I try to make it every week. there'll be people presenting their data in there
Reference 2 - 0.46% Coverage
So they will present for, say, half an hour, and then there will be 15 minutes' question time, so that's when you could ask them questions if you want to.
Reference 3 - 1.13% Coverage
Workshops or seminars that's helping me to learn new things ... No. The only thing I can think of is probably maybe products demonstrations from the companies. They will bring in machines and stuff, and then they would show their equipment, and you come to ... but that's not really specifically for the group, that's for everyone. Specifically for the group is their seminars ...
Reference 4 - 1.05% Coverage
Workshops? To learn new things? Actually, there is. Last year our group and other groups that have similar interests, in the bone area, have created a little ... I don't know whether it's a workshop, but it's a day of presentations, short presentations, of summaries of just key findings in that laboratory. Yeah, so that was that
Reference 5 - 0.33% Coverage
so it's a get-together of people in Adelaide, or research groups in Adelaide, who have similar interests to us.

<Internals\\Group 1\\HM_Group 1 13_7_SA> - § 2 references coded [4.44% Coverage]
Reference 1 - 1.86% Coverage
There's a few seminars I think. I haven't really been to any workshops, just all the … they're mostly theory workshops and then we will work it out as a lab if we want to do something or it's more we just find our own, like

X just recently got sent to Sydney because they're doing something that we just can't get going here, so now she's been shown, she will come back, I think it's more on your own accord the learning, rather than structured like as a workshop for people to go to

Reference 2 - 2.57% Coverage

And these workshops, are they specifically focused on helping members to learn new things?

I think the one we are going to soon, I haven't been to many because I think they're more helpful maybe on the researchers level and the students like just talking about other people's work and what they're doing and sort of gives you inspiration or new ways of thinking of what we are doing. So it's not really technique so much as thought processes of a different path we can take or something like that.

<Internals\\Group 2\\16_7_DF> - § 2 references coded [9.47% Coverage]

Reference 1 - 5.09% Coverage

We provide as many opportunities for people to go to meetings as possible. And even people who may not have been very enthusiastic usually are once they come back from a meeting. They can kind of see the bigger picture and they can talk to their peers in other places, see the way other people are approaching problems, dealing with technical problems and so on. Conferences are absolutely indispensable. So if you want to stay up to date with very current thinking, there is just no substitute to going to the meetings and maybe even - and certainly networking at them, and maybe even going to visit the various institutes where people live and work. I think it really requires all of that to stay up to speed.

Reference 2 - 4.37% Coverage

Yeah, I mean I'm someone who is thrilled by the new understandings, new knowledge. That's why I'm in this game. So that is my purpose and I hope that by exposing other people to it as well, that they will be similarly thrilled and enthused and go back to their workbench with an increased energy and purpose, and understanding. But I have to say if I'm organizing a seminar or bringing a speaker in, my first thought is what is going to interest me and I hope that if it's interesting to me, it's interesting to other people as well. I mean it's crucial that I'm learning all the time, so that would guide my planning and then I would think it's probably going to be good for other people too to and experience as it usually is.

<Internals\\Group 2\\16_7_GA> - § 1 reference coded [1.66% Coverage]

Reference 1 - 1.66% Coverage

There are weekly seminars on campus that my group are encouraged to attend and also I encourage the more experienced members of my team at least, people who are really driving one of the projects themselves, to attend scientific conferences, so usually on a national level and I think people get a lot out of that.

<Internals\\Group 2\\16_7_KW> - § 2 references coded [7.60% Coverage]

Reference 1 - 2.32% Coverage

We go to the conferences too, which is often useful because it's people from the same field as you and so you often present there and that's where you get a lot of ideas to use as well.

<Internals\\Group 2\\16_7_ML> - § 2 references coded [5.65% Coverage]
Reference 1 - 2.84% Coverage
As a student there are every now and then sort of throughout the year there are workshops.
And they're really, really helpful. I mean there mainly on the course of a PhD so thesis writing, how to write a paper, presenting seminars and that sort of type of workshop and they're really, really good. So at the moment I'm teaching med students as well.
And so with that I get training on how to tute, presents tute and how to be a tutor and an appropriate one and a good one.
Reference 2 - 2.80% Coverage
Speakers come and yeah we all try to make the effort to go if we can if we have time we will all go. Most of the students are expected to go to one every week and they're really good like sometimes you come out of it going I don't understand any of that at all or you come out of it going "nah that was really interesting but not related to my work", or you come out of it going "hmm maybe I could do something like that you know with my work" or something so yeah each time is different.

<Internals\\Group 2\\16_7_VL> - § 3 references coded [6.76% Coverage]
Reference 1 - 2.30% Coverage
there are a few seminars and things like that, a few talks that we go to, every Thursday I think they have a presenter. So every now and again we will go to that if it is somewhat relevant to our field, we will go to that.
Reference 2 - 2.62% Coverage
The university organizes a few, but mainly it's like labs, say our lab that we are involved in bone and want to bring someone down from Queensland that is involved with bone to do a seminar, and they will do a seminar or any other lab will do it too. Someone involved in cancer research they will bring someone down.
Reference 3 - 1.85% Coverage
Do you find these workshops and seminars useful to develop your own knowledge?
Yeah, I think it is. It is also good in that you see some people, they do a different sort of work to you but they see things differently to you and it's the big picture. In that way it is good. It opens you up a bit.
So it gives you new insights?
Yes that's it.

<Internals\\Group 4\\6_8_DI> - § 1 reference coded [3.83% Coverage]
Reference 1 - 3.83% Coverage
Yeah, we try to attend a conference probably once a year, at least the students usually get to go away. I've probably been to about five or six conferences so we get to go once a year. There are weekly seminars which we're encouraged to go to and they're usually quite useful. We have

collaborations with other labs so we usually have research meetings amongst those collaborations so I guess - does that answer the question?
<Internals\\Group 4\\6_8_JN> - § 2 references coded [6.47% Coverage]
Reference 1 - 3.78% Coverage
Do you have any workshops or seminars that you attend to?
Occasionally, they are run by the Institute. I attended learning about radioactive nucleotides, safety training course, I attended that and there is every Thursday there is also seminars run by the Institute. They have guest speakers to come and speak about various topics and we go to that if it is even vaguely related to our area of research, but it is also good to go to gain a broader insight on what else is going on in science. So that is every Thursday and occasionally the Institute might advertise a workshop here or there that's outside those times.
Reference 2 - 2.69% Coverage
Journal clubs would be good, we don't have any journal clubs in our lab or, where everyone is given a journal to read and then you go through and discuss it. That would be helpful.

<Internals\\Group 4\\6_8_PL> - § 1 reference coded [4.02% Coverage]
Reference 1 - 4.02% Coverage
There are seminars with the Institute most weeks, which we're encouraged to and meant to attend. I guess it's more like just different people from around generally Australia, sharing their work and all that and there are a few workshops around that come and go either through the Uni or through the institute. I haven't had a need or requirement to go to any of those yet but they are there occasionally.

<Internals\\Group 4\\DC_Group 4_27_7_CW> - § 1 reference coded [2.85% Coverage]
Reference 1 - 2.85% Coverage
We have the seminars – we are affiliated to the institute and so they have weekly seminars, and most of us usually to go to them, these seminars as and when they are held and they are of interest to us. They are held every week or so and perhaps we go once or twice every month, as a group.

<Internals\\Group 4\\DC_Group 4_27_7_ReS> - § 2 references coded [4.68% Coverage]
Reference 1 - 1.75% Coverage
We have the seminars on a Thursday which just gets you, like you can go and you listen to other people's research so you can actually see what's out there and what other people are working on. But that would be it I would say, yeah.
Reference 2 - 2.93% Coverage
so you find these workshops useful, seminars?
Sometimes, it depends how distant their project is from ours, because sometimes it's just totally different and you can't understand it, they go really in-depth and you kind of lose it. Yes some are really quite helpful because they come back, like they have a molecular background. So you know the techniques so you kind of understand it a bit more.

<Internals\\Group 4\\DC_Group 4_27_7_RS> - § 1 reference coded [2.82% Coverage]
Reference 1 - 2.82% Coverage
workshops or seminars happening so that members of your group can learn new things?
Oh yes, There are seminars all over the shop these days. We have our institute seminar every Thursday and there are conferences. Within in the group there are a lot of meetings and then Honours student presentations in the school. There are endless opportunities and there are ?? small conferences which are organised mainly for students, PhD and Honours students so people go ahead and post up their and yeah it is part of the competent-al thing they ?? . So it is quite active on that front.

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