

# **TACIT KNOWLEDGE NETWORKS AND THEIR IMPLEMENTATION IN COMPLEX ORGANIZATIONS**

By

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## DECLARATION

The candidate does hereby declare that:

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Signed:

.....

Susu Nousala

23<sup>rd</sup> March 2006

## **DEDICATION**

Martti Johannes Leppätie, war survivor, artist, musician and my grandfather who showed me the value of the cycles of life and the interconnectedness of humanity. From him I gained a basis of knowledge that would be needed for changing times. He remains my guiding light for the future and I dedicate this work to him.

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## ABSTRACT

It is difficult for organizations to effectively manage personal knowledge so it can be mobilized, shared, and rewarded to benefit the organization. These difficulties occur particularly in large geographically dispersed, hierarchical organizations. The management of developing, identifying successful practices, building up and maintaining tacit knowledge, requires an understanding of how these ideas have emerged within the organization through a Tacit Knowledge Exchange (TKE) process. Identification and understanding of TKE characteristics is difficult as they are invisible (tacit).

The TKE process in action requires the adoption of multiple methods and approaches employed simultaneously. A series of cases study instances were used as a basis for the methodology, each contributing specific aspects of the methodology. The initial three case study instances, each yielded specific characteristics regarding tacit knowledge exchange and networking. The findings from the initial three case study instances were tested in a large hierarchical, complex engineering organization. This final case study instance, prototyped a methodology to graphically codify, index and build up in-house tacit knowledge abilities through mapping staff knowledge. The final case study instance allowed for investigations into what these TKE characteristics of a complex organization would utilize. To date, specific TKE characteristics have not been well understood. This research contributed to specific understanding of the identification TKE characteristics and network structures.

The outcome of the research provided a graphical structure identifying who would be likely to possess the kind of knowledge they need to find. The interview process was an important facilitator to precondition the knowledge bearers for sharing, thus locating key “human attractors” within and between working groups and communities with experts sharing the same issues and interests. The research also focused on the tacit knowledge sharing which occurred as a transition period, prior the formation of Communities of Practice (CoPs) evolving from Communities of Interest” (CoI). Previous research and case studies have focused primarily on the CoP phenomena within larger organizations and not the areas of transition.

New strategies were adopted to highlight characteristics and previously unidentified attributes that support sustainable, successful Tacit Knowledge Exchange (TKE) in relation to explicit structures preventing any unnecessary re-invention through emerging lessons learnt from previous experiences. Through mapping lessons of tacit knowledge protocols and frameworks, the relationship between tacit explicit knowledge management strategies could be understood. These Tacit Knowledge Networking (TKN) strategies were important as they ensured sustainable long-term success, through well-integrated explicit and tacit knowledge management capabilities.

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## Acronyms

<b>TERM</b>	<b>DEFINITION</b>
COI	Community of Interest
CoP	Community of Practice
CEO	Chief Executive Officer
CSIRO	Commonwealth Scientific Industrial Research Organization
DP	Differentiation Program
E	Explicit
ECOI	Expert community of Interest
EE	Effort Elimination
EPMO	Engineering Project Management Organization
EU	European Union
FEAST	Forum for European Australian Science and Technology Co-operation
F to F	Face to Face
HKM	Humanistic Knowledge Management
HRM	Human Resource Management
ICT	Information Communication Technology
IEEE	The Institute of Electrical and Electronics Engineers
IT	Information Technology
ITSA	Intelligent Transport Systems Australia
JIG	Joint Implementation Group
K	Knowledge
KM	Knowledge Management
NOIE	National Office of Information Economy
OODA	Iterated cycles of observation, orientation, decision and action
OECD (OCDE)	Organization for Economic Co-operation and Development
P	Problem
R&D	Research and Development

<b>TERM</b>	<b>DEFINITION</b>
ROI	Rate of Investment
SIG	Special Interest Group
S&T	Science and Technology
T	Tacit
TEAM	Team Expertise Access Mapping
TKE	Tacit Knowledge Exchange
TKM	Tacit Knowledge Management
TKN	Tacit Knowledge Networking
TT	Tentative Theories
UK	United Kingdom
UNESCO	United Nations Educational Scientific and Cultural Organization
UN	United Nations
W1	World 1 from Popper's Epistemology
W2	World 2 from Popper's Epistemology
W3	World 3 from Popper's Epistemology
WG1	Working Group One
WHO	World Health Organization

## Glossary

TERM	DEFINITION
<b>Epistemology</b>	Is a theory of knowledge, being an answer to a question or questions. In the context of this thesis, epistemology refers the theory of knowledge grounded in biology to provide an epistemological framework for exploration and analysis of organizations and their knowledge structures.
<b>Ontology</b>	Ontology is the development of a structure of a body of theoretical knowledge. For this thesis ontology was used in two different ways: (1) “ <i>metaphysical ontology</i> ”, which refers to the basic categories of existence, as discussed by Karl Popper's (1972) division of existence into three “worlds”; and (2) <i>systems</i> or “ <i>empirical ontology</i> ”, that attempts to provide a rigorous conceptual schema for a domain, such as that relating to a system (Lyon 2004).
<b>Autopoiesis</b>	This term means “self production” and is used in this thesis to express complimentary aspects and attributes between function and structure.
<b>Phenomenological</b>	Phenomenology in the context of this thesis refers to the behaviour of certain natural or social phenomenon in relation to complex systems and offers a way of evaluating through observation and is used to describe or formulate this theory.
<b>Emergence</b>	Is a process which highlights aspects or concepts that become evident or more obvious over a period of undetermined time, rather than being immediately obvious.
<b>Hierarchy</b>	Refers to a system or structure containing embedded classes and subclasses within levels or layers. Wholes maybe parts of still larger structures, (Salthe 1993).

## **Chapter 1 – Introduction**

### **1 Introduction**

Firstly, this chapter discusses the relevance, approach and outcomes of the implementation of tacit knowledge networks in complex organizations. These discussions are outlined in the chapter through broad references under the headings of background, the problem, the approach, the research question and finally the methodology. Secondly, this chapter provides an outline of the scope of the thesis (Figure 1) and a list of relevant publications from work undertaken in this study.

#### **1.1 Background and significance of tacit knowledge networks/ exchange and communities of practice**

Wenger (Undated) defined communities of practice as follows:

“Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavour. For a tribe learning to survive, a band of artists seeking new forms of expression, a group of engineers working on similar problems, a clique of pupils defining their identity in the school, a network of surgeons exploring novel techniques, a gathering of first-time managers helping each other cope.”

The significance of Communities of Practice (CoPs) is that they can facilitate TKE which supports sustainable implementation of TKNs within complex hierarchical organizations. Described in the literature as communities of practice (CoPs) (Wenger and Snyder 2000), the value and significance of working groups or CoPs is that they all operate within complex hierarchical organizations and are integral to tacit knowledge networking (TKN). The complexity involved in exchanging knowledge (or tacit knowledge exchange, TKE) between individuals, groups, communities and organizations requires supportive environments where knowledge can be expressed and observed by others. Without supportive environments, these exchanges are difficult and will not be sustainable.

A CoP is an entity that supports individuals having related knowledge needs, where unifying causes or actions hold the interactions of individuals together (Nousala 2003; Nousala and John 2004). The CoP concept has been identified within the current knowledge management

literature as a fundamental aspect of complex human organizations that can emerge naturally, but benefits from nurturing and sustainment (Nonaka and Takeuchi 1995; Wenger 2000). As such, it has similar or sufficient properties to be deemed as an autopoietic entity in its own right according to von Krogh and Roos (1995), Hall (2005). This research treats CoPs as elemental and potentially autopoietic components within larger complex organizational systems. The way of viewing CoPs depends on whether or not the CoP was the unit of analysis or in action as an evolving autopoietic entity within or part of a larger complex organizational system.

### 1.1.1 The Approach

With a focus on tacit protocols and their environmental requirements or structures, the practical research presented in this thesis needed to develop a theoretically grounded framework. This approach would be largely unfamiliar to many in the knowledge management discipline.

The framework was necessary to support the exploration of the environment required for sustainable implementation of TKE within TKN and CoPs. The framework was based on Karl Popper's epistemology as expressed in *Objective Knowledge* (1972) and the theory of organizational autopoiesis which claims many economic organizations are dynamic, evolving, hierarchically complex adaptive (i.e., biological) entities in their own right (von Krogh and Roos 1995; Hall et al. 2005).

The Popperian worldview is based on an ontology of three “worlds” or domains. World 1 (W 1) is external reality. World 2 (W 2) is the domain of cognition and embodied or “dispositional” knowledge. Polanyi's personal and tacit knowledge (Polanyi 1958, 1966) are encompassed within W 2 (Hall 2005). World 3 (W 3) is where explicit or “objective” knowledge such as the logical contents of books and computer memories or other products of human behaviour is found (Popper 1972, p.115).

The biological theory of organization (Hall 2005) is founded on the concept of autopoiesis or “self production”/ self organizing (Maturana and Varela 1980, 1987), and also from Nelson and Winter (1982, 2002) the concept that “*organizational genetics* – the processes by which traits of an organization, including those traits underlying the ability”, which comprise competence, learning and routines. Autopoietic organizations have emergent properties which are accessible beyond current time frames and capabilities of the individual working within or

around the organization. However, to survive in competitive environments, such organizational entities must assemble, deploy, preserve and replicate knowledge in order to respond competitively and successfully to environmental demands. Knowledge in the organizational context is any kind of information that has survival value.

Biological organizations as discussed by Hall et al. (2005) and Nousala et al. (2005b) are hierarchically complex systems, where knowledge pertinent to organizational survival may exist in worlds 2 and 3 in a variety of forms. Knowledge in human organizations may be held in the minds of people in and around the organization, working within the physical layout and using corporate documentation (Nelson and Winter 1982).

## **1.2 The research objectives**

Tacit knowledge (TK) is not very easy to define as it is not tangible. TK has been defined as individual or a set of concepts or ideas which have been developed and held by individuals (Nonaka and Takeuchi 1995; Wenger 2000; Nousala 2003; Nousala and John 2004; Nousala et al. 2005a). These concepts and ideas become explicit when conveyed to a wider audience, which may be a group or organization (Choo 1998). This exchange of TK to the wider group or community is tacit knowledge networking (TKN). It often occurs within the working groups or communities who share or have a need to share their experiences and expertise in practice.

Complex, hierarchical organizational environments (such as engineering organizations) have well-documented, codified, explicit procedures or protocols. Once TK has been expressed and has become explicit, a true understanding of the implicit intent is best experienced through the action or practice that resulted from the exchange. However, the tacit is then no longer tacit and has become explicit. This phenomenon occurs with little or no understanding as to the possible tacit protocols which have occurred during the exchange process. Hence, the objectives of this thesis are to investigate and identify the effects and influences that the codified explicit structures may have on possible tacit protocols and structures are significant but are poorly understood.

## **1.3 Research questions**

This thesis raises the question of implementation of tacit knowledge (TK) issues within distributed operations or organizations, specifically, engineering and technical organizational environments. In engineering and technical environments TK issues are poorly documented and not well understood. In support of the research question, it was also necessary to address the issue of how did working groups within complex organizations (such as engineering firms) share their tacit knowledge? These types of operations typically had specific issues regarding the organization's approach to tacit knowledge management (TKM) within highly complex and hierarchical environments (Nousala and John 2004; Nousala et al. 2005b; Hall et al. 2005). Highly complex and hierarchical environments had various functions which required more formal processes leaving little room for the consideration of TK requirements or approaches. The approach and application of TK creation and exchange highlighted the following key sub-questions (1-3 listed below) as a means for creating sustainability for internal working groups or CoP (Lave and Wenger 1991) within and between complex organizations:

1. What are the key defining elements (if any) of TK approaches for implementation?
2. What are the essential differences between tacit and explicit knowledge approaches in relation to networking?
3. How do you know when tacit knowledge sharing is happening?

The documentation, access and use of explicit knowledge are well understood by organizations with explicit protocols in place. This thesis explores approaching TK, by questioning the possibility of tacit protocols and their possible relevant attributes. Since the literature of CoPs (Lave and Wenger 1991; Seely Brown and Duguid 2000) is well established, the research objectives focused on TK implementation by using case study instances. These initiated a focus on CoPs and their value in highlighting TKE (initially, predominantly through face-to-face meetings or discussions).

The CoP was identified as a favourable starting point from which to investigate TKE within TKNs and their emergent interactive components with explicit complex organizational structures and how these interactive components contributed to organizational sustainability.

A CoP provides an immediate intersection of commonality for the emergence of the knowledge transference and any generic attributes required for the process. The CoP



approach highlighted the attributes required to create a tacit content within a tacit context and the environment needed for sustainable outcomes (Nousala 2003, p. 7). Key triggers for understanding generic attributes of sustainability were derived from observations of individuals in isolation who could not transfer knowledge, so the tacit to explicit exchange could not emerge, and therefore could not continually take place, stifling a sustainable outcome.

The complex and diverse variety of communication required to demonstrate (Choo, 1998) an individual's tacit concept or concepts, is often shown or demonstrated by the original individual's intent and observed by the others in the group or other external environments. The translation of tacit concepts through complex organizational systems (people) can create tensions, if it is not carried out in an efficient or effective manner. Through a working group or CoP, the task of conveying an outcome of a complex TK activity may offer the means by which this task can be achieved.

However, within the organizational engineering environment, this may not be enough to sustain continued TK sharing or exchange, and may need a combination of other approaches which incorporate significant organizational activities in context. More often than not, the TKN process begins with the individual as a starting or "initiating point", working within the organization and their immediate working group (Nousala et al. 2005b). In the context of sustainable TKE and TKN, it is important to understand these key individuals or "human attractors" as initiating points.

## **1.4 Methodology**

A very significant fraction of the knowledge available to an organization (i.e., the organizational memory) is held by its individual members (Lehner and Maier 2000). Organizational memory is more than the sum of the knowledge of the organization's individual members, and individuals with their personal knowledge do count. People currently belonging to an organization also have lives and career histories beyond the bounds of organizations they may belong to (Arthur 1994; Arthur & Rousseau 1996), and in general will have a lot of knowledge the organization (as an entity) does not know about, which would be valuable if made known.

An understanding of the organizational memory through understanding who, what, where, why, when and how TK is exchanged was gained by focusing on CoPs TKE within the TKNs of complex hierarchical organizations (Nousala et al. 2005b; Nousala and John 2004; Nousala 2003). Reported in this thesis are four case study instances, where key attributes of TKE within TKN were uncovered. TKEs within TKN follow tacit protocols which key “human attractors”, acting as initiators, use to develop initial expert communities of interest (ECOI), and communities of interest (COI), and eventually CoPs (Nousala et al. 2005b).

All of these various levels of communities or working groups require sustainable links to existing organizational explicit structures for the TKEs to continue to occur (Nousala et al. 2005b). Understanding these links from TKNs to explicit existing structures is fundamental to developing or sustaining the organizational autopoietic entity. Key attributes were uncovered through the case study instances and in particular, the final case study instance, where testing was carried out through the development of an electronic relational (also tacitly intuitive) data base pilot/demonstration for the engineering project management organization (EPMO). Research outcomes for the EPMO data base pilot project uncovered and used generic attributes of complex hierarchical engineering organizations by facilitating and sustaining cross-divisional ECOIs, COI and CoPs. By combining cartographic and CoP approaches (Nousala et al. 2005b), it was possible to develop the data base pilot project for the EPMO into a working proof of concept. Finally, the data base pilot project was implemented as a trial in the organization’s network as a proof of concept.

A database which only relies on expertise locators or skill listings (Ackerman and Halverson 2004; Becks et al. 2003) does not do a good job of “personalizing” the contact information in a way that will help to facilitate the kind of personal contact required to qualify and effectively use the expertise after it has been located. In other words, such databases are literally “impersonal”.

In this thesis, cartography implies the powerful image of drawing a graphical “knowledge map” to where the knowledge is held. However, concept maps, as defined in the case study instance of EPMO, primarily focused on the logical development of ontologies providing a basis for the links between explicit structures and TKE within TKN, rather than providing a practical means to locate expertise.

## **1.5 Thesis outline**

This thesis is organized into six chapters, as seen in Figure 1. The following section summarizes the thesis and indicates the structure of each chapter.

Chapter 1 Introduction and description of the problem. This chapter gives an overview of the thesis through general headings of background, problem, research questions and methodology.

Chapter 2 Review of the background knowledge and how some of KM theories could be applied directly to the case studies chosen. Significant aspects of the work include background of TKE in relation to sustainable implementation of TKNs within complex hierarchical organizations.

Chapter 3 Proposed methodology, based on the background knowledge from the literature review, case study instances and model development and implementation.

Chapter 4 Description of initial three case study instances quantifying key findings and outcomes of implementation. Key findings relating to the concept of TKE elements and TKN patterns in general require further investigations.

Chapter 5 Final case study instance where application and testing of the methodology was carried out. Final results and findings are discussed, including TKE elements and TKN pattern developments and outcomes.

Chapter 6 Conclusion with discussion of final key outcomes.

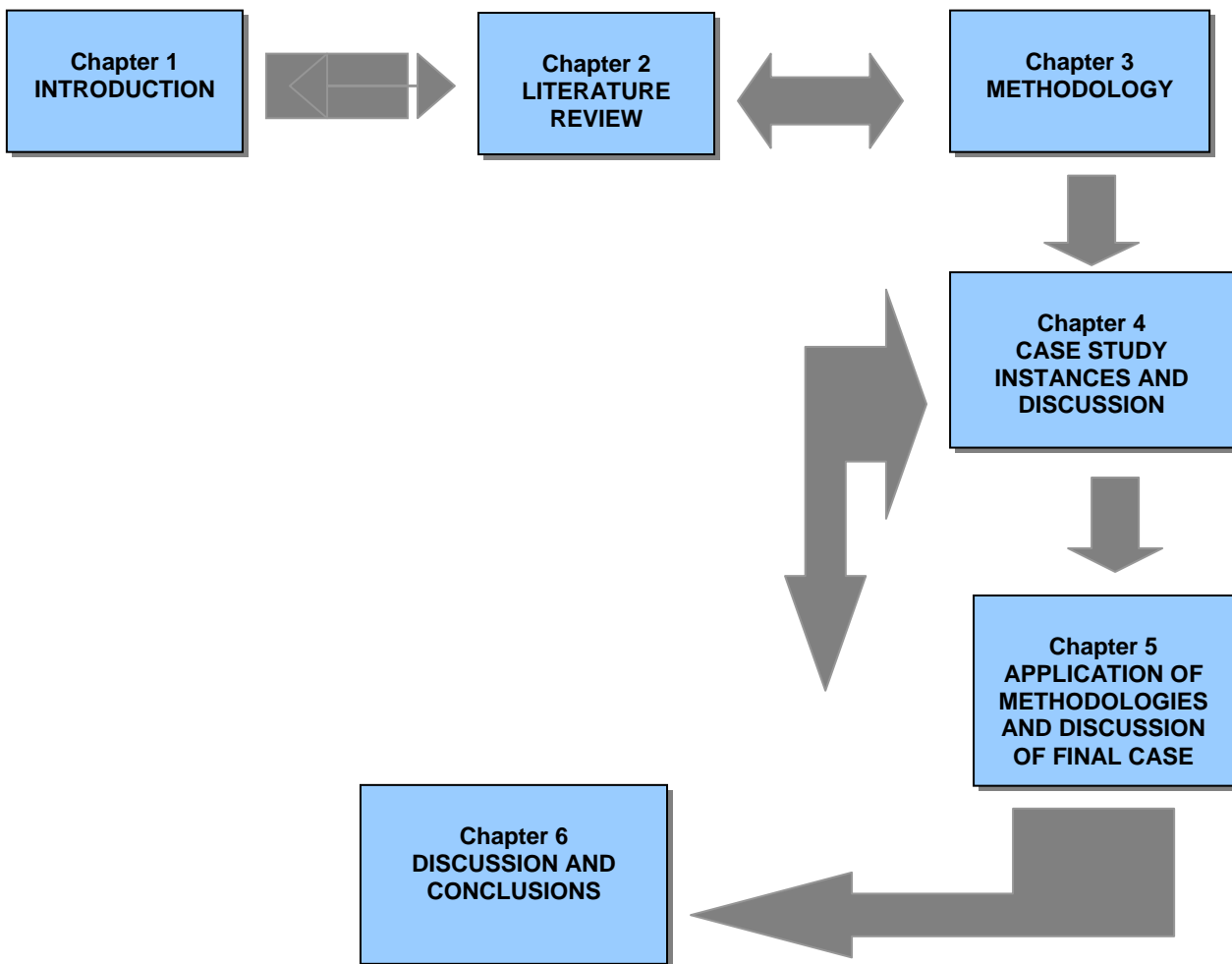


Figure 1 – Thesis Outline

## 1.6 Proof of concept demonstrations

Proof of concept demonstrations are available on the CD submitted with this thesis, complete with an audio visual demonstration, showing examples from the database pilot project for EPMO (as a working proof of concept) named the “knowledge demonstration”.

Please note, that for the purposes of examination only, an example of the data base pilot project with interactive capability has been set up on an external EPMO server. An audio-visual demonstration of how to use the interactive demonstration on the EPMO server is accessible on the attached CD and is named “product demonstration”. Access to this demonstration will be available from February 15<sup>th</sup> 2006 to May 15<sup>th</sup> 2006. Access is password protected; please enter the following; URL - <https://crossbow.tenix.com/km>  
 User name - knowledge, Pass word - kmpassword.

## 1.7 Publications

The following publications below are outcomes from the work undertaken in this study;

1. Nousala, SH 2003, 'Investigations into research methodologies for cultural analysis', *Proceedings of the 4th MAAOE Conference*, 2003.
2. Nousala, SH, and John, S 2004, 'Tacit knowledge management networks and its implication in organizational prosperity', *Proceedings of the Qualcon 2004 Conference*, AQQ, Adelaide, South Australia.
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## Chapter 2

### 2 Literature Review

#### 2.1 Introduction

This literature review uses a two part approach in discussing two aspects of tacit knowledge networking (TKN) within the broader sphere of knowledge management (KM). The first approach is observational and is based on the social science literature. It cites literature which describes and observes the understanding and treatment of tacit knowledge networking in the spheres of knowledge management and communities of practice (CoP). The second approach deals with literature which provides understanding and development of epistemological and ontological views towards tacit knowledge management (TKM) applied in complex hierarchical organisations. These two approaches focus on two key aspects, namely tacit knowledge networks and CoPs.

#### 2.2 Defining tacit knowledge exchange (TKE) within the knowledge management spectrum

Regarding TK and its exchange, the literature to date has generally focused on the tacit and explicit K exchange which has had predominantly a dualistic approach (Nonaka 1998; Nonaka and Takeuchi 1995; Wenger and Snyder 2000). This included discussion on the transitional transfer of TKE and what would be required to develop further understanding in relation to TKE. From the literature, TKE emerges as a phenomenon that would need more than the dualistic literature could offer (Polanyi 1983; Seely Brown 1998; Nonaka 1998; Nonaka 2001; Wenger and Snyder 2000). Popper (1994) TK and exchange from a pluralist point of view, which offered a new context through which to research TKE. From a pluralist point of view, a new avenue emerged for TKE research allowing for greater clarity in expressing any emergent concepts as well as overall understanding of TKE research and its design (Popper 1994).

Popper (1994), a self-confessed pluralist, discussed the possibility of expanding the context of TKE. With regards to the Popperian pluralist point of view, tacit knowledge sharing in the context of TKE could be described as *not conscious competence*, the step before being unconsciously competent, or an expert. The term 'not conscious competence' was the way the

present researcher described TKE during the development of the approach towards implementation (Senge 1998; Whiteley 2002). Implementation of TK sharing in the context of TKE requires an understanding or awareness of the *below the surface* understanding of the particular *know how* or competence on a subject that is to be shared, transferred or expanded. For the TK to be shared or expanded from the individual to others requires some conscious competence just prior to the act of sharing.

Within the organizational context, knowledge creating and sharing can begin with an individual (Nonaka and Takeuchi 1995). Tacit knowledge is not readily definable, in the sense that it is not physical and is often defined as concepts or ideas. In this state it is difficult to codify and is often forming until it is ready to be verbalized, expressed, and in a sense made real to another individual or group. The next step can evolve into a more explicit form of expressing the individual's original experience or idea, which in turn allows the individual to engage with their environment (Nonaka and Takeuchi 1995; Seely Brown 1998; Garvin 1998; Davenport and Prusak 1998; Drucker 1998; Drucker 1999). These actions create content within a context.

Once explicit knowledge is expressed, it can be coded and distributed for wider comment. Environment is a strong element, as this allows the transfer or ripe 'method' or 'pathway' for the transfer to take place. If an individual is in isolation then this transferring of tacit to explicit may not be as efficient or readily carried out (Nousala and John 2004).

### **2.3 Developing an understanding towards tacit knowledge sharing**

Polanyi (1983), Seely Brown (1998), Nonaka (1998), Nonaka (2001), Wenger and Snyder (2000) discuss the more *humanistic aspects of KM* (HKM) which emerge to describe the environment in which the dynamics (and tensions) of TK occurs, identifying relevant TKE aspects within the KM spectrum (Nousala 2003; Nousala and John 2004).

Nonaka and Takeuchi (1995) discuss the individual in relation to their environments and the difficulty of identifying boundaries. The clarification of exactly what the HKM boundaries were has not been rigorously defined by the literature. It would be useful to further investigate the multiple levels of dynamics involved as experienced by definable groupings, such as individuals, working groups, local, global, non-profit, commercial and government. The relationships or links between these groups were far more complex than first thought, and as

such, these multiple levels of dynamics were not as clearly definable (Seely Brown and Duguid 2000a).

## 2.4 Organizational examples of CoPs, tacit and explicit knowledge

Sbarcea (2000) says that, when communities are formed, it is generally due to the need for some sort of innovation. Therefore, whatever the community develops can generally add significant value to the company or organization. This being the case, it is more difficult for the commercial entity to create and sustain CoPs. There are examples of CoPs that have been adopted in commercial organizations (example, IBM, Xerox). These larger companies also have many government “clients” wanting to adopt, create and develop CoPs.

Sbarcea (2000) discusses the global company IBM and how it needed to link its 100,000 employees around the world in such a manner that they could distribute their knowledge. The company investigated the use of anthropological techniques (also discussed by Snowden (2001) as a way of understanding common messages or points of view) and integrated these principles into their own internal communication networks. The company hoped that this approach would assist with the difficulties of transferring knowledge and of transgressing any human or corporate cultural divisions. The metaphors that were created by applying the anthropological techniques were then used to create understanding of common cultural values, which are integral to any society. The metaphors were based on *story telling*<sup>1</sup> techniques, which developed over time. In regard to the issue of the time requirements it was necessary to develop methods to understand and transfer and develop TK levels, as discussed by Nousala (2003). The method of passing on the knowledge to vast numbers of employees was borrowed from a story-telling tradition, which had a long history (Sbarcea 2000; Snowden 2000a; Snowden 2001; 2002). Sbarcea, (2000, p.44) gives a historic example from Christianity of transferring tacit knowledge to large numbers, which they claim is based on a story:

“The parables of Jesus Christ contained in the New Testament and the story of Christ’s life, death and resurrection transmitted and reinforced common stories and values which have become the foundation of Western society and history”.

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<sup>1</sup> This was a term used to describe the method devised from anthropological techniques adopted by IBM.



Sbarcea (2000) says that, in IBM's case, investigation into the common driving force behind the development of an information technology enabled the organization's ability to create virtual communities. This benefit of virtual communities gave individuals the ability to have immediate conversations. This behaviour mimicked the characteristics of a social or oral culture which could be understood by all. This method succeeded in breaking down many cultural barriers that had persisted in non-western IBM offices. Research (Snowden 2001; Snowden 2000a; Snowden 2000b) is still being carried out into the story-telling techniques, and integrating these methodologies into more mainstream parts of the organization. It is interesting to note the success of IBM was in getting communication and corporate messages flowing across to vast numbers of employees, as well as engaging everyone to participate in knowledge transference.

Birtles (1999) discusses a multinational law firm, Simmons and Simmons, and found that the approach to the cultural issues in regards to KM within the organization was a difficult one. Simmons and Simmons had approached the complex KM issue by implementing a KM IT (knowledge management information technology) enabled system. Their approach differed to that of IBM, in that Simmons and Simmons were much more technology based, and seemed to have less understanding of the preparation involved for a successful implementation. Birtles (1999) discusses how the organization found it difficult to make the implemented system distribute all that the entire organization expected or envisaged. Simmons and Simmons focused on the access and retrieval of information as opposed to any interactive distribution of tacit knowledge. The firm's focus on cultural issues was only in terms of differing languages and not communities or working groups. The firm focused on the development of an explicit web-based information system to resolve all their KM issues, including TK issues. Simmons and Simmons focused primarily on directives from senior management with very little input from other members of the firm.

In contrast, Sbarcea (2000) discusses how IBM created qualitative research techniques which they road-tested themselves, as this activity had a high value within their organization. These qualitative methods had evolved over time (since 1977) into a program called 'Knowledge and Differentiation Program' or K and DP.

According to Sbarcea (2000), IBM used techniques which had again been borrowed from anthropological studies and were based on observation derived from a series of workshops selected from various programs. Participants in initial programs were sought to take part, so

that they could offer their knowledge and opinions in order to create consistency within the framework of the organizational community development. In each session of the program, an observer documented the outcome of each working group or team. The story telling techniques facilitated documentation of what decisions were made or implied. Diagrams were then produced showing who was involved at each point of the process, as well as what knowledge was required to produce the decision and the source of the information. The process was then videoed to allow for review of where the observer could also be influencing the process. Sbarcea (2000) notes that IBM found this process valuable, as it showed the story-telling technique in action and the actual knowledge-creating points occurring (Sbarcea 2000; Snowden 2001). IBM also allowed for modification so that the process could undergo future development and be implemented into training programs.

Sbarcea (2000) describes how IBM carried out the same process but used standard interview techniques and questionnaires, with the result that more information was passed on and far less knowledge. The standard techniques did not reveal the type of tacit knowledge that would be useful to the organization.

Birtles (1998) discusses the large chemical company Buckman Laboratories International, which had experienced a great change with the formal recognition of KM. They assured their staff that they did not want to extract knowledge for a database, but to encourage people to build on what they already knew with others. As with the IBM experience (Sbarcea; 2000), Buckman had a strategy to integrate, and they also used qualitative methods of investigation before they attempted to integrate. Staff were invited to be a part of the internal, external, explicit and tacit strategy development, which would ultimately give the company a competitive edge. Birtles (1998) discusses how Buckman used the focused outcome of the competitive edge to help develop their strategy and aid in its implementation. The company believed that the information technology aspect was only a powerful enabler, and, like the IBM example (Sbarcea 2000), did not focus on it as a sole solution.

Birtles (1998) states that the Buckman organization primarily used themselves as a living case study, and gained insight into their issues and in-depth understanding of their KM issues. Through the evolution of their experiences, the Buckman organization came to understand that, in order for KM projects to succeed and be understood, KM activities (and knowledge transference) needed recognition in their own right. The organization believed that the cultural change required within an organization is one that encourages sharing of information

in contrast to past practices, where staff were only valuable for what they knew at the time. When this notion is replaced in a supportive KM environment with learning and creativity, the outcome is new knowledge, encouraged by research. Finally, by sharing the results, the organization can move forward as a whole. Birtles (1998) discusses how the Buckman organization gained insight when the right questions were put forward, triggering new knowledge-building between people and teams.

Birtles (1998) also reports how the Buckman organization, through experience, found it beneficial to use more simple IT that effectively transferred thoughts into explicit and understandable outcomes, rather than allowing some of the more sophisticated systems to create barriers. If unchecked, these barriers limited contribution by restricting participation. The company found it very beneficial for everyone to have access and not to restrict contribution. Through research and in-house trials, the Buckman organization found that document management, imaging, and workflow systems could be restrictive, forcing people to adopt the technology instead of the technology fitting the KM needs.

Birtles (1998) noted that the Buckman organization felt that internal cultural issues were being effectively tackled though the focus on messaging. However, the external cultural issues remain, due to global geographical distribution. According to Birtles (1998) Buckman needed to develop and integrate translating software so that they could extend the knowledge sharing.

Many organizations have struggled with the issue of moving tacit knowledge effectively. Sbarcea (2000) outlines various differences between organizations and their definitions of what is information access and retrieval, what is shared learning, and what cultural attitudes need to be in place to support KM. Sbarcea (2000) discusses the view that the culture of an organization seem to reflect the senior management. This view is reflected in Birtles' (1998) discussion of the Buckman organization's success towards a serious KM commitment and the evolution of the process. Sbarcea (2000) discusses the general issue of how organizations can help themselves by defining KM through a communal approach of online communities. Sbarcea (2000) believed that online business communities can offer to many other businesses what the IBM and Buckman organizations were doing in-house. The IBM and Buckman organizations could be seen as prototypes that have developed KM approaches through forming and recording experiences whilst keeping the technology simple, friendly and

attractive. The ease of access was considered very important by both IBM and Buckman (Sbarcea 2000; Birtles 1998).

Through the IBM and Buckman examples, KM may be seen as the process by which knowledge workers individually create, collect and develop TK to pass on to the organization, to be manifested into explicit knowledge and then applied.

Through the IBM and Buckman examples, Sbarcea (2000) and Birtles (1998) make it clear that by focusing on the strategy of KM and keeping the technology accessible, each employee was an important element in the process and outcome because they were capable of leading as required. The focus on KM strategies contributed to the cultural change required by the organizations, highlighting the idea of why it seems to begin with the individual.

“At Finland’s Nokia Telecommunications Group, about 70 percent of the employees are engineers, with an average age of thirty-two. A large percentage of these engineers are fresh out of university... We’ve redefined the nature of leadership. Everyone has leadership... Our model is that you are your own boss inside the Nokia world” (Goleman, 1998, p.192).

## **2.5 Significance of CoPs and tacit knowledge exchange**

The significance of CoPs is that they provide an environment for tacit knowledge sharing or TKE to occur, which is then exchanged through tacit knowledge networking (TKN) (Nousala and John 2004; Nousala et al. 2005; Seely Brown and Duguid 2000a). CoPs or working groups exist within organizations and have evolved from communities of interest (COIs) (Nousala et al. 2005; Nousala and John 2004). Previous literature cites examples and case studies which primarily focused on the CoP phenomena within larger organizations. Examples of extensive comparisons between different organizations were less common. Identifying examples of COI or CoP groups was difficult as they were not always expressed as COIs or CoPs, making it harder to identify them. Examples which reflected the initiation point of CoPs were difficult to identify. It was thought a “snap-shot” approach could provide assistance in developing the understanding of the CoP initiation point, as in the example of Seely Brown and Duguid (2000a, p. 76) give in regards to the experience of Hewlett-Packard CEO Lew Platt:

“It needs to take practice, practitioners, and the communities that practitioners form seriously. That requires two steps. First, managers need to learn what local knowledge exists. Then, if the knowledge looks valuable, they need to put it into wider circulation...”

Lew Platt’s comments may shed some light on how knowledge gaps form between what information may be processed in written form and how , and what happens in real practice (due to what people know, or what they do not know they know) providing perhaps provide a deeper understanding of CoPs in relation to the research question:

“... the sort of blind downsizing produced by business process reengineering has caused organizations to loose *collective memory* ...business journalist Thomas Stewart estimated the cost of AT&T’s last round as equivalent to an \$8 billion capital write-off” (Seely Brown and Duguid, 2000a, p.122).

It appears that CoPs also have the ability to put into action networks to overcome the difficulty of individuals not knowing what they know, and how this could be useful to others (Seely Brown and Duguid, 2000a). Explicit processes in report or manual form may seem self-contained; however, getting the work done often requires networks of individuals who may be unaware of what they know or how their knowledge could help others. It would seem that the environment is very important in developing and sustaining individuals within groups and the dynamics between process and practice, which “reflect the creative tension at the centre of innovative organization” (Seely Brown and Duguid, 2000a, p. 80).

Polanyi (1974, p. 8) describes an exchange or *two kinds of awareness* and discusses “the lack of specificity of skills”. He goes on to say his assessment of this theory is that there is “subsidiary awareness” and “focal awareness”, which are both “awareness’s” present when carrying out a practice “but in a different way”. The example he uses is a hammer driving a nail. He describes the situation as the practitioner being aware of both the nail and the hammer, however, the feelings and attention given to the hammer; are as intense but in a different way to that of the nail. As Polyani (1974) puts it, the hammer is perhaps not the focus of our attention but the “instrument of it”.

When knowledge exchange is viewed in a more macro fashion, it is often perceived in terms of speed and volume of information delivery and relevant knowledge being created by and for individuals and organizations. Other common issues highlighted seemed to be (perhaps not

specifically by the previously mentioned terms of speed, volume and relevance) described in terms of “organizational culture”. The discussion in the literature regarding culture primarily covered the areas of why and specifically what (speed, volume and relevance) were the issues and how the various organizations were dealing with it internally (Seely Brown and Duguid 2000a; Wenger and Snyder 2000).

## 2.6 A snapshot comparison of tacit and explicit activities of CoPs

Communities of practice typically take time to develop, and develop differently to that of, say, a team. A team, for example, is typically created for a specific purpose, in comparison to a community, which evolves and integrates over time. Communities of practice, formal work groups, teams, and informal networks can be useful in complementary ways.

Table 1 – Task Inter-relations

	<b>What is the purpose?</b>	<b>What holds it together?</b>	<b>Who belongs?</b>	<b>How long does it last?</b>
<b>Community of Practice</b>	To Develop members capabilities to build and exchange knowledge	Members who select themselves	Passion, Commitment and identification with the group’s expertise	So long as there is an interest in maintaining the group
<b>Formal work</b>	To deliver a product	Everyone who reports to the group’s manager	Job requirements & common goals	Until the next group reorganization
<b>Project Team</b>	To accomplish a specified task	Employees assigned by senior managers	The project’s milestones & goals	Until the project has been completed
<b>Informal Network</b>	To collect and pass on business information	Friends and business acquaintances	Mutual needs	As long as people have a reason to connect

(Wenger and Snyder 2000, p.141)

“As communities of practice generate knowledge, they renew themselves. They give you both the golden eggs and the goose that lays them” (Wenger and Snyder, 2000 p.143).

The ability to sustain knowledge throughout these communities is generated by the communities' strength to be "self-perpetuating", which is the essence of their longevity. Organizations need to learn the value and nature of these "sustainable environments of learning" to benefit from their short and (more importantly) long-term productivity (Wenger and Snyder, 2000 p.143).

An important aspect of CoP development is the identification of the core group or the potential communities in development (Nousala et al. 2005b, Snowden 2000a; Snowden 2001; Snowden 2002; Kenichi 1990; Frances 1997; Goldstein 1999). This concept of the potential core group could be described as communities of interest or COIs (Nousala et al. 2005b). Within organizations, core competencies involving key individuals exist and it is a matter of locating and identifying these groups and allowing for the type of environment which will help the COIs emerge as CoPs (Nousala et al. 2005b). To create true support for COIs and CoPs within organizations may require a regular collection of "systematic evidence" as described by Wenger and Snyder (2000 p. 145), which assists with the perception of the value of these communities.

Seely Brown and Duguid (2000a) also discuss the importance of perception through practice vs process, and in a similar manner to Wenger and Snyder's (2000) comparisons of a community to a team. The similarities are that CoPs tend to be from the bottom up, with an emphasis on "effectiveness", whereas the process of the team can be more top-down, with an emphasis on "efficiency" (Seely Brown and Duguid 2000a p. 74).

### **2.6.1 Cartographic approaches**

With regards to explicit cartographic databases, which, as skills or expertise locators and corporate personnel listings like the "Yellow Pages" are of value when addressing the location of experts within organizations. However, they can be difficult to update and maintain. These types of databases can also be difficult to initiate in practice because of privacy concerns and legislation and because some people are unwilling to act as reference points. These databases are often only based on standard metadata about the person and specific tasks which are static snapshots, for example the information that can be gleaned from resumes and CVs. (Ackerman and Halverson 2004; Becks et al. 2003). Such databases do not do a good job of highlighting expertise that might be relevant to the individual's

current position, or how to access the individual's valuable network of people with appropriate qualifications. In other words, such databases are literally "impersonal".

Earl (2001) and Blackman and Henderson (2005) classify "Yellow Pages" and expertise locators as "cartographic systems", in that they point to where knowledge may be held rather than serve up the knowledge themselves. Cartography implies the powerful image of drawing a graphical "knowledge map" to where the knowledge is held. However, in the literature even this term is used loosely for a variety of techniques, including matrices and concept maps (Cañas et al. 2004; Coffey et al. 2002; Dumestre 2004; Eppler 2001). However, these concept maps, as discussed and defined by Cañas, Coffey, Dumestre and Eppler, primarily focus on the logical development of ontologies rather than providing a practical means to locate expertise.

Cartographic approaches can help the organization to identify the knowledge it needs, both tacit and explicit; in other words, how people in the organization can find knowledge that exists in documents or people's heads that is crucial for the mobilization of new projects.

## **2.7 Understanding TKE layers of complexity for development of model representations**

Organizations are not linear; they are complex and dynamic (Tasaka 1999). Organizations constantly evolve and change via their individuals (in COIs or CoPs), who link or create intra-dependant relationships on multiple levels (Wenger and Snyder 2000). Sustainability requires compatible and renewable interconnectedness, from which outcomes emerge (creativity emerging from tensions between intent process and actual practice) and corporate memory is retained (Peroff 1999; Petersen 1999).

The essence of sustainability resides within a well-created contextual environment where there is the possibility for TKE to evolve, exchange and emerge via individuals in CoPs or working groups within the organization. Sustainability requires positive and negative constraints for sustainable cycles to be maintained. These cycles in turn support new, current and existing individuals to carry out constantly evolving activities. These dynamics can translate into organizational behaviour, which can be described as an organic, evolving phenomenon (Garvin 1998; Goldstein 1999; Goleman 1998).



At the core of any evolving CoP, working group or organization, these different levels of inter- or intra-dependence share ideas or common interests through a common shared space (either physical or virtual) and through a common language (Nousala 2003). This common language has the ability to strengthen all links between individuals and groups and the organization (organism) as a whole, with *Tacit – Explicit – Tacit, spiralling to the next level*, and exchange occurring as a constant (Nousala 2003).

The following concept is similar to the bottom-up approach expressed in the CoP literature:

The tacit → explicit → tacit ↑ (spiral upwards) to the next level (Nousala 2003; Nousala et al. 2005b).

The above concept is also reflected in Nonaka and Takeuchi's SECI Loop (1995, p. 62) tacit exchange model. Any models intended to represent tacit/explicit exchanges would need to take into consideration the following questions:

1. What are the knowledge sharing challenges dispersed groups face?
2. Within the relationships between group, community, company and environment, what are the key defining elements (if any)?

The intended models need to reflect questions that attempt to show the dynamics or tensions faced by individuals within an organization, as mentioned by Seely Brown and Duguid (2000a, p. 74):

“It suggests a dilemma that all managers grapple with: the organisational tension between process, the way matters are formally organised, and practice, the way things actually get done. Managers find this tension difficult to handle.”

Although managers are primarily responsible for resolving these tensions, the tensions are not a “one off”; they are forever recurring and thus part of the evolving phenomena of practice. The primary tension as Seely Brown and Duguid (2000a) put it, is process vs practice (see table 2, page 34).

Table 2 – Process vs Practice

<b>Process</b>	<b>Practice</b>
The way tasks are organized	The way tasks are done
Routine	Spontaneous
Orchestrated	Improvised
Assumes a predictable environment	Unpredictable environment
Relies on explicit knowledge	Driven by tacit knowledge
Linear	Weblike

(Seely Brown and Duguid 2000a, p. 74)

Seely Brown and Duguid discuss practice in a similar way to Nonaka and Takeuchi (1995, p. 80), where Nonaka and Takeuchi discuss redundancy as “Information that goes beyond immediate organisational requirements or organisational members...redundancy refers to intentional overlapping.”

Nonaka and Takeuchi go on to discuss the necessity of this action which allows individuals or a group to use this information (which may not happen immediately) but will lead to tacit knowledge creation: “Individuals can sense what others are trying to articulate... in this sense, redundancy of information speeds up the knowledge-creation process”.

This concept of individuals exchanging through their articulation is much like the improvised or spontaneous-web like practice described in the above process vs practice table.

However, if practice is not balanced with some well measured understanding of structured process, then the new ideas may never be put into practice. On the other hand, if the work structure is too restrictive, there is no space in which the new ideas can be voiced and discussed to facilitate exchanges (Seely Brown and Duguid 2000a; Seely Brown and Duguid 2000b). Tacit exchanges become even more crucial when the typical working environment is changing at a high rate. The only way to “keep up” is to exchange ideas and build knowledge bases through a fairly fluid or “live” situation, which CoPs can offer (Nousala 2003).

The management of the tension between process and practice happens on many levels, and unless a good understanding of this exists, it will be difficult to not only manage but also to

identify developing COIs in the workplace or to even know where to begin the COI identification process (Nousala 2003; Nonaka 2001). This beginning point or initiation point is what many may grapple with when looking at the knowledge creation and exchange process as a whole. Allee (1997, p. 43) states that an “imprint” or impression of the organization is necessary to gain an understanding of what it is really like. The point at which a snapshot understanding of the organization is gained may also be the point at which COIs can form and begin TKE (Nousala 2003).

To support the importance or validity of TKE as a sustainable environment or space for COIs and CoPs Marshall (1997, p. 177) argues:

“The unexamined application of Newtonian laws to complex adaptive social systems diminishes our capacity for continuous growth and change because it diminishes our capacity to *grow* or nurture the individual and collective intelligence, energy, spirit and hope of the whole system.”

Nonaka Takeuchi (2001 p. 51), also speaks of a “space” or “*Ba*”, an original concept first voiced by the Japanese philosopher Kitaro Nishida and then further developed by Shimizu, Nonaka and Takeuchi understands this *Ba* to mean a “shared context in motion, in which knowledge shared by those who interact with each other”.

Nonaka discusses the “*Ba*” concept as grounded in an existentialist framework. As such, the basis of knowledge in this framework is phenomenological. A common interest or idea that leads to a physical or virtual space is discussed by Nonaka (2001 p. 52):

“Phenomenal place for knowledge creation can emerge in physical (meeting rooms) virtual (e-mail) or mental spaces (common experiences, emotion or cognition) and he goes on to say that *Ba* exists at many levels, and that these levels can connect to form greater *Ba* that allow further participation of time and space in the knowledge-creating processes.” According to Wenger (1999, p. 280), “organizational theories are concerned with individual ways within the organisation and how the organisation is learning.”

In discussing the various levels mentioned by Nonaka (2001) and Wenger (1999), the issues for individuals are engaging in and contributing to CoPs. For communities, the issues are having the ability to learn ways of refining their practice and creating sustainability for future

members. For organizations the issues are it means learning to sustain the interconnectedness of communities.

Petersen (1999, p. 3), discusses in more detail these observations of knowledge flow within a perceived *knowledge community*. It seems that each community over time develops an identity: “It is as if we can be fluent in different knowledge communities, communities that overlap... we have different levels of knowledge of these communities.”

TKE involves individuals within CoPs and /or working groups learning through practice and changing processes through social frameworks, which trigger reflection and rethinking. These last actions are essential for sustainability and evolution. Tasaka (1999) also discusses these aspects of TKE and defines it further by saying that there are in essence various types or levels of knowing that result in shifts.

Wenger (1999, p. 9) discusses the importance of initial frameworks, triggers and reflections:

“Indeed, the more we concern ourselves with any kind of design, the more profound are the effects of our discourses on the topic we want to address. The farther you aim, the more an initial error matters.”

However, perception of data/information/knowledge seems to be influenced by the activities of gathering, storing, accessing, retrieving, and ultimately developing a practice for management. Seely Brown and Duguid (2000b, p. 74) state, “History will pity the manager of the 1990s.”

The internet has been sighted as one aspect of the new economy which influences data/information/knowledge activities, and has added to the difficulties of managing the layers of complexity of organizations. As discussed by Seely Brown and Duguid (2000b), these phenomena seemingly contribute to the difficulty that management have typically had to grapple with in the past when dealing with complex organizations. Seely Brown and Duguid (2000b) discuss the differing approaches reengineering and KM take towards layers of exchange within complex organizations. The reengineering approach uses a structured coordination from the top down and assumes that it is easy to codify all information. This is in contrast to the KM approach, which is more of a bottom up method. The issue of viewing organizational complexity was touched on by Warner (1996, p. 2136) and described in this

way, “One might draw an analogy with life organisms and distinguish various stages of an organization’s development as captured in an organisational biography of its life.”

The basic elements of this view may not be dissimilar to that of Wilson (1998, p. 310), “The problem of collective meaning and purpose is both urgent and immediate because, if for no other reason, it determines the environmental ethic”. Wilson may not have specifically been thinking of TKE specifically, however, there were similarities with both Warner and Wilson with regards to TKE environments. At the very least, the complexity of layers of the collective need understanding and consideration through the creation of supportive environments through ethics and biography or external constraints determined by ethics (or social rules or biological of life organisms or organizations) through historic considerations. These are important considerations regarding the complex layers of TKE of CoPs and working groups.

Nonaka and Takeuchi (1995, p. 49) discussed differing styles and theories, and found that many major economic management and organizational theories they had reviewed, to be paradoxical, in so far as the theories focused more on the theory of knowledge or, more specifically, the epistemology of “Western tradition”, but rarely touched on knowledge itself.

Nonaka and Takeuchi (1995) discussed the “Cartesian split” between the subject and object or the knower and the known, which gave rise to the development and sympathy of “information processing” for organizations, which then extracted information from the external environment and adapted the information for internal circumstances. The same information processing or the rigidity of the Cartesian split approach would not adequately explain tacit processes such as innovation or *tacit contextual access* (Nonaka and Takeuchi 1995; Nousala 2003)

Snowden (2002) argues that the external or outer “container” of knowledge is the same as Nonaka and Takeuchi’s (1995) external environment; in both examples, this is where more explicit knowledge exchanged occurs. Snowden stresses the practice of practical tacit awareness/identification where tacit knowledge resides before being “accessed”, highlighting the importance of tacit context and content.

Tacit context seems to be a distinctive process within the realm of the tacit and differs from tacit explicit exchange, which Nonaka and Takeuchi (1995) speak about. The tacit context

and content state appears to exist prior to that of the tacit explicit exchange and is almost immediately lost at the point of tacit “access”. However, it is no less important for its short existence. It may help explain the difficulty in pinpointing what makes an effective tacit exchange better, or even the development of an ontology of TKE between individuals, groups or organizations (Nousala 2003). The basic elements of TKE need to be understood, such as communication approaches and the time required for tacit exchanges to be made. The elements that Nonaka and Takeuchi (1995) touched on but Snowden (2002) and Nousala (2003) further summarized are as follows:

- a) Physical external environment supportive of tacit exchange (for people) vs, explicit external environment of information.
- b) Tacit context and content and its relationship with an ontology.
- c) The relationship with tacit context and content and transition or exchange within any of the relevant spiral type tacit knowledge exchange (TKE) models.
- d) The positioning of tacit context and content in relation to tacit and explicit models.

Kenichi (1990) discusses the basic assumption of the recursiveness of environmental influences or impact on CoPs and working groups within organizations. Environmental influences over a period of time supported the creation of practice and procedures for TKE. There is a considerable amount of evidence that time itself implies change. “Time is a proxy for maturation, growth and learning” (Kenichi 1990, p. 3935).

Wenger (1999, p.13) discusses the layers of complexity of TKE through the evolution or emergence required for future sustainability and for retaining what has been learnt so that it can be reinterpreted again and again, through social practices.

Regarding the complexity of TKE, Josefson (1999, p.14) states, “It maintains the vehicle for the evolution of practices and inclusion of newcomers, through the same practices allows for the transformation of identities”. Josefson discusses this action as “naturalistic decision making” and further states that “imperial research it has been shown that situated and contextual learning is important for developing expertise, and insight”.

Nousala (2003) discusses contextual learning in this way: “Practice and Identity” = Social and historical = continuity and discontinuity, and/or, practice and process leads to identification. In this context Nousala (2003) refers to “learning” as an evolutionary practice that requires the support of the TKE environment for sustainability. What is this

TKE environment, how is it created and sustained, or is it created and implemented? Or, is it by-passed altogether by the previously mentioned transformations of identities? If this is so, then what has occurs during these transformations? And what impact do these transformations have on tacit knowledge or networking? These questions may lead to greater understanding of TKE between groups, the complexity of the levels, and the development of possible representative models.

Goldstein (1999, p. 50) discusses emergence as the possibility of viewing the layers of dynamic systems whilst also allowing for “across-system organization rather than on the parts or properties of parts alone”. Emergence is a way to describe or investigate the macro level and its unique dynamics, and properties, in order to explain more adequately what is going on. It is a foundation on which to build an explanation (Goldstein 1999, p. 58). Therefore, as stated by Goldstein, “Complexity theory is developing the necessary tools, methods, and constructs that render the process of emergence less opaque”. Complexity theory offers more scope in terms of non-linearity within dynamic evolving systems, such as CoPs. This is an important component to consider, as the level of investigation into tacit aspects of the research may not be adequately understood by positivism alone.

Since CoPs, working groups, organizations and networks involve complex layers and emergent outcomes (Goldstein 1999, p. 66), complexity theory could offer better understanding of modelling and analysis. As Goldstein states, “Emergent networks can include both intra- and inter group dynamics and also pertain to spontaneously arising organizational structures and practices that accompany mergers and acquisitions and the newly shaped strategic alliances that are so rife in our contemporary business world.”

## **2.8 The observational treatment of tacit knowledge in knowledge management**

Tacit knowledge is not readily definable, in the sense that it is not physical, and it is often defined as concepts or ideas. In this state, TK is difficult or sometimes near impossible to codify as it often remains fluid until ready to be verbalized and made real to another individual or group. This involves a move from the tacit to a more explicit form of expression of the individual’s original experience or idea, which, in turn, allows the individual to engage with their immediate environment. Environment is a strong element as it allows for the emergence of the knowledge transfer to take place. If an individual is in isolation, then this

transferring of tacit to explicit may not have a tacit context from which the exchange can take place.

The tacit, more often than not, begins with an individual, who then communicates with others to create and exchange. TKE is an elemental component of communication. An individual's desire to communicate their complex and diverse concepts occurs when the individual expresses what is observed by others, either individually or in a group, depending on the immediate environment.

This complexity of expression can be seen as differing tensions which are not always efficiently or successfully transferred, or simply may not be possible to carry out, as there is no supportive environment to create a cycle of exchange. On the other-hand, CoPs (Wenger and Snyder 2000) may create an environment where knowledge creating and sharing within and without the organizational context may continuously occur. These continuous cycles of TKE create TKN, where various differing levels of understanding continuously occur and can be continuously explored.

This creates a tacit content within a tacit context (Wenger and Snyder 2000; Nousala 2003). Once explicit, the tacit knowledge is expressed, and can then be codified and distributed for wider comment. However, the nature of the codified is then no longer tacit, and the true understanding of the tacit exchange is perhaps best viewed from what occurs in the action or practice of the exchanges themselves and examining these phenomena.

Internal and external tacit knowledge exchange and sustainable learning are possible through communities of practice, and this occurs in several ways. Communities of practice are what the name implies; that is, communities which are practising *something*, and being a community or group, and they are doing this action or practice together in an interactive manner (Wenger and Snyder 2000; Nousala 2003). Communities can vary in size, but there always seems to be a binding influence for this group of people. Typically, there is a core of individuals who share an understanding or passion which energizes them and creates a bond among them. This sharing can in turn provide not only an intellectual or practical benefit but also social support (Nousala et al. 2000a; Nousala et al. 2000b).

As described by Choo (1998), tacit knowledge is “regularly” transferred by “imitation”. This may be a significant element to consider when discussing or describing activities and/or



behaviours of communities of practice. Choo gives many examples of supportive environments promoting such imitations: apprenticeships, internships, or on-the-job training schemes. The complex and diverse variety of communication required to demonstrate an individual's tacit concept or concepts is often observed by others and shown or demonstrated by the original individual.

Organizations are non-static complex systems which have evolved over time. This sentiment is shared by two economists, Nelson and Winter (1982) who argue that they prefer approaching organizational function with a more "appreciative version" as opposed to the "formal orthodoxy, displayed in logically structured theorizing...". They say that they use the term "evolutionary theory" as it signifies a borrowing of basic ideas from biology, which is centric to their scheme "the idea of economic *natural selection*" (Nelson and Winter 1982, p. 8). Nelson and Winter say the concept of "evolution by natural selection is a view of *organizational genetics* – the processes by which traits of organizations, including those traits underlying the ability are transmitted through time" Nelson and Winter (1982, p. 10). Nelson and Winter are concerned with evolution as focused on the longer term processes which can be "observed in present reality" and are understood as "dynamic processes" produced from known past conditions, allowing for future aspects to emerge from the same dynamic processes.

Popper (1994) regarded the products of the human mind as real, as well as the theory itself since it was possible to interact with it. Popper discusses an ontological domain consisting of *three worlds*:

- a. World 1: Universal laws physically;
- b. World 2: Disposition, the things that have history and the emergence of complex systems and their levels, the way they are constructed and constitute forms of knowledge that successfully survives; and
- c. World 3: The codification of that which emerges from world 2.

Popper (1994, p. 47) himself describes it as the following:

World 3: products of the human mind (theories);

World 2: mental (conscious) experiences;

World 1: physical objects, including organisms.

The fragility or wellbeing of the long term viability of an organization or its sustainability within competitive environments, has been highlighted by Nelson and Winter's (1982, p.10) description of the inadequacy of the "theoretical foundation that orthodox micro-economics provides for macro-economics". Nelson and Winter further discuss the general expression of the current theory, which is unable to adequately deal with uncertainty of large corporations and their organizational complexity.

### **2.8.1 How can sustainability be achieved with limited resources**

Since CoPs are in themselves significant aspects of organizational structures, they are the focus of this research in order to understanding the sustainability of organizational structures. Wenger and Snyder (2000, p.140) discuss this "organizational form", as well as "the hallmarks of communities of practice" are. They argue that CoPs were common (in the past), forming with little more than a commonality of purpose.

During ancient times, for instance in classical Greece, there were "corporations" of metalworkers, potters and stonemasons serving the dual purpose of social and commercial activities; members from the same group would holiday and worship together (Wenger and Snyder 2000). The Middle Ages also had its guilds, which were places for the budding apprentice to practise. This reflects Choo's (1998) comments regarding the supportive environment of imitation.

TKE within a supportive environment has been described in various ways. A supportive environment will be conducive to sustainability, as discussed by Chait (2000), with the common thread of the "conducive environment" needed in order to pass on practised knowledge. Chait discusses how internal tacit exchange can be specifically described as stages. This is a more prescriptive approach in comparison to Choo's (1998) "*supportive environment of imitation*" or Wenger and Snyder's (2000) *organizational form*, with the *dual purpose of both social and commercial*. Chait (2000), Choo (1998) and Wenger and Snyder (2000) all describe stages or multiple levels which occur within an environment conducive to sustainable practice.

An evolving entity can, in its own right, achieve its goals through refining its processes the practices. As supportive environment gives an entity and its individuals or elements necessary constraints for exchanges to occur at different stages, multiple levels knowledge or knowledge linking levels Nousala (2003). Observation of the various levels and their orders

is more clearly explained through the concepts and principles of hierarchy theory (Allen and Starr 1982; Pattee 1973). Being a part of the general systems theory, hierarchy theory has emerged as part of complexity science. The founding work began with the economist Herbert Simon (1962). Hierarchy theory emphasizes the importance of the observer within the system. The concepts of hierarchical organizational and observational levels may clarify the structures of multiple knowledge levels or knowledge linking levels.

Regarding the implementation of tacit knowledge and the mobilization of know-how CoPs were selected as entities from which to begin the investigation for a *starting* or *initiation point* of tacit knowledge exchange (Nousala 2003; Nousala et al. 2005b). The investigation of tacit knowledge networks through selected instances or phenomena began with the CoPs and their initiating points. With regards to developing the understanding of the CoP initiation point, as in the example of Seely Brown and Duguid (2000a, p. 76) it was thought a “snapshot” approach provided clarification with regards to the experience of Hewlett-Packard. According to CEO Lew Platt:

“It needs to take practice, practitioners, and the communities that practitioners form seriously. That requires two steps. First, managers need to learn what local knowledge exists. Then, if the knowledge looks valuable, they need to put it into wider circulation.”

It appears that CoPs also have the ability to initiate networks, thus overcoming the difficulty where individuals are unaware of what they know and how their knowledge could be useful to others. Explicit processes in report or manual form may seem self-contained; however, to complete the work often requires networks of individuals who may all be unaware of what they know or the usefulness of their knowledge. It seems that the environment is critically important in developing and sustaining individuals within groups and in the dynamics between process and practice, which “reflect the creative tension at the centre of an innovative organization” (Seely Brown and Duguid, 2000a, p. 80).

Emergence offered the possibility of viewing the case studies as dynamic systems, whilst allowing for “across-system organization rather than on the parts or properties of parts alone” (Goldstein 1999, p. 50). Emergence may be a way to describe or investigate the macro level and its unique dynamics and properties, in order to explain more adequately what is going on as a whole. It is a foundation on which to build an explanation (Goldstein 1999, p. 58). Therefore, as stated by Goldstein, “Complexity theory is developing the necessary tools,

methods, and constructs that render the process of emergence less opaque”. Complexity theory offers more scope in terms of non-linearity within dynamics evolving systems, such as CoPs.

Organizations not only have networks, but also emergent networks (Goldstein 1999), and this is why complexity theory may offer investigation of networks a means of analysis. As Goldstein states:

“Emergent networks can include both intra- and inter group dynamics and also pertain to spontaneously arising organizational structures and practices that accompany mergers and acquisitions and the newly shaped strategic alliances that are so rife in our contemporary business world” (Goldstein 1999, p. 66).

## **2.9 Theoretical framework for implementation**

Practical research required for implementation purposes is theoretically grounded in two frameworks: (1) Popper’s epistemology as expressed in *Objective Knowledge* (1972) and his later works, as substantially elaborated and closely compared to other epistemologies in Niiniluoto's *Critical Scientific Realism* (1999); and (2) the theory of organizational autopoiesis, which claims many economic organizations are dynamic, evolving, hierarchically complex adaptive (i.e., biological) entities in their own right (von Krogh and Roos 1995; Magalhaes 1996, 1999; Hall 2005; Hall et al. 2005).

The Popperian worldview is based on an ontology of three “worlds” or domains. World 1 (W1) is external reality. World 2 (W2) is the domain of cognition and embodied or “dispositional” knowledge. Polanyi's personal and tacit knowledge (Polanyi 1958, 1966) are encompassed within W 2. (Hall 2005). World 3 (W3) is where explicit or “objective” knowledge such as the logical contents of books and computer memories or other products of human behaviour is found (Popper 1972, p. 115). Critical scientific realists accept the existence and importance of all three worlds, and argue that claims constructed in World 2 to know the truth of the “real” World 1 can be expressed in World 3 as theories that can be evaluated and improved through cycles of action; i.e., testing claims, observing results of the action, and criticizing the observations against the claims (Niiniluoto 1999).

The biological theory of organization (Hall 2005) is founded on the concept of autopoiesis (Maturana and Varela 1980, 1987). It is applied to social/economic organizations by von Krogh and Roos (1995) and (Magalhaes 1996, 1999). Hall's construction derives in part from Nelson and Winter's (1982, 2002) concept that organizations have "hereditary" knowledge in their own right, comprising competence, learning and routines. Autopoietic (or "biological") organizations have emergent properties above and beyond any summation of the properties and capabilities of the individual people belonging to the organization from time to time. However, to survive in competitive environments, such organizational entities must assemble, deploy, preserve and replicate knowledge in order to respond competitively and successfully to environmental demands. Knowledge in the organizational context is any kind of information that has survival value (Nousala et al. 2005b).

## **2.10 Identifying and mobilizing personal knowledge**

A very significant fraction of the knowledge available to an organization (i.e., the organizational memory) is held by its individual members (Lehner and Maier 2000). Organizational memory is more than the sum of the knowledge of the organization's individual members, but individuals with their personal knowledge count. People currently belonging to an organization also have lives and career histories beyond the bounds of organizations they may belong to (Arthur 1994; Arthur & Rousseau 1996), and in general will have a lot of knowledge the organization (as an entity) does not know about, which could be valuable if means existed to identify it to the organization.

As discussed by Hall (2005), Hall et al. (2005) and Nousala et al. (2005) strategic principles articulated by John Boyd (1976-1996), a respected military strategist who worked in rationalist evolutionary epistemology, are directly applicable to all kinds of competing organizations. Through iterated cycles of observation, orientation, decision and action (known as OODA cycles), coupled with comparison of results of observed actions with memories of earlier iterations, the modelling and the understanding of external reality approaches the "truth" of that external reality (Hall 2005; Hall et al. 2005). From an organizational point of view, this may be said to be an organizational learning process to improve organizational adaptation. Organizations able to iterate an OODA cycle faster and more effectively than their competitors will be able to observe and change the environment to their strategic benefit before competitors can fully orient to and act on changes.

To improve its OODA performance, an organization needs a way for people who need particular knowledge to deal with an emerging issue by readily identifying and finding those who may have the kind and quality of knowledge sought and the impediments to locating and mobilizing personal knowledge. A key question for an organization seeking to improve people performance may be how an organization makes personal knowledge more accessible as a whole.

### **2.11 An epistemological approach towards tacit knowledge management**

With a view to understanding the implementation of TK and a possible structure or system which supports it, examination into what is meant by implementation and what is meant by knowledge and knowledge structure needed to be explored. The importance of understanding TK implementation is reflected in Wenger and Snyder's (2000, p.178) statement, "Tacit movement being done by the process, in the form of organizational coordination."

Tacit knowledge management (TKM) is described as knowledge sharing through formal and informal networks, and has been described as being instrumental in the management and implementation of tacit knowledge within and without distributed operations. For example, in the aircraft manufacturing industry, when parts are made for assembly to form part of the landing gear, the parts are designed with certain assembly sequences, dynamic and kinematic considerations (Nousala and John 2004). These considerations constitute TK. With regards to tacit exchange and its implementation, the unit of study is therefore the individual and the organization and its organizational operational process.

CoPs provide the common experience or a common environment (physical or otherwise) where creating a "common base" equals the "tacit environment". As Choo (1998, p. 248) states:

"If I act on the basis of my understanding of that common experience, and you act on your different understanding of that same experience, we remain tied together by the common origin of those understandings. If each of us is quizzed separately as to why we did what we did, our answers flow from the same experience." The commonality of the same experience or the starting point of exchange is also discussed by Weick, "That commonality is what binds us together and makes it possible for each of us to understand the sense that the other has made" (Weick 1995, p. 189).

Polanyi (1966, p. 8) speaks of actively shaping experience in the pursuit of knowledge and it is this shaping that he “holds to be the great and indispensable tacit power by which all knowledge is discovered and, on discovered, is held to be true”. Polanyi discusses tacit knowing by using the results of documented experiments by Eriksen and Kuethe in 1958, in which they exposed a person to a shock whenever he happened to utter associations to certain “shock words”, which showed that:

“One can know more than one can tell...he learned to suppress the uttering of certain associations...the subject could not identify them, yet he relied on his awareness of them for anticipating the electric shock...we see the basic structure of tacit knowing” Polanyi (1966, p.11). Polanyi carried forward the idea that there are always two types, kinds or things that constitute a basic structure of tacit knowing. There is, he argues, “The logical relation between the first and second term of a tacit knowledge. It combines two kinds of knowing.” Nonaka and Takeuchi (1995) also speak of two kinds of knowing and go on to develop the spiral of explicit and tacit exchanges and showing this through four modes of their models of organizational knowledge creation.

Any initial model development needed to show exchanges occurring around tacit exchange and how it would impact the implementation practice through the process. The commonality in a supportive space allowed for the development of sustainable tacit knowledge, creating a possible starting point for the physical implementation of an organisation. According to Choo (1998, p. 248), “The construction of shared meaning in organisational life makes use of myths, symbols, rituals, and stories, which comprise the ‘instruments of meaning’ by which people understand the history of their actions and their place in it.” CoPs are a means by which clarity and sense making can emerge through shared meanings and provide a forum for consensus through diversity (Choo 1998).

### **2.11.1 Is this also part of the origins of Tacit Protocol?**

If tacit protocols’ origins exist as elements, what models for tacit interaction can be developed to express interaction in a way that it can become visible? Bertels and Savage (1998, p. 10) pose the question “What models can support expression of aspirations so that they become visible and valued ‘idea assets’?” They go on to discuss the value and importance of recognizing each other’s work and initiating real dialogue with the view to making it explicit.

They pose another question: “What models and tools will support boundaryless behaviour? We must match our uniqueness to others’ unique abilities”.

Bertels and Savage (1998, p.16) provided examples of the existence of unique abilities or new elements of TKE. Nonaka and Takeuchi (1995) discuss tacit and explicit knowledge and how the individual may make this available to the organization. However, Bertels and Savage suspect that knowledge may exist in several layers throughout the organization, and suggest that multiple levels of knowledge interact in various way in order to create knowledge processes. Bertels and Savage (1998 p. 20), also suggest that there may be “A relationship between the level or depth of knowledge and its impact on the organisation over time”. This may assist with the understanding and exploration of what these different levels may be and what impact or importance they may have with implementation of TK. Bertels and Savage (1998, p. 20) sense “that there is something that makes a difference, but we lack the language to address that difference”, and cite the need for interrelated topics to be investigated through action research learning with an implementation approach.

Verzin, von Krogh and Roos, (1998, p. 32) discuss how “distinct scientific methods” are needed to approach the phenomena of complexity. This phenomenon encompasses organized complexity, to which tacit knowledge networking is integral. Verzin, von Krogh and Roos (1998) suggest characterizing the structure not just by the properties of the individual elements (with various frequencies of interactions) but also by the way they are connected.

Focusing not just on patterns but also the phenomena as a whole would allow for greater understanding inside and outside the organization. However, Verzin, von Krogh and Roos (1998) concede that, because the knowledge formation process is lengthy and seems only partially transferable, new tools are needed to see and understand emergent occurring patterns.

## **2.12 Tacit knowledge networking: the new theoretical perspective**

Since the research question is about the implementation of tacit knowledge networks, the research needed to define the foundation on which both practice and process would be understood and applied. As such, the theoretical knowledge issues and building of the theory would influence any application of transferring knowledge through tacit knowledge



networking and implementation thereof. It was also important to attempt to understand the nature of knowledge in relation to the knowledge process.

Verzin, von Krogh and Roos (1998, p. 35) describe the relationship between knowledge nature and process:

“Knowledge is constituted by the ways in which people categorize, code, process and impute meaning to their experiences...Knowledge emerges out of a complex process involving social, situational, cultural and institutional factors. The process takes place on the basis of existing conceptual frameworks and procedures and is affected by various social contingencies, such as skills, orientations, experiences, interests, resources and patterns of social interaction characteristic of a particular group or interacting set of individuals, as well as those of the wider audience”.

Within the epistemological map, viewed through autopoietic epistemology thereby stressing the interpretation of knowledge derived from relevant information rather than the power of massed information (Verzin, von Krogh and Roos 1998). Verzin, von Krogh and Roos, (1998, p. 36) suggest that it also helps to understand “the process of knowledge development” so as to gain a better grasp of the nature of knowledge. The process of knowledge development is linked to the nature of knowledge, which in turn can be examined through the location of that knowledge. The process of how the knowledge is developed through physical experiences emphasizes the tacit aspect as only part of the process, and that there are other processes involved, requiring an ontological structure or entity to exist (Verzin, von Krogh and Roos 1998, p. 50). The existence of such an entity would mean that tacit processes are somehow linked with other processes that show ontological structures.

Whilst the current literature of tacit knowledge has its epistemological roots predominantly stemming from Polanyi's (1958) tacit knowledge concepts, this thesis ultimately uses Popper (1972, 1994) as a basis from which to begin theory building to support its models for tacit interaction.

The concepts of tacit knowledge found within existing literature, starting with Polanyi have been discussed, explored and developed. They are valuable with regards to the relationship of the inner world and practice, or “interiorization” as Polyani (1966, p.17) describes it. Polanyi puts forward an example of interiorization is where the tacit (perhaps some theory) is brought

into the light and made aware of, in the same way as a mathematical theory is learnt by practice, “Its true knowledge lies in our ability to use it” (1996, p. 17). For Polanyi, the structure of Gestalt as the logic of tacit thought and how this is put into practice, changes the perspective of the whole subject for him.

Polanyi (1966, p. 33) makes the assumption that there is a “correspondence between the structure of comprehension and the structure of the entity which is its object”. That is to say, tacit structures bear correlations to “real comprehensive entities”. He describes how comprehensive entities are real things, just as the objects within, adding to the content of his ontology. The subsequent development of an ontology of the tacit or the interiorization that Polanyi describes does not provide a sufficiently clear enough way forward, or rather beyond, for the building of or subsequent inclusion of new elements to represent tacit interaction within and around the networking of tacit exchanges. These are required to explain implementation of such networks and any new found elements.

However, Popper (1994) provides a better ontological base for interaction and for what is important or central to the concepts. The ontological base allows for a positioning of scientific contributions to be made supported by an epistemology, “Popper’s perception of knowledge is far more general than that of Polanyi as he distinguishes three ontological worlds as he describes them” (Hall et al. 2005; Hall 2003b; 2003a, in press).

Popper’s ontology of worlds 1, 2 and 3 provides a base from which an epistemological positioning can be developed for practitioners dealing with relationships of practice and process (which bear correlations to nature and process). Popper states that it is not possible to understand W 2 without understanding the main function of this world, which is to “*produce*” W 3 objects which can then be “*acted upon*” Popper (1994, p. 7). The importance of W 2 is that it acts not only with W 1 (as Popper suggests Descartes thought) but also with W 3 and its objects, which in turn, can only act on W 1 through W 2 (Popper 1994, p. 7). Therefore W 2 behaves as a sphere for interaction or as an intermediary: “It is only through our intermediary action that world 1 act upon world 3” Popper (1994, p. 7). The explanations for world 1, 2 and 3 are best approached in the same way Popper approaches them, starting with W 3. W 3 consists of “*objective knowledge*” which is to say, anything that constitutes records, theories or hypotheses, which have been stored in books, journals, lectures or computer memory and which are “products of human behaviour”, (Hall et al. 2005; Popper 1994, p.10; 1972, p. 115). W 1 can only act upon W 3 through the intermediary action of W

2, (Popper 1994, p. 7) and is in itself “not a form of knowledge – it is simply that which exists” (Hall et al. 2005).

Whilst Polanyi had a similar approach to world 2 through subjective knowledge which he named “*personal knowledge*” Dalmaris et al (in press), Popper’s interactive relationships between the 3 worlds (in particular, the interactive role of W 2 between W1 and W 3 allowed for the positioning of new-found elements that were developed through the case studies of this thesis.

Popper, as a self-confessed pluralist, suggests that to accept his W 2, is to introduce an unnecessary layer of complications, and that it would be much easier to just accept only physical things or states (Popper 1994). It is important to understand that the W 2 knowledge interactive relationship is important for another reason. W 2 knowledge evolves as an entity in that it “attempts to represent reality in ways that are adaptive to the entity” Hall (et al. 2005). This behavioural concept is important with regards to the development, interaction and implementation of tacit knowledge networks. It is perhaps why tacit knowledge networks seem to “mirror” objective knowledge structures as they evolve.

### **2.13 Summary of literature review**

This literature review was compiled with two aspects in mind. The first was to initially focus on tacit knowledge with regards to tacit knowledge sharing, exchange, networks and CoPs from within the general knowledge management sphere. This was done to narrow the field, as KM literature is very broad and general. The second aspect of the literature review focused on material which assisted with the understanding and development of epistemological and ontological views of TK, CoP, TKE and TKN.

Focusing on TKE, CoP and TKN highlighted the immediate issues regarding the research question and what within the literature required further attention. The order of the topics listed in this chapter records the progress of citing the descriptive and observational process of TKE, CoP and TKN within the social science literature. The process began by highlighting the observations and descriptions of TKE within the KM spectrum, then focusing on tacit knowledge sharing, supported by organizational examples of TKE, knowledge sharing and CoPs. A deeper emphasis on the significance CoPs was highlighted through observing and

describing the relationships of CoPs and TKE, the comparisons between tacit and explicit activities of CoPs, and understanding TKE layers.

The importance of Polyani fitting into the Popper W 2 through subjective knowledge is that it sets up the later work carried out by Hall (et al. 2005) and Nousala (et al. 2005b) who investigate the important of understanding W 2 knowledge as an evolving interactive relationship. This evolving interactive relationship is important with regards to the development, interaction and implementation of tacit knowledge networks and their “mirroring” of objective knowledge structures.

The later part of the literature review focused on the theoretical perspective and epistemological understanding which was critical for the development of the methodology, models and implementation of TKN.

## **Chapter 3 - Methodology**

### **3 Methodology**

#### **3.1 Methodology in relation to the theoretical framework**

The theoretical framework provides the epistemological and ontological basis for constructing an appropriate knowledge management strategy to address organizational needs. This framework made it easier to understand barriers to knowledge sharing within the highly structured project engineering environments (Nousala et al. 2005b). The development of a comprehensive epistemology and ontology helped to define knowledge-related processes in the organization, and to determine what is required to create and sustain horizontal networks for exchanging knowledge within such a hierarchical organization (Nousala et al. 2005b).

#### **3.2 Organizational sustainability in competitive environments**

Organizational sustainability relies on the ability for the organizational complex systems to allow for dynamics that can identify tacit knowledge by tracking from CoP initiating points through the tacit knowledge networks to implementation of the whole process.

##### **3.2.1 Knowledge – as emergent responsive solutions**

This research focuses on organizational dynamics as evolving complex systems with interactive tacit knowledge networks. The work combines concepts from knowledge management, social sciences, engineering and biological processes, supported by an epistemology that provides a framework for examining emergent behavioural interactions. The case study instances within the research examined the emergent interactions of each case study instance. These case study instances also focused on the networked exchanges between entities as human organizations. The specific case study designs used background questions that would assist with the understanding of the “CoP initiation point” (Nousala and John 2004; Nousala et al. 2005b). An epistemology was established to be used to support the case studies instances. This epistemology stems from a more generic approach, encompassing interactive behaviours of complex living systems. This epistemology and the subsequent methodological ontology were both developed to provide a basis from which to identify and

examine any emergent properties or components from the human organizational entities and relate them to other complex living systems.

Studying the case study instances included identifying important aspect or components which, in their interactions, formed part of tacit knowledge networks. These networks had integral, interactive components which contributed to organizational sustainability. If an understanding of what characterizes the interactive components of a tacit network is important, it is equally important to understand how these behavioural interactions of organizations emerged as phenomena.

There was a focus on identifying the interactive components of the TKN of the case study instances and making a comparison with generic autopoietic biological frameworks. The biological generic concept *autopoiesis* (= “self production” /self-organizing) was a term coined by biologists Humberto Maturana and Francisco Varela in the 1970s in the work by Maturana and Varela (1980). This was an attempt to explain the stability of living systems which maintain their integrity while their component parts continually change. This research uses the concept of autopoiesis to help provide the epistemological framework needed to explain the emergent behavioural interactions of complex organizations, and as a means of learning how successful entities can create and maintain sustainability.

The key behavioural interaction of the organizational entities under investigation is the *community of practice* (CoP). CoP offer an intersection of commonality, where unifying cause or action hold the interactions of individuals together. The CoP concept has been identified within the current knowledge management literature as a fundamental aspect of complex human organizational system behaviour. As such, by borrowing and adapting from Maturana and Varela (1980); the CoP has similar or sufficient properties to be deemed as an autopoietic entity in its own right. The CoP in this research was viewed as an elemental autopoietic component that becomes an integral part of the interactive organizational entity. In other words, CoPs were seen as building blocks of complex organizational systems.

The CoPs in this study were identified and expressed through a biological epistemological view of knowledge. This biological concept has similar aspects to those expressed by the philosopher Karl Popper, who, whilst not a biologist, used, observed and described similar properties, thus providing a new ontological domain for new emergent components and properties within an autopoietic epistemological framework.

This research focuses on the intrinsic aspect of CoPs where TKE takes place within organizations. This is the reason that the relevance of CoPs and their tacit interactions regarding knowledge networking have emerged as reference points in understanding organizational sustainability, its identification and its strengthening.

### ***3.2.1.1 Why are CoPs and TKEs so fragile?***

The development of communities requires time, continuity of cause, support and permission. Individuals need support within the community as well as the community itself. The focal points of interest and knowledge-linking levels need support to remain intact. This multi-layered entity will continue to integrate as long as the opportunity for the appropriate constraints continue to occur, supporting continual integration. For example, if the opportunity for feedback or peer review is not possible due to unsupportive constraints, then the evolving entity can no longer continue to integrate and therefore *disintegrates* (Nousala et al. 2005b).

### ***3.2.1.2 How are capabilities applied to achieve goals?***

For capabilities to support desired goals, complex organizational structures need the appropriate environmental constraints. These constraints encourage the emergent behavioural interactions of complex organizations, and provide a means for individual CoP entities on all levels to learn through tacit knowledge exchange. This is how successful entities can create and maintain the sustainability of their organizational complex system. Tacit knowledge exchange requires an awareness of the below the surface understanding of the particular expertise or competence of the subject in question which is being shared or transferred.

## **3.3 Emergent questions and issues for the development of case study instances**

Generally, the main body of KM literature discusses knowledge exchanges (Nonaka and Takeuchi 1995; Polyani 1958) in terms of tacit and explicit knowledge. This dual approach does not offer an adequate framework to explain the emergence of knowledge or what is required to implement, support and sustain it in a complex hierarchical system like a complex engineering organization (Nousala et al. 2005b; Hall 2005; Hall et al. 2005). The theory of complex, hierarchical autopoietic systems provides a framework to understand the emergent nature of CoPs at an intermediate horizontal focal level between people and the complex

organization as a whole (Salthe, 1985). Treating CoPs as entities on the borderline of autopoiesis helps to determine the different stages and factors that were contributing to their integration, emergence, sustainability or disintegration over time.

The following were key research questions emerging from the theoretical framework to determine the study plan and subsequent development of the models that would be tested in the case study instances:

- a) What kind of knowledge exists in the organization, either in people's heads or as explicit documents?
- b) What knowledge do people need to access in order to effectively complete their work?
- c) What can be done to help connect their needs to what exists?
- d) Where solutions can be offered, what can be done to support and sustain these solutions in complex organizations?

Considering that CoPs are popular solutions for the need to provide horizontal connections in distributed organizations, what can be done to support their emergence and sustain them within the larger organization?

### **3.4 The approach**

#### **3.4.1 The nature of the theoretical study design**

This was an inter-disciplinary research, i.e., research that occupies a niche somewhere between disciplines: “There is no standard or uniform approach to qualitative analysis. The common thread that binds qualitative analyses together is the shared goal of uncovering the underlying meanings of the phenomena being studied” (Ticehurst and Veal 2000, p. 96). As such, this research combines the qualitative and quantitative approaches to methodology.

The qualitative aspect of the methodology refers to the approach to the collection of data from the organizations. This was done in an ethnographical manner by using the following approaches:

- a) Approaching the organization with a view to observe and to record the experiences of individuals for the research
- b) Action research with an ethnographic approach,



- c) In-depth interviews using a knowledge mapping tool (on-line tool) across the organization.

### **3.4.2 The purpose of the design**

Emergence, classified under complexity theory, was chosen as a way of combining various observations to analyse each instance and find commonalities. This would assist with identifying of any interactive knowledge exchange, elements, attributes, behaviours or TKE.

The identification of various TKE elements also highlighted intersections of commonality such as CoPs, which were identified in the literature (Nousala 2003; Nousala and John 2004). Identifying any of the emergent elements or descriptors (describing elements of the framework) assisted with describing the differences and combinations of each study instance.

#### ***3.4.2.1 Case study instances – initial steps***

- a) Observing and describing the case study instances, which involved action and ethnographic approaches towards the data collection and gathering.
- b) Final analysis of the organizational sustainability viewed through an emergence construct, based on autopoiesis theory, an evolutionary epistemology.

#### ***3.4.2.2 CoP study focus***

Why are CoPs important? An understanding of CoPs was needed to develop an understanding of the research question. In this regard, this research began with the concept of “human attractors” (Nousala et al. 2005b, p. 22). These human attractors exist within the organization and, through activity and specific networks, highlight the existence of ECOIs (Expert Communities of Interest) (Nousala et al. 2005b). This group of human attractors, with specific purposes within the project environment, can also initiate links to COIs (Nousala 2003, Nousala and John 2004), which were more general communities or working groups and which are also linked to more mature and sustainable CoPs.

How did the study design utilize CoPs in the research investigation? The case study instances reflect various types of organizations. These studies focused on the dynamics and tensions that supported the identification of developing new elements and their competencies and assessing these aspects of CoPs. Examination and understanding of emergent elements

required to create, sustain and develop these CoPs also supported an increased understanding of the practical application and implementation of TKN within CoPs and organizations.

Exploration of TKN (Nousala 2003) through CoP with a focus on identifying common emergent elements (following possible clues which had initially emerged from the literature) was necessary in identifying the initiating or starting points for TKE. These starting points were necessary to identify with regards to design any models of representation.

Figure 2 shows the CoP research and investigations had elements of both qualitative and quantitative research through the descriptive, observational and ethnographical approaches.

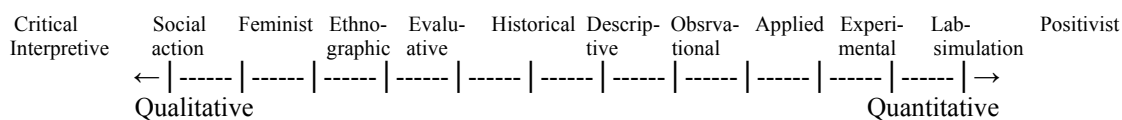


Figure 2 – Approaches and Methodologies (Ticehurst and Veal 2000, p.19)

### 3.5 Case study instances

Emergence, classified under complexity theory, was chosen as a way of analysing of each case study instance and finding commonalities which would lead to a better understanding of the research question. These emergent elements were flexible and were suited to the different applications and combinations of each case study instance. The emergent descriptors are described as follows. The emergent descriptors support the overall analysis of the case studies through an emergent construct. For example, each case study represents differing levels of community development and interaction, geographical distribution, size, organizational culture, language, variety, and length of time in operation. These previously mentioned examples of diversity and differing organizational systems, provided by the case studies, through emergent constructs, were used to investigate the research question and the overall analysis (Nousala 2003; Nousala et al. 2005b; Nousala et al. 2005a).

### 3.6 Structure of the case study instances

### **3.6.1 Case study instance 1 - Forum for European Australian Science Technology (FEAST)**

The main objective of FEAST is to improve European and Australian exchange and cooperation in science and technology (S&T) through a development of a network at the highest level. It consists of Australian Government and the European Member States (through the European Commission). FEAST represented an opportunity as an initial case study instance, which would ultimately provide the framework for the subsequent case study instances.

Using FEAST as a case study instance provided understanding of TKE through examination of the application of the methods and the outcomes. This was realized through the development and design of the methodology of the FEAST survey and its application. The survey took into consideration the following key questions:

1. Is it strictly true that tacit knowledge sharing only occurs when people are face to face?
2. Is a tacit protocol based on the organizational environment?

The opportunity to utilize FEAST as a case study instance was realized in February 2001. FEAST was chosen to provide the initial framework of specific elements of tacit knowledge networking and possible protocols. The FEAST study provided an opportunity to investigate physical and tacit network exchanges in relation to both tacit structures and the elemental interaction with physical complex structures (such as organizations). Investigation into the tacit networks of the FEAST study included an understanding of the time required for examining the contributing factors or phenomena of the tacit knowledge flows and possible evidence of tacit procedures (in particular during FEAST development), and the influence of the methodology in the process as a whole. The FEAST study gave the subsequent case instances a basis for continuous tacit protocol investigation, via other related significant aspects of later case study instances.

The FEAST study was conducted in two parts. Firstly, a pilot study was carried out within the FEAST executive team, followed by a major survey of the FEAST membership. The pilot initially involved only the members of the working group who met face to face, and documented all meetings and actions in a formalized manner. This was later expanded to

include interested (self-selected) members or a wider interested membership which was more informal. Subsequent interaction between members of the working group and the membership began with interviews (working group only), questions (working group and membership) and through unstructured extensive written commentary. An on-line component of the methodology was also developed and added to provide an expanded service and interaction between the working group and the growing membership.

### **3.6.2 Case study instance 2 – OECD ‘knowledge management in the private sector’ survey**

This case study instance was a pre-testing OECD pilot project, which was chosen as a study to reflect different types of knowledge flows in formalized structure within an organization. As the study was an international project it also offered opportunities for comparative analysis of TKE and CoPs in relation to more formal structures and approaches.

The purpose of this case study instance was to contribute to the understanding of how we know how to access tacit knowledge transfer in formal structures. The OECD case study instance methodology and approach followed the structure of the more formalized approach developed for the working group of the FEAST case study instance.

The research also focused on TKE within TKN and what affects a more formalized ecology or environment would have. This required an understanding of what environmental constraints and conditions should be created to sustain and develop these communities in formal settings (i.e., if it was possible to develop CoPs in this environment), especially when the face-to-face element cannot be present, due to geographical dispersion and cultural tensions. In some regards it was possibly more important to examine the tacit exchange elements within these formal settings. For example, each case study represents differing levels of community development and interaction, geographical distribution, size, organizational culture, language, variety and length of time in operation. These previously mentioned examples of diversity and differing organizational systems gave this case study a focus for examining any emergent elements through the final overall analysis of the study. This would yield an understanding of the predominantly tacit aspects of the more formal structures and approaches of this particular study.

### **3.6.2.1 OECD case study development**

Pre-testing study assisted in determining how possible or relevant devising a model would be using the survey/questionnaire method alone. A background discussion carried out by the OECD working group covered the areas of what was relevant to the individual (the smallest known component i.e., individual exchanging/sharing, their immediate system, and the organizational systems.

The following questions were responses to background discussions and arose prior to final pre-testing questions being formulated and developed (listed from 1- 23):

1. How they see themselves in their immediate network?
2. How they see themselves in their organizational network?
3. How much have they learnt?
4. What was the best learning experience?
5. Why was this so?
6. What do feel, see, or know are the problems?
7. How are individual's exchanging/sharing, within their immediate system?
  - a) Expanding to organizations system?
  - b) Inter-organisational?
8. How/what do we need to draw or distinguish a distinction between individual and a tacit knowledge system?

Organizational/group and individual questions which were discussed by the OECD working group;

9. Do you have an immediate network (work group)?
10. How would rate the value of your immediate network?
11. How would you rate the support of your immediate network?
12. Do you have an organizational network?
13. How would you rate the value of your organizational network?
14. How would you rate the support of your organizational network?
15. How would rate the value of support between your immediate network and your organizational network?
16. Are individuals (or, are you) aware of knowledge sharing taking place?

17. Have individuals (or, have you) taken on learning as a result of knowledge sharing?
18. Does the individual (or, do you) value learning?
19. How accessible is the knowledge that individuals (or, you) need to know?
20. How is relevant information passed on?
  - a) Face to face meetings
  - b) Verbal - telecommunications
  - c) Electronic – written
  - d) Hard copy
21. Does the individual (Do you) know what is relevant?
22. How important is the future of knowledge sharing?
23. How did all of the above interactions contribute to tacit knowledge sharing between geographically dispersed groups?

It was hoped that the pre-testing pilot would provide relevant “links” between layers and provide outcomes which could be used in possible model development.

### **3.6.3 Case study instance 3 - Intelligent Transport Systems Australia (ITSA)**

The format for this case study was to use exclusively an on-line questionnaire, following methods and approaches developed for the informal interaction of the FEAST membership. The starting point was the key individuals within the organization. The questionnaire was then repeated for each contact group using their informal and more formal structures or networks e.g., ITS, Govt, industry groups, other clients. Since there was such a diverse group, the need for flexibility in presenting the questions was crucial, as was indicated by feedback from the initial informal contacts with key individuals. The following initial questions (1-5) were workshopped with key individuals at ITSA:

1. What do the knowledge links in the “map” look like?
2. What are the types, frequencies and useability of the links?
3. What is the level of understanding between groups/individuals/networks/organisations?
4. What are the perceived knowledge gaps?
5. What is perceived as relevant for forecasting issues and developing potential new services?

The questionnaire workshopped with key individuals at ITSA to consider knowledge as action or learning by doing, or learned action that could be applied as explicit or tacit (or intuitive) set of doing. The following are a list of questions (6-21) which were workshopped with key individuals and members for a period of time (3mths) to finally develop the on-line questionnaire:

6. How/what do we need to draw or distinguish a distinction between individual and a tacit knowledge system?
7. Do you have an immediate network (work group)?
8. How would rate the value of your immediate network?
9. How would you rate the support of your immediate network?
10. Do you have an organisational network?
11. How would rate the value of your organisational network?
12. How would you rate the support of your organisational network?
13. How would rate the value of support between your immediate network and your organisational network?
14. Are individuals (or, are you) aware of knowledge sharing taking place?
15. Have individuals (or, have you) taken on learning as a result of knowledge sharing?
16. Does the individual (or, do you) value learning?
17. How accessible is the knowledge that individuals (or, you) need to know?
18. How is relevant information passed on?
19. Does the individual (Do you) know what is relevant?
20. How important is the future of knowledge sharing?
  - a) Formats of the outcomes
  - b) Face to face meetings
  - c) Verbal - telecommunications
  - d) Electronic – written
  - e) Hard copy

In the end only one on-line question was thought necessary as the concept was to eventually develop a series “snapshot” approach of the emergent issues. It was thought that it maybe possible to elicit a more focused approach in a short space of time, and if necessary to build up these snapshot profiles over time, rather than more lengthy surveys which may not elicit current thinking of the membership as successfully.

### **3.6.4 CoPs and TKN questions with significant similarity across case study instances**

These sub-questions form the basis of the EPMO case study instance and the direction for the final phase of the research. The sub-questions also reflect the findings and outcomes from the previous case study instances. The following questions supported and influenced the research direction, and in particular the issue of implementation:

1. What are the knowledge sharing challenges dispersed groups face?
2. Within the relationships between group, community, company and environment, what are the key defining elements (if any)?
3. What are the essential differences between tacit and explicit in relation to networking?
4. How they see them selves in their relative networks?
5. How do you know that tacit knowledge sharing is happening?
6. Given the difficulties in the above questions, what were the circumstances of TKE and the difficulties of sustaining it, eg: physical separation of countries, towns/cities states, languages and cultures?
7. Given that there is protocol for explicit knowledge, is there such a thing for tacit knowledge?
8. Is it strictly true that tacit knowledge sharing only occurs when people are face to face?

These questions required a focus of CoPs in relation to TKE.

### **3.6.5 Case study instance 4 - Engineering Project Management Organization (EPMO)**

This case study instance focused on the testing and implementation of new emergent elements that were identified through the process of establishing sustainable working groups and CoPs within complex organisations. The identification of the new emergent elements that supported sustainable CoPs were instrumental in the building of sustainable foundations for TKE and TKNs.

#### ***3.6.5.1 Community of Practice approach***

The purpose of the EPMO study was to investigate CoPs in complex organizations by utilizing previous findings, (from the previous case study instances) by investigating different



ways to connect people who have particular kinds of knowledge with those who need that knowledge to establish CoPs. Wenger (Undated) defined communities of practice as follows:

“Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavour: a tribe learning to survive, a band of artists seeking new forms of expression, a group of engineers working on similar problems, a clique of pupils defining their identity in the school, a network of surgeons exploring novel techniques, a gathering of first-time managers helping each other cope.”

To summarize, a methodology for identifying CoP was to highlight entities that supported individuals with related knowledge needs, where the specific needs unified any cause or action, creating intersections of individuals. The CoP concept has been identified within the current knowledge management literature as a fundamental aspect of complex human organizations that can emerge naturally, but benefits from nurturing and sustainment. As such, it has similar or sufficient properties to be deemed as an autopoietic entity in its own right. This research treats CoPs as elemental and potentially autopoietic components within larger organizational systems.

### **3.6.5.2 *Testing theoretical models***

The study reported here was a pilot/demonstration project to facilitate and sustain cross-divisional communities of practice combining cartographic and CoP approaches. The theoretical models and framework were tested in practice using a mind mapping technology and approach, developed by Hall and Kilpatrick (unpublished) and later forming the basis for the Team Expertise Access Mapping (TEAM) which is elaborated here.

Specific approaches and protocols for collecting and analysing interview data were based on the TEAM process. Analysing the TEAM interviews helped the researcher construct an ontology required for developing an electronic search capability that would provide access to interrelated personal knowledge while still in the context of the organization as a whole. This approach was based on the initial mind mapping process that described (through extensive documentation) the observations of instances relating to the individual's experiences (Nousala et al. 2005b).

## **3.7 Model and theory development**

This section describes the historical development of the model. Initial research of the model and theory development for the thesis was based on ideas for socializing knowledge in a CoP, as expressed in Nonaka and Takeuchi's (1995, p. 62) SECI loop:

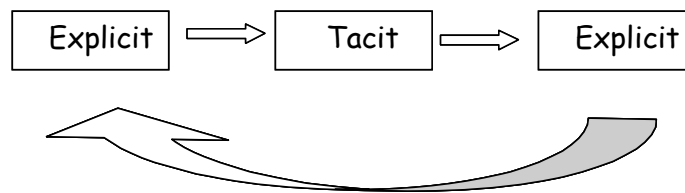


Figure 3 – Nousala's adaptation of the Nonaka and Takeuchi's SECI Loop

The difference (at this point) is that Nonaka and Takeuchi (1995) a dualist approach, and Nousala's adaptation is the additional layer which links to Popper's tetradic schema (Popper was a pluralist) described below.

The Figure 3 above clearly resembles Popper's tetradic schema (1972 p. 164; 1994, p. 55) which has the similar element of the "never ending" or iterated process

$$P_1 \rightarrow TT \rightarrow EE \rightarrow P_2$$

where  $P_1$  is a problem situation, TT refers to a tentative theory to solve it, EE refers to a process of criticism for eliminating errors and  $P_2$  is the problem situation remaining after the surviving theories have been applied. Popper (1994, p. 55) calls this a schema of the formation of theories:

"We start with problems, we put out tentative theories, then comes a process of critical effort elimination or criticism, and then the new problem arises...I assert that all organisms are all the time problem-solving...they are all the time problem-solving...TTs the tentative trials, are very different at the different levels. The individual itself constantly puts forth trials which it corrects by error elimination – not just human beings, but amoebae...these trials are behavioural trials."

The transition of never-ending exchange of constant, emerging solutions can be seen in Popper's diagram, Figure 4 (1994, p. 7) of the relationships of the three worlds:

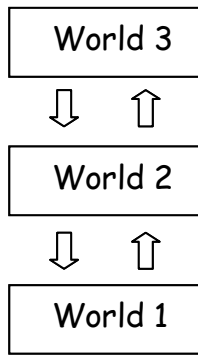


Figure 4 – Popper’s Three World Diagram

Popper’s three world ontology (slightly modified) provides the basis for the tacit knowledge structure. Figure 4 and Figure 5 are stages in the development of Popper’s diagram to explain the evolutionarily emergent and fundamentally cyclical behaviour of knowledge exchanges. Figure 5, emphasizing the cyclic aspect, formed the basis of the model in Figure 6, showing the elements, the CoP position, initiating points and interactive behaviours of tacit knowledge structure.

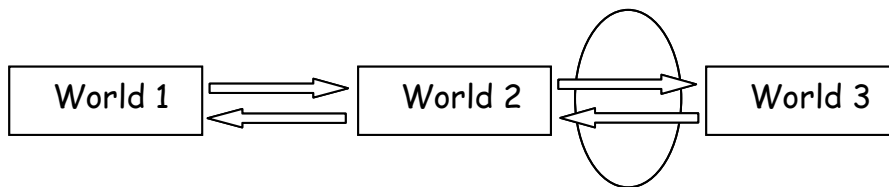


Figure 5 – Modification of Popper’s world diagram

Modification of Popper’s world diagram to show cyclical movements, the circle emphasizes the enhanced cyclical exchanges between W 2 (Tacit world) and W 3 (Real or explicit).

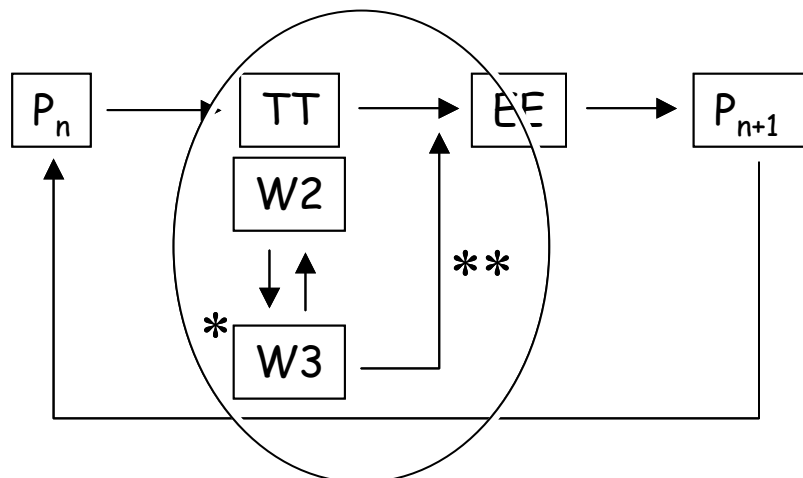


Figure 6 – Modification of Popper’s tetradic schema and three worlds diagram

Modification of Popper's combined tetradic schema and three worlds diagram shows the beginnings of the cyclical nature of tacit knowledge exchange. \* The tentative solution is objectified as a tentative theory in W3. \*\* The tentative theory in W3 is subjected to critical analysis to eliminate errors. The circle emphasizes the area expanded in Figure 7 and discussed on page 69.

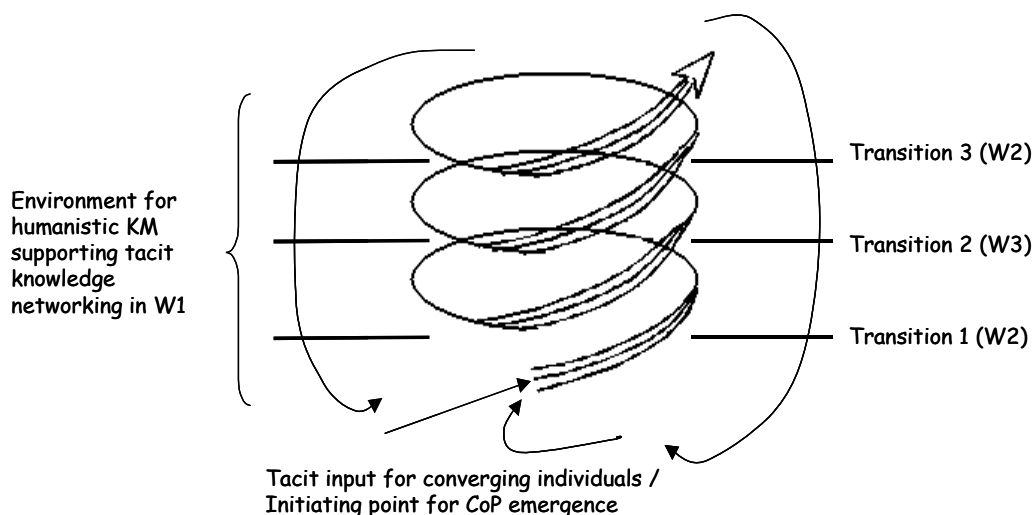


Figure 7 – Spiral transition exchange model (Nousala et al. 2005b)

Processes within the structure of the CoP cyclically transform knowledge between tacit forms in W 2 and explicit forms in W 3. This CoP, as an entity, may join other CoPs to build larger knowledge networks either within the boundaries of the parent organization or crossing the boundaries of several organizations having similar knowledge needs. As Popper (1972) notes, the cycles are not exactly repeatable, as the incremental additions of tested knowledge change the problem states from one cycle to the next. The following explains the transition levels of the model in Figure 7:

- Time and practice = evolving to the next level;
- Transition 1 = tacit knowledge exchange (TKE) forming initiating points;
- Transition 2 = TKE evolving to the next level;
- Transition 3 = solution with adjustments to constraints, an on going process.

Between each transition is “time and practice”. Time is required for the community to actually put its knowledge into practice (i.e., to test it). Each of the transition levels 1, 2 and 3 represents a tacit exchange. The following is the explanation of the movement between the transitions.

The HKM environment, i.e., the human aspects of the organization, supporting the tacit knowledge network, i.e., tacit aspects of corporate structure that allow knowledge to cross boundaries (Nelson and Winter 1982, 2002), makes adjustments to culture, strategies, structure and environments on an ever-evolving basis (Nousala 2003; Nousala and John 2004).

The model in Figure 8 can be interpreted as an element or potentially autopoietic component within the environment formed by the organization as a whole (for a CoP within an organisation) or a potentially independent entity within the larger multi-organizational environment.

Hall (2005 p.184) states that:

“W 2 is the emergent body of knowledge represented in the dynamic structure of the autopoietic system as a consequence of its history of variation and survival (natural selection). Popper talks about “dispositions” of “subjects” (knowing entities). Personal knowledge in the form of instincts, talents, predispositions, etc. all qualify as dispositional knowledge. This is the only kind of knowledge possessed by primitive/recently emerged autopoietic systems.”

Note that this dispositional knowledge at the level of the emergent community is not the same as the personal knowledge held by individual people forming the community.

Within hierarchy theory (Salthe 1985), in a scalar or nested hierarchy, the concept of triad defines three levels:

1. The level of focus (“focal level”) that contains a system of particular interest (a “holon”);
2. The level of the hierarchy next above the focal level that contains a “supersystem” or the environment that contains the holon; and
3. The level of the hierarchy next below the focal level that contains the subsystems and other components that collectively form the holon.

Focal levels can be viewed from a structural and ontological position (Salthe 1993). The definition of focal level is from a systems point of view not an individual component’s (i.e., a person’s) point of view. The triad including the holon has three layers of complexity. The environment or a super-system establishes situational boundary conditions to shape and constrain or regulate the focal system to determine its emergence and development through

history. The (focal) layer contains the system of interest along with other systems the holon relates to horizontally (e.g., competes or otherwise interacts with). Sub-systems below the focal layer determine what is possible for the system to do via initiating conditions and universal laws governing the interactions of subsystem components. Figure 7 attempts to illustrate this for the Nousala et al. (2005b) spiral transition exchange model.

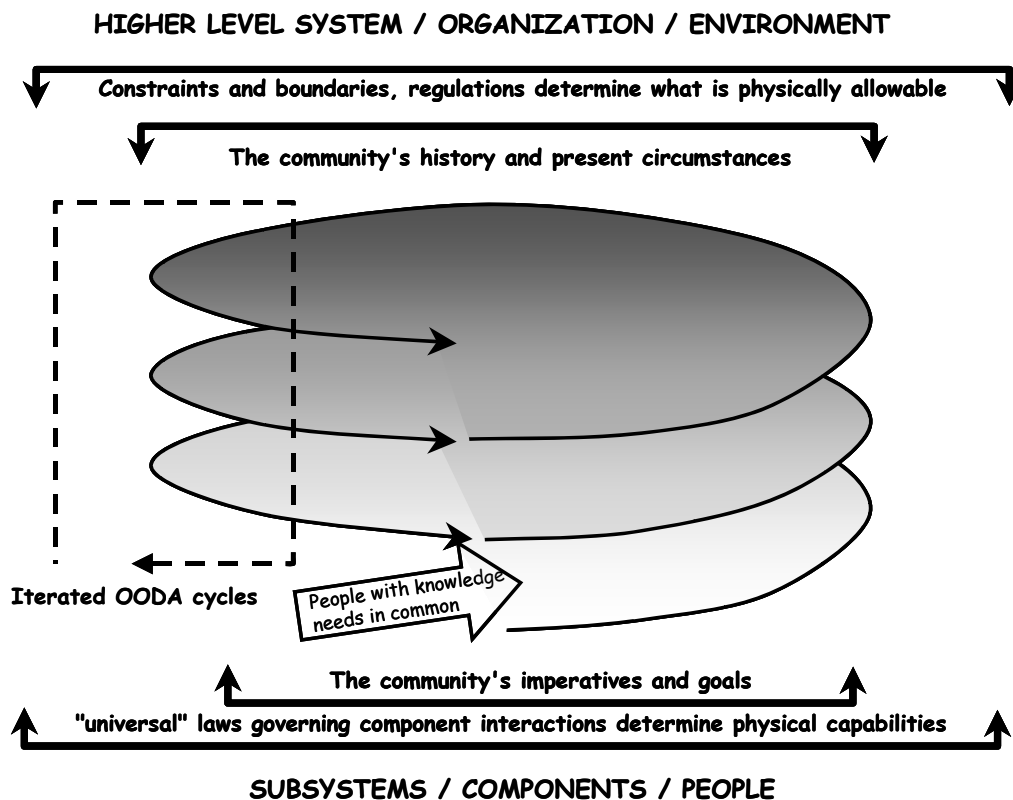


Figure 8 – Emergence of an autopoietic community of practice (Nousala et al. 2005b)

Clarification of a CoP's position and significance within the tacit knowledge network can be understood through tracing emergence of the different attributes that collectively provide the properties of autopoiesis.

“Still more interesting will be to explore the boundaries of the autopoietically learning organization. Most enterprises are founded by individual entrepreneurs, or as entrepreneurial partnerships or family concerns. They initially represent the economic activities of a single person, or small group and are managed as autocracies. However, if the business grows, at some point it begins to take on a life of its own. What happens in such transitions to cause the emergence of life? Answers here will provide some interesting feedback into studies on the origins of biological life, the possibilities for artificial life and forms of life not based on macromolecules with carbon background” (Hall 2005 p. 184),

CoPs may offer an even more appropriate system framework in which to study the initial emergence of autopoietic systems.

## **Chapter 4**

### **4 Initial Case Study Instances - Introduction**

This chapter consists of three case study instances; the Forum for European Australian Science and Technology (FEAST), Intelligent Transport Systems Australia (ITSA) and the OECD International knowledge management survey, including their findings and discussions.

The first case study instance FEAST focused on tacit knowledge with regards to tacit knowledge sharing, exchange and networks as an evolving geographically dispersed CoP. The ITSA case study instance continued to build on the findings and outcomes from the FEAST case study instance. Specifically, the ITSA case study focused on deeper issues regarding the significance of CoPs, the relationships of CoPs and TKE, the comparisons between tacit and explicit activities of CoPs and understanding TKE layers. The OECD case study instance continued to build on the findings and outcomes from the ITSA case study instance focusing on the explicit and more formal aspects.

The chapter concludes with findings, discussion and summary where the case for further testing on a final case study instance is made. The final case study instance is required for testing and implementation through developing an understanding of epistemological and ontological views of TK, CoPs, TKE and TKNs.

#### **4.1 Forum for European Australian Science Technology (FEAST) case study instance**

##### **4.1.1 FEAST background development**

FEAST was launched on 9 November 2000, and was supported by the joint European Union and Australian implementation group (also funded by this group). Pierre Viaux, French Ambassador, representing the Presidency of the European Union at that time, was the European Union representative at the launch of FEAST and its web site on 9 November 2000. This was a European initiative aimed at enhancing bilateral and multilateral science and technology cooperation between Europe and Australia. The intention was based on regular working meetings and electronic forums on the internet (Moulet 2001).



The “Joint Implementation Group” or JIG was formed to launch FEAST at the conference, which was the inaugural event known as “FEAST 1” and was held from 30-31 May 2001. It was an international event, and in essence a face-to-face gathering.

The JIG committee consisted of key players, which were responsible for coordination, and development of the overall vision and the direction of the emerging organization. The intent was that FEAST would eventually take on a shape and life of its own, and that in time it would be a self sustaining working group or international community of research and exchange. It was intended that, with time, it would become a one-stop-shop for networking in science and technology between Europe and Australia.

#### ***4.1.1.1 Initial case instance background development***

Initial background development specifically for this study was realised after discussions with Mr Moulet, (the science and technology officer at the French Embassy in Canberra), who had a background in community development and sustainability, from his previous working experience. He was initially concerned with developing interests and contributing toward the development of the French - Australian research cooperation, with particular interest in developing and establishing permanent new services through a “working network”.

The initial discussions regarding FEAST development occurred mainly at face-to-face meetings. These core discussions typically focused on the type of structure, how the foundations of developing the entity should be shaped or guided, and how this was to be achieved. Explicit documents were prepared between meetings, and then distributed, often via electronic means. Central to many of the discussions was the form or shape of the FEAST of the future.

An interesting, but also important aspect of FEAST development was the establishment of “Local FEAST clubs” or, “French FEAST groups”. Whilst this was specifically for the French - Australian interests, it was worthy of investigation, as it was a community in development, on a volunteer basis (simultaneously to the main FEAST development).

The French - Australian cooperation developed into communities of interest or COIs, (Nousala 2003) where common interests were aired and shared with a view to forming

alliances or projects at a later date. The “French - Australian Research Group” formed, and had all the hallmarks of a “community of practice” (Seely Brown and Duguid 2000a).

The structure for this initial French venture was kept quite fluid, with an intention of supporting lively discussion and debate regarding particular interest within the community. This was done without necessarily constantly developing new structures or adding modifications before the infant community could come to an understanding as to how it perceived itself and how it might develop in the future.

To give direction and support to the developing FEAST France initiative, growing interests and the formation of new groups of FEAST France around Australia, a “National Charter” was drawn up, mimicking Australian political jurisdictions, namely, local, state and federal groups. Close attention was also paid to existing groups and associations, which had formed over the years through various other diplomatic links, such as AFAS (Australian French Association of Professional Technical Specialists).

#### ***4.1.1.2 The Charter’s main objectives***

- a) Develop community activities to enhance the supporting framework and shared tools.
- b) Share experiences with visiting colleagues with a view to practical help needing to develop projects in cooperation between France and Australia, which may also involve the development of a community of practice.

#### ***4.1.1.3 The founding principles of the Charter***

The members were invited to register so as to actively be a part of their particular research group. Active support was seen as important as it would maintain the groups’ activities, which in turn, had the opportunity to introduce more members. The initiative was a response to the everyday needs and questions of many French - Australian researchers, students, engineers and other professionals.

The core working group of the French - Australian research group was initially driven by the French Embassy, with a view to establishing a framework and protocols, to allow increasing autonomy for the future group. The intention was that the group would become self-sufficient

(a time line of three years was given). In order to do this, cooperation and the establishment of partnerships was crucial supported by enthusiasm and efficiency across a broad spectrum.

To examine the issues and interests of both FEAST and FEAST France (but mainly focusing on the FEAST conference), through outcomes of prior discussions and developments that had taken place, it was decided by the JIG to investigate several key topics for the first FEAST conference. This conference was to be the initiator and attractor for the development of FEAST groups to come together and expand. The JIG agreed that the FEAST conference topics should touch on fundamental FEAST development issues. As a result of FEAST conference discussions, the JIG formulated four topics for the FEAST conference workshops, one of which was the virtual working group. This virtual working group was chosen as a case study instance. The focus was to determine how cooperation developed into communities of interest or COIs (Nousala 2003) through common interests of developing CoPs (Seely Brown and Duguid 2000a).

## **4.2 Research methodology approach**

### **4.2.1 Proposed methodology of working group 1 (WG1)**

The WG1 or virtual working group 1 focused on cooperation of developing communities of interest or COIs, (Nousala 2003), and the development of the JIG as a working group itself through common interests, which again were hallmarks of a CoPs (Seely Brown and Duguid 2000a). The key methodological approach towards the WG1 study was ethnographical, recording and describing any emergent elements specifically relating to COIs prior to the formation of CoPs.

WG1 was described in an initial JIG (joint implementation group) discussion paper which determined the scope of FEAST 1 and also the scope for WG1. The FEAST aspects investigated by WG1 were the method and possibilities for addressing issues that needed resolving regarding the formation of FEAST itself, which were evolving through the preparation of FEAST 1.

Further discussion between WG1 and members of the JIG (joint implementation group) consolidated FEAST viewpoints, which arose from the initial issues paper. The following points were raised:

- a) Define objects/concepts of Information Systems for FEAST, for example what people needed, support services, rules of participation, required input to build all of these aspects.
- b) Define the structure of FEAST both organisational and/or legal.
- c) What type of technical network management was to be developed and what type of code of conduct would need to be designed and introduced.
- d) Methodology or approach for tracking the “links” of TK needed to be developed between knowledge bases, individuals, groups (some already existing) and relevant organizations.

The approach for developing the links between the knowledge bases needed to include FEAST core values. These were outlined by JIG: vision towards an outcome, ethics (for privacy) and respect for existing services (as in other existing relevant organisations), as well as how to build up and engage methods or systems for mutual exchange between key stakeholders.

The outcome of the JIG discussions (included the previously mentioned points) resulted in the following WG1’s short, medium and long term strategy, which was the starting point for the initial pilot framework and subsequent surveys.

## **4.2.2 Strategies**

The outcome of JIG discussions resulted in the following outline of the WG1 strategies.

### **4.2.2.1 Short - term:**

- a) Look at developing structures, which provide mutual benefit in supporting or linking existing bilateral and multilateral initiatives and organizations with FEAST.
- b) Developing two way electronic brainstorming to encourage mutual support and engagement towards FEAST and create a pilot framework.
- c) Development, analysis and monitoring of pilot framework:
  - i. Pilot framework in place
  - ii. Feedback and additions
  - iii. Analysis and synthesis
  - iv. 2<sup>nd</sup> level framework (repeating the process)
  - v. Outcome

- d) Analysis of pilot frame outcome to provide basis for developing structures for long – term FEAST.

#### **4.2.2.2 *Medium - term***

- a) Develop strategies to support the transition from FEAST 1 to a long – term project.
- b) FEAST used as a means to enable the development as a framework of networks, specifically to allow FEAST to support organizations/new initiatives.

#### **4.2.2.3 *Long - term:***

- a) Proposed structure for long – term FEAST – management structure, physical working space, virtual working networks and long – term staff required and future funding processes.
- b) Support for development and on-going input and maintenance from management towards virtual working networks
- c) Defining the FEAST the core or initial organization (the legal entity) and the links, relationship, support and management towards FEAST the spin-off groups or initiatives:
- d) The developing virtual working networks or CoPs and a framework for linking related skills for sustainable, tangible outcomes.
- e) Identifying, developing and linking networks with networks – which should be looked at in relation to virtual networks in the European Union and develop a mirror structure to FEAST 1 in Australia.

#### 4.2.2.4 Methodology approach developed from WG1 strategies

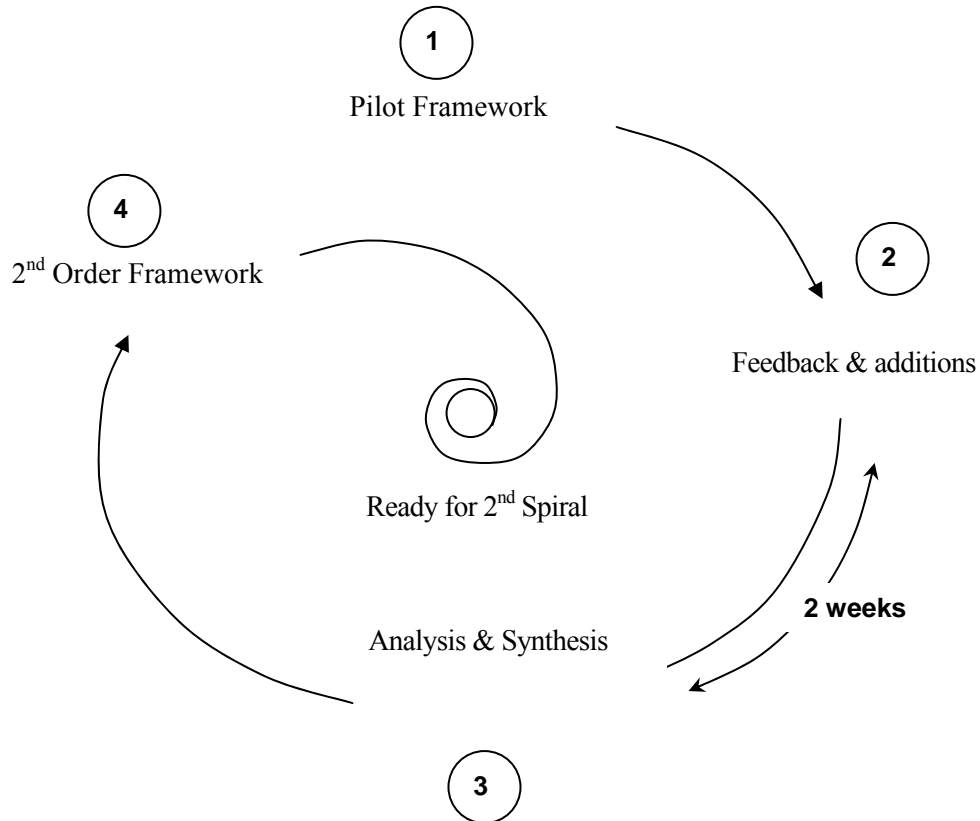


Figure 9 – Diagram of the level 1 spiral of the initial pilot survey development

### 4.3 Pilot survey data collection and results

#### 4.3.1 Data collection

The data collection of the initial pilot survey was conducted on-line and by fax. Apart from the main FEAST working committee, which served as an initial face-to-face core survey group, the pilot survey was conducted on-line. The initial core of results collected was a sample of fourteen responses to a questionnaire which was sent by email to all those who had registered on the FEAST website and had expressed an interest in contribution to the discussion of WG1.

The content of the initial pilot was discussed and fine-tuned by the FEAST JIG, with the core members of the FEAST JIG contributing their hands-on knowledge of the development of the FEAST WG1. These JIG discussions were ultimately reflected in the contents of WG1's

main survey questions. The WG1 developed the main survey from the results of the pilot survey.

WG1 sent out the initial pilot survey to not only the core FEAST joint implementation group, but also to those who had responded and registered their interest in the WG1's activities. Although this was thought to be an interested target group (or a relevant COI), the WG1 registered response rate (those responses outside the core FEAST working committee) was low, initial response of 30+ participants (researchers only) out of a possible 700 who had registered as FEAST members.

The pilot questionnaire solicited responses on the areas of science and technology in which Australian respondents were seeking to collaborate with European counterparts and vice versa, the countries and locations where respondents as well as their counterparts were based, the kind of assistance that would be sought by respondents from FEAST, the kind of interaction respondents proposed with FEAST, and, to some extent, the kind of structure respondents wished FEAST to take.

#### **4.3.1.1 Results**

The FEAST Virtual Discussion Group consisted of 14 participants.

##### *Areas of Interest for EU/Australian Collaboration:*

- Biology
- Biochemistry
- Environmental Studies
- Food Science (3)
- Industrial Engineering
- Nanotechnology
- Artificial Intelligence
- Information and Communication Technology
- Bioinformatics

##### *Regions of Interests:*

- Canberra
- Sydney

Melbourne  
Perth  
Newcastle  
Geelong  
Townsville  
CSIRO  
Germany (14)  
France (11)  
UK (5)  
Italy (3)  
Spain (2)  
Netherlands (2)  
Belgium (2)  
Turkey  
Iceland

*Preferred Modes of Communication:*

Email for day-to-day communications (100%)  
Face -to-face meetings every 2/3/6/12 months especially for initial collaboration and project set up (100%).  
Online forum, eNewsletter, informative website  
Phone and fax

*Requested Support from FEAST:*

Funding for travel/workshops/conferences  
Project seed funding , e.g., travel or PhD  
Information on funding opportunities, potential research/industry partners, positions, travel.  
Web links to institutions and industry  
Database of interests and research groups  
Opportunities for “like-minded” people, lobbying, policy development, priority setting, both on EU and Australian sides.  
Conduit into EU or Australian funding bodies  
Vetting agency for EU and Australian funding bodies



*Structure of FEAST:*

Formal membership organization (50%)

Informal structure/community of interest (50%)

Objectives of FEAST meetings

research level meetings?

Network of interaction and liaison with other S&T organizations?

Regional or chapter structure?

#### **4.4 Analysis of pilot survey findings**

##### **4.4.1 Areas of science and technology**

The areas of science and technology in which the sample of respondents expressed a wish to collaborate between Australia and Europe included biology, biochemistry, environmental studies, food science, industrial engineering, Nanotechnology, artificial intelligence, information technology and bio-informatics.

It could, however, be reasonably expected that, as more researchers become aware of FEAST in the future (and its potential), the areas of scientific and technological interest would eventually span the whole spectrum of science and technology.

##### **4.4.2 Countries where respondents wish to be involved in FEAST projects**

Even though the initial pilot sample was still quite small, the respondents indicated that they wished to collaborate in projects that span Australia and most of the European Union countries. The present responses included, on the Australian side, the CSIRO and universities in New South Wales, Victoria, Queensland and Western Australia, and on The European side Germany, Spain, UK, France, Belgium, Italy, the Netherlands, Turkey, Iceland, as well as the UN bodies UNESCO and WHO.

As the sample of respondents increased, it was again reasonable to assume that FEAST may be called upon to facilitate projects in all Australian states and European Union countries.

#### **4.4.3 Modes of communication within FEAST**

The respondents were in strong agreement that communication within FEAST should take the form of email as well as regular face to face meetings. It was suggested that FEAST provide processes for project facilitation, such as an online forum, an eNewsletter and an informative website. The proposed frequency of FEAST meetings varied between once every two months and once every 12 months. It was remarkable that all respondents stressed the importance of physical meetings, especially in the initial phases of projects.

#### **4.4.4 Expected FEAST support for Euro-Australian projects**

Several respondents expressed expectations – or hopes – that FEAST would provide direct funding for Euro - Australian research projects, e.g., travel funds, workshops and conferences, a fixed conference centre, seed funding for projects, support for postgraduate students, or even health insurance while working with the overseas research partners.

However, there was also a strong desire among the respondents for FEAST to provide information on a variety of related topics, from funding opportunities, potential research or industry partners, training, doctoral and postdoctoral positions etc. to basic travel information. Web links from the FEAST site to institutions and the industry and the advertising of FEAST with European and Australian organizations, industry and government was suggested as an important FEAST service. Furthermore, FEAST should maintain a database of interests and research groups as well as information on Australian researchers in Europe and European researchers in Australia which might, among other things, simply provide opportunities to communicate with other like-minded people, e.g., “Europhiles” in Australia or “Australophiles” in Europe.

Respondents also pointed to an important role for FEAST in the area of lobbying, policy development and priority setting, both on the Australian side and that of the European Union. Last, but not least, FEAST was expected to become a conduit to European and Australian funding bodies, as well as a vetting agency for Euro-Australian projects which rely on funding by those bodies.

#### 4.4.5 Structure of FEAST

Respondents were almost equally divided between FEAST being a formal membership organization and an informal structure or community of interest.

From the strong desire to conduct regular FEAST meetings, the question arose as to the specific objectives of such meetings. Should FEAST facilitate research-level meetings between Australian and European researchers in any of the areas of science and technology, represented in FEAST, already have one or more established international and /or national research meetings, it did not appear to be a reasonable objective for FEAST meetings to provide alternative for such research meetings between researchers. On the other hand, FEAST should probably create a network of interaction and liaison with other science and technology associations. If FEAST meetings, on the other hand, brought together researchers from different areas of research interest but a common desire to foster collaboration between Australia and Europe, was unlikely that researchers would have either the travel funds the necessary time to travel between countries, or even centres within a country, to attend such a meeting.

These considerations, pointed to a structure of FEAST comprising regional or “local chapters”. These would be enabled to organize networking and other social activities that would bring together researchers who shared an interest in collaborating with European colleagues – in the Australian chapters – or with Australian colleagues – in the European chapters. If FEAST was to adopt a workable regional/local structure, it was suggested to look at existing international organisational structures as examples for FEAST, such as the IEEE with its significant activities in local chapters and sections, with its special interest groups (SIG), its support for eminent speakers, local workshops/seminars, student competitions etc.

A FEAST regional or local structure of the kind described above would only be sustainable if supported by a well-resourced central office, which would house and maintain the necessary web server and software, provide for the necessary online networking and administrative support for the organisation, and disseminate relevant information to the members of FEAST.

These considerations led to the further question of the corporate and legal framework for FEAST, including its ownership, legal incorporation, profit vs non-profit organization, structure and appointment of the governing board. Respondents suggested looking at other

existing organizations, such as the British Council and others, for models of the FEAST corporate structure.

## **4.5 FEAST main survey data collection and analysis of results**

### **4.5.1 Main survey**

The virtual and physical conference environments were utilized as “starting points or initiators” for the main survey. There were 1000 main surveys distributed, prior to the first FEAST conference. The FEAST case incident work was the result of analysis carried out on 101 main FEAST survey responses collected from participants. This main survey had been refined from previous pilot questions respondents which indicated four main directions. These main directions were: management, policy, structure and funding. The main survey’s focus of the four main directions led to a shortening of the final version of the main survey, from the initial eight questions to the final four.

This was an approximate 10% return rate. However, not all responses were collected at the time of the paper produced by WG1 for the FEAST conference. Therefore, final results of the “green questionnaire” or main survey are discussed in this “main survey results” section.

Even though responses were sent out prior to the conference (as organized by WG1), a greater percentage of the responses was gathered at the conference, face-to-face.

## 4.5.2 Results of main survey

### 4.5.2.1 Question 1

If FEAST were to provide a well-managed and maintained on-line/web research information service, what would be the key areas to consider?

- Possible research partners
- Possible industry partners
- Current and future project positions
- Web links to practical travel information
- Other related web links
- Others – Please specify

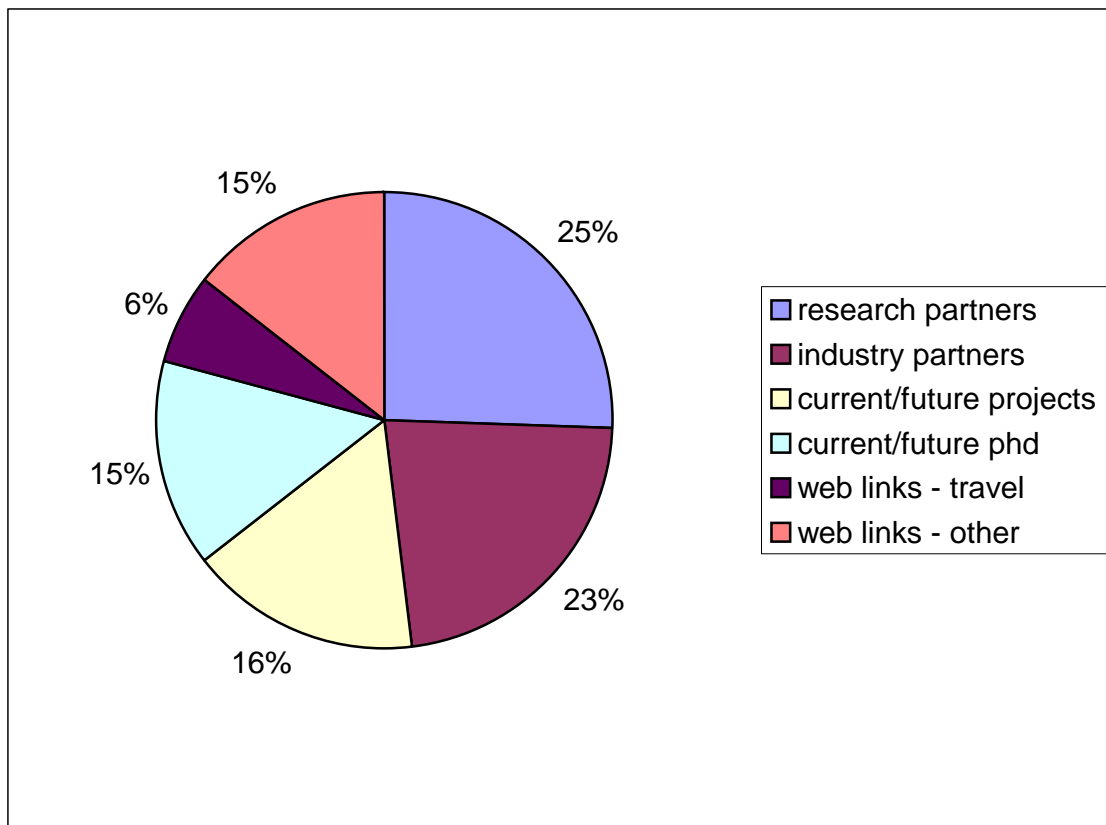


Figure 10 – Key areas of FEAST

4.5.2.2 Question 2

How should FEAST provide or develop policy?

By developing priority setting

By coordinating activities between European-Australian research bodies

By lobbying and raising awareness for European-Australian research organizations

Others – please specify

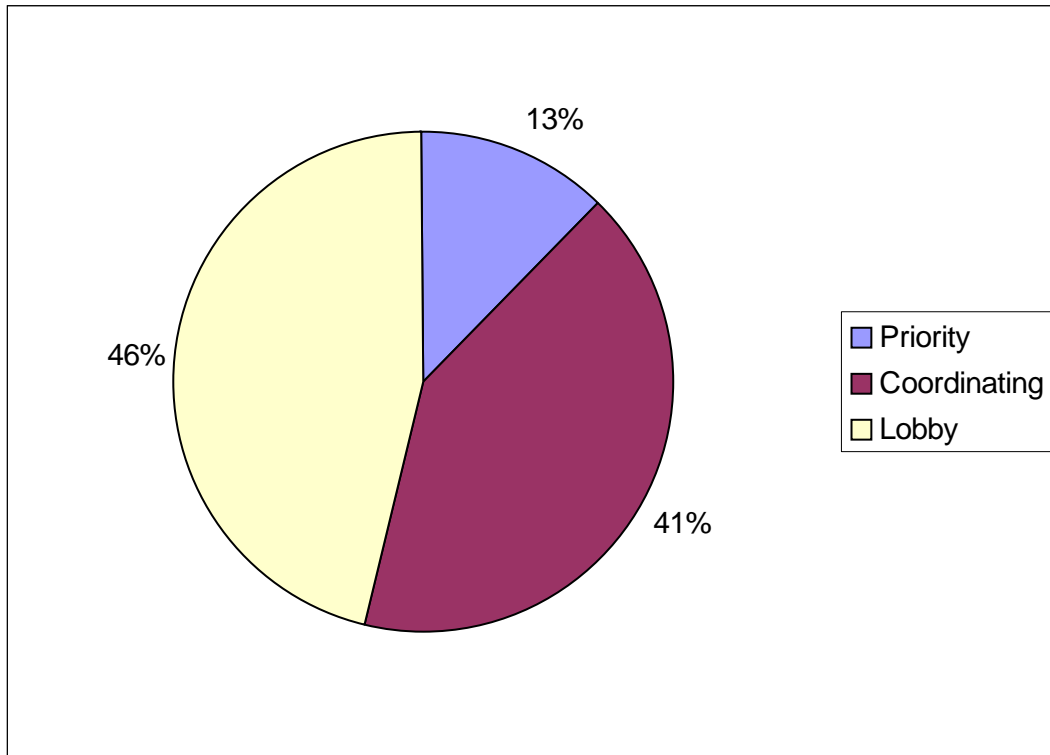


Figure 11 – Policy development of FEAST

4.5.2.3 Question 3

In order to support the anticipated future initiatives FEAST should be:

A formal/legal incorporated entity

An organization with informal local “chapters” groups

An informal on-line network

Others – please specify

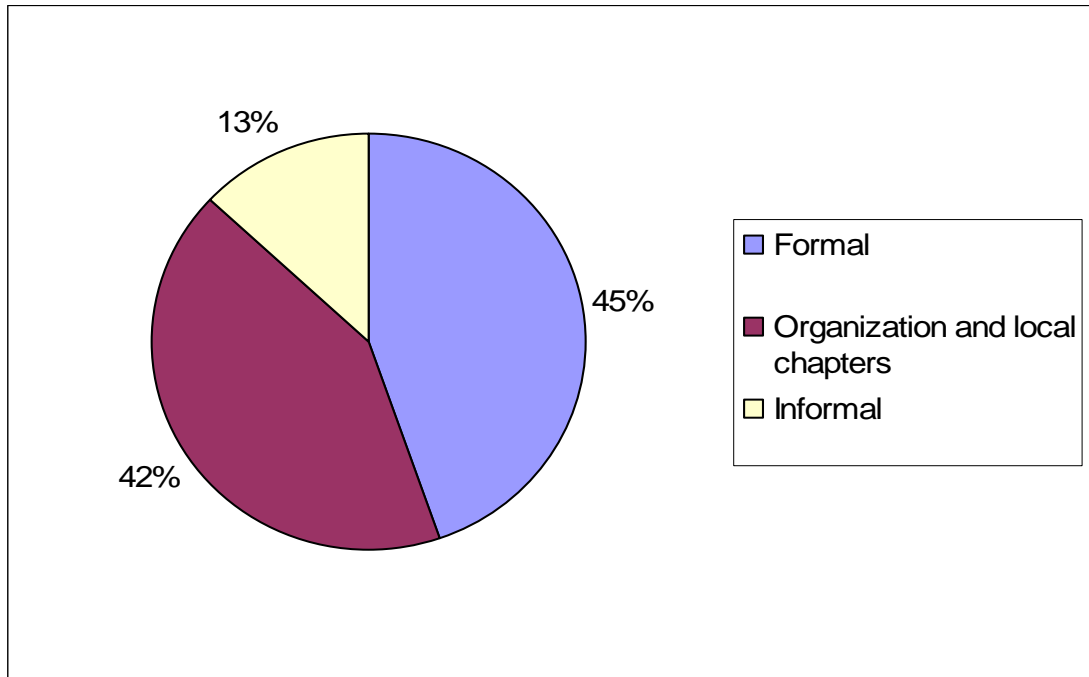


Figure 12 – Anticipated future Initiatives of FEAST

4.5.2.4 Question 4

How should FEAST be expected to support/coordinate/administer funding activities?

By providing targeted, accurate funding information for grants and travel

By coordinating with and assisting existing granting bodies

By becoming a granting body itself

A variation or all of the above

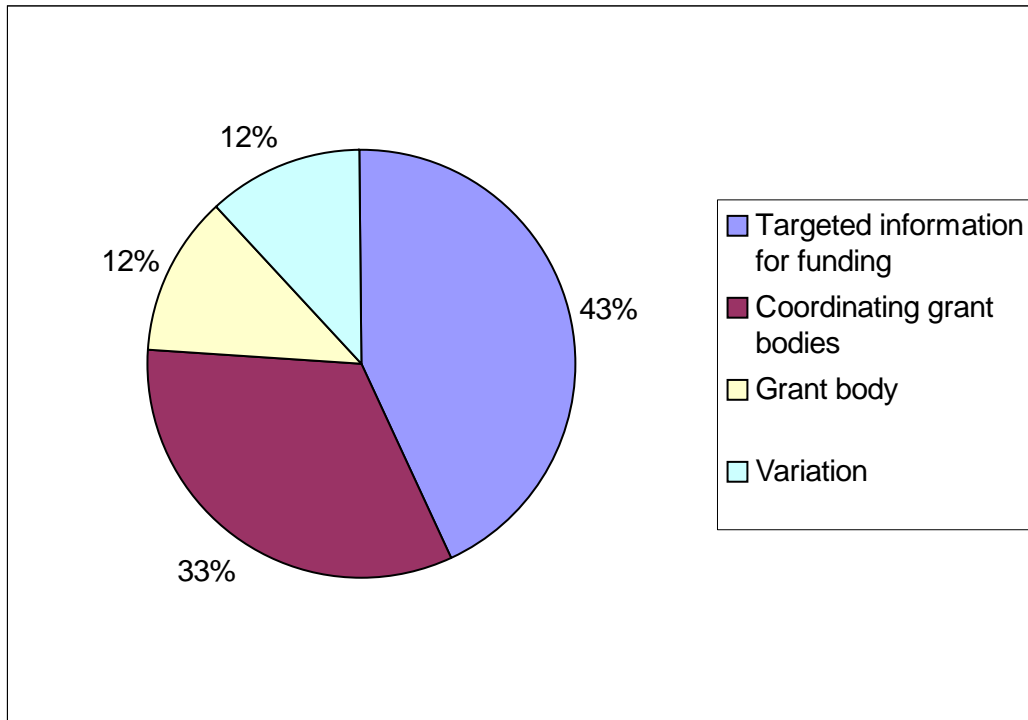


Figure 13 – Funding activities of FEAST



## **4.6 Analysis of findings for main survey**

### **4.6.1 General analysis**

Although the results of the initial pilot survey were low, the results were considered sufficiently significant to make relevant contributions towards the development of the main survey. The main survey evolved from eight questions to four.

The main survey questionnaires were distributed and collected prior and during the first FEAST conference (where there were face-to-face participants at the conference, in combination with the on-line contributions prior to the conference).

#### **4.6.1.1 *Question 1 discussion***

Question 1 was structured to reflect response in relation to management and information ideas, suggestions and concerns from the pilot survey, as well as the discussions of the FEAST JIG. The issue of how FEAST could manage and disseminate information, and what would be the most useful to current and future FEAST members, was a major concern. Regarding question 1, the key area of concern in relation to management and maintenance for respondents were research partners and industry partners, which constituted also half of the responses (48%). The next major concern indicated was with current and future PhD opportunities at 16% and current and future projects at 15%. The on-line aspect was of interest, but suggested a more supportive role in comparison to the linking and collaboration of research and industry partners. Written comments for question 1 reflected an approximate 51% support in favour for more linkages and collaboration for research and industry partners. The other 49% of written comments were concerned primarily with funding issues. These related to linkages, collaboration as well as current and future research and project opportunities.

#### **4.6.1.2 *Question 2 discussion***

This question reflected (and was influenced by) a previous pilot question regarding policy. A majority of respondents indicated that FEAST policy development would be best served through better lobbying and focused coordination. Thirteen percent of respondents indicated that prioritizing would assist in FEAST policy development.

Written comments focused on coordination of activities at a high level (national level) and lobbying, but also a strong combination of both. There were no written comments directed at priorities specifically.

#### **4.6.1.3 *Question 3 discussion***

This question focused on structure and was influenced by results and subsequent discussions from the pilot questionnaire in relation to the structure and also modes of communication within FEAST.

Respondents indicated forty-five percent preferred a formal arrangement. The other 42% percent indicated they wished for local access via groups, with the final 13% wanting to remain informal. There were more respondents overall, indicating that local or informal access was preferable to a formal organization.

Written comments, however, seemed to indicate the need for information access or exchange, in areas of organization, electronic exchange, organizational networking, workshops, meetings and links to other structures. There was no clear indication as to whether these comments were strictly formal or informal; however, it was clear that access to information was of more concern to the respondents.

However, from looking at the information exchange concerns, it would appear that some type of structure was necessary to conduct these exchanges, one which would perhaps lean towards an organization or local chapters at the very least.

#### **4.6.1.4 *Question 4 discussion***

This question focused on funding and was influenced by results and subsequent discussions from the pilot questionnaire.

There were strong indications that respondents wanted directed (more specific) information in relation to funding, and that FEAST should also coordinate other organizations in relation to funding. Only 12% indicated that FEAST should become a granting body itself. 12% of respondents preferred a variation of all possibilities.

This question had the most written comments, as would be expected due to funding references evident in other questions. Many respondents indicated that assistance in coordination of funding or support for their efforts was needed. Fewer comments were directed at FEAST becoming a granting body itself, which was consistent with the previously discussed twelve percent. The FEAST structure would ultimately have a strong influence on how the FEAST organization approached funding issues.

## **4.7 FEAST case summary**

### **4.7.1 FEAST and associated chapters**

FEAST, the main body, appointed an executive with a formal premises and budget, which continues to operate from Canberra as an organization in its own right, with local chapter groups present in other states (mostly via FEAST France as local chapters).

FEAST France as a group of local chapters continued to gain interest, relying much on the CoP spirit. These groups seemingly had the ability to continually create, with minimal management and support from the French Embassy's Science and Technology Attaché.

### **4.7.2 Observations and outcomes of the FEAST study**

Since the main survey used the initial FEAST conference as an instigator, the main survey also reflected the issues of the day. As such, the main survey that had been developed to record specific initial issues outline in the WG1 strategies simultaneously recorded reflections of the FEAST conference environment itself.

The data and responses that were collected from the pilot, constituted the first level "spiral" as shown in Figure 9 (page 78). The results were used to develop the next survey, the second level spiral for the pilot survey, which would ultimately consisted of the final four questions. It was hoped that the FEAST conference would provided enough interest to collect the main survey data before the event; however, given the difficulties of data collection for the pilot, WG1 also planned to distribute the survey during the conference, collate and carry out analysis during and after the conference. The FEAST conference provided a unique face-to-face opportunity to gather the surveys, in one physical space at the one time, and definitely contributed to the success of the survey data collection.

The methodology allowed for the emergence of responses from participants in two significant forms, the answering of the specific questions and the subsequent comments (voluntary), which were prompted by the questions. The comments did not always reflect directly what the statistical information showed. Although the data were similar, the written comments seemed to allow for a more in-depth response. On the surface this may seem obvious. However, the information elicited in this way often allowed for a more substantial understanding of a subtle but equally important aspect of the exercise. In essence, the way in which the questions were arranged in relation to the timing of the “space” for comments showed what was possible for the questionnaire to gain in terms of the tacit responses.

An example of this is in the last question, regarding funding. The responses were strongly in favour of funding support in various means, which in itself was unsurprising, as funding comments were prevalent throughout the questionnaire. However, the written responses (although similar) reflected a deeper request for information pertaining to access, and for the funding to support this, not just the physical funding issues themselves. So a deeper issue of accessibility emerged through written comments, which in itself is another form of interactivity, and would not have emerged through data collected via quantitative means.

The issues of physical interaction and access was strong. Comments regarding face-to-face meetings, workshops and other opportunities were very prevalent. This would suggest that, along with the access issues, individuals preferred a means of development which included these more interactive aspects. Perhaps this was also a clue regarding the research question, that dispersed groups seem to show a tendency or were more willing to share tacit knowledge when there were face-to-face opportunities.

#### **4.7.3 Lessons learnt in development and the need for future case studies**

This access may also offer a further clue, in relation to “openness to express”, in that there needs to be an environment and/or system which will support these actions of the individuals. This openness to express may need further investigation by means of a comparison in approach; for example, two or more case studies, with the same objective to understand how tacit knowledge is being exchanged but with different approaches, for example, one which promotes spontaneity from the participant and the other which is more prescriptive. FEAST has perhaps provided examples which leaned more towards the spontaneous approach,

through the survey development, the face-to-face components and subsequent “space” created within the survey process.

#### **4.8 The Intelligent Transport Systems Australia (ITSA) case study instance**

The aim of the ITSA case study was to continue the investigation as to the development necessary to support an interaction that would allow the participants to respond beyond what a prescriptive survey could offer.

In relation to the FEAST case study, ITSA offered a further opportunity to examine these possibilities of creating access or interactivity while still being geographically dispersed, but linked by a common cause, such as FEAST members had with the first conference. In this case, it was possible to link ITSA members, as a group, through industry interests. The ITSA case study was created to allow participants to respond as openly as possible by applying certain components from the FEAST case study.

##### **4.8.1 Background**

When organizations are faced with vast quantities of information to be examined, information transfer capabilities and tacit knowledge flows within organizations can be hampered. It is not difficult to foresee how the end user may be overwhelmed by what is relevant or up to date and what, in fact, is being under-utilized, or worse, being lost.

The issue of what is data, how is it being transformed into information and how this information is being utilised for knowledge bases to exchange between individuals and the organization as a whole, highlighted the importance of understanding data, information and subsequent knowledge flows within and between individuals, groups and organizations. Understanding these significant areas may shed light on how better to guide or direct policy of future development of organisations in general.

With these issues in mind, a single question case study was conducted within ITSA with the specific purpose of exploring the issues regarding the generation, use and transfer of knowledge. An emphasis was placed on the “tacit knowledge” aspect, with an understanding that this knowledge phenomenon, in particular, be it individual or organisational, was in many cases the final destination for data and information processes, and that it was specifically these “actions” that were not readily definable.

#### **4.8.1.1 Background development**

The general outline for the methodology and objectives:

1. Initial interview/in depth discussion regarding the organizational meta structure, and to determine what form the case study should take, and how it would interact with participants.
2. An analysis of that discussion to determine key elements on which to focus.
3. Development of key question/questions for a survey.
4. In depth interview/discussion regarding the survey outcome.
5. Analysis of the survey to identify and develop who and how needs to participate and what common points of reference can be identified for the future.

#### **4.8.2 Research details**

The initial discussions focused on the input from CEO Brent Stafford of ITSA and other key staff as necessary. It was agreed that the project would rely on his working knowledge of the organizational workflow and on which specific area to focus initial efforts. These initial efforts were crucial in developing any potential questions, which could help pinpoint an outcome that was both typical of and fundamental to ITSA.

These discussions resulted in the “snapshot” approach, which would involve developing a simple way to elicit specific interaction from participants. This in turn assisted in identifying the “knowledge holes” within the matrix or knowledge web or structure.

##### **4.8.2.1 Research discussion**

It can be appreciated that these knowledge matrices are quite complex structures, as they often mirror the complex interactive networks between individuals within and without organizational boundaries. The total understanding of any type of matrix or web is further hampered by the evolution or change over time (which is constantly taking place), as well as different types of knowledge (or levels) determining the flow of knowledge between points (Prusak 1998, p. 74). These are individuals to individuals or organizations, hence the snapshot approach.

To identify holes or knowledge gaps, the discussions included not only the immediate issues, but also the long-term vision. The discussions covered how that could be developed into a

mind map and also how it could possibly be applied to the organizational structure as well as subsequently being applied to the knowledge matrix or web.

However, determining a relevant starting point was still crucial. In determining this starting point, the snap shot became very useful in creating a “context” (Nonaka 2001, p. 52) within which both tacit and explicit issues could be included, giving more relevance to the exercise.

Because organizational structures can differ to that of a knowledge matrix or web, determining a starting point becomes even more critical as the knowledge gaps would appear differently depending on how the different structures are used (organizational structure or knowledge matrix).

Organizational structures can relate to a more explicit knowledge base which is relevant to the action of knowledge transfer. On the other hand knowledge matrix or webs can be more tacitly related. Organizational structures may not on their own provide a comprehensive enough basis for the snapshot, and may perhaps not allow for a comprehensive understanding of current knowledge gaps, pending or long range future ones. Achieving an eventual ability to overlay these differing matrixes would be useful to show up areas or gaps and could also give some indication as to current and future requirements, not only in the explicit but also, more importantly, in the tacit aspects.

#### **4.8.2.2 *ITSA research question structural development***

To determine some actual starting point, initial discussion centred on how organisations or groups were being “born global” due to the individuals ability to convey their tacit thoughts and experiences into explicit reports etc with IT support through the use of email etc. Within organisations, or even projects within groups, the aspect of being born global inspired the thought or discussion regarding aspects of usability or user friendly access. Usability was seen as a key component to creating useful links between individuals inside and outside the organisational boundaries. So the discussion group (CEO Brent Stafford of ITSA and other key staff as necessary) began by asking and discussing the following question regarding usability.

*What determines/drives user adoption?*

Several factors were involved with usability and adoption, and include the following:

*Access or use was achieved through the following;*

1. interpersonal networks,
2. face-to-face,
3. virtual or
4. word of mouth.

These and other user adoption issues could be overcome as a matter of course by successful interpersonal networks. These user adoption issues may be cultural barriers, knowledge content/segmentation difficulties, or a lack of understanding or awareness that these issues exist. The user adoption issues could also include the different levels of knowledge not matching up, so to speak; for example, the matrix or knowledge maps used as reference points could be tacit or explicitly based with the user understanding this and creating different industry networks. These networks, being so different render any attempt to find reference points difficult, if not impossible, for example a politically based map as opposed to actual physical structure.

It is important that the interpersonal networks have the support and usability to ensure user adoption, so that the continuous cycle of knowledge creation and use can be achieved. In many organizations this already occurs on a low level in loosely arranged communities of interests (COIs) which, may over time (as the knowledge web changes) develop into CoPs (Wenger and Snyder 2000). These are socially developed interpersonal networks, which are usually able to transgress more formal knowledge level mismatching, matrix mismatching and cultural barriers, due to knowledge creation needing a context. Interpersonal networks or CoPs are supportive environments for tacit exchange and, therefore, have the ability to overcome many of the previously mentioned issues due to the all binding aspect of the “tacit context”. This essentially is the “knowledge-creating process in context specific terms of who participates and how” (Nonaka 2001, p.52).

The areas of focus finally pointed to what environment or “context” was to be emphasised and how was the communication to be carried out. The environment or tacit context would determine the “who” and those who participated would then indicate on the survey as to “how”.



#### **4.8.2.3 *Designing the survey question***

After extensive discussions with the CEO, it was understood that the survey question needed to reflect the basis of the questions from prior research. However doing this involved getting past the detail through indicating what context or environment would trigger a fully tacit response; for example, investigating “between the lines” and identifying what the “space between” explicit represents. Identifying the “between the lines” and “space between” and identifying the tacit responses, created a focusing or unifying goal for the overall research intent.

The question needed to be short, simple and user friendly. It also needed to engage as many people as possible, operating from their differing knowledge levels.

It would be difficult for a single question to cover everything that had been discussed, so a only an indication of knowledge exchange was to be sought. If the technique was successful, a series of prepared single questionnaires would be used to build a framework to be used within the organization. The guiding, overall mission or vision was to elicit an understanding of knowledge flows at different levels.

#### **4.8.2.4 *The final question reflected specific ITSA concerns***

These background questions needed to reflect all who might participate, local or distant individuals or groups. The question also needed to be presented in such a manner as to reflect the concerns raised earlier regarding usability, which would trigger the “who” aspect.

1. What are physical and non-physical environments for tacit context?
2. What type of tacit sharing exchange happens in physical or non-physical environment or context?
3. What are the knowledge sharing challenges dispersed groups face?
4. Within the relationships between groups, communities, companies and environments, what are the key defining elements (if any)?
5. What were the essential differences between tacit and explicit in relation to networking?
6. How do they see themselves in their network?
7. How do you know that tacit knowledge sharing is happening?

8. Given the difficulties in the above questions, what are the circumstances of tacit importing and the difficulties of sustaining it e.g., physical separation?
9. Given that there is a protocol for explicit knowledge, is there such a thing for tacit?
10. Is the basis of a tacit protocol environmental?
11. Is it strictly true that tacit knowledge sharing only occurs when people are face to face?

#### 4.8.2.5 *Layout of the Survey Question*

This was the final layout for the survey question.

When sharing or discussing ideas or issues with others, which of the following would you most prefer to do:

***Tick your preference***

Discuss it face-to-face, individually, or in a group?

***OR***

Verbal real time discussion, e.g., phones, video conferencing?

***OR***

By electronic means, e.g., email?

***OR***

By writing, e.g., memo, letter, newsletter or fax?

***OR***

None of the above

***If none, please specify if possible:***

.....

#### 4.8.3 **Results**

When respondents were questioned as to how they would most prefer to share or discuss what they knew or engage in an exchange regarding their issues or concerns, the most preferred category of “Face-to-Face” was selected, as the results below indicate. The “ticked” responses to the questions in the sub-section (see Appendix 3, p. 193) were as follows:

- |                 |    |
|-----------------|----|
| a) Face-to-Face | 27 |
| b) Electronic   | 19 |
| c) Real Time    | 1  |

d) None of the Above 3

The written responses were as follows:

1. Depends on idea or issue. If technical, then e-mail is best. If a value, personal or moral proposition then face to face is essential.
2. What I would prefer to do and what is realistic are two different issues – what is realistic is email.
3. It is important to do both email and face to face depending on the situation and circumstance and as I am only a new member it is difficult to judge.
4. If face to face is not feasible then by phone and finally email.
5. F to F, however, this is not always expedient. Email is sufficient.
6. It's a matter of priority.

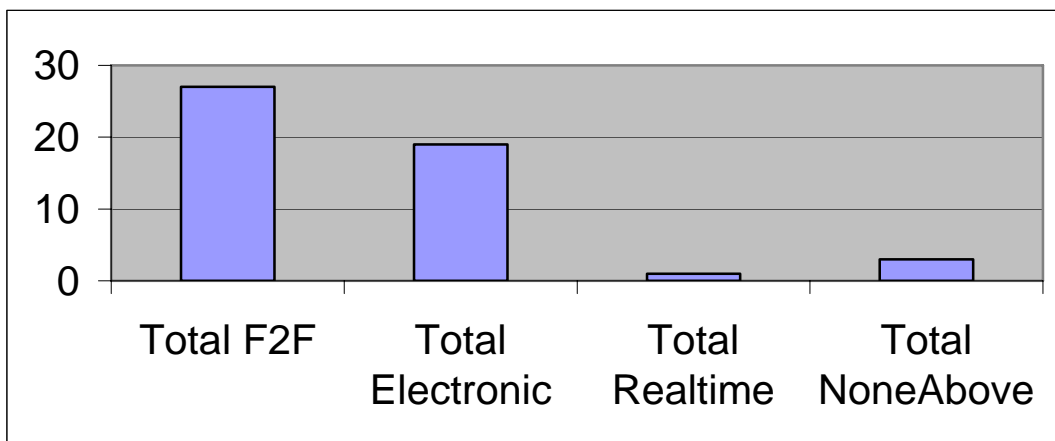


Figure 14 – ITS Australia Survey Comparative Results

#### 4.8.4 Analysis

Written responses indicated (the participant may have been aware of) some type of knowledge level linking was required for understanding to occur. For example, the responses which stated that there was a difference between what is possible or realistic (to do with time and distance) and what level of interaction was needed, such as, technical or moral (more personal). As the question only took several seconds to complete, this factor may have contributed to the responses coming from a more tacit space, before becoming an explicit part of the survey. Also, it was hoped that the question being presented in this quick and “instant” manner would allow the participants to give a more spontaneous response, and decide for themselves what “ideas or issues” meant, when applying their understanding to their response.

When viewing the results in relation to the background questions, an understanding of the “type” of tacit knowledge sharing was important when choosing a method of exchange. Although this point may seem obvious, it clearly implies that the knowledge levels are crucial when looking at who needs to exchange what type of knowledge and how this was happening, so that issues and obstacles of knowledge transfer are overcome. An analysis of the written responses in correlation with the desire for face-to-face seemed to indicate a new understanding regarding “tacit protocol”.

#### **4.8.5 Summary of ITS Australia case study**

Explicit protocol is known and understood. However, through the ITS Australia case study a key finding was the identification of “tacit protocols” which seem to exist within levels of differing knowledge. The “what” or “tacit content” are the levels which need to find corresponding similar levels between those who are exchanging. This is easier to do when the levels are similar between both parties. This also relates to the “how” aspect of knowledge exchange. For example, if the level or content is of a technical nature then there is already a “language” or common understanding of how things or concepts are named or expressed, it is if you like an agreed language (i.e., scientific). Therefore, non-agreed language (such as personal or moral) is less definable. Therefore face-to-face for example is preferred or even necessary in such cases and becomes crucial when cultural implications are involved.

#### **4.8.6 Summary of ITS Australia research outcomes**

The ITS Australia research outcomes included the identification of tacit protocols and their significant link to differing knowledge levels. This was achieved through the development and refinement of the questionnaire into a single question on-line survey. The use of a single question on-line survey contributed to eliciting and identifying subtle tacit protocol and knowledge level links. Collectively, a number of single question on-line surveys would have the capability of building a broader understanding of tacit protocols within CoPs and the tacit knowledge exchange within complex systems.

Gaining a better understanding of both informal (ITSA case study instance) and more formal approaches (OECD case study instance) was important as it might contribute to a better comparative understanding of the significance of the relevant methods, during initiation, development and reflections of TKE and the development of TKNs.

## **4.9 The OECD knowledge management survey; knowledge management in the private sector case study**

The OECD survey was chosen as a case study as it served several aspects simultaneously. Firstly, it was attempted to gain an understanding of knowledge management in the private sector. Secondly, it was an internationally comparative survey including geographically dispersed groups involved (which was directly relevant to the research question). Thirdly, the OECD KM survey had been (relatively speaking) developed in a more prescriptive or formal approach, which was in contrast to the previous two case study instances, FEAST and ITS Australia. This contrast provided an important comparison between formal and informal approaches. The relationship between formal and informal approaches had significance with regards to the contrast between tacit and explicit knowledge exchanges (Wenger and Snyder 2000, p. 141; Nousala 2003; Nousala and John 2004), with the informal approach relating to tacit behaviour of CoPs or working groups.

### **4.9.1 Background**

This pre-testing pilot case study was the smaller Australian component of a larger OECD (Organisation for Economic Cooperation and Development) international initiative, which aimed to carry out an international comparative investigation into knowledge management in the private sector. This investigation included what is understood by the term, types of knowledge management practices in use, awareness, active support and effectiveness of these practices in this sector.

The purpose of a pre-testing pilot was to test the questionnaire to ensure that the questionnaire was as user friendly as possible. The usefulness of was a concern, given the difficulty of defining the subject matter of KM, which for some of the participants would cover a large spectrum.

In both the Canadian and Danish full pilot projects, pre-testing were essential to ensure language and subsequent translations were understandable. In the Australian case, although we have a common language, we also have great cultural diversity in the workforce, so it was

thought necessary to carry out a pre-testing project. Though small, it gave a possible indication as to how well the questionnaire would be received.

It is intended that this information and report be passed onto the Australian Bureau of Statistics for their possible future use of a full pilot program in connection to an innovation survey, in a similar format to that of the French pilot survey.

#### ***4.9.1.1 Research development for the pre-testing project***

Due to the collective experience of the Canadian, Danish, German and French pilots, it was suggested during the fourth OECD meeting in Karlsruhe 25-26 March 2002 that it would be beneficial for those countries wishing to carry out a pilot or the full survey to conduct some level of pre-testing. It was also discussed by the Danish that there was great benefit in recording respondents when they were given “thinking aloud” time, as it encouraged more cognitive or more tacit processes to occur in response to the survey questions. This experience was initially carried out and discussed by the Canadians, as they conducted extensive “cognitive testing” (Earl and Bordt 2002 p.13) in the early development of their pilot survey. The Canadian experience had approximately 30 respondents thinking aloud, which gave important insights as to how knowledge management was being perceived. It also gave some guidance as to how modifications could be made to the survey to include more informal practices. These informal practices included sharing of best practices and collaborative working programs. This cognitive testing was not part of the Canadian standard testing procedures. It was also not standard procedure for the interviewer to be present and engage in dialogue with participants.

The OECD instigated this study in an attempt to examine what the knowledge management influences were developing and how these were being perceived used or instigated throughout private practice. These concepts were supported by the modern management theorists Nonaka and Takeuchi (1995) and Davenport and Prusak (1998), who advocate that knowledge management is a “knowledge creating process”. Nonaka and Takeuchi (1995) and Davenport and Prusak (1998) state that management can no longer rely on tangible processes, hence the rise of the knowledge economy with a heavier emphasis on the tacit aspects of organizations. This had introduced new challenges to the current management throughout the private sector.

To date, very few internationally comparative studies had been carried out for those using the concepts and practices of KM. The studies that had been carried out were primarily investigated single large firms, with no real comparative components regarding national or cross border investigations. Therefore there were no real possibilities of comparative studies with industry sectors or any other linkages with relevant studies which might contribute to a more in-depth view of KM development within international private sectors.

The intention of the OECD survey and the subsequent Australian pre-testing pilot project was to contribute to the clarification of knowledge management in general, and to clarify or contribute to the understanding of what was meant by knowledge management in the private sector, as well as some type of coherent or common terminology in order to deal with the whole knowledge management concept.

To date, the member countries involved with carrying out pilot projects were initially Canada, Germany, France and Denmark. Canada was the main editor of the pilot survey, which was conducted by Statistics Canada. Contributing member countries to the survey were Germany, France, Canada, UK, Sweden, Italy, Denmark, USA, Holland and Australia. Four face-to-face meetings were held to develop the survey and discuss changes. Contact was also made via email to discuss specific experiences, issues, solutions and suggestion of concerned members.

#### **4.9.2 Results**

The data collection for the pre-testing project started in September 2002 and was finalized in mid November 2002.

As previously indicated, the Canadian study conducted this pre-testing phase with results from about 30 respondents. The Australian equivalent was conducted with 14 respondents, which is approximately half the Canadian study, and comparable to the respective countries' population size, distances and geographical distribution etc. The Results of the pilot study questionnaire are listed in Figure 15.



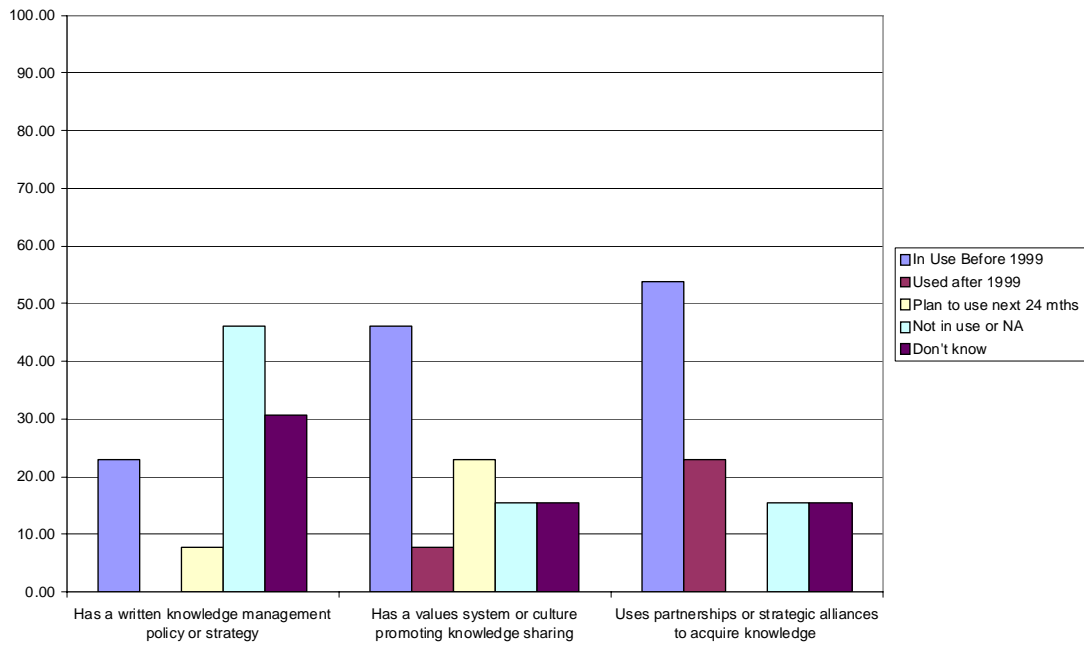


Figure 15 – Policies and strategies questions A - C

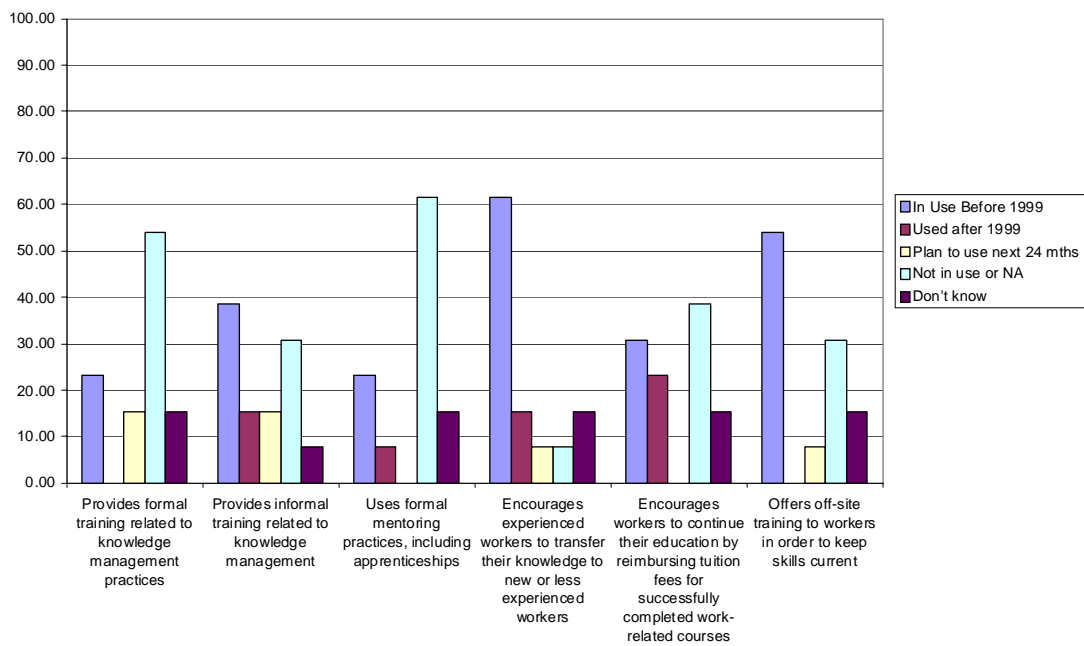


Figure 16 – Training and mentoring questions A - F

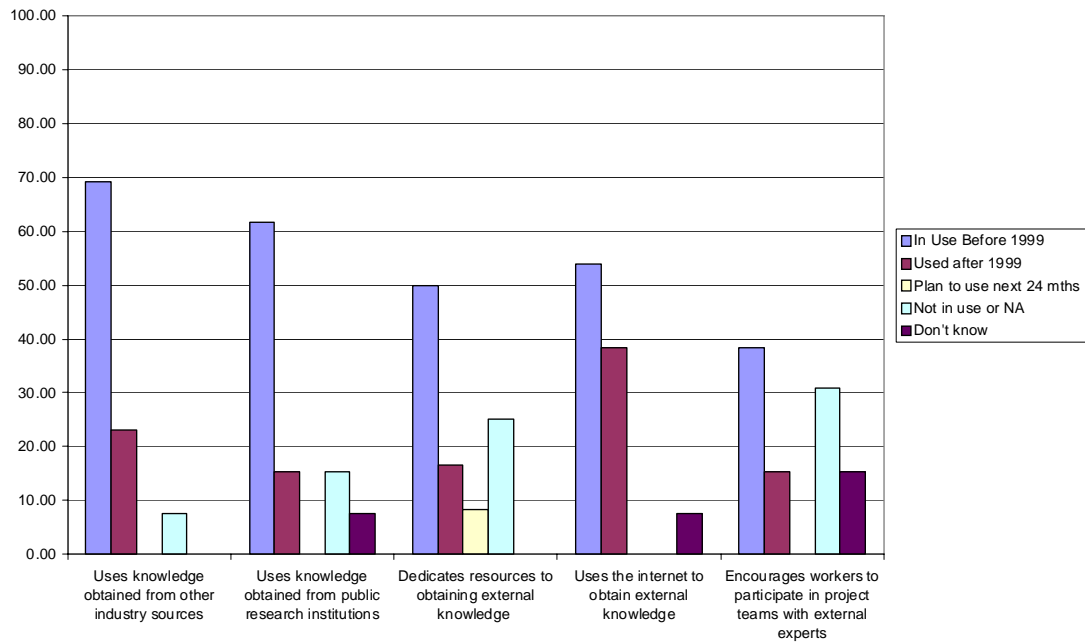


Figure 17 – Knowledge capture and acquisition questions A - E

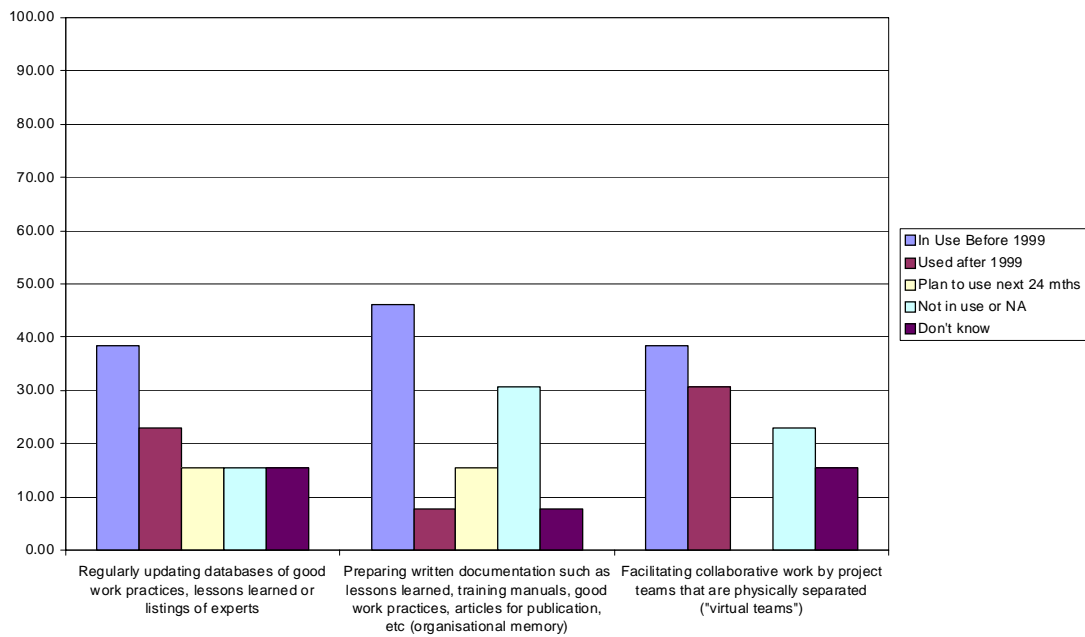
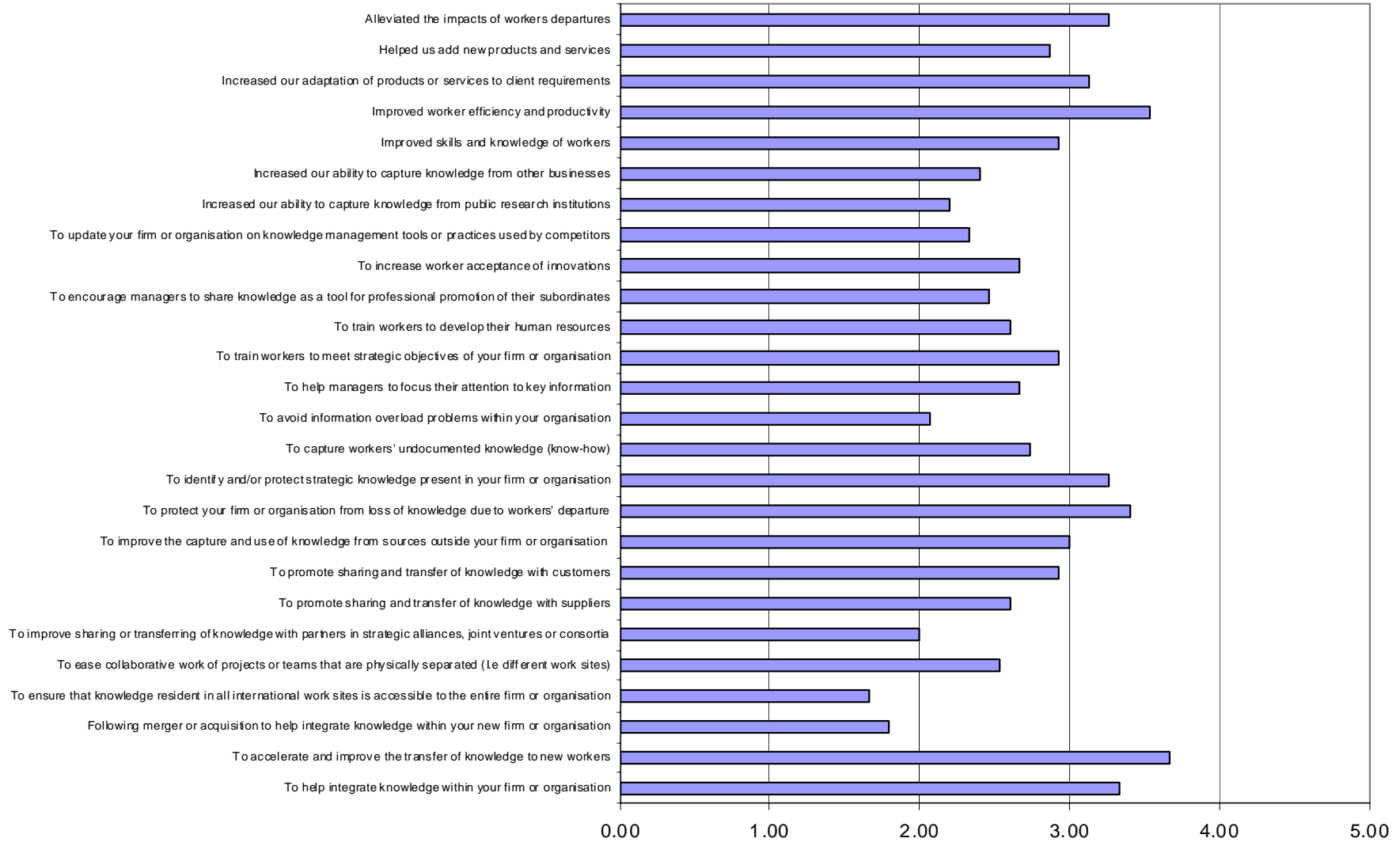


Figure 18 – Communications questions A –

Figure 19 – Knowledge integration /sharing questions A – S  
 (Where 0.00 is not applicable – increasing in importance)



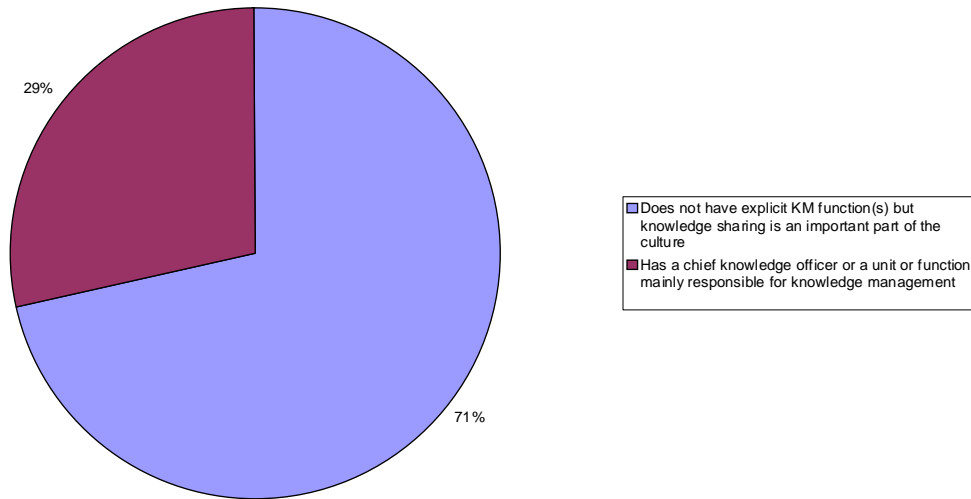


Figure 20 – Knowledge management practices/responsibility questions 1-2

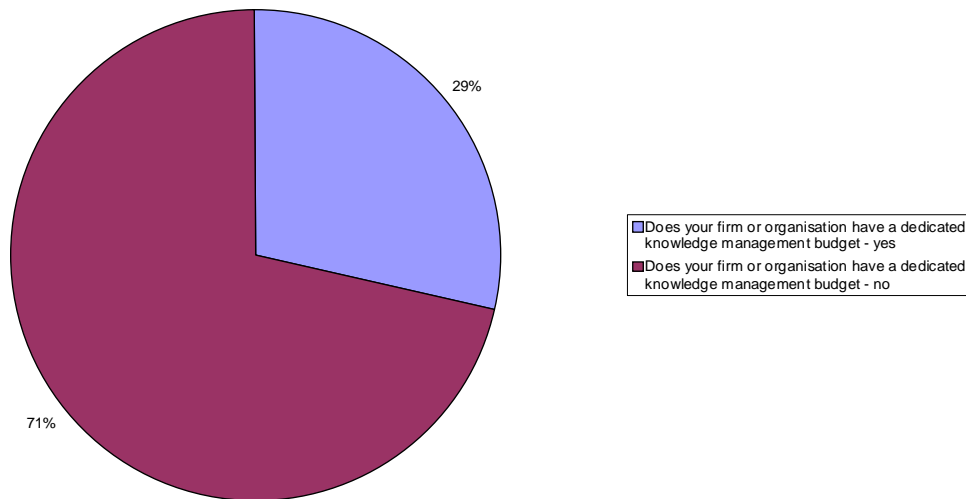


Figure 21 – Dedicated knowledge management budget questions 1-2

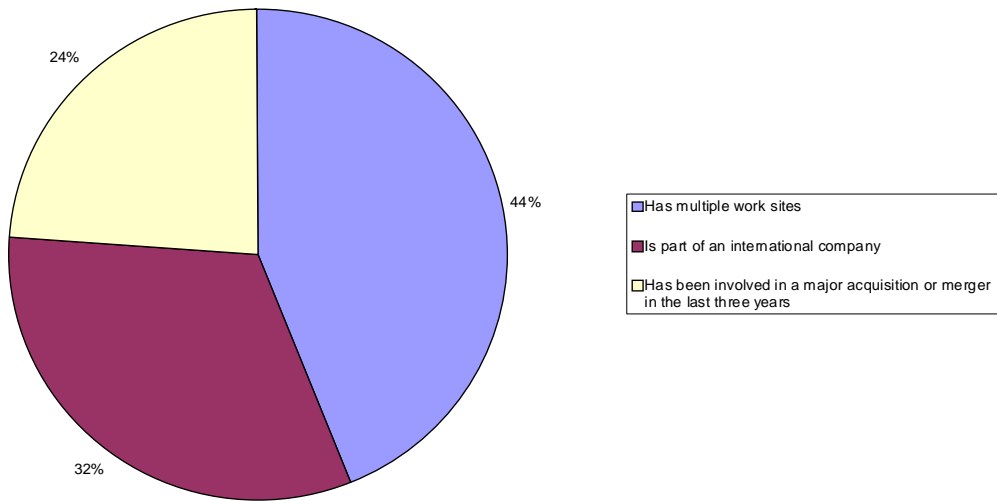


Figure 22 – Employment structure questions 1 - 3

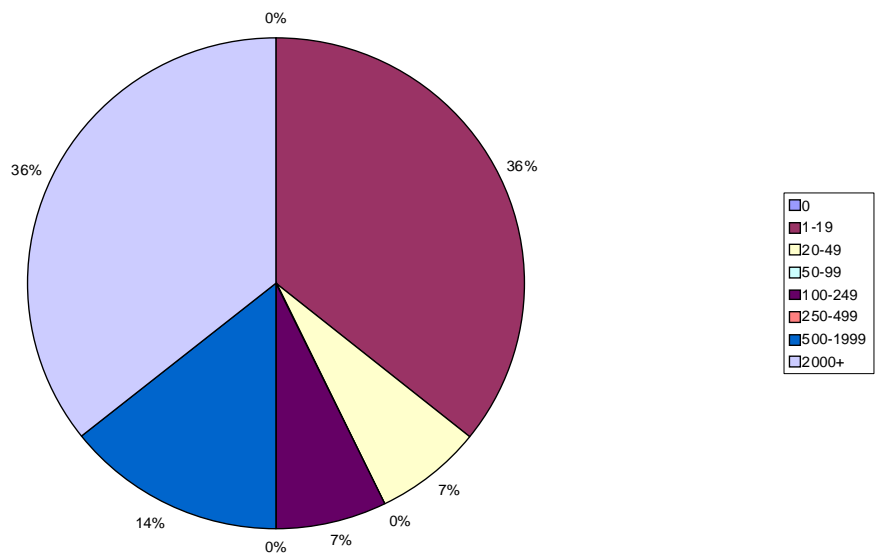


Figure 23 – Number of staff question, selection of 1-8

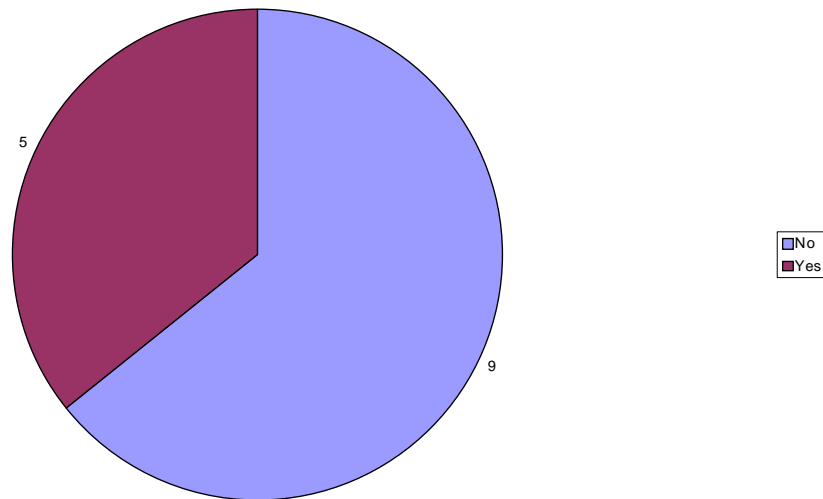


Figure 24 – Staff working outside or in country

#### 4.9.2.1 *OECD survey data*

With the assistance of the National Office of Information Economy (NOIE), 100 companies were selected to participate in the survey on a voluntary basis. This indicated a 14% response rate.

#### 4.9.3 **Analysis**

The sectors chosen were ICT, IT and high-end services (e.g., medical, legal, financial). This selection of the sectors was the result of previous discussions held at the OECD Karlsruhe meeting, where it was suggested that a core group of sectors could be used to help provide comparisons with other existing studies and possible related studies, including the countries engaging in main surveys in the future. The choice of sectors was also the preferred focus of the Australian Government departments, NOIE, and the Australian Department of Industry Science and Resources.

##### 4.9.3.1 *Discussion*

The participants were contacted by phone and the survey described to them. They then received the survey via email, and were requested to send a hard copy by post, to comply with ethics requirements. Initial direct contact was considered favourable, as was found with the Danish and Canadian experiences. Participants had reminders via email and by phone, as in

the Danish, Canadian and German experiences. Many indicated that they were interested and would like the results, but then failed to return the survey. The major reason, (as indicated by potential participants' failure to respond) the length of the survey was seen as a deterrent. Many also indicated that they would have preferred to carry out the survey completely on-line (which was also the experience of the Canadian pilot), but that the length was still too long (length was mentioned more than once, in some cases).

In addition to physically completing the survey itself, (as in the case of the Canadian pre-testing cognitive testing, and subsequent Danish pilot), participants were asked if the investigator could be present (where permission was given and where possible to do so) to record the participants thinking aloud. Seven surveys were collected, which contained more of this qualitative data, which assisted in giving more of an insight into the way in which the participants experienced or perceived the survey as a whole. Some participants' comments were recorded in person. With others, the comments were discussed over the phone or written on the survey form as added comments.

The participants for each company held the office of director or CEO or some equivalent senior position, and were considered as the responsible recipient of the survey for the company. Participants who responded to the survey were self-selected by their own company process. The investigator had no involvement or influence as to what individual completed the survey within each organisation.

Due to the size of the survey, it could only possibly serve as an indication or added commentary to aid any subsequent main surveys yet to be carried out. A significant proportion of the information gained will be of a qualitative nature, as there is not enough data for pure statistical purposes.

#### **4.9.3.2 *Issues and limitations***

From analysing the experience of the first four pilots, (conducted by Canada, France, Germany and Denmark), questions in relation to their experiences were formulated as a focus point for the analysis of results in preparation for carrying out the Australian pre-testing project. Some of the questions remained unanswered. However, this highlighted issues and possible limitations that the Australian pilot survey could have encountered, and also identified where Australia could ultimately contribute to the process as a whole.

#### **4.9.3.3 *Questions from analysis of previous pilot studies***

The questions listed below from A - I are actual questions which resulted from direct discussions during the analysis of the first four pilot survey results conducted by Canada, France, Germany and Denmark.

- a. How relevant is the term KM, or would it be preferable to use “capture and sharing” as Denmark did?
- b. How well are the terms “don’t know/not applicable” understood, or as in the Danish and Canadian experience will they need clarification?
- c. Looking at the experience of the German pilot, how will we clarify the perception of “high level of KM practices” in comparison to relevant KM strategies, which are in use in relation to formal and informal?
- d. How much explicit description of terminology can be given before a danger of influencing the respondents is created (Danish vs German pilots)?
- e. The German experience was that although KM concepts were generally understood and they were seen in the context of HRM or RD. Would the survey be useful in eliciting KM for KM reasons?
- f. What differences can be created between terminology and explanations?
- g. As in the Canadian experience, is on-line the best way to secure an efficient response rate?
- h. Is the survey too long?
- i. Does self-selection of the organizations participants affect the future development of the question of validation?

#### **4.9.3.4 *Limitation discussion***

The following discussion is in response to the previously listed questions which resulted from the analysis of the first four pilot survey results (conducted by Canada, France, Germany and Denmark).

The pre-testing project indicated that there were some differing responses towards the term KM. These were generally voiced during discussion, and were also reflected in some of the responses, as well as some written comments. The differences were generally indicated between what practices were considered KM and what were not. These responses also reflected some confusion as to how KM was perceived in regard to what were high level KM practices, could these be considered formal, or what part of KM strategies could be perceived



as high level, formal or informal. These thoughts were voiced as concerns by the respondents in the pre-testing project and needed to be addressed in any subsequent survey.

The issue of “don’t know” and “not applicable” caused concern (and needed explanation). This was also the Canadian and Danish experience, and would also need to be addressed in any subsequent survey.

Respondents found the initial description of KM useful, but then continued to interpret the questions in their own way, typically adding written comments or voicing their opinion in addition to the questions. This may indicate that it is perhaps better not to provide too much explicit description of terminology or definitions, allowing the respondent more opportunity to provide responses with minimal influence by the investigator.

KM practice and concepts were generally seen as part of the organizational structure and perhaps attached to training. However, this was possible to carry out throughout the organization, rather than being attached to or seen in the context of R&D or HRM, as was the experience with the German pilot.

Some difficulties were indicated, written or voiced regarding the differences between explanations of various meanings and terminology. However, these were generally confined to the point made earlier, about how different KM practices were perceived as high level strategies, either formal or informal.

Every respondent indicated that an on-line approach would be preferable (which was also similar to the Canadian experience). The other difficulty in relation to completing the questionnaire physically was that it was still too long. This would need to be addressed in any subsequent survey attempts.

Some participants raised the question of what type of participant was suitable, as they were self-selected. This issue was also raised by NOIE, which was supporting the project. This issue would need further discussion and work. Some organizations selected participants, some were nominated, others were the CEO or business owner. This information was not formally part of the questionnaire, but was revealed during conversations. As was pointed out during several discussions, this issue needed further investigation due to the relevance of validity. It is not clear as to the extent this issue has influenced the questionnaire, or how the

investigator in the future needs to approach this issue. If the project should escalate into a formal survey, this could then be discussed in more of an Australian context.

The question was also raised, as to what effect did comparative participants' organizational positions have on each other's perception, and that of the overall organization, when answering the questionnaire. This issue was brought up during the pre-testing project and required clarification in any subsequent investigation in relation to future surveys.

#### **4.9.4 Summary of OECD case study**

##### ***4.9.4.1 Difficulties with universal identification of KM practices***

Although most respondents indicated that the more physical practices such as database management, written documentation from lessons learned, training manuals, articles for publication etc, had been in use since 1999, a fairly low response rate for the same period of time was indicated for why organizations applied KM practices (as a whole). This is interesting, as a significant level of respondents indicated that virtual teams had been collaborating in projects (within the organization), which were supported by presumably the same databases, management, written documentation etc, and yet low responses were indicated for applied KM practices but high levels of virtual KM team over the same period of time, highlighting a conflict with the responses regarding what were KM activities. Half of the respondents indicated that they had experienced other KM practices that were not included in the survey. The written comments all supported more tacit aspects of KM practice, and indicated that this was of interest or an aspect commented on by respondents. This perhaps needs to be explored in possible later designs of the questionnaire.

##### ***4.9.4.2 Difficulties of formal questionnaire designs and tacit responses***

Parts of the written responses might have been recorded in previous questions, prior to the respondents written comments. However, the fact that they still felt it necessary to provide written comment when the opportunity presented indicated that in attempting to elicit more conceptual or tacit responses, the questionnaire in itself may not be adequate, and that perhaps for less tangible responses, more scope may be needed within the questionnaire design for respondents to express these thoughts. It is perhaps also worth noting that the placement of the comments section at the end of all the previous questions may have assisted the

respondent's thought processes and helped them to identify further KM practices, which previously may not have been obvious to them. The possibility for respondents to provide comment with less constraint than in previous questions may indicate that they did so with minimal outside influence, which may have contributed to valuable insights.

#### ***4.9.4.3 Pre-testing project outcomes***

The pre-testing project outcomes indicated differing concepts of knowledge exchange and practice regarding with regards to individuals or the groups or organizations. If this is so, then the context or the environment is an important factor as to why knowledge exchange has been perceived in this way. With regards to individuals or the groups or organizations the knowledge flow between all these levels, may then, be significantly influenced by their environments. The knowledge context, environment and climate could be interpreted as supporting the same cause in regards to knowledge sharing or flow, that being a “space” in which to operate.

#### ***4.9.4.4 Formal survey tools and experience based information collection***

The survey tool is useful in defining how the data are to be collected, based on existing frameworks, (OECD 2001b). However, a survey, as a tool, may be less successful in collecting necessary examples of “experience bases” of information or knowledge. More importantly, the collection of the individual and/or organizational knowledge either by individual concepts or whole knowledge bases of the organizations (which also characterise that particular corporate identity) or individuals knowledge bases, may be difficult to gather though the use of formal surveys. The identification of knowledge flows throughout the corporate sector, can be assisted with solid statistical measurements, but may need to incorporate a broader range or conceptual information with methodologies, which integrate all these entities.

#### ***4.9.4.5 Perceptions of KM practices***

KM practices were not perceived as clear and tangible organized activities. There was a reasonable emphasis placed on the individual to acquire new skills and be responsible to pass them on. Organizationally, the KM practices did not reflect strongly, and subsequently, did not reflect whole working groups, whether they were national or international. The emphasis

was again placed on the individuals. This reflected on the use of the questionnaire itself, whether or not it successfully elicited tacit links between what was happening between individuals, their organizations and how all these entities were engaging, on differing levels, in regards to KM practices.

#### **4.10 Discussion of all case study instances – FEAST, ITSA & OECD**

##### **4.10.1 An emerging analytical framework**

To summarize the emerging framework begins with the (1) FEAST case study which resulted with both formal and informal research outcomes regarding TKE. TKE favored the informal approach with regards to results. This led to further investigation into the differences and advantages between formal and informal approaches with regards to TKE research. (2) The ITSA case study was designed to follow the informal approach from the FEAST case study which led to the identification of tacit protocols. (3) The OECD followed the more structured, formal research approach previously undertaken in the FEAST case study. This more formal approach failed to elicit the experiential or tacit aspects of TKE. (4) The comparative analysis between these case studies highlighted tacit knowledge networks and possible connected attributes through contextual and experiential threads. (5) The concepts of contextual, experiential threads and their attributes were then tested in last case study the EPMO. The emerging analytical framework is discussed in more detail in the subsequent paragraphs.

Complexity, as a new paradigm or new conceptualization practice, allows a shift in the way in which knowledge is viewed allowing for a new perception of understanding of tacit knowledge concepts which may not have previously been recognised. If one is not aware of these different perceptions or have some understanding of them, then it would be difficult for anyone to comprehend how complexity can assist in bringing forth new concepts or views about any area of TKE. Tasaka (1999), attempts to define the complexity paradigm as “complexity knowing” and the subsequent shift that occurs once this paradigm is understood and put into practice.

In relation to the sub-questions supporting the thesis question, many different aspects of individual and group dynamics evolved, which rendered investigations into emergence, complexity sciences and theories as well as the organizational management, relevant. It also seemed a natural progression to the complexity society biology, which seemed to be the

supportive basis in Snowden's (2000b) third generation TKE work. This area of complexity may also change the approach and underlying relevance in developing a model as was previously envisaged.

Vocabulary and its possible relevance or relation to organizational management and knowledge exchange seems to have similar significance to that of complexity theory, and perhaps further utilization of this possibly as an evolving tool and method needs further research. Final analysis starts with a focus on the environment of the organisation and the context in which communities of practice operate in.

An attempt to design a model was made, which was to assist in the understanding in (Humanistic Knowledge Management) HKM environment:

- a. Organizational
- b. CoP
- c. Individual

Wenger and Snyder (2000, p.178) also states the importance of "tacit movement being done by the process, in the form of organisational coordination". Or in other words, getting local small groups of knowledge into wider circulation. With this concept of local and simultaneous global movement of tacit knowledge, the importance of communities of practice perhaps becoming "core elements" would perhaps need to be emphasised in any design for a model.

Preliminary design elements of these tacit processes in movement, were put forward as;

CoPs as core elements (encompassing social and intellectual capital) with peer recognition and career advancement as motive.

Exploiting the tension between process and practice (with CoPs as the "practical tool") where tension = innovation → TKN.

The research analysis endeavoured to encompass the elements that were been previously discussed with the view to the organisational overall process being important. However, it is the "human practice" or "human practical action" which gave life to the process. As

discussed by Seely Brown and Duguid (2000a, p. 97) the practitioners of CoPs their use of peer groups more than their supervisors. This is an important point, as their peers are involved in the practical aspects and are more likely to share in similar experiences from which they can learn. This was evident for the working group for the OECD survey. The members involved shared experiences and the most amount of sharing and understanding took place during face to face meetings. Work continued to be carried out via email and phone calls between meetings, however, this was only possible after an understanding of specific means, targets and tasks had been clarified at previous meetings. It was also easier to carry out the knowledge exchanges in person as some of the concepts being conveyed were complex, and also had cultural and language implications which were again, easier to convey in person.

Seely Brown and Duguid (2000, p. 94-95) also discuss the importance of the “experiencing the process”, as apposed to “re-engineering” which is very longitudinal (or linear). They go on to say how management has proven to be a difficult candidate for re-engineering, as “meaning and knowledge are at a premium”. Management, research and development, are difficult to re-engineer, as they are “less definable”, for example, pin pointing inputs and outputs (this is also important with regard to the tacit knowledge network or practical networking in progress). Although the intent of the surveys carried out for the case studies was to contribute as much as possible to the tacit exchange, in all cases, a traditional survey was not sufficient to elicit this, and was perhaps too linear and not as multidimensional as tacit elicitation requires.

Petersen (1999, p. 5) suggests a common way of learning seems to be transferred to us by small pieces of knowledge via instructions, “this is the algorithmic model”. However, this would suggest that most tacit knowledge is also hidden from ourselves. This would also correlate with the findings from the ITSA case study, regarding the differing knowledge levels, within and between communities or groups.

Knowledge has been in more recent times diversified, meaning that you rely on the knowledge of others to have a more detailed tacit understanding of particular areas. This would also mean that this “detailed tacit understanding” is also “stored” with different individuals in different locations, and perhaps the “communities” are an increasing necessity for forming important relationships between individuals and communities themselves. Here

again, the importance of connecting relevant knowledge levels found in the ITSA case study, is touched on.

Petersen (1999), suggests that there is a tacit connection between:

- a) Pockets of knowledge access eg; books etc.
- b) Physically making the tacit links.
- c) Connecting and interacting with different communities of knowledge

All of the above are needed to create a desired outcome eg; to build or make something or to design or create a methodology for an outcome. Petersen (1999, p. 6) also states, “tentatively we may assume that more and more of our knowledge is becoming as it were outsourced”.

For example, with the ITSA case study instance respondents indicated that they had their own ways of making connections regarding sharing something they knew or wanted to know. Many preferred to share their know knowledge face-to-face, as they preferred ‘physically making the tacit links’.

When looking at CoPs it is important to understand that all CoPs have their own tacit language or body of knowledge which needs to be understood in a “taken for granted” (Petersen 1999, p. 3), manner, in order for more explicit methods and translations to evolve. When developing the model, the importance of the process for the organization as a whole needed to be recognised, however, it is also the human practice or the human practical action, which gives life to the process.

#### **4.10.2 Using tacit knowledge networking (TKN) to explore the relevance of an environmental model**

Regarding HKM, the environment can be an influencing factor. Which CoPs or communities of practice can foster TKN?

“The most important invention that will come out of the corporate research lab in the future will be the corporation itself. As companies try to keep pace increasingly unstable business environment, the research department has to do more than simply innovate new products. It must design the new technological and organisational ‘architectures’ that make possible a continuously innovating company” (Seely Brown 1998, p. 154).

Seely Brown (1998) argues that successful companies or entities will need to know how their people really work and how they engage technology to support the knowledge workers ever changing and evolving innovative environment. TKN can in effect create spirals of tacit and explicit exchanges and sustain them within supportive HKM environments. Internal TKNs involve CoPs, which may be viewed as the following:

1. Vision and alignment or creation and sustain (initiation by individual)
2. Manage or evolve (process)
3. Content
4. Culture
5. Process
6. Infrastructure
7. Creating an effective plan (process)
8. Never ending effort (sustainability of practice)

The above stages (1-4) are how Chait (2000, p. 92) describes specific internal tacit exchange. However, with regard to the case study experiences, in particular ITSA, this approach seems to suggest that TKE, both internal and external may not occur or be adequately described in this way.

The importance of knowledge workers continues to evolve in ever changing environments. However, relating these concepts in “model” form may not be as important as once thought; indeed it may not even be appropriate. Therefore, the question or issue may be how is it possible to show that the TKE is occurring within CoPs and subsequent TKN (on all levels)? A clue to this may be found in face-to-face results of the individuals in the case studies and how their experiences were relayed to their organisations (if at all). The less prescriptive, the more evidence of emergent type of behaviour occurred.

Josefson (1999, p14) describes this “A system which allows *experience* to be uncontrolled when exchanging reference”. For example in the FEAST case study instance, far more exchange of knowledge sharing occurred with the less formal working groups where individuals could experience the emergent ideas, well before they were set into concrete procedures of any kind. He goes on to say regarding the tacit experience “To have the ability to *reduce* or *discard* certain information that could be seen as important to a particular problem, without precisely knowing why may offer *hints* to what aspects of expertise are. In other cases it looks as if missing parts are filled in order to see something” (Josefson 1999, p.



2). There is a relevant link between the recognition of individuals' practice and the group practice regarding tacit explicit exchange required to continue that exchange. Josefsen (1999, p. 23) also states, "In analyses of the reasoning of experts it has been found that they seem to depend on a superior kind of pattern recognition, and that they more often than non-experts rely on forward reasoning."

There is a sense of relevant relationships and how they need to interact, and how it is easier to recognize patterns than bodies of knowledge. When considering CoPs in action, the physical is easier to discern than the tacit exchange, however both contribute to the development and evolution of the community's language and identity as a whole.

The tacit knowledge exchange is described by Josefsen (1999, p. 23) as, "shared informal knowledge" that we all possess in various levels and which can come to the fore when in a CoP. This type of knowledge is filtered as a group through peers and the result could be compared to Josefsen's "common sense". This is what can be applied to a practice and can be the knowledge born out of a CoP. Peers in CoP are all giving their view of "common sense" but it has also been "filtered" through a social peer group whose end result is to apply it in a practical way through their individual ability or practice.

Snowden (2002) raises the point that we are in fact entering a "third age" of knowledge management, and as such, the previous emphasis on the tacit and explicit transitions, as expressed by the SECI model Nonaka and Takeuchi (1995), is no longer adequate. In the third age Snowden (2002) argues "We recognise that people always know more than they can say, and will always say more than they can write down. This leads to a separation of context from content management and a new focus on the management of narrative, or colloquially story". Snowden goes on to describe a model by which a "narrative database" can be constructed, using abstraction emergent properties. This was evident throughout all case study participant responses, as in many instances, extensive written comments were provided regardless of survey requirements.

#### **4.10.3 Findings of the initial three case study instances – FEAST, ITSA & OECD**

The use of discussion in narrative or story form within the working groups of ITSA, FEAST and OECD seems to have elicited or exposed the emergent common messages or points of individuals in all the case study instances. Each case study revealed common messages, lessons learnt, or actions, and, given enough time, revealed some sort of discernable pattern,

as described through discussion or narrative patterns. For example, members of the working group for OECD case study instance were meeting face-to-face, and reserved this time to discuss their difficulties through stories of the experiences they had had, to gain understanding of the issues involved from other members for the purposes of feedback. The outcome of using discussion and narrative patterns to describe knowledge disclosure through narrative patterns became a means by which to create circumstances that “trigger” people into knowing what they know, when they need to know it.

Triggering people into knowing what they know was a useful outcome of the case study instances, as human knowledge is a “contextual” thing shaped by circumstance. It was difficult to otherwise track or analyse the possible contextual structures that may have been involved.

The experience of the contextual was evident in written comments, and within the working groups of ITSA, FEAST and OECD. Members of the respective ITSA, FEAST and OECD working groups described their experiences as a way to overcome any language or cultural aspects by creating a context for their issues at the time of exchanging information or knowledge.

If circumstances created the contextual aspect of the individuals engaging in TKE, then the content of what they had experienced was contained or at least influenced by their environment (which could also be a reference to ecological influences). Codification or the more explicit aspect of the members work focuses heavily on the “container” the thing that holds the “information” not the actual contents being contained.

An interesting contrast can be drawn at this point. It is the different approach taken when focusing on the content of the work being done and the context in which the work is done. As in the OECD survey work for example, there were significant differences between how the codifying aspects of the KM survey activities needed to be carried out and how the working group itself interacted. Informal ways were adopted by members to gain an understanding of how each member state achieved or approached its particular tasks. This contrast was similar to the point that Nonaka and Takeuchi (1995) argued, that previous focus has been on the “theory” of knowledge as apposed to knowledge itself.

When, human knowledge is “accessed” as its required, very little emphasis is placed on where or how it was “stored” tacitly at that moment of access. However tacit context was relevant during the subsequent “application” that created the new outcome. *Tacit context* and *content* are equally important during the creation of new outcomes. However, the tacit is temporarily diminished during explicit expression. This very movement or transition from thought to explicit expression seems to diminish the relevance of the tacit content and creates rather large loss in relation to tacit context. In relation to tacit content and context creation, there is little difference between the individual, the working groups and organizations. Snowden (2000a) argues that most of the second- generation approaches are “content management” driven, with the primarily focus on easily distribution. Documents supported by formal structures were for the most part disconnected from their creator, and therefore, by nature, mostly “reflective”. Much of the information gleaned from the formal aspects of the surveys was more “content management driven”.

In contrast to this, “context” management can be described as a concept which:

1. Places more emphasis on the links between people and their networks as well as their expertise,
2. Achieve enthusiasm and support through social networks,
3. Transfers of knowledge through practice via continuous learning process or engagement with past staff.

Managing this way through context requires a fundamental recognition that the “ecology” or “environment” must not only be recognized, but also actively supported to allow for evolutionary exchange that supports the continuous cycle of tacit to explicit knowledge between individuals, groups and organizations. Therefore, tacit context and content are perhaps relevant and linked with supportive ecologies or environments, which are conducive to reflection. How possible or probable is this for geographically dispersed groups in complex hierarchical organizations? As was seen and experienced through the surveys of all case study instances of ITSA, FEAST and OECD, where it was possible, environments were specifically arranged to support tacit exchange, TKE did occur, for example, during the working groups. The wider membership may not have experienced the working groups more intermittent environment, but reflection still occurred through written comment as a response to questions which needed expanding, as was demonstrated by participants. This was a way for reflection to take place for the wider membership of the surveys, through creating a “space” or environment (albeit virtual) of supportive ecology.

The informal approach that each respective working group experienced created a social context where members of the local group individually related, but the narrative aspect of the work (the open ended questions with room to respond) had the ability to draw out an underlying sub text, which remained unspoken. Snowden (2001) discusses fables that are in used or circulation. They are long and complex and difficult to remember accurately; however, the “message” was more easily remembered.

The tacit content has the ability to emerge in message form supported by the social context (given form through the narration), allowing individuals (or agents) to relate as a collective, to this new learning or experience. The tacit context allowed for the tacit content to emerge (in the forms of patterns, from collective understandings) from the individuals within the group and from the group itself, as there is no real attempt to analysis or interpret, only to listen and observe for later reflection and exchange.

#### ***4.10.3.1 Implications and levels of understanding***

The main implications are that many levels of understanding occurred simultaneously during, in particular, face to face interaction. The view that tacit and explicit exchanges take place in an uncomplicated dualistic action was not evident during informal working interactions of the case study instances. There was a sense of the macro and micro levels of interaction occurring simultaneously, and that differing types of specific tacit knowledge were required to successfully exchange at specific know levels. This specific type of knowledge exchange was particularly true of the OECD case study instance, where the language differences with regards to KM definition was an obvious example where members of the working group struggled with the essence of the definitions and the contextual aspect during application.

The essence TK implies nothing tangible but every level of understanding of the object/system/issue in question of that particular thing is wholly encapsulated. This is what happens at the macro and, simultaneously, at the micro levels, and exists as many levels/spheres or rings of different type of knowledge making up all the components of the organisation and its exchanges. This macro and micro levels all happen at once, as in an engine in which each component is running and is part of and connected to many other components, which are running simultaneously to create a whole working engine which may subsequently be part of a larger environment, for example, a factory or a ship. An imprint or impression of holographic or multi-dimensional images (like a 3D chess game) the “whole

working engine” is equal to that of the personality of an organization or in one word its “essence”. This word “essence” was also used by Allee (1997, p. 43) in the same way.

To analyse the complexity of such simultaneous exchanges of micro to macro to micro would require an understanding of the single to the whole. As Peroff (1999, p.101) states:

“Emergent behaviour of living systems may be expressed by the behaviour of the elements of a system in interaction with one another and the environment, but the emergent behaviour of a system is not a property of any individual element and it can not be explained as a summation of the properties of those elements.”

One may not recall exactly each action, sequence, detail but the overall affect is remembered and understood. Open discussions and narrative patterning assisted with difficult definitions, but the overall message is understood through discussion and exchange. Therefore, an understanding of all CoP and TKE components is essential but simultaneous in-depth knowledge of the whole organization is not possible. It is possible to know each level separately and the different types of knowledge at one time or another.

The differing levels also highlight the impact of time. The understanding of the exchange of tacit and explicit knowledge is needed to help distinguish timing and its effects on communication. As tacit and explicit knowledge can determine fundamental differences between actions, this can greatly influence the initiation of knowledge in its creation, use and flow, and therefore timing and length of these actions.

Time is not only involved intimately with the development of different types of knowledge but also with differing knowledge levels. For each organisation or entity, time applies differently to relevant knowledge levels. Applying the appropriate time line or frame would be difficult without the understanding of the knowledge levels involved. This then adds to another layer to be aware of when considering different groups interested in the communication or exchange of their knowledge.

#### **4.11 Chapter summary**

Key outcomes from the case study instances were derived from the examination and analysis of CoPs. Key elements became evident, such as the identification of tacit protocols. Tacit protocols are important, and exist in a “non form”, and mirror explicit actions and structures

through a series of sequences. Tacit protocols are important in relation to how they create links into the way in which tacit context influences or is influenced by the tacit content, depending on the level of knowledge interaction. These knowledge levels interact with and correspond to explicit content and context. In this way, the tacit can mirror the explicit structures, albeit in a different time sequence.

Knowledge levels are fundamental in developing an understanding of a tacit protocol. This understanding may be found in the approach to knowledge within the primary or immediate environment, as well as the approach to the experience and how it is expressed.

This type of understanding of knowledge levels through tacit protocols may be achieved through various ways, for example physical interaction by working in the same space, by combining inter-relating tacit and explicit work through each other's networks, data bases, codified reports etc. The tacit and explicit content and context which occur simultaneously are guided by focusing on both tacit and explicit protocol interaction. Therefore, protocol of the tacit variety can be applied individually and collectively when access is made via one point connecting to or tapping into a wider, more encompassing meta-cognitive knowledge system.

Tacit protocols are imbedded by individual behaviour over a period time, within the group or organization. Individuals can connect due to a tacit protocol pre-existing sequence being present. This may be possible because of the sum of all the past and present experiences, captured and retained by an impression or imprint by individuals as a collective and then accessed accordingly when the call arises, but seemingly, never in a conscious manner. Tacit protocols could thus be the unseen building components in the tacit environment, subtly driving tacit content within the tacit context.

So how should one go about isolating and explaining such a phenomenon? Perhaps the answer is that these phenomenon are "exposed" through a series of emergent sequences, and over time, show the alterations much like biological or adaptive behaviour theories suggest. Through examining CoPs, emergent TK elements such as tacit protocols and knowledge levels are identified via using discussion or narrative patterns as relevant communicative tools or methods for local ecologies or groups (CoPs).

These TK elements required further investigation to develop a methodology and representative models of TKE and their TKN, where identification of TK elements could be

explained and tested. The lack of TKN in complex hierarchical organizations would increasingly create difficulties for developing and retaining relevant skills and project know-how. Relating the concept of TKE elements to TKN patterns in general, required further investigations into implementation, via development and testing within a final case study instance. Given the difficulty for CoPs and working groups within complex hierarchical project engineering organizations in successfully facilitating TKE within and between various project functions, for these reasons, the final case study instance needed to be based on a complex hierarchical project engineering organization.

## Chapter 5

# 5 Application of the Methodology to Case Study Instances

## 5.1 The Engineering Project Management Organization (EPMO)

The organization studied for this chapter is a large engineering project management organization (EPMO) that manages large, complex and long-lived projects. Operational requirements of this EPMO dictate that this EPMO shall remain unnamed for the purpose of this study. Its organizational imperatives are to qualify and win more contracts (increasing revenue), perform better on contracts won (improve RoI, rate of investment), continue to satisfy customers, comply with regulations, and finally respond to community environmental standards. All these imperatives must be achieved within a fiercely competitive environment.

The EPMO had grown over the past decade and a half from a company centred on a single large project to a large and diverse organization with multiple business units and multiple divisions, where the largest business unit was distributed across several time zones.

The fluctuating employment typical of the engineering project management industry has made it difficult to build and retain skills within any single division. Without the benefit of knowledge networks retaining relevant skills and project know-how, the task of competing successfully becomes increasingly difficult. It is difficult for working groups within complex project engineering firms to successfully transfer past and current personal knowledge within and between various project functions. The successful navigation of shared personal knowledge requires a competent level of sharing through complex and diverse communication networks which are both implicit and explicit Choo (1998) and Nousala et al. (2005a).

The development of specific knowledge intensive tools and methodologies for implementation into the EPMO is important for future project and product development. Due to the very nature of any project-oriented engineering organization, which is heavily regulated and often hierarchical, it can be difficult for knowledge networks to gain traction horizontally across different project teams, divisions or business units (Nousala et al. 2005b).



The current and future organizational imperative for the EPMO is to make better use of the personal skills and knowledge in the winning and mobilization of new projects. The EPMO focuses on the continuing development of tools and methodologies to facilitate the emergence and sustainment of CoP within the knowledge networks of the organization.

## **5.2 Methodology to test the theory**

The methodology and subsequent testing for the EPMO, whilst based on earlier research and findings from chapter four (subsection 4.10, page 116), is interdisciplinary and thus novel in its approach and application. For such research, “There is no standard or uniform approach to qualitative analysis” (Ticehurst and Veal, 2000 p. 96). The research combines the methodological approach of qualitative and quantitative techniques. The qualitative aspect of the methodology refers to the approach to the data collection from the organization. An ethnological approach was taken to data collection:

- a) The organization was approached with a view to observe and to record the experiences of individuals for the research
- b) Action research was selected with an ethnographic approach
- c) In-depth interviews were conducted using a knowledge mapping tool (on-line tool) across the organization.

Looking for emergent organizational phenomena, classified under complexity theories, was seen as a way of combining various observations to find commonalities that would help identify any interactive behaviour.

The identification of interactive behaviours would also highlight intersections of commonality such as CoPs, which were identified in the literature (Lave and Wenger 1991; Seely Brown and Duguid 2000a; Nousala 2003; Nousala and John 2004). The emergent descriptors (for elements of the framework) assisted with describing the differences and combinations of each study instance.

### **5.2.1 Plan of the study**

The plan was to observe and describe the case study instance using a phenomenological paradigm, involving action and ethnographic approaches towards the study or phenomena. An analysis of the sustainability of emergent CoPs was carried out, based on autopoiesis theory, within an evolutionary epistemology.

### **5.2.2 Areas of focus**

#### **5.2.2.1 Why are CoPs important?**

An understanding of CoPs was needed to develop an understanding of the research question. Research for the EPMO case study instance began with the recognition of *human attractors* (Nousala et al. 2005) that existed within the organization. Many of these human attractors belonged to and helped to identify the existence of ECOI (expert communities of interest) (Nousala et al. 2005), which are groups of people with very specific interests within the project environment. These people also initiated links to COIs (Nousala 2003; Nousala and John 2004), which were more general communities or working groups and which also linked to form more mature and sustainable CoPs.

How did the study design use CoPs in the research investigation? Various chosen instances reflected various types of organizations. The EPMO study focused on the testing of dynamics and tensions that allowed for investigation into the development of new competencies for assessing the values of CoPs. Initial testing and implementation focused on examination of emergent elements needed to create, sustain and develop these CoPs. This supported an increased understanding of the practical application and implementation of tacit knowledge networking with in communities and organizations.

Exploration of tacit knowledge networks (TKN) (Nousala 2003) of CoP focused on identifying common emergent descriptors or elements which had emerged from the literature and was useful as an initial point from which to design a model and carry out testing.

## **5.3 Implementing the Methodology**

### **5.3.1 Background**

The methodology used was based on an in-house feasibility study with two respondents. The responses from this were useful and resulted in positive outcomes for all concerned. However, it was difficult to extend the work to a larger scale, as people in the division concerned were totally focused on completing a large project and thought any KM initiatives would distract from their work at hand.

The methodology used a cartographic approach, known as knowledge mapping. This differs from the concept of merely mapping a register of information about individuals, for example, “Yellow Pages” or a human resource “skills audit”. Whilst these sets of data and information are very useful in their own right, they do little to establish an interactive or intuitive knowledge network. The mapping of knowledge structures or flows can offer a great deal more understanding of to how individuals carry out certain processes and what type of data and information they use, as well as how they use it within a particular project (Nousala et al. 2005). When basic data and information are integrated into an ontology recognizing knowledge networks and flows, this allows for greater understanding of horizontal connections within the organization without breaking down or altering any necessary hierarchical structures that existed within project oriented engineering organization (Hall et al. 2005; Nousala et al. 2005).

### **5.3.2 Method**

A series of semi-structured interviews were conducted, supported by the mind mapping tool (Mind manager). The semi-structured interviews closely followed the methodology used in the prior in-house feasibility study. Interviewees were sought who served as key human attractors and were willing to share their experience. These individuals were possible identifiers or instigators of existing ECOI, COI and/or CoPs which were, or had been in operation during particular projects or product development cycle. The approach to identifying key individual attractors was important to help gain peer acceptance within their particular ECOI, COI, CoP or working group.

The method initially used these semi-structured interviews guided by the mind mapping tool, as the mind mapping tool was readily available throughout the organization and was used for a wide variety of purposes by individuals within the organization. The tool itself made for

easy conversion and greatly facilitated the different stages of data collection, analysis and presentation of the vast amounts of information gathered.

The ease of conversion was an important characteristic of the mind manager mapping tool, allowing all the information to be organized for the first time in an electronic format. Even though further analysis was required to fully understand the knowledge networks, transcribing the interviews into the mind mapping tool facilitated early access to individual lessons and experiences.

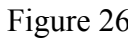
The most time-consuming stage was information collection and final conversion into a comprehensive knowledge network capability in an electronic format, with a specific user-friendly interface. However, once the mind map level was achieved, the later on-line access and retrieval processes were far quicker to analyse and record.

#### **5.3.2.1 *The interview process***

The core structure of the entire interview process was not just to record the obvious “register” type information, but also to record the career knowledge brought to the company and gained on the job by the individuals concerned. This included their career highlights within the company, war stories, lessons learned, networks they had built over time, and finally the types of tools they had used to build up their personal knowledge. The primary aim was not to transform personal to explicit knowledge, but to identify and humanize the knowledge into an understandable knowledge flow, which would later contribute to the organizational knowledge network. The interview process also contributed to the preconditioning of the experts into seeing the value and experiencing of sharing what they knew with those who needed to know it.

Several key factors contributed to a successful interview: ethics, the process, and the preparation.

1. Preparation of the respondent for the interview was very important. This preparation gave the respondent the opportunity to engage and be a part of the process and becoming responsible for their part. The preparation typically involved initial discussion, making the appointment, distribution of methodology paper and map of the leading questions to be asked and clarifying any queries or concerns.

2. The preparation also introduced the ethics of the process which created a platform for a good participatory engagement. For a sample interview structure,  Figure 26.
3. Interviews were normally conducted by two interviewers.

An “old hand”, who knew the general history and significant issues of the organization and by following the format and guidance offered by the Mind Map asked questions which highlighted critical areas of knowledge for the individual in relation to the organization as well as previous relevant experience.

A "naive student" who needed to understand the stories and explanations (i.e., to request translation of jargon that would be unfamiliar to company inductees and to retain focus on the big picture vs in-house minutiae) performed a vital role of clarification and, more importantly, provided a point of reflection for the interviewees.

The interaction of these roles was crucial, as they provided the interviewee opportunities to reflect on and clarify significant life experiences, which, for them, constituted their specific lessons learnt. The interview process was based on discovering the interviewees’ significant experiences that supported their specific lessons learnt. These experiences were significant enough for the individual to have been retained (in some cases for more than 30 years) and recalled for the process of sharing.

### **5.3.2.2 *Recording and Transcription***

Analysis of the individual transcripts focused on the interviewees’ careers. These were broken down into categories of knowledge in their career contexts. The mind mapping tool assisted the individual through the process by retaining the focus of their experiences on who knew whom, what, where, when, why and how.

The analysis of the results was based on a specific emergent ontology to capture the various experiences in context. The ontological structure also provided the basis to construct a corporate roadmap leading from categories of knowledge to the individuals who have it.

## 5.4 Results

### 5.4.1 Interview maps

Interview duration depended entirely on the interviewees and their responsiveness. The mind map process provided a comfortable method to help the interviewee focus on essential issues and helped them structure their responses. The types of material solicited were the nuggets of gold, where they found knowledge and how they transferred it.

The interview process also had an initially unanticipated outcome of social facilitation. Several interviewees commented, “Why hasn’t anyone asked us this stuff before now?” A few even offered that the process was one of the more enjoyable things they had done for a while.

The role of the mind map as a guide for the interview and its participants was primarily to provide clarity in a format that individuals could visualize and feel comfortable with, thus also facilitating the interview process.

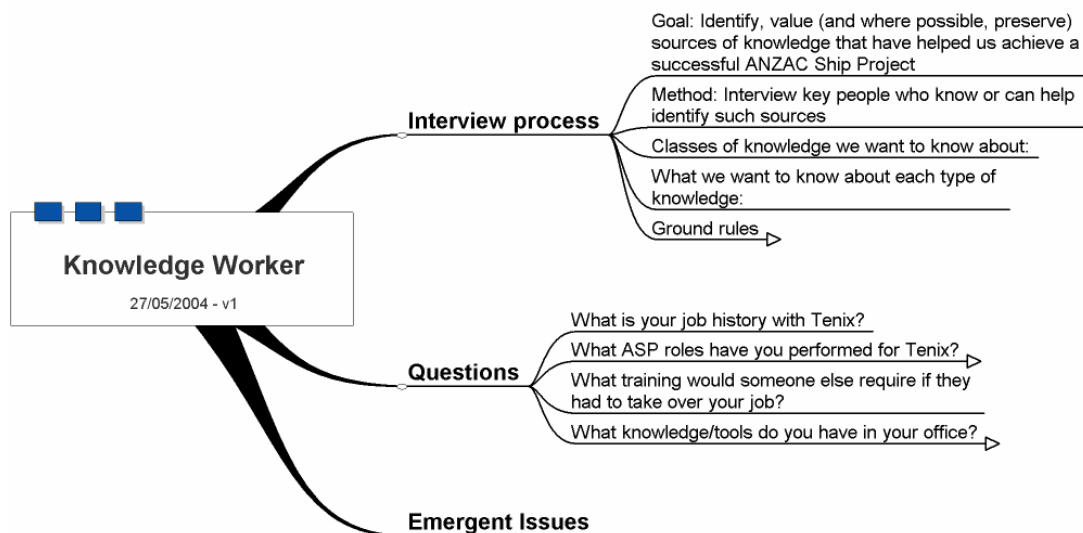


Figure 25 – Initial knowledge worker interview process

## 1

### Interview process

1.1 Goal: Identify, value (and where possible, preserve) sources of knowledge that have helped us achieve a successful ANZAC Ship Project

1.2 Method: Interview key people who know or can help identify such sources

1.3 Classes of knowledge we want to know about:

1.4 What we want to know about each type of knowledge:

1.5 Ground rules

1.5.1 Voluntary interview. No one is required to participate in the study

1.5.2 Answers will be recorded and transcribed to ensure an accurate record of what we are told. Raw transcripts will remain confidential between the interviewee, the interviewers and the transcriber.

1.5.3 After transcripts are reviewed, Interviewers may request an additional interview to explore questions raised in analysis.

1.5.4 Interviewee will have the opportunity to read the transcript of their interview at each stage and make deletions, corrections and add comments as desired.

1.5.5 Only the final transcript as approved by you will be retained as a permanent record

1.5.6 Where interviewees do not wish possibly adverse stories/comments to be associated with their names, interviewers may include in the study in unattributable form lessons learned

## 2

### Questions

2.1 What is your job history with EPMO?

2.2 What ASP roles have you performed for EPMO?

2.2.1 For each role:

2.2.1.1 Why is the role performed?

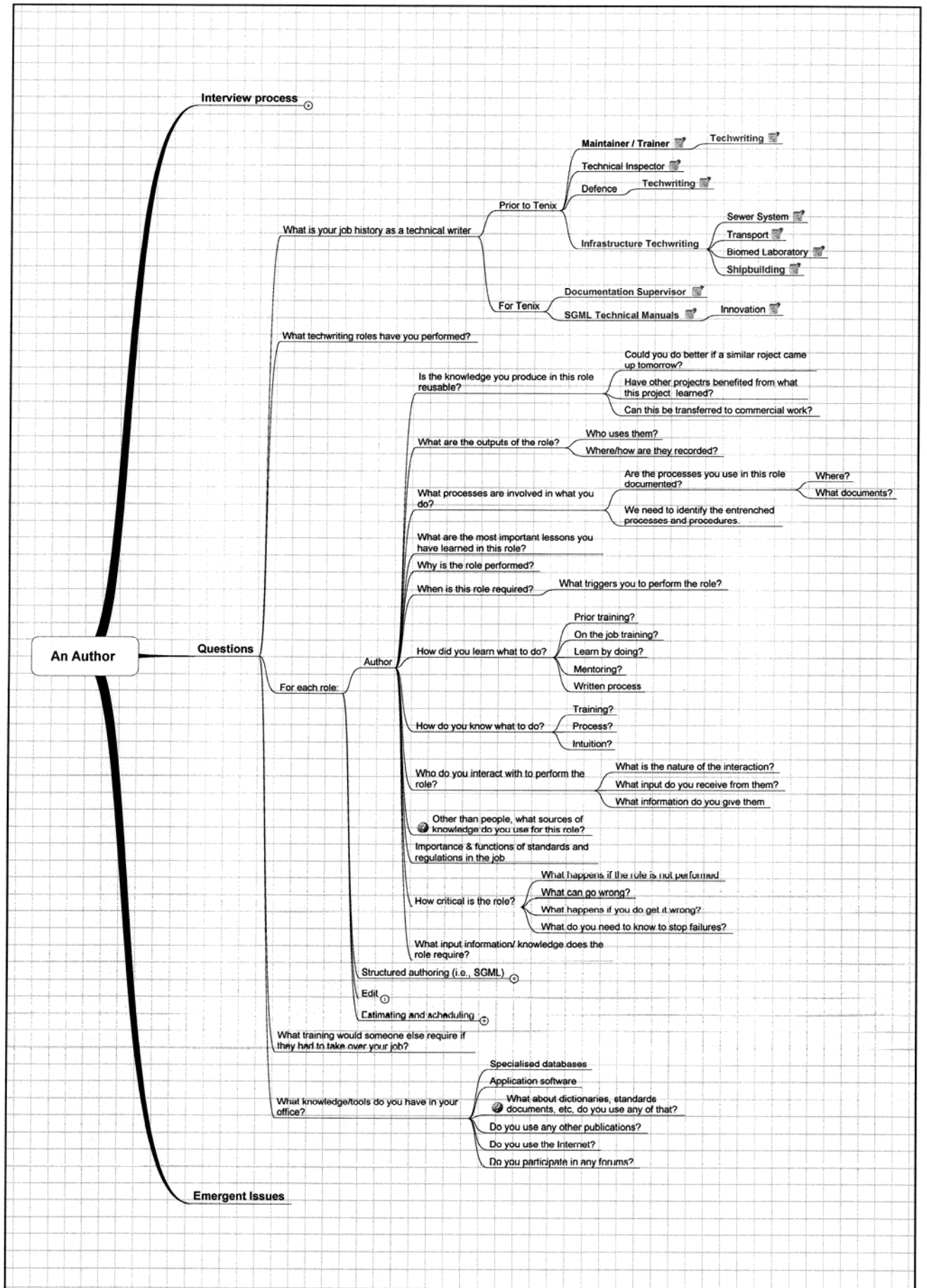
2.2.1.2 When is this role required?

2.2.1.2.1	What triggers you to perform the role?
2.2.1.3	How critical is the role?
2.2.1.3.1	What happens if the role is not performed
2.2.1.3.2	What can go wrong?
2.2.1.3.3	What happens if you do get it wrong?
2.2.1.3.4	What do you need to know to stop failures?
2.2.1.4	What are the outputs of the role?
2.2.1.4.1	Who uses them?
2.2.1.4.2	Where/how are they recorded?
2.2.1.5	What input information/ knowledge does the role require?
2.2.1.6	Who do you interact with to perform the role?
2.2.1.6.1	What is the nature of the interaction?
2.2.1.6.2	What input do you receive from them?
2.2.1.6.3	What information do you give them
2.2.1.7 knowledge	Other than people, what sources do you use for this
2.2.1.8	How do you know what to do?
2.2.1.8.1	Training?
2.2.1.8.2	Process?
2.2.1.8.3	Intuition?
2.2.1.9	How did you learn what to do?
2.2.1.9.1	Prior training?
2.2.1.9.2	On the job training?



2.2.1.9.3	Learn by doing?
2.2.1.9.4	Mentoring?
2.2.1.9.5	Written process
2.2.1.10	Is the knowledge you produce in this role reusable?
2.2.1.10.1 tomorrow?	Could you do better if an ANZAC Ship Project came up tomorrow?
2.2.1.10.2	Have other projects benefited from what ASP has learned?
2.2.1.10.3	Can this be transferred to commercial work?
2.2.1.11	What processes are involved in what you do?
2.2.1.11.1	Are the processes you use in this role documented?
2.2.1.11.1.1	Where?
2.2.1.11.1.2	What documents?
2.2.1.11.2 procedures.	We need to identify the entrenched processes and procedures.
2.2.1.12 this role?	What are the most important lessons you have learned in this role?
2.3 take over your job?	What training would someone else require if they had to take over your job?
2.4	What knowledge/tools do you have in your office?
2.4.1	What is in your office that helps you do your work?
2.4.2 any of that?	What about Dictionaries, CCH type information, do you use any of that?
2.4.3	Do you use any other publications?
2.4.4	Do you use the Internet?
2.4.5	Do you participate in any forums?
3.	Emergent Issues

Figure 26 – Example of full knowledge worker interview process shown on page 138



## 5.5 Analysis

The importance of human attractors, ECOIs, COIs and CoPs is that they are key starting points to identify key individuals within the dynamics of a complex organization. Working outward from them, it is possible to track, record and develop knowledge flows for implicit/explicit knowledge network structures.

### 5.5.1 Analysis of the Team Expertise Access Mapping (TEAM) transcripts

The analysis sought to identify and understand emergent local sensitivities, circumstances, potential blockages, etc. relating to knowledge sharing and networks, as elicited from the transcripts of individual experiences. The initial aim was achieved with the help of an initial ECOI within the EPMO, which broadened over the months, and through which other key people were identified.

The ‘formal’ interviews using the mind mapping process established a clear protocol for a type of continuing informality that facilitated additional deep sharing of individual personal knowledge and experiences outside the interview process. Transcribing the first interviews to mind maps also helped build further spontaneous networks. The success of the facilitation was demonstrated through invitations for TEAM project people to joint additional formal and informal meetings within the EPMO organization.

Mind mapping requires the analyst to keep track of the experiences as they occurred in relationship to overall job roles as described by the individual. Two threads need to be tracked: an “experiential thread” and a “contextual thread”.

*Key experiences:* The analysis requires key experiences to be identified as described by the individual or interviewee. These key experiences are important enough to the individual to have been retained and shared. These key experiences are then subsequently *followed* through by the analyst using the mind map process, which allows for the emergence of the *experiential thread*. This experiential thread is followed as the individuals have presented it, in context.

*Contextual threads:* Contextual threads help to define relationships of key experiences to other aspects of the work, and are potential clusters of key knowledge.

This is where the link between experiential and contextual threads forms the basis for developing an ontology, using the individual's experiences as the key "knowledge objects".

The knowledge objects are essentially different experiential elements collected into "knowledge containers". These containers hold sub-categories of experiential themes, which are linked with contextual threads. In this study, the key knowledge containers began with individual history (containing specific names, project etc) and other individually relevant experiences, for example lessons learnt, which varied throughout the interviews, depending on the individual's experiences. The historic knowledge container was important, as it often provided vital links between all other containers. Through these containers, the experiential and personal attributes could be "followed", relating them back through the historic links (the personal attributes provided both past/historic and present elements, providing the relational historic links).

The ontology could then be structured to contain different elements of experience within its construction depending on the access requirements at a later date, these being as follows:

Historic

Current continual

Possible future innovations.

### **5.5.2 Deriving an ontology from the analysis**

To build an ontology, the transcribed histories of the individual interviewees were broken down into *contextual points*, which were then formed into an ontological structure. The contextual points in turn identify "information clusters". These information clusters are sentences or paragraphs that "belong together" or are held together by a theme, which is based on the epistemology of the initial theoretical framework. The ontological structure imposed on the interview results (see Figure 26) then what is possible to access and ultimately retrieve from an electronically organized database of the transcripts.

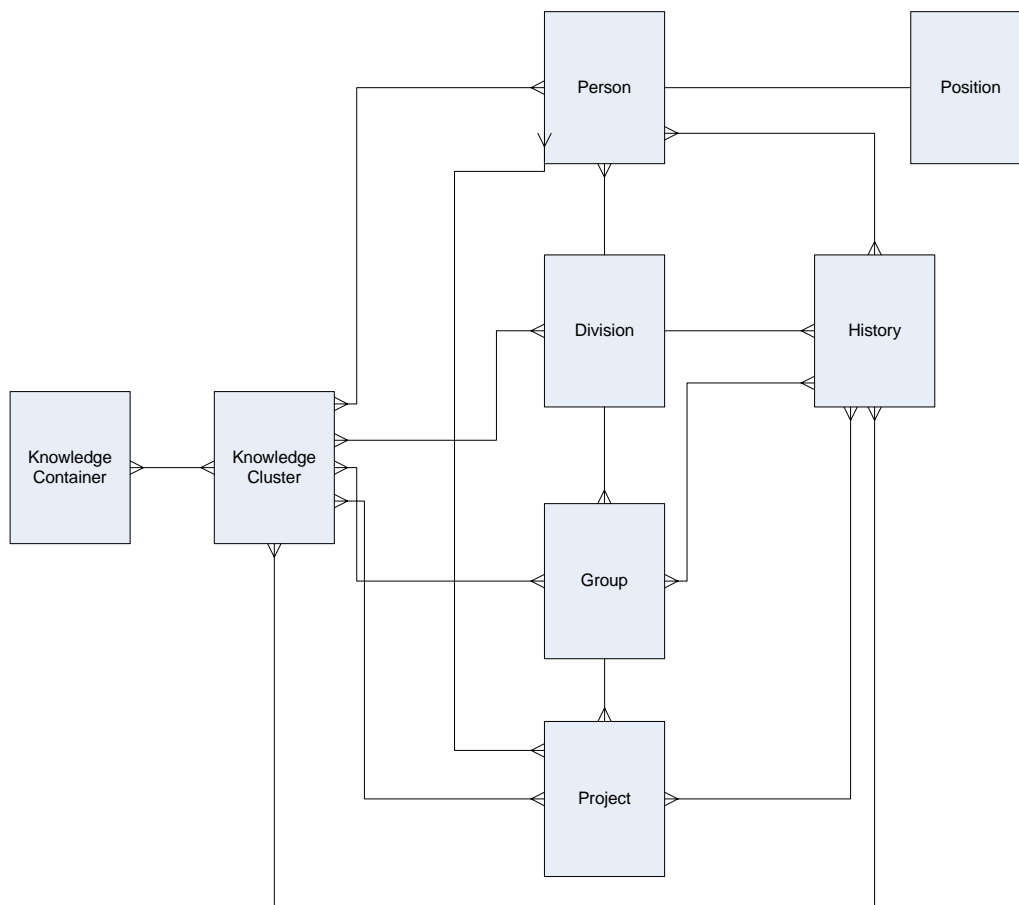


Figure 27 – High level ontology for the TEAM database

### 5.5.3 Defining the human attribute ontology for an electronic search capability

The ontology should include both experiential and personal attributes (i.e., metadata) for knowledge containers. Personal attributes are based on both historical and present experiences.

Figure 27 shows the four primary attributes which emerged from the initial analysis of interview transcripts. These four primary attributes are as follows:

- Person
- History (Person Position)
- Knowledge Instances (Knowledge Nugget)
- Knowledge Categories (Tag).

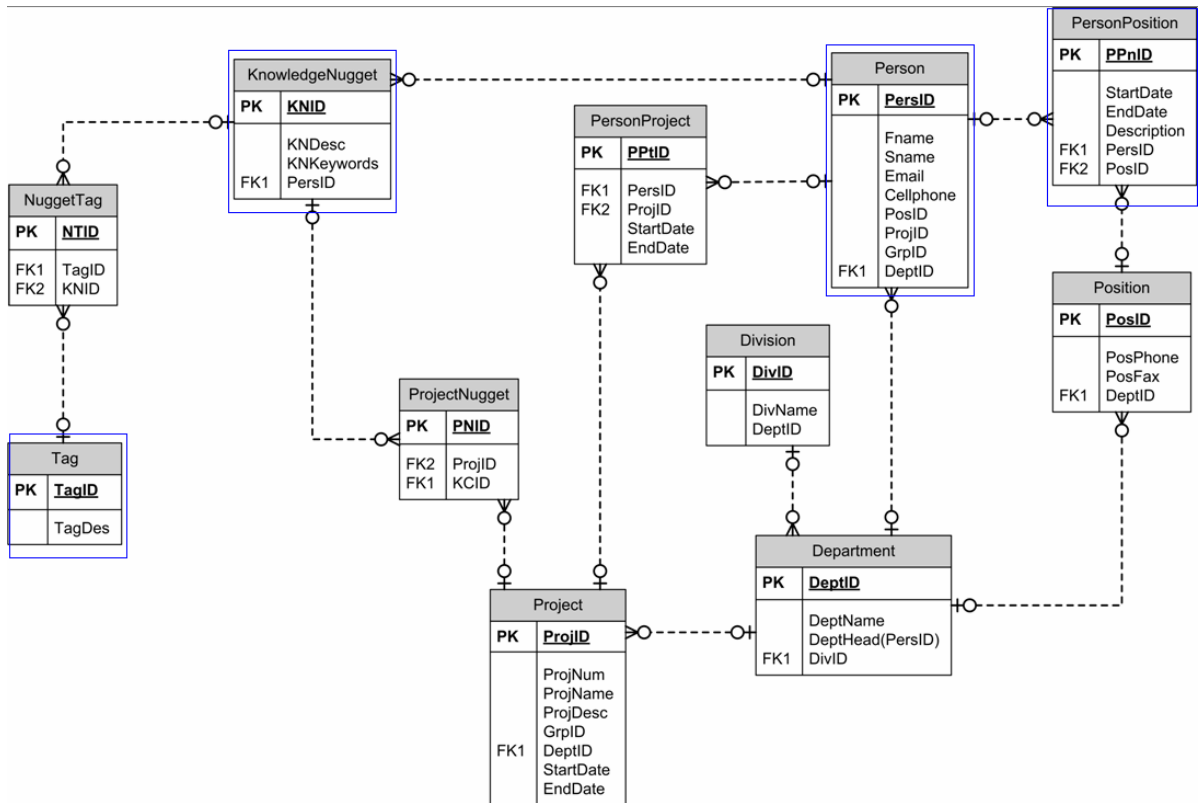


Figure 28 – High level ontology and primary attributes

Figure 28 shows the detail of the high level ontology and primary attributes. Boxed categories with a blue outline indicate primary attributes.

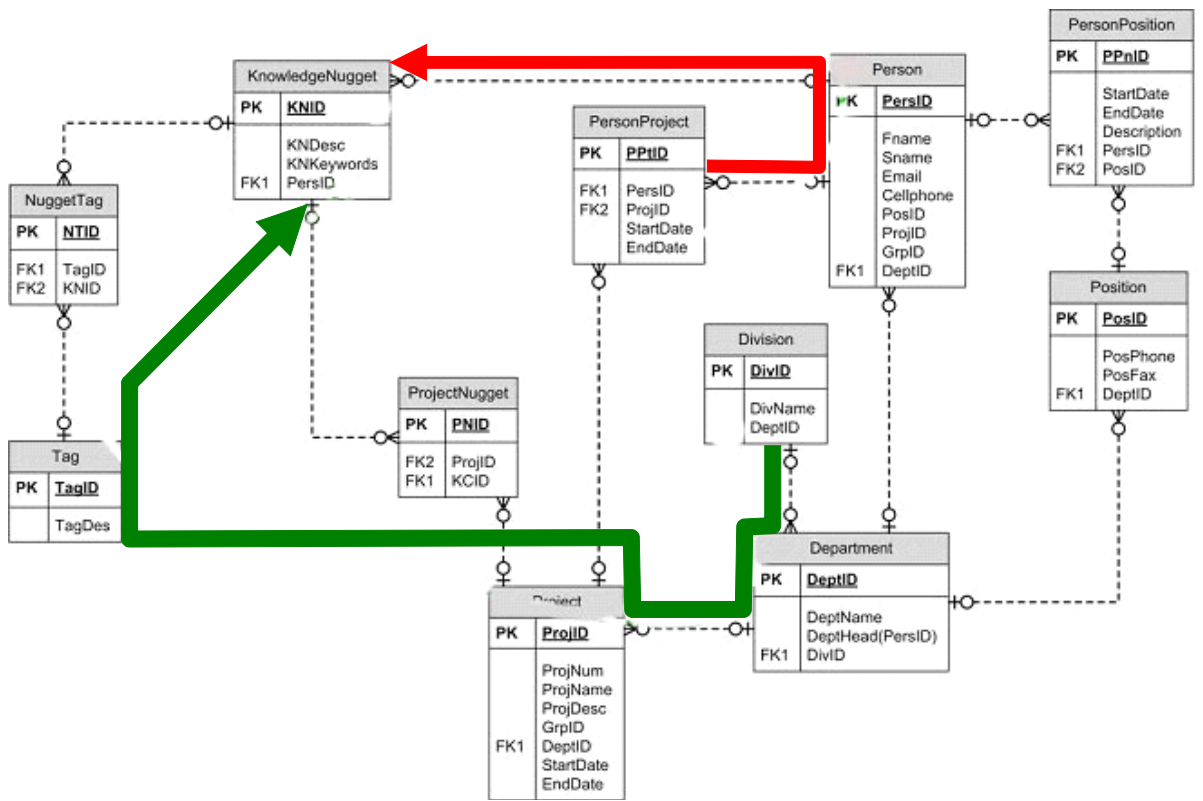


Figure 29 – High level ontology with linked experiential and contextual threads

Figure 29 shows in detail the high level ontology with linking experiential and contextual threads. Note that, in figure 28, experiential threads are displayed in red and the contextual threads are in dark green.

Primary relationships are the contextual and experiential threads. The contextual thread uses the tag to provide context, along with the other information such as project and department. The history items provide experiential thread, where the user can identify the time frame and experience of the nugget.

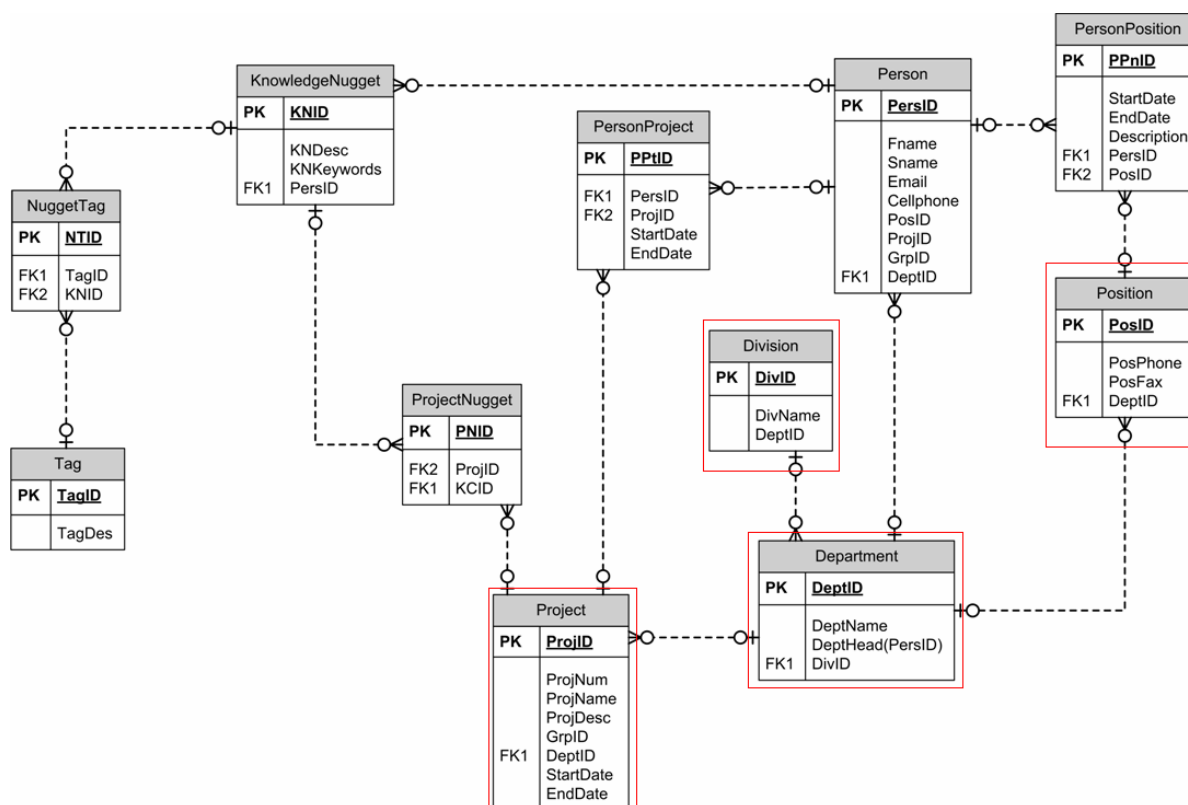


Figure 30 – High level ontology with secondary attributes

Figure 30 shows the boxes with red outlines detailing secondary and recurrent attributes. Attributes whose values were reasonably unique to the instances, such as a persons name or email address were inserted as attributes within the entity. Recurrent attributes were those such as department or division, where the number of options was limited and each one was repeated many times between person instances. These deserved their own table and were therefore separate, although secondary, entities. The primary entity retained an instance of the secondary entity though using the primary key of the secondary entity as a foreign key.

Figure 31 is an example of defining human attributes for the ontological construction from contextual points. These contextual points are the “knowledge containers” to which the attributes are linked:

- a) History (position, organisation, project, length of time, project connections to other projects and people).
- b) Knowledge sharing (difficulties and solutions)
- c) Physical organization and people structures
- d) Creating organizational models.



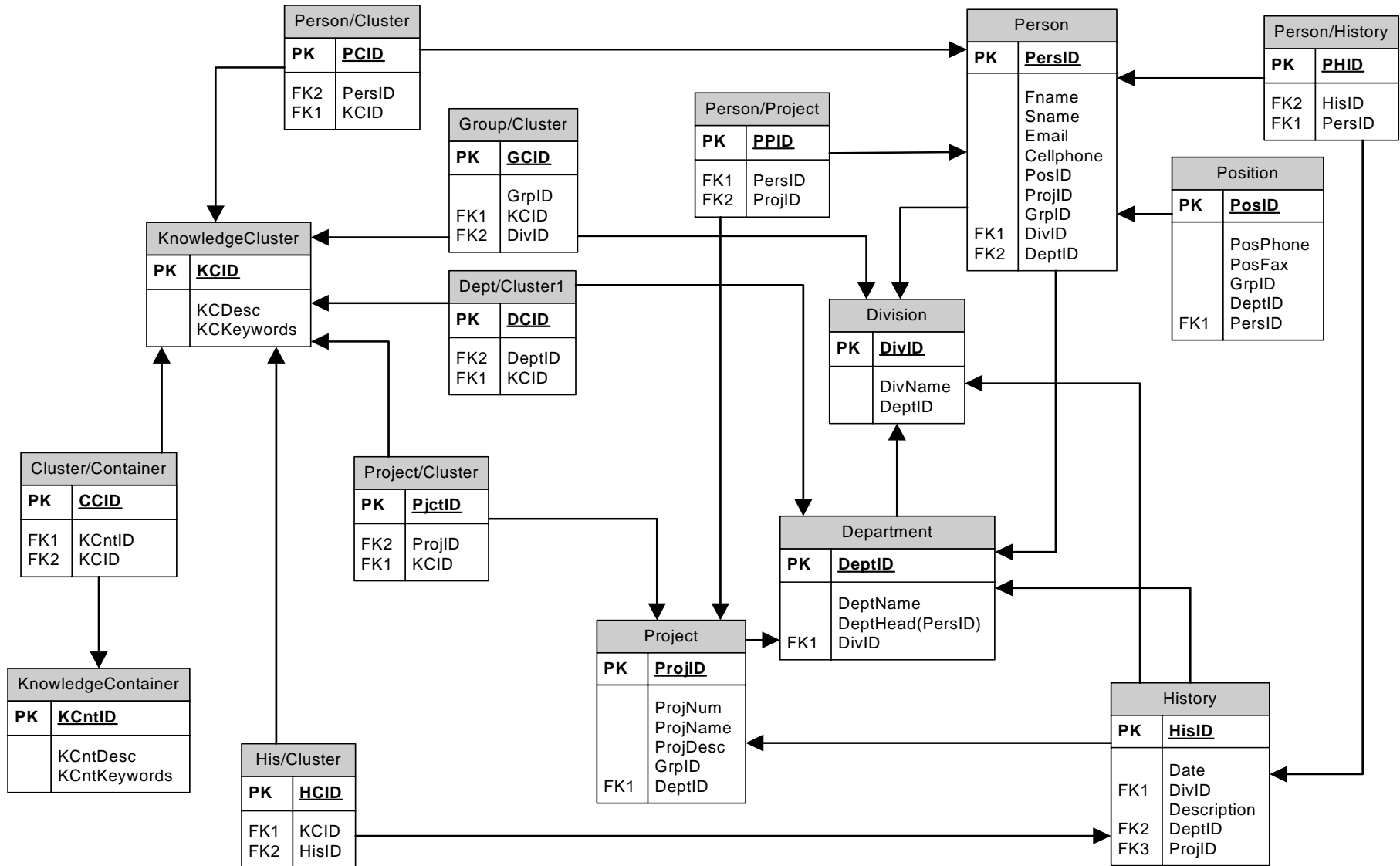


Figure 31 – Detailed ontology with attributes

Figure 31 presents the detailed ontology displaying the various attributes identified to this point.

Figure 32 to Figure 36 (Nousala et al. 2005) represent a story board for an on-line display of a graphical user interface, from which the detailed ontological attributes form the basis for this knowledge sharing environment. This interface is demonstrated in the enclosed CD titled – ‘Proof of Concept Demonstration’.

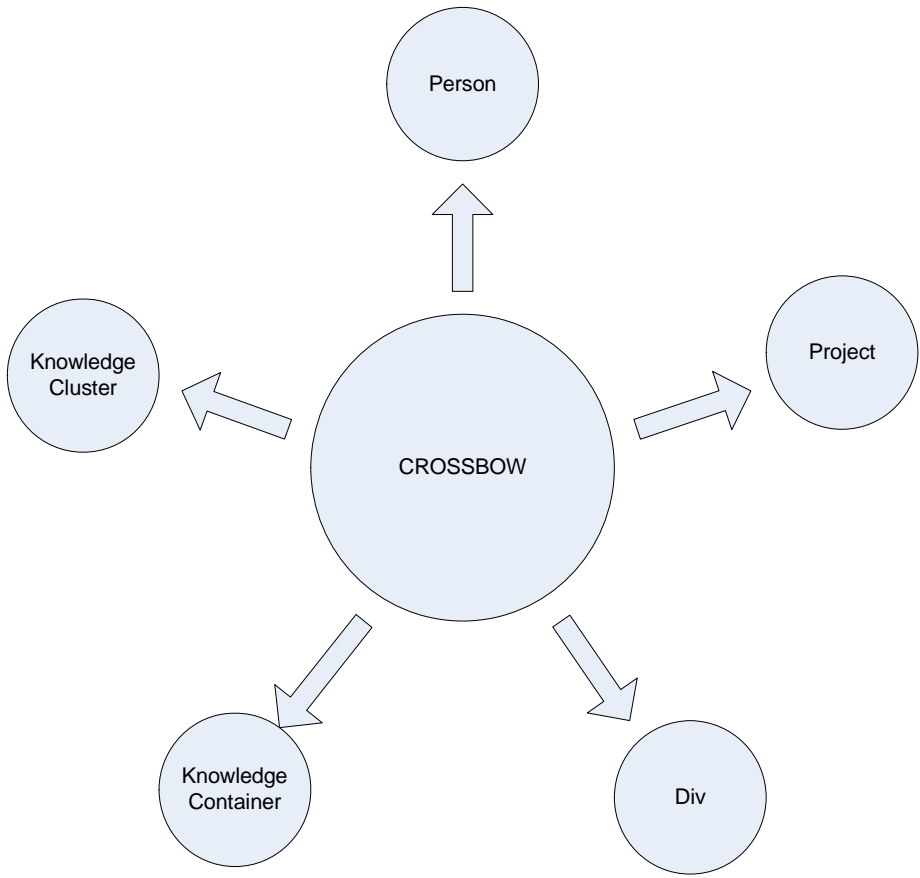
<b>Description:</b>	Crossbow front page with the star diagram presenting the different areas the user can conduct a keyword search into.
<b>Screenshot:</b>	
<b>User Action:</b>	User selects 'Knowledge Cluster' icon using the mouse.
<b>Alternatives:</b>	User can select any of the outer options. In the case of <i>Kcluster</i> or <i>Kcontainer</i> , they are presented with the drop down boxes below. If they select <i>Division</i> , they only get list of divisions, if they select <i>project</i> they can only conduct a search and order by division, and if they select <i>person</i> they can search, and order by project or division.

Figure 32 – Story board A

<b>Event:</b>	Commence Search process.
<b>Description:</b>	The user is presented with a search screen that allows them to enter the keywords they wish to search on, as well as a series of drop down boxes that allows them to narrow the search field down.
<b>Screenshot:</b>	
<b>User Action:</b>	The user enters their desired search terms in the text box and uses the drop down boxes to narrow the search. The drop down boxes are linked so that if a division is selected, then only the people or projects in that division are displayed in the lower drop down boxes, however they are not purely cascading as the person drop down can be selected first off.
<b>Alternatives:</b>	The user can change their mind about the area they wish to search and by clicking on the appropriate option on the star diagram bring up the search page for that section.

Figure 33 – Story board B

<b>Event:</b>	Listing of search results.
<b>Description:</b>	Once the database is organisation wide, a large number of results can be expected from the above actions. In order to allow easy filtering of the available results, the star diagram is put at the top of the screen. If the user wishes to look through the results individually at this stage, and scrolling panel at the bottom of the page will display the results collected so far.
<b>Screenshot:</b>	<p>The screenshot displays a central 'CROSSBOW' node connected to four other nodes: 'Person', 'Project', 'Knowledge Container', and 'Knowledge Cluster'. Each connection is marked with 'x'. Below this diagram is a scrollable area containing three identical result entries. Each entry consists of a text box on the left stating 'This area contains the first xx number of the cluster to give the user an idea of whether it meets their purposes or not.' and a filter menu on the right with four options: 'Author', 'Division', 'Project', and 'Knowledge Containers'. A vertical scrollbar is visible on the right side of the scrollable area.</p>
<b>User Action:</b>	In this case the user selects division.
<b>Alternatives:</b>	The use may select any of the options for filtering.

Figure 34 – Story board C

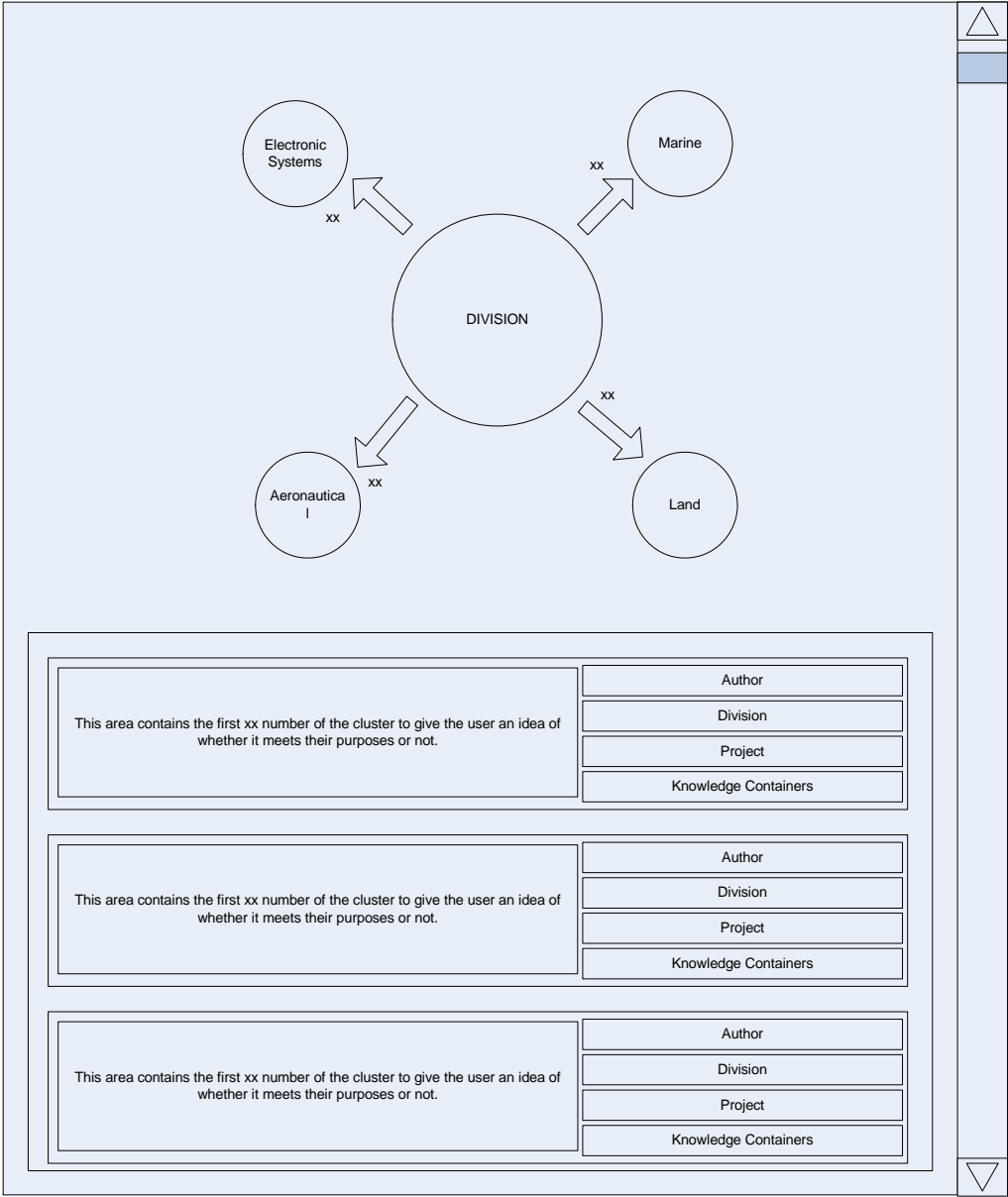
<b>Event:</b>	Select item to filter by.
<b>Description:</b>	This page displays the options available to the user for filtering the results obtained. In this case division has been selected and the star diagram displays the specific options. If the user had selected person or project at this stage, they would have too many sub options to allow a star diagram to be created. In this case the ideal would be to present them with another search screen and commence a stacked approach, however this is likely to confuse and difficult to implement, therefore a simple search screen with a list of results is displayed. The user selects a person from the list and the top level search screen appears with only the remaining available results displayed. This user can review the filtering actions taken by looking at the breadcrumb trail.
<b>Screenshot:</b>	 <p>The screenshot displays a central 'DIVISION' node connected to four sub-nodes: 'Electronic Systems', 'Marine', 'Aeronautica', and 'Land'. Each connection is marked with 'xx'. Below this diagram are three identical stacked panels. Each panel consists of a text box on the left stating 'This area contains the first xx number of the cluster to give the user an idea of whether it meets their purposes or not.' and a list of filter options on the right: 'Author', 'Division', 'Project', and 'Knowledge Containers'. A vertical scrollbar is visible on the right side of the screenshot area.</p>
<b>User Action:</b>	The user selects electronic systems
<b>Alternatives:</b>	The user could select any of the options, or by clicking in the centre icon return to the first result page to use another area to filter by.

Figure 35 – Story board D

<b>Event:</b>	Electronic Systems results displayed.
<b>Description:</b>	The results, filtered to exclude any from other divisions, are displayed along with a star diagram that displays the next level of filtering that can be applied. Division is no longer present because filtering has already been applied. If the user wishes to move backwards to select another division they use the breadcrumb trail.
<b>Screenshot:</b>	
<b>User Action:</b>	The user continues to select filtering options recursively to narrow down their search or they select a cluster. Clicking on an author should bring up their contact details as well as the option to view a full copy of their transcript or mind map (whichever the final display option is selected to be). The division, project and knowledge container box simply displays text fields displaying the relevant information.

Figure 36 – Story board E

## **5.6 Observations from the EPMO case study**

Even this pilot study revealed deep reservoirs of valuable personal knowledge that were apparently unknown by present managers and other staff in the EPMO organization. They had thus been untapped, even when they would have been critically valuable to resolve issues or to avoid them in the first place.

One of the problems identified in the TEAM project was the issue of boundaryless careers (Arthur 1994; Arthur & Rousseau 1996). Divisional/project management requirements changed with project phases; thus many managers in the organization were familiar only with the kinds of project phases they were used to manage, and often only knew the competencies of their immediate jobs in relation to the current project phase. Standard HR systems are not good at revealing deep competencies that are not reflected in formal qualifications.

In other cases, individuals showed career progression in relationship to particular project they were involved with. Even when the individual progress from a journeyman to manager, other managers in the organization still lose sight of the personal competencies and knowledge relating to other project phases and types of projects that would be invaluable if anyone would only ask.

Much of what the organization had learned was retained in the careers of people who were still located somewhere in the overall EPMO. But because their networks were constantly being broken and reformed, other people in the present networks simply did not know the knowledge existed. What was once organizational knowledge had become only organizational information.

All indications are that a wider application of the TEAM methodology, combined with some community of practice facilitation, should be able to re-establish many of these connections to substantially improve the EPMO's overall effectiveness in its competitive environment.



## **5.7 Discussion**

### **5.7.1 Success of the method**

The success of the method and approach was initially more costly than a ‘Yellow Pages’ style skills database, but it would cost little to deploy compared to potential returns. At present, one division in the EPMO is planning to implement TEAM as an organizational strategy.

#### ***5.7.1.1 Benefits for the organization***

The individuals interviewed all showed great allegiance to the organization, even when they regarded themselves as being under or poorly-utilized by the organization. This highlights the importance of better using personal competencies of individuals within the organization, making a strong argument for this type of process to take place.

This work is particularly important in a project-oriented organization where individuals tend to focus on long-lived projects that span an appreciable fraction of an individual member’s career, and where there are several ongoing projects at different phases in their lifecycles, and where new projects periodically need to be mobilized.

Individuals cannot clearly exercise all their competencies at once, but CoPs and COIs can provide opportunities for low-time cost sharing and mentoring where expertise can be shared via key ideas, guidance and mentoring.

Mapping competencies provides a method that allows peers and managers to locate hidden/forgotten resources in their own or sister teams relating to their current problems and needs. The narrative texts captured within the mapped structure gives a genuine flavour of the personal competency and possibly even hints as to how particular problems were solved.

Mapping also gives HR and management a tool for understanding the kinds of personal training, skills and knowledge required to deal with particular kinds of situations. For example, used as an exit interview, particularly when numbers of experienced staff are lost with the completion of a large project, the methodology gives an idea of the kinds of knowledge lost to the organization with the departure of an individual. It also provides a much more effective

search image of what should be sought in a replacement for the departing individual and for induction/mobilization training when a new project is mobilized or reaches an equivalent stage.

### **5.7.1.2 *Benefits for the individual***

There are social rewards for experience and sharing, which can provide better security and the possibility of better remuneration, as job requirements change through the organization's increased competitiveness from better use of the personal skills of its members.

### **5.7.1.3 *Theoretical implications***

Even though the EPMO organization currently fails to make full use of the career competencies of its members, it is clear that individual competencies do contribute strongly to the capabilities of the organization as a biological entity in its own right.

## **5.8 Summary**

Human attractors are important initiators of COIs, ECOIs and CoPs in project-focused organizations, and probably have the power to apply appropriate constraints to assist in sustaining them (Nousala et al. 2005).

ECOIs and COIs are important because it is at this level that appropriate constraints are applied to determine whether the ECOI and COI is to develop into a functional and self-sustaining autopoietic CoP. CoPs are important not just as a social science phenomenon, but also as a means of describing the view/perspective and interaction between working individuals around initiators – groups – working clusters – horizontal networking.

It is difficult to implement KM processes in project-based engineering organizations because KM involves horizontal activities that cut across strongly hierarchical and “stovepiped” project organizations within the larger commercial organization.

The practice of KM in project-based engineering organizations is a specialty sub-discipline in an ever growing knowledge intensive society with increasing levels of complexity.

Please note that proof of concept demonstrations are available on the attached CD enclosed with this thesis, complete with an audio visual demonstration, showing examples from the database pilot project for EPMO (as a working proof of concept), named the “knowledge demonstration”.

Please also note that, for the purposes of examination only, an example of the data base pilot project with interactive capability has been arranged on an external EPMO server. An audio-visual demonstration of how to use the interactive demonstration on the EPMO server is accessible on the attached CD and is named “product demonstration”. Arrangements for access to this demonstration will be available from February 15<sup>th</sup> 2006 to May 15<sup>th</sup> 2006. Access is password protected; please enter the following URL; <https://crossbow.tenix.com/km>, user name; knowledge, password; kmpassword.

## Chapter 6

### 6 Conclusions

#### 6.1 Case study outcomes

Identification and understanding of TKE characteristics within and between organizations and their TKN strategies were identified through tracking and mapping techniques. The methodology applied to the case study instances yielded key findings.

A summary of the key findings from the case study instances are:

(1) The importance of understanding knowledge exchange in the context of the “whole environment”, rather than the breaking down of parts into the “separate components” of individuals for analysis. This is explicitly discussed in subsection 4.10.3.

The findings also included the identification of:

(2) Human attractors, expert community of interests (ECOIs), community of interests (COIs) and community of practices (CoPs) as key starting or initiating points for identification of key individuals within the dynamics of tacit knowledge networks (TKNs). Subsection 5.8 discusses this in detail.

(3) Working outward from COIs and CoPs instigates the actions for tracking, recording and developing knowledge flows for implicit/explicit knowledge network structures. Subsection 5.8 discusses this in detail.

The case study instances assisted in the research and analysis of tacit knowledge exchange (TKE), TKN and CoPs within complex hierarchical organizations. A key to understanding organizations and their relevant complex knowledge flows was to recognize the emergent behaviours of elements, attributes and the characteristics of tacit knowledge exchanges. The following is a chronological breakdown of the outcomes:

- a) The influence of the environment being crucial for the sustainable support and existence of CoPs, TKE and TKNs as initially highlighted in the FEAST case study instance.

- b) The highlighting and identification of the elements and attributes of CoPs, TKE and TKNs as initially highlighted in the ITSA case study instance.
- c) The importance of the informal environment for TKE to occur through the TKNs as initially, highlighted in the intelligent transport systems Australia (ITSA) case study instance and validated through the Organization for Economic Co-operation and Development (OECD) case study.
- d) The validation of the elements and attributes of community of practices (CoPs), tacit knowledge exchange (TKE) and tacit knowledge networks (TKNs) via testing through the engineering project management organization (EPMO) case study instance. The development of the ontology to support key attributes and implementation via the mind mapping protocol through the EPMO case study instance.
- e) The discovery of contextual and experiential threads within TKNs via the EPMO case study instance, which was an extension of the identification of tacit protocols from the ITSA case study instance.

## 6.2 Tacit protocols

In subsection 4.8.6 on page 101, the issues of tacit protocol identification were mentioned. Through the case study instances, tacit protocols were evident as applicable behaviour of both the physicality of communities (organisations, groups etc) and the individual within. Both unconscious competence and conscious competence were present in tacit protocols, which were triggered by linking appropriate knowledge levels. These become evident or even more evident when consciously sort for or looked for. This may seem obvious, however, tacit protocols have not been considered or seen as fundamental in regards to CoP in complex, hierarchical or dispersed groups. Tacit protocols were also found to have levels within levels. For every gathering under a unified cause, i.e., CoPs, COIs or ECOIs tacit protocols were active.

## 6.3 Knowledge levels

Knowledge levels that continued to link did so through pre-existing linked knowledge levels, thus creating environments or spaces which supported ECOIs and COIs. These knowledge levels were necessary for the continuation of existing and evolving ECOIs, COIs and CoPs, CoPs that not only supported sustainable implementation of TKN, but also supported the possibility of geographical dispersion. Through tacit protocol awareness, dispersed groups experienced the cognitive process of becoming explicit, as part of a cycle. In subsections 4.8.5 & 4.8.6 on page 101, the issues of knowledge levels were identified.

## **6.4 Emerging communities of practice outcomes**

It is difficult for organizations to effectively manage personal knowledge so it can be mobilized, shared, and rewarded to benefit the organization. The difficulties are compounded in large organizations where people with potentially valuable knowledge are unknown to one another and dispersed geographically across time zones. Issues that are potentially amenable to knowledge management solutions include identification, indexing and codification of personal knowledge and the cultural issues of discovery, mutual trust and sharing at the personal level. This was highlighted in subsections 5.2.2.

### **6.4.1 Case study instances**

The three initial case study instances each yielded very specific characteristics regarding tacit knowledge exchange and networking. These were significant as they covered key attributes which had emerged from each case study instance, beginning with a combined methodology of the FEAST case study using formal and informal approaches. The findings and results of the FEAST case study set the foundation for the ITSA case study. The ITSA case study investigated the informal and the OECD case study investigated the structured or formal approach. It is interesting to note that in all the case study instances a mixture of formal and informal were used and relevant, however, when ever the issue involved tacit knowledge, the informal yielded better results. Finally, the EPMO case study instance was used as a final prototype for methodology to graphically codify, index and map staff knowledge using mind mapping technologies. This final case study instance allowed for investigations into what characteristics a complex organization would utilize in order to build up in-house tacit knowledge management abilities.

## **6.5 The developed methodology**

The developed methodology emerged from a comprehensive epistemological and ontological basis initiated by a specific focused literature review. The literature review is significant as it specifically focuses on two key aspects. The first being a focus on the tacit sharing, exchange,

networks and CoPs, the second part focused on the development of epistemological and ontological views of TK, CoP, TKE and TKN. The later literature focus was the link to the basis of the methodological development.

The EPMO case study instance used a methodological approach specifically developed and adopted for project engineering organizations. This approach was adopted, since project-oriented organizations are hierarchical by nature, which is in contrast to knowledge sharing through CoP which relies on horizontal tacit knowledge networks (Nousala and John 2004). Personal knowledge needs to be shared across the organization in order to be sustainable. The approach, testing and implementation of the method needed to overcome the tension between the typically vertical structures of project engineering organizations, and the horizontal structures of operational CoPs. CoPs are entities made up of individuals who connect through intersections of commonality, maintaining interactions of individuals. Some such communities appear to have some or all of the properties to be deemed as an autopoietic entity in their own right (Nousala et al. 2005). The CoPs analysed in this research are treated as autopoietic components or holons within the larger supersystem comprising the project oriented organization (Nousala et al. 2005; Hall et al. 2005).

## **6.6 Knowledge Mapping**

The mapping competencies used and developed in the EPMO case study instance provided a method for individuals and their networks to manage and locate difficult to find or dis-used resources in their own or other teams relevant to their current or future problems or needs. The narrative text aspect of the mind mapping method captured within the mapped structure a genuine essence of the personal competency and clues as to how particular problems were or could be solved. The results from mapping yielded knowledge about the organization which is useful for HR and management to gain an understanding of the kinds of training, skills and knowledge that is required. For example, the information can be used in introduction and exit interviews to record tacit experience, knowledge of personal networks both within and without the organization. This type of integrated knowledge is particularly important when numbers of experienced staff are lost due to the completion of a large project. The results of applying this methodology can give an indication of the kinds of knowledge lost to the organization when individuals leave.

## 6.7 Implementation of key outcomes

The case study instances revealed (in particular the EP MO case study instance, in the analysis 5.5) that certain key individuals were important “*human attractors*” who were important parts of, or initiated, communities or groups. As such, human attractors were instrumental for the development of expert communities of interest (ECOI). These ECOIs were communities that occurred within the project engineering organization, due to the specific expertise required within these project environments. Human attractors as initiators were the precursors to ECOIs, and were also precursors to the more general communities of interest (COI). Both of these communities of interest were precursors to the CoP. At the ECOI and COI levels, if appropriate constraints (for example, peer review) are applied, the communities of interest have an opportunity to develop into sustainable CoPs. Within the environment of project-based engineering, tacit knowledge networks need to be based on well-structured ontology if there is to be successful development of knowledge management capabilities that can truly deliver horizontal activities cutting across a hierarchical organization. Knowledge management in project-based engineering organizations is developing a real level of specialty in an area of ever-increasing knowledge intensity, in a global society with increasing levels of complexity. Starting with human attractors and working with identified key attributes, the primary key outcomes were as follows:

1. *Key experiences*: where the analysis identified key experiences as described by the individual or human attractor. The human attractors were also key “starting points” for the analysis. These key experiences were important enough to the individual to have been retained and shared. These key experiences were then subsequently “followed” (working outward for tracking, development and analysis) through by the analyst using the mind map process that allows for the emergence of the *experiential thread*. These experiential threads were followed as presented, in context.
2. *Contextual threads*: which emerged from the experiential threads that helped define relationships of key experiences and linked to other aspects of the individual’s work (in various different contexts), and also identified potential clusters of key knowledge. Where links between experiential and contextual threads formed was the basis for developing an ontology, using the individual’s experiences as the key “knowledge objects” for the database presented in Figures 27 – 35.



Managing knowledge in this way through context required a fundamental recognition that a supportive ecology for individuals in CoPs must not only be recognized but actively supported to allow the CoP to share necessary knowledge between individuals, groups and organization. The case study instances identified specific emergent factors of CoPs and working groups and individuals discussing similar types of successful ideas and working experiences as well as common barriers. For successful implementation of TKNs it was important to identify and understand the specific emergent aspects, which would help to sustain CoP and TKE within a project oriented organization. Sustainability of TKE and TKNs require the understanding of specific emergent aspects identified in this chapter. These emergent aspects are constantly evolving creating interactive relationships which “mirror” their explicit knowledge structures. The case study instances assisted in the research and analysis of tacit knowledge exchange, tacit knowledge networks and CoPs within complex hierarchical organizations.

## **6.8 Further work**

Future investigations and research will focus several new aspect of work. 1) Work will focus on the investigations on the emergence (or turbulence) of a fully autopoietic community with large complex organization, for example; focusing on specific levels at which the human attractors and their networks operate within and between organizations. 2) Investigations could also focus on the significance and type or level of turbulence indicating emergence of activity of individuals who are undergoing integration and disintegration, with regards to their tacit networks and organizational processes and systems. 3) Looking at the organizational environment, there is a requirement for focusing on the attributes that underpin the integration and disintegration that are relevant to soft systems which in turn are relevant to physical environments and systems. Understanding these key attributes which have currently been identified as constraints will determine what physically occurs within an organization. 4) To examine future findings via more quantitative methods supported by statistical analysis.

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## **APPENDICES**

## Appendix 1. Full Set of Pilot FEAST Survey Results



Forum for European – Australian  
Science and Technology Cooperation

### Introduction

- FEAST Registrations and Expressions of Interest in WG1 → 30+ researchers
- Virtual Discussion → 14 participants
  - areas, regions, services, assistance, working
- Green Questionnaire → 80+ responses
  - information, policy, structure, funding



Forum for European – Australian  
Science and Technology Cooperation

## Virtual Discussion Group

14 participants



30.05.01

Working Group 1

Slide 3



Forum for European – Australian  
Science and Technology Cooperation

## Areas of Interest for E-A Collaboration?

- Biology
- Biochemistry
- Environmental Studies
- Food Science (3)
- Industrial Engineering
- Nanotechnology
- Artificial Intelligence
- Information and Communication Tech
- Bioinformatics

**However: is this a sensible question??**

30.05.01

Working Group 1

Slide 4



## Regions of Interest

- Canberra
- Sydney
- Melbourne
- Perth
- Newcastle
- Geelong
- Townsville
- CSIRO
- Germany (14)
- France (11)
- UK (5)
- Italy (3)
- Spain (2)
- Netherlands (2)
- Belgium (2)
- Turkey, Iceland

30.05.01

Working Group 1

Slide 5



## Preferred Modes of Communication

- Email for day-to-day comms (100%)
- Face-to-face meetings every 2/3/6/12mths especially for initial collaboration and project setup (100%)
- Online forum, eNewsletter, informative website
- Phone and fax

30.05.01

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Slide 6



## Requested Support from FEAST

- Funding for travel/workshops/conferences
- Project seed funding, eg travel or PhD
- Info on funding opportunities, potential research/industry partners, positions, travel..
- Web links to institutions and industry
- Database of interests and research groups
- Opportunities for “like-minded” people /...

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Slide 7



## Requested Support (cont'd)

- /... Lobbying, policy development, priority setting, both on EU and AUS sides
- Conduit into EU or AUS funding bodies
- Vetting agency for EU & AUS funding bodies

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Slide 8



## Structure of FEAST

- Formal membership organisation (50%)
- Informal structure/community of interest (50%)
- Objectives of FEAST meetings
  - research level meetings??
  - network of interaction and liaison with other S&T organisations?!
  - Regional or chapter structure?!!

30.05.01

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Slide 9



## Green Questionnaire

80+ respondents



30.05.01

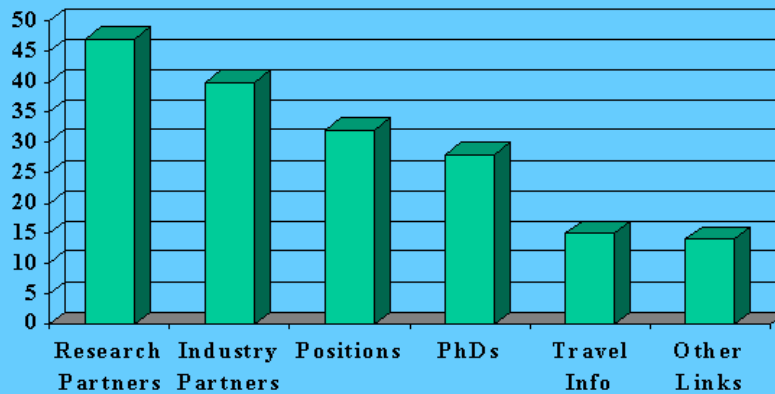
Working Group 1

Slide 10





1. If FEAST were to provide a well-managed and maintained online/web research information service, what would be the key areas to consider?



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Slide 11



...other comments to question 1:

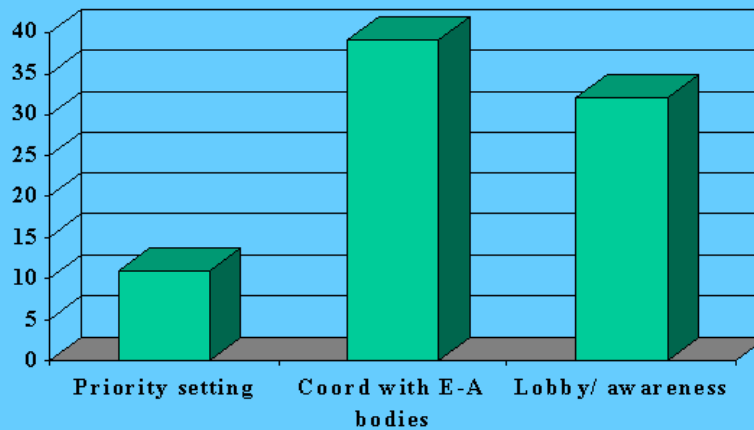
- Info on funding bodies
- Info on funding for exchanges
- Info on scholarships
- Links to funding bodies/information
- Links to research managers/S&T orgs
- Index/Links to E-A ongoing projects
- Contacts with mentors/advisers

30.05.01

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Slide 12

## 2. How should FEAST provide or develop policy?



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Slide 13

### ... other comments to question 2:

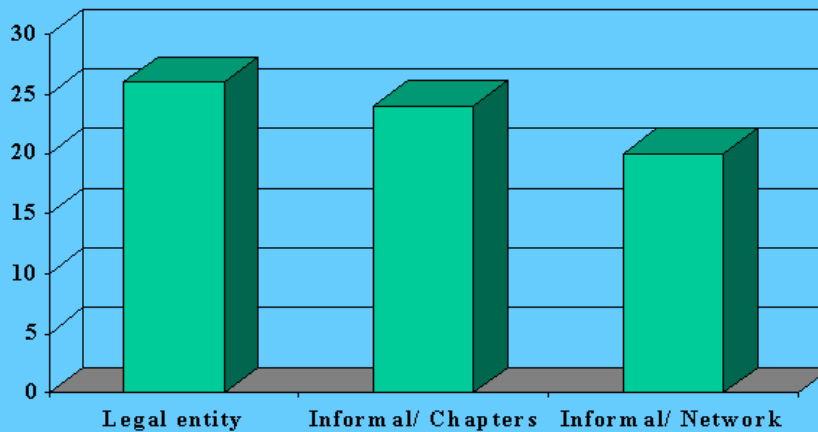
- Share research management policies between E-A organisations
- Develop complementary approaches
- Develop preferred research providers in industry R&D
- Coordinate links with/between E-A centres of excellence and major research facilities

30.05.01

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Slide 14

### 3. In order to support the anticipated future initiatives, FEAST should be:



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Slide 15

### ... other comments to question 3:

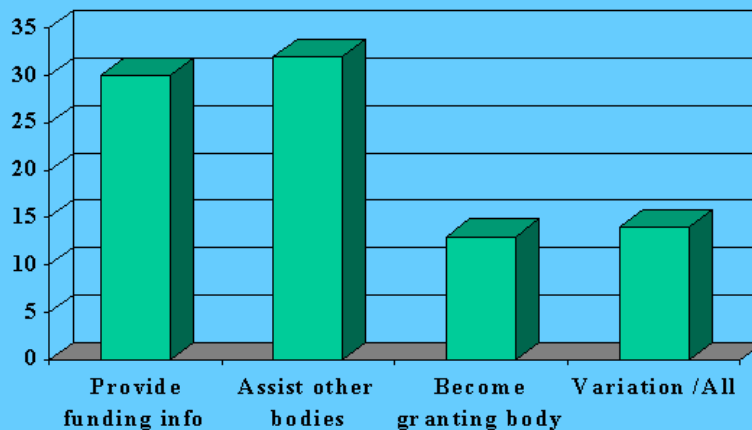
- Start informally, then become formal
- Formal local chapters for longevity, consistency and diversity
- Regular workshops
- Network of capabilities between R&D groups
- Also “national” groups, eg between countries

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Slide 16

#### 4. How should FEAST support/coordinate/ administer funding activities?



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Slide 17

#### ...other comments to question 4:

- Involve young people in decision making
- Divide funding by age: <35, 35-45, >45
- Coordinate, lobby, provide info and events
- Develop reciprocal arrangements between E-A
- Provide dedicated funding for E-A collaboration
- FEAST should be standard for A grant bodies
- Streamline IP sharing and flow-on for investors
- Coordinate prj mgt info, distribute to industry

30.05.01

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Slide 18

## **Appendix 2.** Plain Language Statement For OCED Interviews

### **Invitation Letter for Participation Questionnaire**

Plain Language Statement: for the OECD pre-testing project survey.



MANAGEMENT

Dear Participant,

You are invited to participate in a survey for Knowledge Management in the Private Sector.

The following information will include who is involved, why we are doing this, what exactly is involved and how you can participate.

Level 16  
239 Bourke Street  
Melbourne 3000  
Victoria Australia

GPO Box 2476V  
Melbourne 3001  
Victoria Australia

Tel +61 3 9925 5919  
Fax +61 3 9925 5960  
Website [www.bf.rmit.edu.au/Management](http://www.bf.rmit.edu.au/Management)

University - Royal Melbourne Institute of Technology University  
Department - School of Management  
Project Title - How do geographical dispersed groups share tacit knowledge?  
Investigator - Ms Susu Nousala, Masters student  
Supervisor - Prof. Peter Sheldrake

Explanation:

This survey is the Australian part of a larger international comparative study being conducted by the OECD, the project title is "knowledge management in the private sector". The results of the survey are intended to help develop an understanding of how knowledge management is being used currently and how it is being shared.

The statistical results of this survey will be used for a case study for the thesis being produced by the investigator (Susu Nousala). Any data from this survey not produced in statistical form, will use devices such as pseudonyms to disguise any possible links to personal or company details. No personal or company details will be collected or published. The OECD will produce a published report, based on survey results from all member countries. This report will be available publicly through the OECD publishing department.

Distribution of the survey will be carried out by approaching participants individually (such as yourself) because you fit into one of the following sectors; high level services, ICT, IT and Bio Tech. The survey will not be mailed out.



**Prior permission** will be sort from all participants.

**Prior permission** will also be sort from participants (from approximately 10% of Melbourne participants, Melbourne participants are being chosen, as this is the base city from where the survey is being conducted) who wish to assist with the understanding of tacit knowledge within the research. **If it is agreeable** to the selected 10% of Melbourne participants, it is hoped that the survey may be completed in the presence of the investigator, so that any thoughts voiced aloud by the participant can be recorded by the investigator to indicate generally how well the survey was understood. **At no stage will any recipient be formally interviewed. No confidential information or specific personal details will be recorded, published or used.**

The survey is 8 pages long, which includes explanations and will take approximately 15 mins to complete.

**This survey is voluntary for all participants, and in all cases prior permission will be sort.** Should you wish to participate, you will need to complete the attached compliance form, fill out the survey and return them to the investigator. Should you wish to withdraw, you may do so at any time, and where possible have unprocessed data returned to you.

Any complaints about your participation in this project may be directed to the Secretary, RMIT Human Research Ethics Committee, University Secretariat, RMIT, GPO Box 2476V, Melbourne, 3001. The telephone number is (03) 9925 1745. Details of the complaints procedure are available from the above address.

Thank you for your time.

RMIT HUMAN RESEARCH ETHICS COMMITTEE

**Prescribed Consent Form For Persons Participating In Research Projects  
Involving Interviews, Questionnaires or Disclosure of Personal Information**

**FACULTY OF** RMIT school of management  
**DEPARTMENT OF** \_\_\_\_\_  
 Name of participant: \_\_\_\_\_  
 Project Title: How do geographically dispersed groups share tacit knowledge?  
 Name(s) of investigators: (1) Susu Nousala Phone: 0419 502070  
 (2) \_\_\_\_\_ Phone: \_\_\_\_\_

1. I have received a statement explaining the interview/questionnaire involved in this project.
2. I consent to participate in the above project, the particulars of which - including details of the interviews or questionnaires - have been explained to me.
3. I authorise the investigator or his or her assistant to interview me or administer a questionnaire.
4. I acknowledge that:
  - (a) Having read Plain Language Statement, I agree to the general purpose, methods and demands of the study.
  - (b) I have been informed that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.
  - (c) The project is for the purpose of research and/or teaching. It may not be of direct benefit to me.
  - (d) The confidentiality of the information I provide will be safeguarded. However should information of a confidential nature need to be disclosed for moral, clinical or legal reasons, I will be given an opportunity to negotiate the terms of this disclosure.
  - (e) The security of the research data is assured during and after completion of the study. The data collected during the study may be published, and a report of the project outcomes will be provided to \_\_\_\_\_ (specify as appropriate). Any information which will identify me will not be used.

6.8.1.1.1.1.1.1

6.8.1.1.1.1.1.2 Participant's Consent

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
(Participant)

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
(Witness to signature)

6.8.1.1.1.1.1.3 Where participant is under 18 years of age:

I consent to the participation of \_\_\_\_\_ in the above project.

Signature: (1) \_\_\_\_\_ (2) \_\_\_\_\_ Date: \_\_\_\_\_  
(Signatures of parents or guardians)

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
(Witness to signature)

Participants should be given a photocopy of this consent form after it has been signed.



Any complaints about your participation in this project may be directed to the Chair, RMIT Business Human Research Ethics Committee, RMIT Business, GPO Box 2476V, Melbourne, 3001. The telephone number is (03) 9925 5594, the fax number is (03) 9925 5595 or email address is

### **Appendix 3. The Results of ITS Australia On-Line Survey**

# ITS Australia KMX Server Communications Survey August 2002

Total F2F	Total Electronic	Total Realtime	Total NoneAbove	
27	19	1	3	

F2F	Electronic	Realtime	NoneAbove	Question1
	1			Electronic
1				Facetoface
	1			Electronic
1				Facetoface
			1	Noneabove
	1			Electronic
	1			Electronic
		1		Realtime
1				Facetoface
	1			Electronic
	1			Electronic
	1			Electronic
1				Facetoface
1				Facetoface
	1			Electronic
1				Facetoface
	1			Electronic
	1			Electronic
1				Facetoface
1	1			Electronic
1				Facetoface
1			1	Noneabove
1				Facetoface
	1			Electronic
1				Facetoface
1				Facetoface
1				Facetoface
	1			Electronic
	1			Electronic
1				Facetoface
1				Facetoface
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1				Facetoface
1				Facetoface
1				Facetoface
1				Facetoface
	1			Electronic
	1			Electronic
1				Facetoface
1				Facetoface
	1			Electronic
1				Facetoface

			1	Noneabove
	1			Electronic

Noneaboveinput

Depends on idea or issue. If technical, then e-mail is best. If a value, personal or moral proposition then face to face is essential.

What I would prefer to do and what is realistic are to different issues - what is realistic is email.

It is important to do both email and face to face depending on the situation and circumstance and as I am only a new member it is difficult to judge.  
If face to face is not feasible then by phone and finally email.

However, this is not always expedient. Email is sufficient.

It's a matter of priority.  
High priority issues need face to face or verbal real time to ensure feedback is quickly considered, options quickly generated, focus aligned etc. Even within ITS, subjects have varying priority.