UNIVERSITY OF KWAZULU-NATAL

KNOWLEDGE MANAGEMENT PRACTICES IN THE FUEL PRODUCTION INDUSTRY: A CASE STUDY OF PETROSA MOSSEL BAY REFINERY

By
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DECLARATION

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Knowledge management practice in the fuel production industry:
A case-study of PetroSA Mossel Bay Refinery

This research outlines knowledge management practices at the PetroSA Refinery in Mossel Bay. The basis of such a study is that knowledge management has become a critical resource to organisations and there is a need to study such practices. It is also important that in as much as knowledge has become vital for organisation's competitiveness it has not received the attention it deserves. Knowledge has become an important tool for business because knowledge as a resource, it has moved to the strategic centre of the economy. The study of knowledge assumes that knowledge within organisations is contained by individuals and it is against this background that the role of Social Networks and Communities of Practice was explored. Also central to the study is the creation, sharing, transfer, storage, retrieval and application of knowledge by organisations.

Knowledge plays a central role in today's business at a number of levels: global, national and individual (Prusak, 2001:1). It is important that the fundamentals of knowledge management (tacit and explicit knowledge) are understood well because they play an important role in understanding knowledge processes like externalisation, socialisation and internalisation.

The purpose of this research is to understand in context knowledge management as a concept and its underlying premises; what its stands for, where it comes from and how knowledge flows within communities of practice and epistemic communities. This approach deals with trying to understand the distribution of knowledge within an organisation.

The understanding of Social Networks and interactive sharing of information suggests that knowledge is an important factor of production and it is from this background

that knowledge is assumed as intellectual capital. The study of knowledge capital discusses the epistemological nature of knowledge. Intellectual capital views knowledge beyond what accounting balance sheets and income statement reveal about assets in a business. Intellectual capital's link to knowledge management should be viewed from employee practice and creativity.

The research carried out at PetroSA's Mossel Bay Refinery used interviews and observations as research instruments because the author intended to gather much information from the respondents by including follow-up questions and clarifications and by part of the participants. Various questions were

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put forward to respondents in order to understand knowledge what knowledge management practices exist at PetroSA. The author's investigation measured the views of various professional; scientists, geologists, engineers, accountants and managers and artisans at the refinery before proposing the ideal practice. The conclusion of the work challenges PetroSA to ensure that that knowledge management policies are better known by employees and that the organisation should maximise the use of technology like e-rooms, portals, and other information technology to increase knowledge usage. The role that could be played by the Chief Knowledge Officer (CKO) in driving a knowledge management culture is highlighted.

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LIST OF ABBREVATIONS

CAS	Complex Adaptive Systems
CKO	Chief Knowledge Officer
COI	Communities of Interest
CoPs	Communities of Practice
CPS	Creative Problem Solving Method
DEC	Decision Execution Cycle
DLL	Double Loop Learning
DOKB	Distributed Knowledge Base of the Enterprise
IC	Intellectual Capital
IT	Information Technology
IS	Information System
KLC	Knowledge Life Cycle
KM	Knowledge Management
OLL	Organisational Learning
SGKM	Second Generation Knowledge Management
SLL	Single Loop Learning
TNKM	The New Knowledge Management

CHAPTER 1

INTRODUCTION TO THE STUDY

1. INTRODUCTION

This research is concerned with the emerging area of study referred to as Knowledge Management (KM). The research will look, in particular, at knowledge practices at PetroSA. The research project on knowledge management will also focus on the development of Communities of Practice (CoPs), epistemic communities and how knowledge is socially constructed. In understanding knowledge practices, it is necessary that one should understand the theory of knowledge management. The research project will also look at knowledge management and its relationship with intellectual capital. The study of both knowledge management, communities of practice and intellectual capital is important in understanding knowledge management practices as shown by the analysis in later chapters of this research. The relationship between knowledge management and intellectual capital is important in understanding the utilisation of resources by organisations. One such example on the importance of the relationship between knowledge management and intellectual capital is that organisations producing information and knowledge would not let its intellectual assets be under managed.

The general importance of knowledge management and its implications in the work environment have long been written about by scholars like Ponelis and Fair-Wessels (1998); Sveiby (2001) and Nowtony *et al.* (2003). Knowledge management is studied in this research because of its value in the knowledge-based economy, building organisational intelligence (Liebowitz, 2000) and also because it is a source for competitive advantage (Liebowitz and Beckman, 1998: 47-48). Knowledge is studied because it is an explanatory variable and a phenomenon that should be managed. It is also studied because knowledge management as a concept has a lot of relevance to business and has been applied extensively. Knowledge is also studied because there is a need to demonstrate it as a source for economic growth. This makes knowledge a strategically important source of competitive advantage (Nonaka, 1994). This management of knowledge has been recognised as having value because it brings expertise to organisations and is the source of organisational power and provides an opportunity to increase know-how in a specialised area.

Although there has been a stimulating discourse about knowledge management between academics and business over the years, there still remains a need to understand knowledge management practices within the fuel production industry because the industry itself has done well in utilising knowledge as a field. Utilising knowledge management has been studied at Shell and BP by Amidon (1997) and the results of that study show the importance of knowledge management.

The study of knowledge has brought new dimensions to the field of organisational studies. This has brought new insights into the role of knowledge in organisations. For example, research has shown that Taylor's call for the externalisation of personal knowledge – in order to instruct workers in standardised procedures – has serious drawbacks (Brown and Duguid, 1991; Tsoukas and Vladimirou, 2001; Tsoukas, 2002).

The concept of knowledge is important because it underlies many other concepts like core competencies (Prahalad and Hamel, 1990). It also underlies concepts like organisational learning, dynamic capabilities and managerial cognition; intellectual capital and Communities of Practice – some of which will be discussed in Chapter Three of this study.

This chapter begins by providing the context in which the research will take place, and providing an overview of what knowledge management is. The problem statement and scope of the research is stated, together with the questions that will be researched. This is followed by an overview of the research methodology used to conduct the case-study research. The chapter concludes with an outline of the structure of the remaining chapters in this research.

1.1 Research Context

The study of knowledge management and its meaning has been debated by academics for centuries. The main studies have been on tacit and explicit knowledge. Tacit knowledge, or personal knowledge, is information processed in the minds of individuals; and it is difficult to capture, store, articulate and distribute (Polanyi, 1966; and Alavi and Leidner, 1999). Explicit knowledge is knowledge that can easily be captured, articulated and communicated in the form of text, computer output, the spoken or written word, or through other means (Alavi and Leidner, 1999).

The first question that needs to be answered when dealing with the subject of knowledge management is why knowledge is important for organisation and organisation studies. Research shows that for most organisations, knowledge does not have intrinsic value, but an instrumental value and facilitates actions. Organisations normally do not collect knowledge for their own sake but to be used by others. This assertion means that the prime contribution of collecting knowledge is that it should be used by others. Knowledge enables actions and that is why it is studied. The study of knowledge enables organisations to learn from their own experience by codifying what they learnt.

As stated earlier, there is no clear definition of knowledge by academics. Other academics still consider knowledge to be locked in epistemology, by believing that knowledge consists of a subset of true beliefs about the world, while others compare knowledge with an accurate map of a district. Such a comparison provides natural analogy about knowledge. Knowledge itself is about beliefs and beliefs themselves are sometimes referred to as 'maps by which we steer' (Braddon-Mitchell and Jackson, 1998). Maps are themselves compared with scientific theories and cognitive models. Having a map of the territory in which we want to travel, gives the traveller the coordinates of the places the traveller wants to go and routes to get there. The map enables efficient travelling and avoids moving around by trial and error. In such a way, knowledge is about its technology, customers, competitors and ways of organising, help an organisation to act efficiently and effectively (Solow, 1957). From this perspective, knowledge has two opposites: ignorance (the lack of a map) and error (an erroneous map). An erroneous map may lead the traveller in the wrong directions.

The definition of knowledge management is still elusive to many academics although knowledge is recognised as a factor of production alongside with capital, labour, and materials and is not affected by the Law of Diminishing returns (Liebowitz and Beckman, 1998:47). The use of knowledge as a factor of production can bring about the improved competitiveness of a firm (Amidon and Skyrme, 1991). These different resources are used alongside with each other in organisations.

This distinction of knowledge management as a factor of production has been popularised in the last fifty years by writers like Polanyi (1966); Nonaka and Konno (1998). This popularisation set out to answer the question: *"Why is knowledge important for organisational studies and organisations; and why is it studied?"* The advent of the study of knowledge by academics has

forced business to look again at the value of knowledge, to look again at the sources of knowledge, together with how knowledge is created, shared, distributed and archived.

The contributions of knowledge are far-reaching, with some organisations arguing that it is the coin of the 21st century. As stated earlier in this chapter, epistemologists consider knowledge to be in the same realm as an accurate map of a district – which shows tourists how to navigate the paths of that district. But a map alone is insufficient to navigate a district, one need to have resources- food, money and a compass too. Likewise, the application of knowledge in organisational practices depends on the availability of other resources like people. The other resources could be an accurate mental map or technology which helps in the development of knowledge.

Knowledge is becoming more important in the current economy and society for various reasons: the first one is that more and more people are performing knowledge intensive work and the second one is that with technology advances there is a need to learn more and this learning of advancing technology needs knowledge management. Technologies develop fast and knowledge workers have to learn in an increasing pace to keep their knowledge up-to-date.

There has also been a lot of interest in studying knowledge, particularly from the recently coined 'knowledge based theory of the firm' (KBT), which was developed by (Demesetz, 1991; Kogut and Zander, 1992 and Spender, 1996). This theory has both economic and organisational side to it. As an organisational theory, the knowledge based theory of the firm, (KBT) uses knowledge and knowledge processes to explain the structure and performance of organisations. It emphasises the collective characteristics of knowledge in organisations. Theorists of KBT argue that the capabilities of an organisation reside not only in the knowledge of individuals, but particularly in the way this knowledge is integrated (Kogut and Zander, 1992). The collective nature of these capabilities makes them difficult to transfer, replicate or imitate.

Knowledge is rooted in practices and systematic processes. This is evident from the attention paid to knowledge by Smith and Taylor. The study of processes and practices gave birth to Communities of Practice which are dealt with in Chapter Three. It is on this basis that the author has undertaken a research project on knowledge-management practices in the fuel producing industry, using the PetroSA Refinery as a case study.

Knowledge-management practices include creating and discovering new knowledge, sharing existing knowledge and learning through social practices which involve CoPs and epistemic communities. This study seeks to explore and assess such knowledge-management practices in the fuel-production industry, using PetroSA Refinery in Mossel Bay as a case study. In assessing knowledge-management practices in the fuel-production industry, the study will also investigate the existence of CoPs and epistemic communities.

The creation and discovery of knowledge as a practice is important in understanding knowledge, because knowledge is considered to consist of true beliefs about the world. The creation of new knowledge requires that one should acknowledge existing knowledge practices which involve the creation and discovery of knowledge, including data mining, text mining, knowledge elicitation and information-content analysis. Then there is also 'sharing and learning'; this underlines the value of CoPs and epistemic communities. (These will be discussed at some length in Chapter 3 of this dissertation.)

Knowledge sharing and learning which occur in CoPs include learning networks, sharing best practices, structured dialogues all of which contribute to the understanding of knowledge practices. Knowledge is shared through cross-functional teams using enablers like computers, web-based technology – or simply through social interaction. Knowledge-management practices include managing the knowledge processes; as well as understanding rules that govern the creation, distribution and use of knowledge. A more detailed explanation of these is offered in chapter Two.

The study of knowledge management is exciting, both as a field of study *per se,* but also in its practical application in business. The study of knowledge management involves defining the two distinct types of knowledge: tacit knowledge and explicit knowledge (see sections 2.1, 2.1.1 and 2.1.2 for a detailed explanation of tacit and explicit knowledge). The study of both tacit knowledge and explicit knowledge is helpful in explaining knowledge practices. The tacit component of capabilities makes them a source of competitive advantage. Tacit knowledge is that knowledge that we use unconsciously when we take conscious actions or apply explicit knowledge (Polanyi, 1958). Tacit knowledge is difficult to transfer, observe or sell. Capabilities built on tacit knowledge are therefore hard to replicate by others. Competitive advantages based on such collective, are tacit capabilities and have higher chance of being sustainable. Explicit

knowledge is documented knowledge, captured, structured and can be shared through information technology and other means.

The particular emphasis of the study is on understanding the current knowledge-management practices at PetroSA and to compare them with theoretical concepts offered by Chapters Two and Three of this thesis. There is also need to understand what influences knowledge practices. The study of knowledge practices requires that one should understand the processes which govern knowledge creation, as well as the dissemination and utilisation of knowledge. It is also important to state outright that knowledge-management practices include the culture of creating new knowledge, the sharing of existing knowledge and managing knowledge processes.

Practice is linked to process by ensuring that there is a continuous renewal of the organisational knowledge base. Proper knowledge practices should improve the processes which can create supportive organisational structures, improve the functions of knowledge enablers and enhance knowledge diffusion.

The researcher's intention of carrying out this study is, firstly, to understand knowledge management as a concept – together with its underlying premise: what it stands for and where it comes from. Secondly, the researcher aims to show how knowledge can be shared in CoPs and epistemic communities. Thirdly, the researcher hopes that by exploring knowledge management practices in PetroSA, this would help in understanding the effectiveness of knowledge-management activities in the organisation.

The researcher also understands that a study of knowledge management should assist in identifying the gaps in knowledge practice between PetroSA and the established literature; and it should also help to develop a framework improve the existing knowledge practices.

The study of knowledge management theory and observation of knowledge practices will provide a gap analysis between theory and practice. The forthcoming answers from the gap analysis are intended to add to the body of knowledge in this field – in which the writer has a keen interest. The study aims to provide concrete answers to specific questions. Some of the fundamental questions that need to be answered include questions like: Why is knowledge studied? What is its value? What gaps exist in understanding knowledge as a production factor?

Some of the answers are to be found in exploring the perception of knowledge management, as provided by PetroSA; the effectiveness of knowledge-management activities; the source of knowledge practices; understanding the role played by employees in enhancing knowledge practices. PetroSA was chosen because the literature review revealed that petroleum-producing organisations are among the companies that have succeeded in implementing knowledge-management initiatives. Thus, it is interesting to find out how successful PetroSA has been in implementing knowledge management practices as expounded by theory.

Knowledge management is studied because it has become an important tool for business. It has also been academically recognised as a factor of production alongside capital, labour and materials as earlier intoned. This assertion ensures that knowledge, as a resource, has moved to the strategic centre of the economy. Knowledge in today's business world plays an important role at a number of levels: global, national and individual (Prusak, 2001:1). It is against this background that the study of knowledge and knowledge practices has become central to organisations willing to harness all the relevant existing intellectual assets. The study becomes important to find out the degree to which PetroSA is willing to harness all the relevant intellectual assets.

Knowledge-management systems consist of methods, practices and technologies. Although these three are mentioned as concepts in this dissertation, the focus will mainly be on methods and practices – while trying to find gaps – and suggesting corrective measures to close the gaps between theory and practice.

In discussing knowledge-management practices, it is imperative that one should emphasise the importance of knowledge-management technologies (such as mapping tools, collaboration tools and knowledge databases) as being crucial, and as enablers to support the existing credible knowledge-management practices (Egbu and Botterill, 2003:10). Fouche (2006); Egbu and Botteril (2003:10) argued that although most organisations use the internet as a major tool for accessing knowledge, there are other technologies, like document management, group ware, databases and e-rooms. The question is "does PetroSA have these and how do they use them effectively?"

The importance of the technologies that support knowledge-management practices needs to be stressed and well understood, because practices are facilitated by tools and techniques (Fouche, 2006).

1.2 Problem Statement and the scope of the research project

The dissertation probes fundamental questions, such as:
- Does PetroSA have existing knowledge practices?
- Do the current knowledge-management practices at PetroSA help management to understand and appreciate the value of knowledge?
- What gaps exist in the practice of knowledge management at PetroSA; and if they exist, how could these gaps be closed?
- Do existing knowledge-management practices recognise knowledge as intellectual capital?
- Do the existing knowledge management practices enhance the development of Communities of Practice and epistemic communities?

The focus of the study is the PetroSA refinery in Mossel Bay. (Note that the term 'the organisation' referring to PetroSA will be used henceforth throughout this work).

1.3. Research Question

Does the exploration of current knowledge-management practices at PetroSA show gaps between theory and practice? Gaps which prevent the organisation from realising the value of knowledge as intellectual capital?

1.3.1 Sub-research question

How can the exploration of practices of knowledge management at PetroSA help to close any gaps in knowledge management in the organisation?

1.4. Nature of the study

The study focuses on existing knowledge practices in PetroSA; but additionally, it seeks to draw parallels between current practices on knowledge management that exist at PetroSA, and what

the theory says. This linking of theory with practice is intended to reveal whether gaps exist or not. This is important because theory establishes the basis on which practice is built. The study starts by defining what knowledge management is; followed by the identification of the different types of knowledge; explicit and tacit; identifying those processes that govern the creation, dissemination and utilisation of knowledge.

A brief history of knowledge management is given – in order to understand its development and direction. Knowledge management, in this context, is defined in simplistic terms, "as the ability to manage knowledge". This implies that knowledge management deals with managing collective knowledge (ideas converted to practical value) by employees. Coakes *et al.* (2004:3) argue that in line with managing aggregate intellectual capital, knowledge management should emphasise the management of repositories, in order to facilitate the easy convertibility of knowledge into assets. To do this, organisations need to have strong and active CoPs.

The above line of reasoning suggests that knowledge is used by enterprises as a factor of production which can increase a firm's returns; and that knowledge can help to improve processes by identifying the gaps within an organisation. Knowledge also connects the organisation to the outside world. Organisations utilise knowledge to tap into the creativity of individuals in their employ, and also to reap the benefits from their investment in intangible capital; and hence, the need for knowledge as a concept to be studied.

Organisations like PetroSA operate in a very competitive environment which is characterised by the need for it to manage all its information assets – to ensure that it can compete efficiently in the oil production industry. PetroSA has different divisions which operate independently; hence, the need to manage and to share enterprise assets like databases, documents, policies and procedures – and to manage systematically the aggregate expertise and knowledge that is housed in people's minds. The study of knowledge management will help us to tap into the creative and innovative capacity of the organisation's employees.

It is against this background that the author believes that this dissertation should be able to contribute to a better understanding of knowledge management – by linking theory to practice, by identifying gaps in the practice, and by suggesting some improvements to knowledge practices at PetroSA. The analysis of intellectual assets is done in order to better understand the

value of knowledge as capital. This should also assist in the study of knowledge as a production asset – and in its conversion into applicable practices.

Explicit and tacit knowledge will be discussed in detail and their different meanings will be clarified in Chapter Two. Explicit knowledge is knowledge that is written down and contains information (Bukowitz and Williams, 1999). Tacit knowledge is knowledge that is realised through communication and conversation, and on the job – through learning (Skyrme, 1997:24-26). Knowledge-management practices within PetroSA are explored by considering the Social Networks which arise, as a result of informal and formal interactions by individuals, and in the subsequent building of epistemic communities.

Moreover, a definition of what the author understands as knowledge is given; and this is not meant to marginalise other given definitions of what constitutes knowledge. Knowledge is defined as, 'the only factor of production that is not subject to diminishing returns" (Liebowitz and Beckman, 1998:47). This definition introduces the assertion that knowledge is a factor of production and need to be managed like the other factors. Davenport and Prusak (1998:5) defined knowledge as "a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experience and information".

Knowledge constitutes the aggregate know-how contained in people's heads, and in various practices: and how such knowledge can be implemented for organisational benefits. This definition of knowledge suggests that knowledge flows from the knower to the user, and is housed temporarily in repositories, company documents, procedures and server rooms. It can easily be distributed thence for use at any time.

This dissertation also seeks to show that the understanding of knowledge needs to be improved, if organisations like PetroSA intend understanding the full value of knowledge. This could be done through continuous learning and by thoroughly interrogating the concept of knowledge itself, what it stands for, its features, and how it can be turned into an asset. The concept of learning as place, in which knowledge in CoPs are housed is discussed in detail in Chapter 3 of this dissertation. The concept of knowledge needs to be properly interrogated, in order to

understand it better. Improvement of knowledge through learning – in order to harness performance – can be done through CoPs (Wenger, 1998).

CoPs come about as a result of cultivating learning systems within organisations. Communities of practice originate from active social knowledge processes (Wenger and Snyder, 2000:139-145). Communities of practice are essential in the sharing of knowledge for organisational learning; and such communities are important for transforming knowledge into intellectual capital, whence it can be utilised and implemented in practical situations.

The social process is a feature of knowledge creation and production, as suggested by Brown and Duguid (1998:90-103). The social process investigates how communities of practice engage in sense making and shared practice, and in developing shared assumptions, methods and in procedures for validation. The assumption that is proposed here is that knowledge originates from people and flows through people to other people. This assumption is critical in any adequate understanding of organisational knowledge, because organisational knowledge, by its composition, comprises two different, but related phenomena: organisational-learning flows and intellectual-capital stocks.

In order to evaluate the current knowledge management at PetroSA, it is important to understand what CoPs are, and what their role is in sharing existing and new knowledge. Communities of Practice will be discussed in this dissertation, because there is a need to show that knowledge-management practices at PetroSA exist within CoPs. Communities of Practice are important, because they turn theoretical knowledge into practical use; and thereby, create new knowledge and share it – with the view of improving practices.

Communities of Practice produce knowledge by engaging in the creation of social knowledge, as well as in the production process. Brown and Duguid (1998) have argued that Communities of Practise utilise humanity's social character by emphasising the importance of shared and co-ordinated efforts. This means that collective sense making, which is a feature in the social process of knowledge creation, is also critical in Communities of Practice. The dissertation also discusses organisational learning, as this helps in understanding the complexity of knowledge, and in the implementation of complex adaptive systems.

This understanding of Complexity and Complex Adaptive Systems (CAS) helps in the understanding of the concept of 'deteuro-learning' – from single-loop learning and double-loop learning (Cohendet et al., 2003; Nonaka and Takeuchi, 1995).Deteuro-learning occurs when organisations learn to carry out single-loop and double-loop learning, (Argyris and Schon, 1978) 'Deteuro-learning' is fundamental in learning organisations like Communities of Practice. This is true because the creation of Communities of Practice is seen as a renewed approach to organisational learning. (A more explicit explanation of single-loop learning, double-loop learning and deteuro-learning is given in chapter 3 of this dissertation)

1.5. Intangible assets defined

Intangible assets comprise knowledge, together with its value, in an organisation. These intangible assets are represented by human capital, organisational capital and customer capital. The accounting balance sheet cannot reflect the true value of these elusive concepts. It is the purpose of this dissertation to show that intangible assets are related to knowledge and intellectual capital – which can be best understood through practice and understanding the knowledge epistemology. Intangible assets, of which knowledge is one, exist within employees' heads and are manifested by their creativity.

Intangible assets can also be shown by what process improvement, efficiency and skills that are possessed by individuals have in making the organisation competitive. It is the purpose of this dissertation to show that the measuring of intellectual capital cannot be done by using conventional accounting methods. This, in no way, detracts from the exactness of accounting methods; but, it reinforces the claim that knowledge is an asset – by assigning value to its output (Bontis, 2001).

The link between the definition of intangible assets and intellectual capital assumes that society can find economic value by harnessing knowledge; and thereby, defining the competitiveness of the organisation.

Having defined intangible assets, the writer explains why knowledge is perceived as an asset. This is done by explaining how knowledge assets enable information to be translated into those objectives which can create wealth. Knowledge, as intellectual capital, stems from the understanding of explicit knowledge, which allows for objectivity and expression in the form of words. This is linked to the dialogues in Communities of Practice and epistemic Communities, which turn knowledge into value.

The dissertation intends showing the importance of knowledge in an organisation – by showing what practices exist and why they exist. This includes understanding how existing knowledge is shared, how new knowledge is created and produced, and what processes define such particular practices. It further looks at knowledge as intellectual capital, by comparing the theoretical constructs with the existing practices at PetroSA.

It is through this study that the author will show that knowledge – as capital – can be used to further business goals. The author will challenge the organisation to begin viewing knowledge as intellectual capital. The author also understands that the assertion that knowledge is intellectual capital is still confusing to many, because organisations like PetroSA are still confused on how knowledge as an intangible asset can create value and improve the organisation's business goals.

Knowledge as capital can best be understood from the classical viewpoint. This perspective argues that knowledge is a critical factor of production; and that it should be managed to drive down costs, replace inventories and improve corporate ability. The value chain of knowledge-derived benefits can easily be measured by using standard accounting methods. This view might seem to be conflicting with the earlier assertion by the writer that intangible assets cannot be measured by using standard accounting methods. Here, however, the author is discussing the bottom-line value addition of knowledge, i.e. looking at the savings and benefits accruing from the effective use of knowledge.

It is imperative to define what capital is – in order to understand knowledge as such. Capital is viewed as a tangible economic resource that can be transformed to yield value. This differs from knowledge as intellectual capital because knowledge is the intelligence that resides in peoples' minds; and it can turn ideas into substance, hence creating value and competitive advantage for the organisation. Knowledge is intangible, elusive, mobile and hard to pin down. It is also invisible.

The author also includes the challenge faced by businesses in converting intangible assets, like knowledge, into value. Converting knowledge into value is set to alter the ratio configuration of material to knowledge. The ratio of a firm's material to knowledge needs to be looked at once more. Knowledge needs to be converted into value – by emphasising the importance of employee know-how, competency and trust – in relation to business performance (Sveiby, 1997).

Organisations leverage intangibles, such as social citizenship and environmental responsibility – in order to create value.

It is important also to understand the concepts of value and value conversion. Value may be described as the addition of an attribute to an existing object. Value conversion is accomplished by translating the value of an attribute into something that increases the value of that asset.

It is also important to understand the concept of 'value conversion' in the study of knowledge, as intellectual capital, because it is through this conversion process that an intangible asset is transformed to yield a distinct financial value (Allee, 2008).

The identification of knowledge as intellectual capital assumes that knowledge can be converted into value which can be measured in monetary terms. It is the purpose of this dissertation to show that knowledge measurement forms part of the processes and practice of knowledge management. Knowledge assets are measured by disclosing non-financial assets, which cannot be quantified in the form of traditional financial statements.

Although there are many models for measuring knowledge assets, all highlight a common feature; that there is a need to invest in knowledge assets in the 21st century – given the increasing competitiveness between organisations. Knowledge does not lie in documents or servers only, but it also exists in processes, practices and norms; hence, the need to measure its epistemological value in some way.

In short, to answer the questions posed, the author has developed a flow, starting with the problem statement, and then by addressing what processes and practices are embodied in knowledge management as discussed in Chapter Two. This is followed by an overview of the research methodology used to conduct the case study research (see Chapter Four for more detail). The chapter concludes with an outline of the structure of the dissertation as a whole.

It is important to note that this dissertation discusses knowledge-management practices within PetroSA at the refinery in Mossel Bay. This is what constitutes the case study. To unravel the purpose of the dissertation, the author gives some background of knowledge management, its history, and how it has come to be recognised as a factor of production, particularly during the last fifty years.

1.6. Research design

A case study approach was followed, in order to assess knowledge practices and policies in real life. This research approach was considered to be appropriate, given the purpose of the research, particularly since it presented the author with the opportunity to use the case-study approach to gain an in-depth understanding of knowledge practices. The researcher seeks to address the questions raised under the heading of "Problem Statement".

The intention of this dissertation is to explore the knowledge-management practices within PetroSA. PetroSA's Mossel Bay refinery is used as a case study to carry out fieldwork. It is purpose of the research design to show the responses from those interviewed, by using a defined set of questions. The research will be based on the literature review, which will provide the context to the research; and also by an interview process and observations. These should help collect the required information to address the problem.

The author uses various methods of literature search to review the existing literature on knowledge management. The purpose of the literature searches is to gain an in-depth understanding of the theoretical foundations and premises of knowledge management, including the tools and methodologies proposed for conducting an assessment of knowledge practices in the fuel-production industry.

The nature of the topic 'Knowledge-Management Practices in the fuel production industry' does not allow the author to use questionnaires, because it was felt that questionnaires would not yield in-depth answers which would answer the pertinent research questions. To justify the research design, the author has used observations and interviews (structured, unstructured, and semi-structured). Observations have also been used, to a limited extent, in order to understand the behaviour of employees in relation to the research questions. Site visits and observations would entail collecting all the data through occurrences that could be visually observed.

The interviews have been conducted on a sizeable population of respondents. These form the key-focus group of the case study. The choice of using a sizeable population is explained by the need to have an interactive process which includes the major users of knowledge; and also, to have a balanced profile of respondents. Interviewing and observing a sizeable population will enable the author to achieve more meaningful responses to address the questions asked.

A set of standard questions was drawn up and tabled during the interview process. This was followed by subsequent questions – to get clarity and further details.

All the requirements, obligations and rights of interviewees to participate voluntarily in the interview process were explained to the participants. Additionally, as part of the research design, the author justifies the use of interviews ahead of other research instruments. Although other research tools are mentioned, the focus in this dissertation has been on interviews and observations.

1.7 Research methodology

The aim of this research is to explore knowledge-management practices and processes within PetroSA – using the Mossel Bay refinery as a case study. A basic research approach has been adopted to achieve this purpose. This approach utilises an in-depth literature-review process to gather theoretical data from the knowledge-management body of knowledge, together with observations and face-face interviews conducted on the key-focus group. A more detailed methodology is presented in Chapter Four.

1.8 Data analysis

Data analysis included an in-depth analysis of the responses given, in addition to the follow-up responses emanating from further questions. The responses to the interview questions were grouped into broad themes. Since the methodology used mainly interviews, there can be no right or wrong answers; and the responses merely captured the experiences of the respondents in knowledge management. The responses were captured, and an analysis of how the respondents answered different questions is given in Chapter 5 of the dissertation.

1.9. Limitations of the study

The study was limited to the Mossel Bay Refinery. This was to allow the researcher to explore and review the knowledge-management processes in PetroSA. The author understood that the various participants in interviews and observations came from different departments in the refinery, which gave a fair representation of the focus group.

1.10. Brief chapter breakdown

The study is organised into six chapters that seek to address the main aims and objectives, in addition to providing answers to the research questions. The first three chapters provide a

background and theoretical framework to the study. A case study was selected as the preferred research strategy. Next, an outline of the full research report is provided.

Chapter 1: This chapter introduces the research work, identifying the information gaps as it progresses, as well as outlining the methodology and objectives of the study.

Chapter 2: The theoretical grounding of knowledge-management as a concept is given. The chapter also defines what knowledge management is, and why it is important to study knowledge management. It also introduces other terminology, like tacit and explicit knowledge, and intellectual capital. These terms are essential in understanding the study of knowledge management. The chapter also discusses knowledge in the light of whether it is to be understood as a process or as an object. A classification of knowledge is given. This is followed by a brief analysis of the concept of 'ba' which explains the emergent systems in knowledge management.

The four patterns, whereby knowledge is converted from one mode to the other for example from tacit knowledge to explicit knowledge, are also given. Social interactions and shared experiences are explained; through a combination of various knowledge forms; from tacit to explicit through externalisation, and from explicit to tacit are given. These precede the *Socialisation, Externalisation, Combination,* and *Internalisation* model (SECI), which explains how knowledge is created through social interaction. The chapter also includes an analysis of the entire knowledge-management process by including the 'Three-Tier Reference Model'.

In order to define the theory of knowledge management, the writer also includes an analysis of the knowledge-management process. This includes knowledge creation, knowledge storage and retrieval, knowledge distribution, and knowledge application - all of which help to explain the processes that define the generic practice of knowledge management.

Chapter 3 is on Communities of Practice and intellectual capital. The chapter discusses the study of Communities of practice, epistemic communities from the viewpoint of aiding the learning process – in which organisations use knowledge. Definitions of Communities of Practice and epistemic communities will be given; and their roles in knowledge management are acknowledged, by discussing how Communities of practice in particular are formed, together with their relationship to learning as a vehicle for dispensing knowledge.

The need to infuse knowledge management, as an important tool in the production cycle, and as a source of intellectual assets will be examined in detail. Communities of Practice generate and share knowledge at various levels of the enterprise.

These are discussed in detail in this research, as well as their ability to collaborate, learn and support each other – resulting thereby in knowledge creation that can be used to produce best practices, creatively solve problems, and effectively communicate standards and procedures (Wenger and Snyder, 2000). It is the purpose of this chapter to show how firms manage codified knowledge and the need for managing it.

The assumption that is maintained here is that firms manage codified knowledge in order to harness knowledge for competitiveness, and that such knowledge is usually fragmented; and there is a need to collate it, in order to increase its value addition to the organisation. The chapter also discusses the dichotomy between social networks and Communities of Practice.

This dichotomy, furthermore, discusses the personalization and codification strategies. The chapter concludes by discussing knowledge as intellectual capital, and by showing how knowledge is converted into value; in addition to how this value can be measured.

Chapter 4: This chapter deals with the research design and the chosen method of data gathering to be used for the research. The writer justifies the choice of research methods used (structured, semi-structured and unstructured interviews) together with observations.

Chapter 5: This section of the dissertation highlights the analysis forthcoming from the interviews and the follow-up questions that were used to gather the data. The responses given by interviewees are analysed, and the meaning of these responses is recorded. It is through these responses that the writer assesses the practice of knowledge management at PetroSA, by comparing what the respondents say and their understanding of knowledge processes and practices.

The pattern of the responses is grouped and the analysis of their understanding of the research questions is recorded in broad themes.

Chapter 6: This chapter gives the author's conclusion of the knowledge practices existing at PetroSA, and whether these processes and practices have gaps. From the responses given by the

interviewees, the writer concludes the assumptions made about the existence of knowledge management practices at PetroSA. This conclusion identifies gaps if there are any and whether PetroSA realise the full value of knowledge, Communities of Practice and Social networks. The conclusion also assumes how these social networks can be strengthened – in order to increase the knowledge value added.

The findings from the observations and interviews will be compared with the theory; and any deviations will be noted and commented on. A suggestion will be made on how to improve the processes and practices of knowledge management.

CHAPTER 2

Understanding the Theory of Knowledge

"Knowledge is defined by how it is managed. Knowledge is the only instrument of production that is not subject to diminishing returns." (Liebowitz and Beckman, 1998: 47)

"The knowledge management movement is still in its early stages. Of late, there have been some changes in the way organisations manage knowledge (Bukowitz and Williams, 1999:8)

2. Introduction:

This chapter provides an overview of knowledge management and the development of knowledge theory. Particular reference is therefore made to the understanding of knowledge theory. An emphasis is on the difference between tacit and explicit knowledge, understanding whether knowledge is an object or process and the classification of knowledge. The chapter is also centred on knowledge-management processes, like production, the sharing of knowledge, the storage, indexing, retrieval and transfer of knowledge. Understanding knowledge theory and of the various processes of knowledge management is important because it provides evidence to support the research findings.

2.1 Understanding the knowledge theory

There are many approaches to managing knowledge and the Communities of Practice (CoPs) that have gained momentum in the last fifty years. Managing knowledge means that organisations manage what they know; the value the intellectual capacity that is housed in the minds of individuals, and on the various pages of company documents and in server rooms.

An understanding of knowledge management requires that one should be able to distinguish clearly between tacit and explicit knowledge, knowledge and data as discussed herein. It is also important to understand the meaning of concepts like Communities of Practice and intellectual capital (IC), all of which will be discussed in detail in Chapter 3 of this research thesis.

From the outset, it is important to clearly define the two distinct types of knowledge: tacit knowledge and explicit knowledge. These are vital in understanding the various knowledge processes that are discussed in this research. It is also important that the different typologies that comprise knowledge as a subject should be clearly outlined. This is done, in order to set the scene – before commencing the discourse on knowledge management.

Many writers confuse – rather than clarify – the difference between tacit and explicit knowledge. Tacit knowledge is regarded as personal knowledge which is stored in the heads of the people and is accumulated through study and experience, while explicit knowledge is considered codified knowledge and is stored in documents, databases, websites, emails etc. (Polanyi, 1958). Clarifying this difference is important in establishing a departure point in explaining knowledge management and understanding the theory of knowledge management, knowledge as a process, and its relationship with data and information. Understanding the difference between tacit and explicit knowledge would help understanding and merge the various scholastic views on both tacit and explicit knowledge. This would help to provide a background to the broader problem statement of this research. It would also help in explaining what knowledge practices exist at the PetroSA refinery in Mossel Bay, and how knowledge can be utilised as an asset in practice.

The understanding of knowledge demands that one understands both tacit and explicit knowledge. The core of this research deals with how knowledge is used/changed from tacit knowledge to explicit knowledge, and vice versa. In understanding knowledge management as a concept, one has to clarify the understanding of tacit knowledge. In understanding what tacit knowledge is, there is a compelling factor to understand how such knowledge is managed.

2.1.1. Understanding tacit knowledge

The understanding of tacit knowledge offers a pragmatic approach in conceptualising knowledge, because it offers the connection between the individual and such knowledge. It also involves understanding between what the individual knows and what the organisation knows.

This connection depicts the 'conceptual and contextual' framework that underlies tacit knowledge. From the literature accessed, it is clear that a systems approach to understanding tacit knowledge is required, because such knowledge is entrenched in people's minds; and it also has a link to their environment.

Individuals interact unintentionally with each other and the environment to produce tacit knowledge (personal knowledge stored in the heads of people). However, Polanyi (1958, 1966) was cautious of such an approach in understanding tacit knowledge, although he failed to describe the systemic interaction. It is therefore important that one should separate tacit knowledge which is difficult to formalise, record, or articulate from explicit knowledge which is any knowledge that can be codified, documented and archived (reports, memos, business plans, drawings, patents, trademarks, customer lists, methodologies).

The difficulty in capturing and codifying tacit knowledge stems from its informal and unstructured nature. The individual's actions and experience, which explain the individual's values and ideals, are contained in tacit knowledge. This view is corroborated by Nonaka and Konno (1998:42), who presented tacit knowledge as being technical (people's technical skills and crafts).

This is called know-how, while the other aspects of knowledge comprise values, beliefs, schemata, ideals and mental models. Such concepts are more cognitive. These writers warn that it is difficult to understand the cognitive aspects of tacit knowledge, because of the lack of a proper understanding of the philosophical underpinnings of the subject. It is clear that tacit knowledge is the knowledge used by experts in most fields (Polanyi, 1966)

Tacit knowledge is also useful in solving complex problems – by groups like those in ICT trouble-shooting. Tacit knowledge can easily be connected to skills and performance. This depicts tacit knowledge as 'non-codified, disembodied know-how that is acquired via the informal take-up of learned behaviour and procedure' (Vlok, 2004 and Hedesstroom and Whitely, 2003).

2.1.2 Understanding explicit knowledge

The importance of understanding explicit knowledge is vital to this research, because it provides the platform to understanding the knowledge in written documentation, company servers and computers. This type of knowledge is used to formulate procedures and policies. Explicit knowledge assumes some codification, and is more formal. This is the type of knowledge that conforms to systematic language. Explicit knowledge results from social processes that occur internally or externally from organisational boundaries.

Nonaka (1994) explained these four processes as socialisation, internalisation, combination and externalisation. These processes occur because individuals interact and observe, imitate, or are in formal learning situations like apprenticeships.

Processes of internalisation and conversion are important in explaining explicit knowledge; while externalisation helps to change tacit knowledge to explicit knowledge. This changing of tacit knowledge into explicit knowledge explains how Communities of Practice convert knowledge into intellectual capital.

However, there is some argument among knowledge professionals on the difference between 'tacit and explicit knowledge' since some argue that tacit knowledge is the aggregate knowledge that employees have; while others argue that the difference between the two gives researchers a tool to understand knowledge better.

Maasdorp (2001) argued that it is being myopic to argue that tacit knowledge sums up organisational knowledge, since organisational knowledge is more than just knowledge in individual minds, because it also includes the value of that knowledge. What is clear about tacit knowledge is that it cannot be captured and codified. Therefore, one could sum up the difference tacit and explicit knowledge as follows. While tacit knowledge is personal, context-specific, difficult to formalise, record, or articulate; explicit knowledge is knowledge that can be readily made available to others and transmitted or shared in the form of systematic and formal languages since it is codified, stored in documents, data bases, websites, emails and the like (Uriarte, 2008).

Having made a clear distinction between tacit and explicit knowledge, it becomes necessary to discuss the theory of knowledge emphasising the nature of knowledge, the importance of knowledge as a factor of production, the history of knowledge management as well as defining knowledge and making a distinction between knowledge, data, and information.

2.2 The theory of knowledge

In order to give substance to the importance of Communities of Practice and epistemic communities which are discussed in Chapter Three of this research, the theory of knowledge needs to be known. The theory of knowledge discusses the various ontologies, the epistemic

nature of knowledge; and furthermore, it keeps us thinking on just what knowledge is. Hence, from the onset it is important to define the term knowledge.

2.2.1. Defining knowledge

Knowledge is referred to as *"that slippery and fragile process we have a hard time defining. It has the curious characteristic of changing into something else when we talk about it"* (Spiegler, 2000:9). Knowledge explains the experience and narrates a story about how individuals engage data, and information at higher levels. Thus, many scholars suggest that knowledge is based on a 'philosophical' foundation, that is to say: metaphysics, logic and epistemology (Nowtony *et al.*, 2003 and Vlok, 2004).

Defining knowledge by using World 2 and World 3 approaches gives us an idea of how taxonomy works. Firestone and McElroy (2003a) explain that; *"World 2 knowledge relates to ideas in the mind and what society believes in having stood the test of time; and "World 3" relates to shareable, linguistic formulations"*.

Vlok (2004) argues that one has to be careful when interrogating the two schools of thought in order to avoid being subjective. This he based on the fact that there are in some cases conflicting views on how experience is shared.

Furthermore, people engage in knowledge management for a purpose; while others engage in knowledge management because they need to make decisions; while others want to transfer information; but for whatever reason, the person initiating this should be able to capture the intellect and experiences of another.

There is a challenge facing organisations that deal with knowledge. The problem is how to establish a common acceptable definition of what knowledge is, and how to use it. The consideration of such a view can sound surprising, given the various inroads that have been made in the last twenty years, but the truth is that there is no uniform definition of knowledge (Tiwana, 2000). Defining knowledge would help practitioners and organisations to separate it from data and information, and to recognise its value. Therefore, it is vital at this juncture to make a distinction between knowledge, data and information. The value of knowledge is discussed under the heading of intellectual capital.

2.2.2 Knowledge, information and data

The challenge of studying knowledge as a discipline is that very few writers distinguish it from data and information. Perhaps the identification of knowledge and data or information comes from the belief and premise that both data and information make up what is called knowledge; and that at a rudimentary level, one cannot find any difference between knowledge, data or information - although a more detailed approach shows that knowledge is more than just data or a pile of information.

Knowledge is more complex and cannot be measured in simple terms. The true measurement of knowledge lies in its value to the organisation. The various critics on knowledge management argue that (knowledge) has no reliability and is still confused with 'higher-order information' (Denning, 1998). Denning (1998) further stated that the problem is also evident in how societies (Western rationalism versus Asian *yin* and *yang)* view the status of intuitive and rational knowledge.

A popular approach has been to explain the difference between knowledge, information and data by referring to knowledge as a higher order of information. Figure 2.1 shows the hierarchical nature of data, information, knowledge and wisdom as suggested by Snowden (2003a).

Figure 2.1: Data to wisdom hierarchy
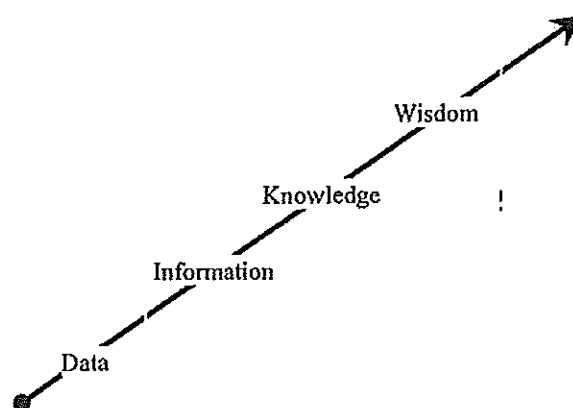
Source: Snowden, 2003a

Figure 2.2: Snowden's view on knowledge and information

Wisdom i
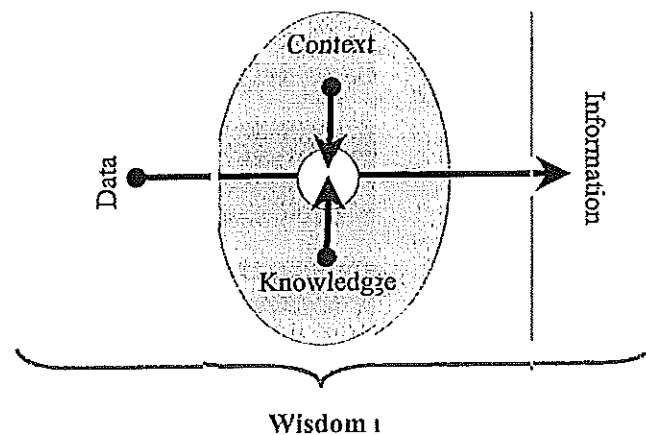
Source: Snowden, 2003a

It is clear from the figures above, that knowledge is systematic and complex; and that it possesses boundaries that define a system. The above figures depict knowledge as a subset of information, and Snowden (2003a) argue that it needs to be evaluated and validated before it can be presented. This does not, however, explain why knowledge is not affected by the law of diminishing returns, as are data and information.

Snowden (2003a) and McElroy (2003) analysed the link between knowledge and other areas like 'knowledge economy and knowledge society' – in order to find out what constitutes knowledge; but they could not conclusively say that knowledge is a subset of data or information. The attribute that knowledge has a status above data and information was articulated by Amidon and Skyrme (1991). They argued that the consideration of capital drivers sets knowledge up as an intangible asset, which drives innovation. This they termed 'The Knowledge Superhighway".

The above analysis show that knowledge is still not properly understood; and that there is a need to define it in terms of its value; hence, the need to carry out research studies focusing on redefining knowledge and understanding knowledge practices in the fuel-production industry.

The other issue is whether knowledge is a public good or merely a private good. Those who assume that it as factor of production would argue that it is not subject to the law of diminishing returns, as are the other factors of production (Liebowitz and Beckman, 1998:47).

Nonaka (1994) distinguishes between knowledge and information, while discussing the knowledge-creation theme. As explained in Dretske (1981:44), "knowledge is that commodity capable of yielding knowledge; and what information a signal carries is what we can learn from". In the quest for understanding fully the idea of knowledge creation, emphasis should be placed on the active and subjective nature of knowledge, which is represented by *'belief'* and *'commitment'*.

Nonaka (1994:14-37), argued that information is used when formalising knowledge. These approaches are referred to as the "syntactic" and "semantic" approaches.

From the literature accessed, it has become clear that the concept of knowledge has established a new epoch in the management of resources; and it calls for firms to look again at how they manage their competitiveness. "Knowledge has become the resource of modern firms that cannot be copied or imitated by competitors." (Ponelis and Fair-Wessels, 1998: 34)

Knowledge creation and the management thereof add value to earlier or existing knowledge repositories. The addition of new knowledge to existing repositories brings in some innovation, and allows firms to actualise their competitiveness more fully. The stored knowledge allows firms to streamline and validate it, and to render it legitimate for use. The process of creating knowledge allows for the recycling of some of it, and for modification, depending on the needs of the situation, and on time.

Thus, in understanding knowledge it is important to define epistemology – what it is, and how it can be used, and what it can be used for. This gives us a reflection on what knowledge is used for, as well as its reliability. This assertion infers that knowledge possessed by individuals can be stored and transferred to others through social interaction, or by using technological means like portals, intranets, virtual communities etc. (Al- Hawamdeh, 2002).

Nowotony *et al.* (2003) emphasised the fact that knowledge can be understood from an inclusive perspective (production, sharing and application). This inclusivity defines the holistic nature of knowledge; that is, it defines the inherent methods used in knowledge distribution, archiving, as well as defining the different categories of knowledge users.

It is important that in understanding knowledge, a systematic approach is followed, which will define the system's boundaries, as well as its interaction with the environment. Knowledge consists of various fields, technology, epistemology, innovation and the understanding of intellectual assets and the different Communities of Practice. But what is common about these facets of knowledge is the importance of the human interface (knowledge is housed in people's minds and its power lies in people turning it to use). Hence, it is important to understand how knowledge core competencies are managed.

The ways in which organisations manage knowledge challenges the traditional view on information dissemination. These ways present a need to come with solutions, which, in the field of knowledge, emphasise the importance of developing systems, which enhance the production, storage, distribution and retrieval of knowledge. Those who manage knowledge (asset or resource easily understood, classified, shared and measured) understand that it is important to manage tacit knowledge, and that they should manage this resource called knowledge better than they manage information (organised data endowed with relevance and purpose).

The management of knowledge functions by putting the emphasis on people and managing their capabilities. There is also a huge improvement in communication, the transfer of vital information, and the enhancing of collaboration between individuals. This collaboration allows individuals to interact socially and share vital knowledge in the process.
As individuals share knowledge, the growth of Communities of Practice in an enterprise is facilitated. At times, different streams of individuals share knowledge in a competitive spirit, something that builds a 'collaborative advantage' to the firm (Amidon and Skyrme, 1991).

Vlok (2004) argued that knowledge is abstract, and many who think they are practising it are actually only doing information management or data mining. Vlok (2004) based his argument on the fact that the recyclability of knowledge and its importance are factors of production. The question that the researcher asks is: *What exactly is knowledge?* This touches on the intuitive meaning of what is defined as knowledge.

The intuitive sense of what is perceived as knowledge is challenged by McElroy (2003a), who argued that those defining knowledge as intuitive misrepresent its true value. Vlok (2004) challenged scholars on knowledge management to provide clarity on knowledge and its importance. Following the argument by Vlok (2004), one can see that the meaning of knowledge

is greater than how the world perceives it, and that only those who have a philosophical understanding of it can know its true value.

Knowledge is still poorly understood by many practitioners, even though many have written about it (Al-Hawamdeh, 2002 and Prusak, 1998). Al-Hawamdeh (2002) further argues that even writers in other subjects, like economics, have failed basically to capture the importance of knowledge. This puts another slant on what knowledge is, and what its components are. Thus, Davenport and Prusak (1998:5) argued that:

"Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experience and information. It originates in and is applied in the minds of the knowers. In organisations, it often becomes embedded, not only in documents or repositories, but also in organisational routines, processes, practices, and norms."

This assertion by Davenport and Prusak (1998:5) clearly shows that knowledge is more than printed media, or what the reporting media can produce. Knowledge needs to be understood by those that are transferring it. Understanding this knowledge means that people become primary repositories of this knowledge and transmit it via known and agreed-upon language. This means that, "knowledge can only reside in the minds of people, and the minute it leaves the human mind, it is called information".

Thus, the interaction through knowledge can be understood by using mental models and team learning. These are essential aspects of the systems approach.

It is important to note that in discussing knowledge management, one has to be aware of the views of knowledge critics, such as Skyrme (1997) and Broadbent (1998). These authors argued that 'Knowledge is just another fad like Total Quality Management and Business Process Re-engineering'. This is because knowledge has a strong link to information management, and its transfer is still heavily linked to scientific processes. However, what is true, as the research will show, is that knowledge management is more than mere information management. To make further distinction between knowledge and information perhaps one should understand whether knowledge is an object or a process.

2.2.3 Understanding whether Knowledge is an Object or a Process

In trying to understand whether the subject under discussion is an object or a process, it is essential that the importance of knowledge as an ongoing process can be understood. Knowledge is understood as being process-driven (Alavi and Leidner, 1999). This, they argued, is facilitated by human thought and actions. Knowledge is housed in people's activities and these activities determine how knowledge is going to be managed.

People's actions determine how knowledge is processed (Sveiby, 2001). This process is dynamic, personal and is clearly distinct from data (discrete, unstructured symbols), and also from information, which is a medium for explicit communication. Individual competency is important in understanding knowledge competencies. Organisations are challenged to understand the role that the individual plays in distributing knowledge, because it is individuals who interact through a social process; and in the process they transfer vital information, which is thereby turned into knowledge.

These sharing capabilities by individuals are what characterise Communities of Practice and epistemic communities.

Individuals are important, in that they are the ones engaged in the process of learning. This view is confirmed by Maasdorp (2001) and Sveiby (2001), who argued that knowledge is indeed a process, because it is through such a process that learning occurs. It is important that as individuals learn, decisions are made. Through learning, the individual learns; he acts and makes decisions in the organisation.

It should be pointed out that there is a contradiction in the perceived role that knowledge plays. From a global perspective, knowledge is assumed to be at the centre of decision-making, while at the firm's level, knowledge possessed by individuals is valued because it serves to create wealth. Whatever the perspective is, it has become clear that knowledge has become an important resource for the 21st century world of business. This has made its creation, classification, storage, and management essential. Thus, the section that follows will gravitate around theories on knowledge creation and management as well as on how it is classified.

2.3 Knowledge creation, classification and management

This section starts with looking at how knowledge is created with emphasis put on the Social, Externalisation, Combination and Internalisation (SECI) model by Nonaka. The section progresses to look at how knowledge is classified and ultimately managed.

2.3.1 The SECI Model – Understanding Nonaka's model of knowledge creation

The SECI model explains how knowledge can be created through social interaction – by those people who engage in knowledge processes. New knowledge is created through the four processes: *Socialisation, Externalisation, Combination,* and *Internalisation.* Figure 2.3 illustrate the four processes. The process of self-transcendence explains how knowledge conversion occurs in each of these modes.

Figure 2.3: Nonaka's model of knowledge creation (SECI model)
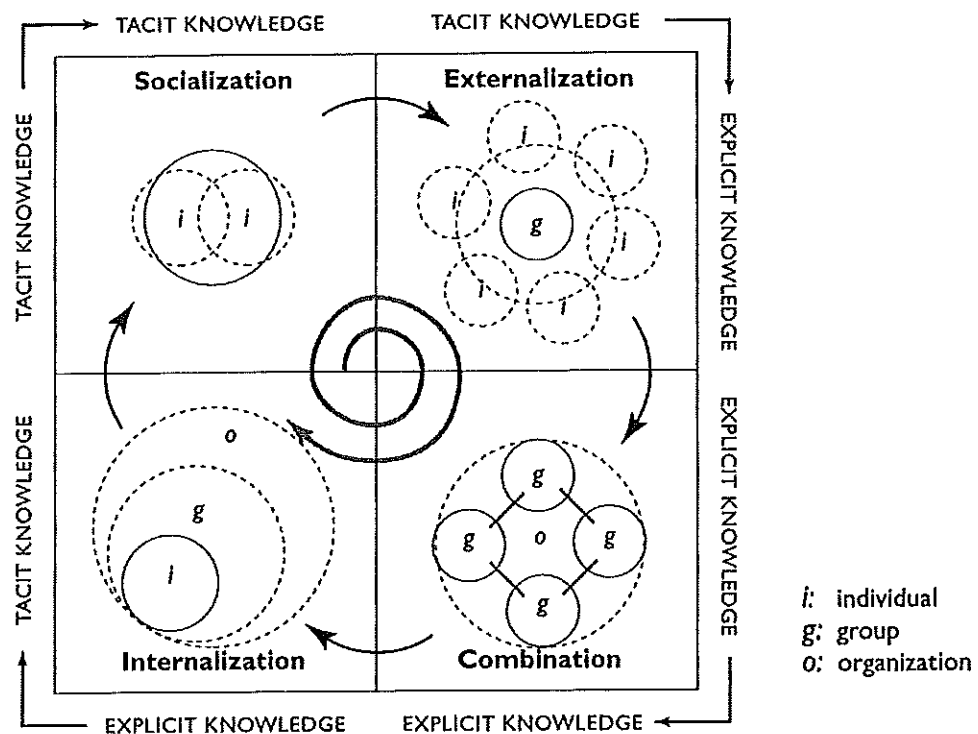
Source: Nonaka and Konno, 1998:43

As explained by Nonaka and Konno (1998), the process of socialisation involves capturing knowledge through physical proximity (through direct interaction with suppliers and customers) while in externalisation tacit knowledge is expressed and translated into comprehensible forms

understood by others. On the other hand, combination and internalisation involves the conversion of explicit knowledge into more complex sets of explicit knowledge and conversion of explicit knowledge into the organisation's tacit knowledge respectively (Nonaka and Konno, 1998).

Knowledge-management systems are also used in the creation of knowledge networks (Ruggles, 1998).

Nonaka (1994) further asserted that organisational knowledge is clouded by an ideology that portrays a firm as a data processor or an artefact, instead of viewing it as a system that deliberates on other systems. In this assumption, Nonaka (1994) asserts that the fundamental task of the organisation is how to deal efficiently with information and decisions in an uncertain environment.

Organisations use the 'input-process-output' sequence of hierarchical information processing. Organisations are challenged to deal with the dynamics of the changing environment, while, at the same time, efficiently creating information and knowledge (Nonaka, 1994:14-37).

Alavi and Leidner (1999, 2001) discuss organisations as, "social collectives and knowledge systems". The basis of this prototype or construct is the assumption that it is based on the premise that "organisations as knowledge systems consisting of four sets of enacted "knowledge processes": (1) Creation (also referred to as construction); (2) Storage/retrieval; (3) Transfer; and (4) Application (see Figure 2.6 and Table 2.2).

The basic constructs of the theory of organisational knowledge explore the "distinction between 'tacit' and 'explicit' knowledge" (see sections 2.1, 2.1.1 and 2.1.2). This distinction represents "the epistemological" dimension to organisational knowledge creation (Nonaka, 1994:14-37). Epistemological discussions include a "continual dialogue between explicit and tacit knowledge, which is underpinned by the concept of 'communities of interaction" (Nonaka, 1994:14-37).

Communities of interaction usually span departmental and organisational boundaries; and they define organisational knowledge creation. Knowledge creation is done through social processes. This is called the "ontological" dimension of knowledge creation, which is founded on 'continual dialogue'.

Nonaka (1994:14-37) discussed the two dimensions of knowledge creation; the first one being drawn from a distinction between "tacit knowledge" and "explicit knowledge". Nonaka (1994)

pursued the philosophical dimension of tacit knowledge description, as offered by Polanyi (1966:4), by including as well the cognitive aspects of knowledge. These aspects are referred to as "*mental models*" (Nonaka, 1994). These 'mental models' are created by people's mind sets.

There are schemata and beliefs that are contained in mental models. The second dimension is the "Ontological", which highlights the level of "social interaction". The assumption is that there are those individuals who create some aspect of knowledge. Individuals are paramount in the creation of knowledge, and the organisation should always recognise and support such creativity.

There is also some discussion on the "combination mode", which refers to the *creation of new explicit knowledge by merging, categorising, re-classifying, and synthesizing existing explicit knowledge* (Alavi and Leidner, 2001). The writers further discussed the concepts of "externalisation and internalisation modes". These involve the conversion and interactions between tacit and explicit knowledge.

Tacit knowledge is converted into explicit knowledge through the process of externalisation. This involves the transferral of known practices. There is also a process of internalisation, which involves creating tacit knowledge from explicit knowledge. Creating tacit knowledge from explicit knowledge also involves learning and discussion. Alavi (2000) and Alavi and Leidner (1999) agree that the four modes depend to a large degree on one another and are intertwined, each mode being reliant on the other. The illustration below explains in-depth such a dependency.

Alavi and Leidner (1999, citing Nonaka, 1994) and Nonaka and Konno (1998), argued that the 'ba' plays a crucial role when one makes a decision to consider environments that are suitable for knowledge creation.

These authors acknowledge four modes of knowledge creation: (1) Originating ba; (2) Interacting ba; (3) cyber ba; and (4) exercising ba. The ba concept is discussed in detail below.

The five options proposed to organisations on knowledge creation by Davenport and Prusak (1998: 52-67) include:

- *Acquisition:* This refers to knowledge acquired by the organisation from external sources, including knowledge internally generated. This is not necessarily new

knowledge, for it also includes knowledge copied from competitors or other industries, as well as knowledge from mergers.

- *Rental:* For example, through an external research unit or hiring a consultant with specific expertise.

- *Dedicated resources:* This is derived from utilising resources exclusively for this purpose, for example Research and Development units.

- *Fusion:* This is the deliberate introduction of complexity, diversity and conflict to create new synergy.

- *Adaptation:* This constitutes external changes that cause organisations to "adapt or die"; this implies a warning against complacency, *"core rigidities"*, or the tendency to stay on well-known paths. Some organisations at times generate a crisis in order to stimulate further creativity in their employees.

- *Network:* This comprises informal, self-organising networks of people that might become formalised, for example in Communities of Practice. (These communities will be discussed later in this chapter.)

Davenport and Prusak adapted Couger's (1996) Creative-Problem-Solving Method (CPS), cited in Liebowitz and Beckman, 1998). This CPS method works by identifying six problem-solving steps: problem definition, problem analysis, generation of solution ideas, the evaluation and selection of a solution, testing and implementing the solution – and finally, the documentation and sharing of the results.

Nonaka (1994) expanded on Polanyi's argument on knowledge creation, by including 'intention', 'autonomy' and 'fluctuation' as important decision aspects in ensuring that individuals are fully committed to learning while in an organisation. The three additional factors could be outlined as follows:

- *Intention:* This discusses the approach that people take to deal with their environment. People's reactions become a sub-system of the bigger environment.

- *Autonomy:* This assumes that in organisations where individuals are given space to act autonomously, there is a greater possibility of knowledge creation, since freedom encourages creativity. The argument is reinforced by the fact that self-motivation is based on deep emotions, and serves as a driving force for the creation of metaphors.

- *Fluctuation:* This assumes that knowledge is created by the individual relating to his/her external surroundings. It involves chaos, connectivity and interaction with the environment. "Individuals recreate their own systems of knowledge to take account of ambiguity, redundancy, noise, or randomness that is generated from the organisation and its environment" (Nonaka, 1994:18).

The sharing of tacit information will be dealt with in Chapter 3, under Communities of Practice and Epistemic Communities.

Another model that supports Nonaka and adds to the discussion of the different types of knowledge is by Boisot shown in Table 2.1 below.

Table: 2.1:   Boisot's knowledge category model

Codified	Property knowledge	Public knowledge
Un-codified	Personal knowledge	Common sense
	Un-diffused	Diffused

Source: McAdam and McCreedy, 1999:97

The model depicts the use of codification, which will be explained further in Chapter 3. Codification refers to the capturing of knowledge; and it allows such knowledge to be transmitted to others. There is another type of knowledge which the writers label as 'un-codified' – meaning knowledge which cannot be shared with others.

The SECI model provides similarities to both Boisot and Nonaka's models, although this has been questioned by Firestone and McElroy (2003a). The argument presented by Firestone and McElroy is that Nonaka failed to interpret Polanyi's tacit model properly. The argument by

Firestone and McElroy (2003a:22) points to the failure by Nonaka to acknowledge 'implicit' knowledge.

In explaining implicit knowledge, the writers conceived it as 'cognitions and beliefs that, while not focal or explicit, are expressible, given the environmental conditions effectively eliciting these cognitions and beliefs' (Tsoukas, 2002:15).

Tacit knowledge cannot be externalised, i.e. converted or "transformed" into explicit knowledge, because "tacit and explicit knowledge are not two ends of a continuum, but the two sides of the same coin; even the most explicit kind of knowledge is underlain by tacit knowledge" (Tsoukas, 2002:15).

This view is shared by some other writers, like Zander and Zander (in Howels, 1996:92-106), who asserted that "tacit know-how is articulable under certain circumstances: when the pace of performance is slow and pace variations are tolerable, when a standardised, controlled context for the performance is assured, and when the performance as a whole can be simplified to basic interactions".

Although it seems that most writers in knowledge management agree on what tacit knowledge is, there are different opinions that still exist as to why it should be located in individual heads. This has resulted in the two schools of thought. These present ways in which such knowledge is formalised, and whereby its codification can be dealt with. It is clear, however, from the literature, that codification does include tacit knowledge being made explicit — on account of its form and content.

Continuing further on this line of thought, Nonaka and Takeuchi (1995) maintain that this form of knowledge (tacit) is "difficult to codify, standardise and transfer", and is "not easily embodied in a blueprint or operating manual"; and is "hard to formalise and communicate to others". The difficulty of understanding tacit knowledge still remains, when choosing what elements constitute it.

In discussing codified knowledge, McAdam and McCreedy (1999: 98) explained that, "codified knowledge is friendly to the printed page and can easily be transmitted, in the form of designs and specifications; and it is therefore, less proprietary than tacit knowledge, which is far more

.

difficult to codify and to imitate". Tacit knowledge acts as a sub-system of the greater knowledge system. It can be of two types namely knowledge that has not yet been formalised because of cost or time limitations and knowledge that cannot be formalised because it is containable and also because of the form of the knowledge.

It also essential, that, in discussing knowledge as a concept, one should look at the concept of 'ba' (a Japanese concept roughly translating into the word place), because it is fundamental in explaining emergent systems in the knowledge management framework. As explained by Nonaka and Konno (1998:40), "ba can be thought of as a shared space for emerging relationships. This space can be physical (e.g., office, dispersed business spacer), virtual (e.g., e-mail, teleconference), mental (e.g., shared experiences, ideas, ideals), or any combination of them". According to Nonaka and Konno (1998), 'ba' deals with knowledge creation and knowledge management. As explained by these authors (Nonaka and Konno, 1998), the concept of 'ba' details the experiences that knowledge workers have shared in practice – as well as in their ideals. The 'ba' creates knowledge, which makes it different from other human creativity; and it is, furthermore, responsible for elevating the part played by individual knowledge in the entire knowledge debate.

From the analysis of the concept of 'externalism', it is also clear that the 'ba' acts as a centre for individual creation and distribution. This type of thinking assumes that knowledge is shared easily in 'ba'. This further assumes that there is a space for constructing knowledge and distributing it. Knowledge is termed information, once it is separated from the 'ba'; and this allows it to be transferred independently of the 'ba' constituent.

The above view is reinforced by Nonaka and Konno (1998), who asserted that the 'ba' shows itself as a place where Communities of Practice craft and disseminate knowledge. These authors, (Nonaka and Konno, 1998), further asserted that various modes of communication of such knowledge actually do exist. These include mails, intranets, broadcasts and meetings. Thus, the concept of 'ba' unifies the physical spaces, the virtual space and the mental spaces.

Therefore, the 'ba' is the world where the individual realises himself as part of the environment on which his life depends (Nonaka and Konno, 1998).

Individuals emphasise the importance of the "ba" by showing the effectiveness of teamwork, which comprises individuals acting together to achieve a common goal. The importance of the 'ba' is in knowledge-creation, and how such created knowledge is distributed. Knowledge-creation and or conversion can be understood from the perspective in which it is created and used - that is its value depends on the time and space in which it is being used. Knowledge resources need to connect in order to be effectively utilised and or converted.

There are four patterns, which show how knowledge is converted from one mode to the other. These according to Polanyi (1966) and Nonaka, (1994) (also refer to figure 2.3) could be outlined as follows:

- From *Tacit* to *Tacit:* through social interactions and shared experiences, e.g. apprenticeship and mentoring;

- From *Explicit to Explicit:* through the combination of various knowledge forms, e.g. merging, categorising and synthesising;

- From *Tacit to Explicit :* through externalisation, e.g. the articulation of best practices;

- From *explicit to tacit:* the creation of new knowledge from explicit knowledge through internalisation, for example learning.

The knowledge created needs to be classified and stored although authors such as Martennson (2000) and Vlok (2004) are of the view that it is difficult to classify and store knowledge.

2.3.2 How Knowledge is classified

The various definitions of knowledge convince the researcher that the subject should be redefined from its base definition. Knowledge management authors acknowledge that:

- It is difficult to store knowledge (Martennson, 2000; and Vlok, 2004).

- There is no value derived from information until it is transformed into something tangible by human beings.

- Knowledge should be studied in context (Davenport and Prusak, 1998; Kirchner, 1997; Frappaolo, 1997; Allee, 1997; Knapp, 1998; Martennson, 2000, and Vlok, 2004).

- Knowledge depreciates in value if it is not used (Davenport and Prusak, 1998; Sveiby, 1997, and Vlok, 2004).

- Users capture and retain knowledge for further use.

- Learning, innovation, as well as creativity, all help to enhance knowledge development. Knowledge is refined, organised, changed into assertions, and then stored in repositories.

- Further learning occurs when knowledge is applied tactically and leveraged to produce the required results. Snowden (2003b) adds to this by stating that, "knowledge can only be volunteered; it cannot be conscripted"; "knowledge can only be known when one needs to know it"; and "we always know more than we can say, and we will always say more than we can write down".

Despite all the above contentions, but particularly, the notion that it is difficult to classify and store knowledge, there are many different knowledge classifications that are based on worldviews, as mentioned by Polanyi (1966). These different classifications are: Popper's World 1, World 2 and World 3 knowledge typology (Popper, 1994; Firestone and McElroy, 2003a).

Finally, (Popper 1994); Firestone and McElroy (2003a); and Vlok (2004) present their own version of a knowledge typology:

- World 1 (material) knowledge;
- World 2 (situational, tacit, implicit, or potentially explicit) knowledge;
- World 2 (pre-dispositional) knowledge;
- World 3 (explicit) knowledge; 24 types are listed by authors;
- World 3 (implicit) knowledge; potentially 24 types dependent on derivation from explicit types.

These views are further strengthened by Alavi (2000) who asserts that there are various kinds of knowledge taxonomies. They all require a different approach, in order to make meaningful interventions in knowledge classification and management. Moreover, Alavi (2000) suggests that different knowledge taxonomies help to develop our understanding regarding the complexity of knowledge as a construct. In understanding this construct, reference is made to two most popular knowledge taxonomies, namely those of Polanyi (1966) and Nonaka (1994, McAdam and McCreedy, 1999); Martennson (2000); Alavi (2000); Firestone and McElroy (2003a). Polanyi (1966) distinguishes between *tacit* (personal) and explicit (codified) knowledge. This distinction has already been explained earlier. Tiwana (2000:14) took the argument further by explaining that knowledge is "a grounded intuition that provides an environment and framework for evaluating and incorporating new experiences and information".

2.3.3 Knowledge Storage/Retrieval

The discussions on enablers of knowledge highlight the importance of technology and information systems in ensuring that the knowledge cycle is complete. This view is shared by Alavi (2000); Blacker (1995) Alavi and Leidner (1999). These authors asserted that the 'creation of new knowledge alone is not enough'; "people and organisations simply forget; and mechanisms are needed to store acquired knowledge and to retrieve it when needed".

Knowledge is stored and retrieved, as and when the organisation deems this to be necessary. This process defines "organisational memory", which includes the process whereby individuals store knowledge and use experiences when sharing that knowledge. Individual knowledge could be archived in experience or in an individual's brain or cultural practices, as well as in human knowledge ecosystems, knowledge chains and in knowledge ecology.

As part of the organisation's attempt to manage knowledge, there is a need to have repositories where knowledge and experience can be stored. This would help the organisation to tap into these repositories and would obviate any necessity to re-invent the wheel every time the organisation executes a project (Alavi and Leidner, 1999:118).

Organisational memory plays a major role in ensuring that such invaluable organisational information is instantaneously available, when needed. The easy availability of such organisational information means that knowledge can be shared and distributed quickly.

However, organisational memory should not prevent the organisation from continually learning and improving its processes, because it is clear from the literature consulted that many organisations do not update their systems. Instead, they rely heavily on organisational memory.

Organisations are challenged to embrace change and adopt innovation as part of their knowledge package. The author cautions that the above statements should not throw away the positive aspects of organisational memory. These include: IT-enabled organisational memory on the behaviour and performance of individuals and organisations. This improves the functions of technology as a facilitator in knowledge transfer, sharing, storage, distribution, archiving and retrieval.

Organisational memory artefacts include intranets, groupware and computer technology. This last discipline acts as a repository for the storage of knowledge. Effective document-management

systems and knowledge banks are useful tools for storing and retrieving useful customer information, which can be helpful to the organisation in the short-term or long-term future.

2.3.4 Knowledge distribution

Knowledge distribution forms part of the knowledge-management framework as well as the knowledge creation, storage and retrieval framework, but little emphasis has been placed on it. Most writers still view knowledge distribution as being part of information management; and there are many reasons advanced for this way of thinking. Whatever reasons are being advanced, knowledge distribution still remains on the outskirts of the knowledge chain.

Knowledge distribution suffers the same neglect as communication. This neglect is because most writers think knowledge distribution is part of information transmission. The other challenge is that organisations view knowledge distribution in line with knowledge sharing, social networks and working teams. What is certain is that knowledge distribution is enabled by technology, emails, intranet portals, discussion threads and social networks.

It is essential that the relationship between knowledge distribution and knowledge transfer should be acknowledged. The transfer of knowledge relates to moving knowledge from one source to another, while distribution relates to the holistic spreading of knowledge through different media, and through different sources.

- Transfer occurs when there is an exchange of tacit to tacit knowledge as shown by arrow C.

- Transfer can occur between tacit and explicit knowledge holder and tacit knowledge holder as shown by arrows A and B.

- Transfer can occur through Internalisation as shown by arrow B.

- Transfer can occur through Combination, i.e. between explicit and explicit

This distribution is shown in Figure 2.4:

Figure 2.4: The Relationship between Knowledge Distribution and Transfer

Legend: Each arrow represents a form of knowledge creation. A—Externalization; B—Internalization; C—Socialization; D—Combination
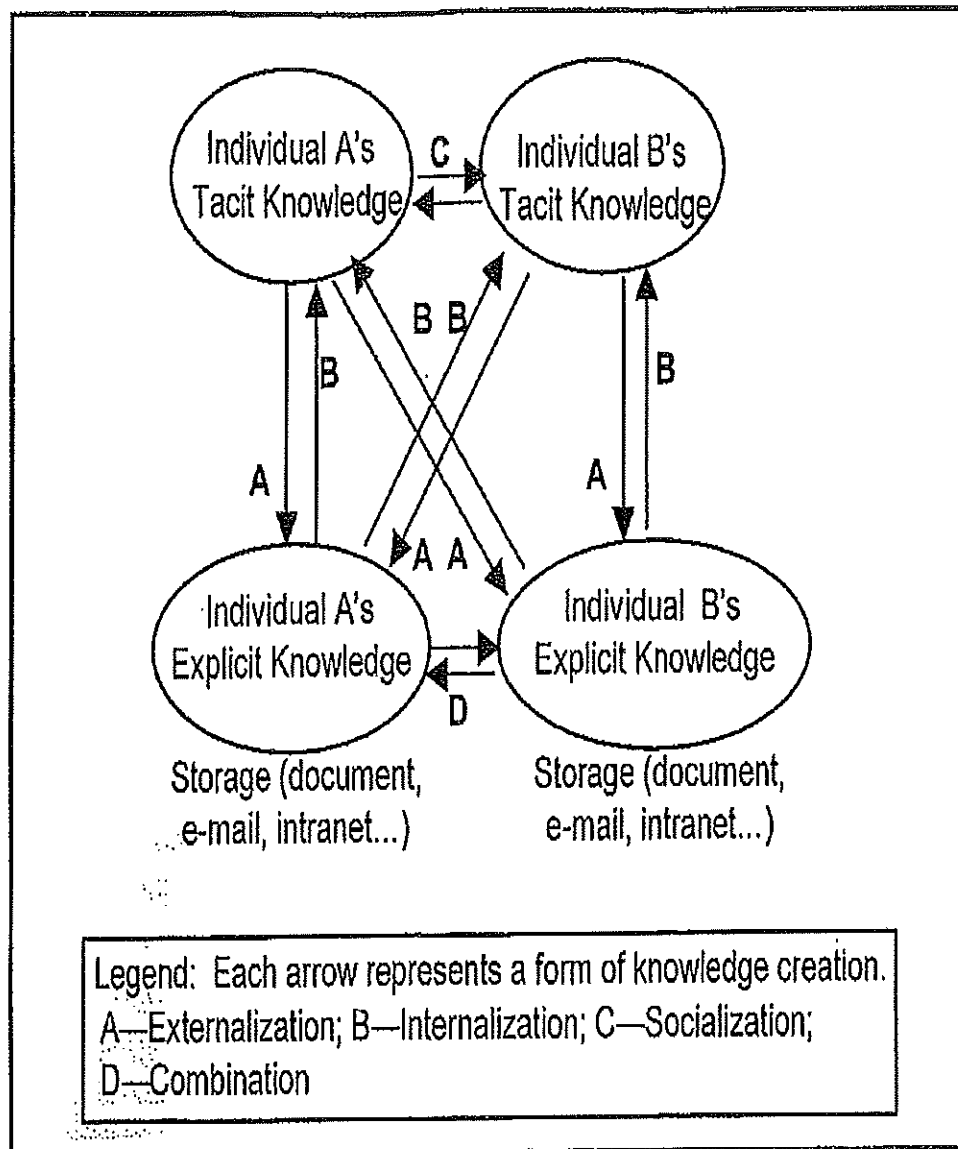
Source: (Alavi and Leidner, 1999:53)

Alavi and Leidner (1999); Gupta and Govindarajan (2000), conceptualised knowledge transfer in terms of five elements: (1) Perceived value of the source unit's knowledge; (2) Motivational disposition of the source (that is, their willingness to share knowledge); (3) Existence and richness of transmission channels; (4) Motivational disposition of the receiving unit (i.e., their willingness to acquire knowledge from the source); and (5) The absorptive capacity of the receiving unit.

This is defined as "the ability not only to acquire and assimilate but also to use knowledge" (Cohen and Levinthal, 1990; Alavi and Leidner, 1999). The authors assert that the capability of

the system to absorb knowledge is controllable. This is because knowledge is recreated when it reaches the mind of the receiver. Most of the literature reviewed for this research focuses on the 'knowledge-transfer channels'.

The argument that is put forward here is that knowledge-transfer channels can be formal or informal, personal or impersonal (Alavi and Leidner, 1999). Knowledge transfer involves informal mechanisms, like "unscheduled meetings, informal seminars, or coffee-break conversations". These may help in the promotion of socialisation, but may not involve wide knowledge distribution to community members or other employees.

This failure to disseminate information could be a result of the failure to filter knowledge, to exchange and to interpret it.

Companies should use mechanisms like training sessions and plant tours for fast-tracking the formal transfer of knowledge. This would ensure greater distribution of knowledge, although proponents of knowledge management argue that these restraints inhibit creativity. Companies usually propose the use of personal channels, which may include aspects like: '*apprenticeships or personnel transfers, which they claim may be a tool for distributing highly context-specific knowledge*'. Thus, it is the intension of this research to find out how knowledge is distributed at PetroSA.

Alavi (2000) and Alavi and Leidner (1999) argue that instead, companies should rather promote the use of impersonal channels. These channels would also be effective in knowledge storage.

Technology, like IT, plays an important role in transferring knowledge, because it acts as a medium through which various sources of knowledge can be connected. Examples of technology include Lotus notes, databases, knowledge maps and corporate directories, which are used for knowledge transfer. Networks are useful in transferring knowledge, because it is from such networks that different groups can be connected and are thereby enabled to share knowledge.

Other mediums for knowledge transfer include bulletin boards, where knowledge is broadcast. Bulletin boards allow all knowledge users to share common knowledge in an uninhibited manner and without boundaries. These bulletin boards could be programmes in the computer, which allow a particular group to publish essential information required by the group. The question the research addresses is which method is applicable or used at PetroSA the author's case study.

2.3.5 Knowledge application and use

Knowledge alone does not give any competitive advantage to an organisation, but it is its use that gives meaningful advantages, because it turns it from its tacit form into an active asset. Alavi (2000), Grant (1996a; 1996b), and Alavi and Leidner (1999) identified three ways in which knowledge is integrated in order to create organisational prowess:

- Directives: sets of rules; standards, procedures and instructions converted from tacitly held specialist knowledge into explicit forms for communication to non-specialists;

- Organisational routines: these relate to patterns for task performance and co-ordination, interaction protocols and process specifications;

- Self-contained task teams: these refer to the creation of teams to attend to tasks where a high degree of uncertainty exists and where group synergy can be exploited. Group problem-solving often requires co-ordination and the facilitation of frequent interaction and intense collaboration (Adapted from Alavi and Leidner, 1999).

There is a host of challenges linked to the application of existing knowledge. They further argue that, despite certain challenges, Information Technology (IT) can have an impact on the application of knowledge positively – by improving the way knowledge is integrated, accessed and updated. Table 2.2 illustrates the potential role that IT could play in integration of knowledge. Organisational memory capacity may be increased by enlarging Communities of Practice (Alavi, 2000).

Table 2.2: Summary of Knowledge Management Processes and the Potential Role of IT

Knowledge Management Processes	Knowledge Creation	Knowledge Storage/Retrieval	Knowledge Transfer	Knowledge Application
Supporting Information Technologies	Data mining Learning tools	Electronic bulletin boards Knowledge repositories Databases	Electronic bulletin boards Discussion forums Knowledge directories	Expert systems Workflow systems
IT Enables	Combining new sources of knowledge Just in time learning	Support of individual and organizational memory Inter-group knowledge access	More extensive internal network More communication channels available Faster access to knowledge sources	Knowledge can be applied in many locations More rapid application of new knowledge through workflow automation
Platform Technologies	Groupware and communication technologies			
	INTRANETS			

Source: Alavi & Leidner, 1999

It becomes clear from the earlier sections of this chapter that knowledge can be produced, stored and retrieved for future use. The explanations given on knowledge suggest that one has to look beyond knowledge itself. Thus, instead of only focusing on knowledge production, storage and retrieval, one should also touch on knowledge management.

Knowledge management has evolved over the years to include concepts like "The New Generation of Knowledge Management" (TNGKM) which is discussed below. The growth of knowledge management to TNGKM assumes that knowledge has a strong link with time and the architecture of process.

2.4. Knowledge management

This section focuses on aspects comprising knowledge management. The section kicks off by defining knowledge management. It then discusses components of knowledge management such as knowledge management theory, the new and second generation knowledge management and the approaches to knowledge management.

2.4.1 Knowledge management re-defined

Although knowledge management has been defined in earlier sections of this chapter, it is important to delve more deeply into what is really meant by knowledge management. Although it is related to organisational learning, intellectual capital and project intelligence, it has its own boundaries as a concept. Knowledge management should not be confused with these other

terms, since a link with these terms suggests that knowledge management is just an extension of information management, which it is not.

The definitions of knowledge management offered by several writers reveal some weaknesses (McAdam and McCreedy, 1999a:8). Most definitions do not separate knowledge management from information management, because they make use of the 'mechanistic' approach, which falls short of the social interactions that define knowledge management. They further fall short of placing knowledge as capital.

Viewing knowledge as capital assumes that it is converted from its epistemic value into an intangible asset. Also viewing knowledge as an intangible asset confirms the earlier assertion that knowledge has an instrumental value. The emphasis on knowledge having an instrumental value suggests that an organisation does not collect knowledge for its own sake but to achieve the objectives of the organisation. Knowledge management therefore is the systematic, explicit, and deliberate building, renewal, and application of knowledge to maximise the knowledge – related effectiveness and returns from all knowledge asserts of an organisation, (Wiig, 1997). This perspective is quite control oriented, focussing explicitly on treating knowledge as an asset, which is discussed in detail in Chapter 3).

The following critique begins to present knowledge as something more than mere information management, in that it identifies the following:

- Information Technology is a useful facilitator of knowledge management; but it is not regarded as pivotal in understanding knowledge management;

- People and learning are pivotal in the management of knowledge;

- Knowledge management has strong multi-disciplinary influences, with practitioners holding a wide array of perspectives;

- Knowledge management is used interchangeably with intellectual capital, but there is no clear distinction between them – and this causes much confusion;

- Practitioners normally confuse knowledge management and knowledge processing;

- Practitioners should understand that knowledge management is more than just measuring how effective the firms' workforce is.

Firestone and McElroy (2003a) analysed the definitions of knowledge management given by various authors (Malhotra, 1998; Sveiby, 1997; Wiig, 1997 and Davenport 1998). They found that the definitions afforded by these authors all had weaknesses. The obvious weaknesses exhibited by these definitions are (the critique refers to the specific author in parentheses):

- Failing to distinguish between knowledge and information (Malhotra, 1998);

- Failing to reflect the notion of the validation of knowledge claims (Wiig1997; Davenport, 1997);

- Failing to demonstrate how knowledge can be managed (Wiig,1999);

- Failing to address the concept of "management "in knowledge management;

Firestone and McElroy (2003a:70, 2004) defined knowledge management as *"a management discipline that seeks to enhance organisational knowledge processing"*. They stress that "knowledge management's immediate purpose is not to improve either worker effectiveness (though it may well do that), or an organisation's bottom line. Its real purpose is to ensure that knowledge is used effectively to create value for organisations".

Knowledge management should enable the organisation to use its skills and intellectual resources in order to become more competitive. This competitiveness will be shown in the form of returns, profits, and market share – and in the firm's ability to lead and control industry trends.

These authors proffer the notion that in undertaking knowledge-management projects, practitioners must evaluate their participation in order to enhance the quality of knowledge produced (Boyd and Robson, 1996).Emphasising the quality of knowledge produced in knowledge management projects, sees it more as a process of capturing collective expertise of the organisation wherever this expertise resides: in databases, on paper, or in the heads of the people, and distributing it to whoever it can help to produce the biggest payoff.

Practitioners should think about knowledge processing, knowledge, and the impact on their interventions by these above-mentioned concepts (knowledge processing and knowledge).

Firestone and McElroy (2003:71) citing Gold *et al* (2001) further defined the knowledge-management process (KMP), as "an on-going, persistent, purposeful interaction amongst human-based agents through which the participating agents *manage* other agents, components, and

activities participating in *basic knowledge processing*". As explained by Firestone and McElroy (2003), the purpose of this is to contribute to the creation and maintenance of an organic, unified whole system, producing, maintaining, enhancing, acquiring, and transmitting the enterprise's knowledge base. The management by participating agents is through handling, directing, governing, controlling, co-ordinating, planning, organising, facilitating, enabling and empowering. The basic knowledge processing are knowledge production and knowledge integration. The management by participating agents and the basic knowledge processing all add up to knowledge management, thence the need to discuss the knowledge management theory, the new knowledge management and generally the knowledge management process.

2.4.2 The knowledge-management theory

This section will describe the knowledge-management theory. The focus is on understanding the origins of knowledge management, its importance as a factor of production, and understanding the transition from Business Process Re-engineering (BPR), Organisational Learning (OL) and Total Quality Management to Knowledge Management.

An understanding of all these processes highlights the reason why organisations have adopted knowledge management as a category. The importance of these is to gain an insight into the historical development of knowledge management, which will help to understand its importance and the reason why the author has undertaken this research project.

The theory promulgates the idea that, although knowledge management has always existed in organisations, knowledge has not yet been studied or considered as a factor of production. The study of knowledge management assumes that one considers knowledge and its value to organisations, understanding the different types of knowledge, tacit and explicit, and how these different forms of knowledge can change from one form to another, the production of knowledge, the sharing and transfer of knowledge, indexing it, archiving it in repositories and the various retrieval processes.

This is called "Comprehensive Knowledge Management" (Wiig, 1999). The sharing of knowledge discusses the role of Communities of Practice and how they can use codified knowledge.

Knowledge as intellectual capital is included in the knowledge theory, although the focus of this is on the value of knowledge rather than on how it is produced, shared and archived. To understand the knowledge theory, it is important to discuss intellectual assets with the focus on explaining how knowledge sustains innovation and competitiveness.

In discussing the theory of intellectual assets, it is prudent to give a brief history of knowledge management and why it has gained such momentum in the last fifty years.

There are various accounts given by several writers, but what strikes the author is that knowledge management has leapt into prominence, because there is a high failure rate in processes like Business Process Engineering (BPR), Total Quality Management (TQM), and Organisational Learning (OL), as has been intimated by Baker and Badamshina (2002), citing Halal, (1998).

Knowledge management became important because businesses were often faced with stiff competition from competitors and they needed to develop and leverage their core competencies, in order to survive the needs of the last quarter of the 20th century – and hence, the focus on what they know. Also, businesses considered the fact that it is only knowledge that cannot be copied or imitated by its competitors. The 21st century has seen a huge decline in the strength of world economies, which has brought with it a challenge on how to survive the global slump, hence the need to manage knowledge accordingly.

Businesses often find themselves now having to compete for scarce resources in the global economy, and had, therefore, to develop survival modes that would place them above others.

The other reasons advanced for why knowledge management has become so important are:

- The impact of the downsizing strategies of the 1980s, and the subsequent loss of human capital, as people walked out of the door with their personal store of knowledge.
- The explosion in information and related technologies has led organisations to search for ways to cope with the complexity and the accumulating volumes of information.

Various facts for and against knowledge management were presented by the literature accessed. Stewart *et al.* (2000); Hellstrom and Ramon (2001) asserted that people study knowledge because of the benefits derived from the accumulation of knowledge while others study it because of the view that knowledge is the source of economic growth. The later reason

emphasises cements the earlier view by the writer that knowledge is a strategically important source of competitive advantage.

The benefits as advanced by Stewart *et al* (2000) are summarised in Table 2.3 below:

Table 2.3:Knowledge benefits

Assumption	Support for assumption	Negation
Knowledge is worth managing	-Recognition of the knowledge economy. -Knowledge management initiatives in numerous organisations.	Much effort spent managing explicit knowledge when most knowledge is tacit.
Organisations benefit from managing knowledge	-Effective data mining	Business process re-engineering severely downsizes company which initiates long-term success despite knowledge loss.
Knowledge can be managed	-Appointment of Chief knowledge officer	Difficult to transfer best practices
Little risk is associated with managing knowledge	-Organisational structures for knowledge management	Tacit knowledge may contain incorrect assumptions

Source: Stewart *et al.*, 2000:45

Stewart's model does not show how knowledge management is used. For example, it does not show how knowledge is managed. In trying to improve the shortfall of Stewart's model, the author proposes the following assumptions on knowledge management:

- A way to improve an organisation's performance, productivity, competitiveness;

- Acquiring, sharing and the usage of information and knowledge;

- A tool for decision-making;

- A way to capture best practices;

- A way to reduce research costs and delays;

- A way to become innovative;

- Improvement of internal operations, and to embed such knowledge in products and services;

- Working in teams plays a crucial role in knowledge transfer through teamwork – on which social networks are built. Social networks have been proved successful in transferring knowledge in project management, which has improved project performance;

- Improving financial earnings; and

- Developing networks (social) and relationships.

2.4.3 The New Knowledge Management (TNKM)

The concept of "The New Knowledge Management" originates from the need to understand exactly what knowledge is and what it constitutes it. However, this does not assume that the concept of knowledge management is new; it suggests that the recognition of the value of knowledge as a factor of production is perhaps a novel idea in the knowledge world.

Neef (1999) asserted that practitioners should understand that the value of knowledge as a factor of production has been propagated by recent changes in the global economy. This view is supported by Spender (1996); Scherer (1999) citing Solow (1957) and Vlok (2004), who argued that the value of knowledge in the global economy has championed innovation in various fields, like medicine, petroleum, communication and banking.

These innovations have much in common, in defining the various aspects of knowledge, namely:
- Know-what: (referring to the accumulation of facts); this type of knowledge leads to information.
- Know-why: deals with scientific knowledge.
- Know-how: deals with how capable individuals are in a knowledge economy.
- Know-who: this has to do with understanding relationships and dichotomies.

2.4.4 Second-generation knowledge management

Second-generation knowledge management seeks to address questions like: 'How do knowledge workers tap into the technology at their disposal to effectively utilise knowledge?' Knowledge workers tap into technology by operationalizing knowledge. They tend to move away from the connotations of the First-generation knowledge management, which focused on the "supply side" (Firestone and McElroy, 2004). The supply-side knowledge management does not discuss knowledge creation as a core process; however, there is evidence that knowledge can only exist once it has been created.

The second-generation knowledge management emphasises the importance of knowledge processing and knowledge integration as pivotal concepts in its configuration, but one should understand that these two are separate processes, which occur in different steps. Knowledge management enhances the quality of knowledge processing and its outcomes and should be a distinguishing feature of the two (McElroy, 2003a).

The second generation knowledge management (SGNKM), which was popularised by Nonaka and Takeuchi's SECI Model, describes how knowledge is converted from explicit knowledge to tacit knowledge by means of socialisation; tacit knowledge to explicit knowledge by means of externalisation; tacit knowledge to tacit knowledge by means of internalisation and explicit knowledge to explicit knowledge by means of combination (see figure 2.3). It is important to note that the SGNKM is outcomes-based and compares outcomes with risks.

This analysis brings the following description of SGNKM:

"*A management discipline that seeks to enhance performance in business by enhancing the capacity of its people to produce and to integrate knowledge (i.e. that seeks to enhance their performance by enhancing their capacity to learn and to adapt)*". (McElroy, 2003)

The importance of this discipline includes the following:

- The creation of a bottom-up knowledge management strategy, not a top-down one;

- A focus on the improvement of the quality of knowledge as a basis for making decisions, especially where the cost of errors in decision-making is high;

- It stresses the integration of enhanced knowledge processing in business processes, where high-risk decisions occur;

- A focus on enhanced knowledge making, and not just on sharing;

- A value proposition of knowledge;

- It analyses the iterative nature of knowledge management;

- It addresses knowledge production, not just knowledge integration and conversion;

- It reflects on the emergent, non-deterministic nature of organisational phenomena, e.g. organisations as social systems;

- It addresses knowledge management methodology;

- SGKM is both supply-side and demand-side oriented. Knowledge is not only something that is shared, but something that is also created. Firestone and McElroy (2003) assert that, "We can only share knowledge that exists, and knowledge can exist only after it is created by people";

- 'Knowledge processing' is differentiated from 'knowledge management'; and their different processes are outlined. These processes include how knowledge is produced and integrated. This confirms the view that knowledge processes are social processes through which organisations make and share their knowledge (Firestone and McElroy, 2003);

- Knowledge processing in knowledge management follows a chaotic and complex trajectory.

There is a link between (TNGKM) 'The New Generation of Knowledge Management' and Complexity Theory because of feedback loops and complex adaptive systems (CAS) that present an emergent order on what would otherwise be an orderly system. The characteristics of these systems are that they are self-organising and require continuous learning, as well as being dynamic in nature.

Complex Adaptive Systems (CAS) is, "about understanding human factors, organisational learning, and knowledge creation, viewed as the conversions among tacit and explicit knowledge" (Firestone and McElroy, 2003). The Complex Adaptive Systems model (figure 2.5)

presents knowledge as, *"a thing and a flow; context, narrative and content"* (Snowden, 2003a, cited by Firestone and McElroy, 2003).

In presenting the (CAS) complex adaptive systems phenomena, Snowden (2003a) asserts that organisations are engaged in sense-making. Figure 2.5 shows the Complex Adaptive Systems Model.

In analysing TNKM, McElroy (2000), asserted that, "organisations are permeated with complex adaptive systems phenomena, and that knowledge management in them is about using knowledge management to enable or reinforce self-organisation in knowledge processing -- for the purpose of achieving sustainable innovation in support of organisational adaptation".

In order to adapt and to ensure their continued existence, agents (people) formulate theories and mental models and test such theories and models as part of a problem- solving process (McElroy, 2003a). Theories and mental models (which define systematic learning) are then reinforced by rules i.e. (predispositions and beliefs).

Figure 2.5: Complex Adaptive Systems (CAS) model
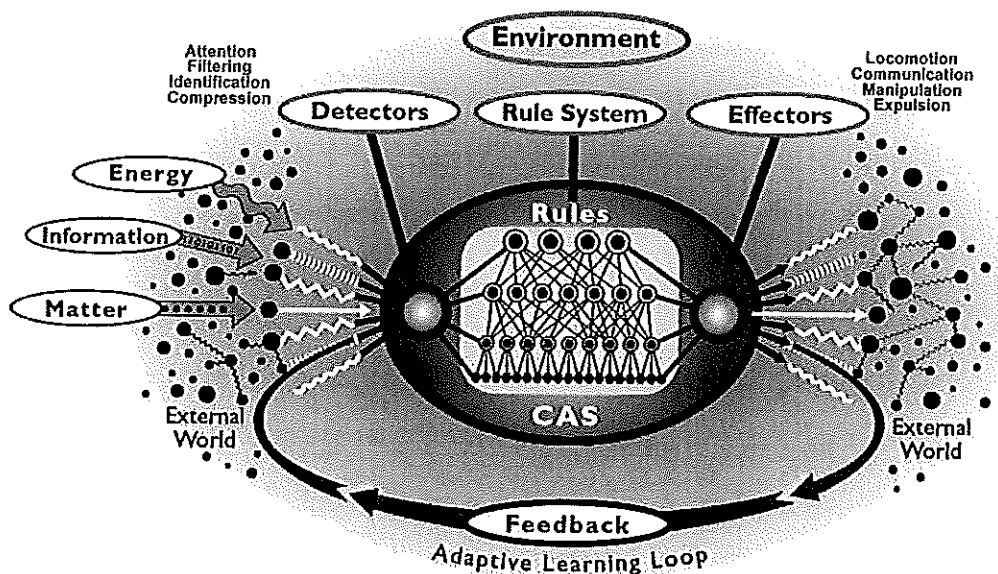
(Source: McElroy, 2003a:36)

2.4.5 Approaches to knowledge management

Wiig (1997); Kazi *et al.* (1999) and Vlok, (2004) admitted that there is no simplistic way for the management of knowledge to be undertaken. The following three divergent approaches were identified:

- Firstly, how explicit knowledge is managed;

- Secondly, the management of intellectual capital; and

- Thirdly, a broader, more holistic approach.

In order to understand knowledge management, it is essential to group the various models into three categories, as shown in Table 2.4 below:

In understanding the analysis of various models given by McAdam and McCreedy (1999), there is a need to integrate the work of Demerest (1997). Demerest (1997), created a KM model which emphasised the scientific and social construction paradigms. Figure 2.6 is an illustration of Demerest's KM model.

Table 2.4: Approaches to knowledge management

Model	Source	Characteristics
Knowledge category models	Nonaka Boisot	Mechanistic
Intellectual capital models	Skandia	Mechanistic
Social constructed models	Demerest	Holistic

(Source: Adapted from McAdam and McCreedy, 1999: 95-98)

Figure 2.6: Modified version of Demerest's KM model
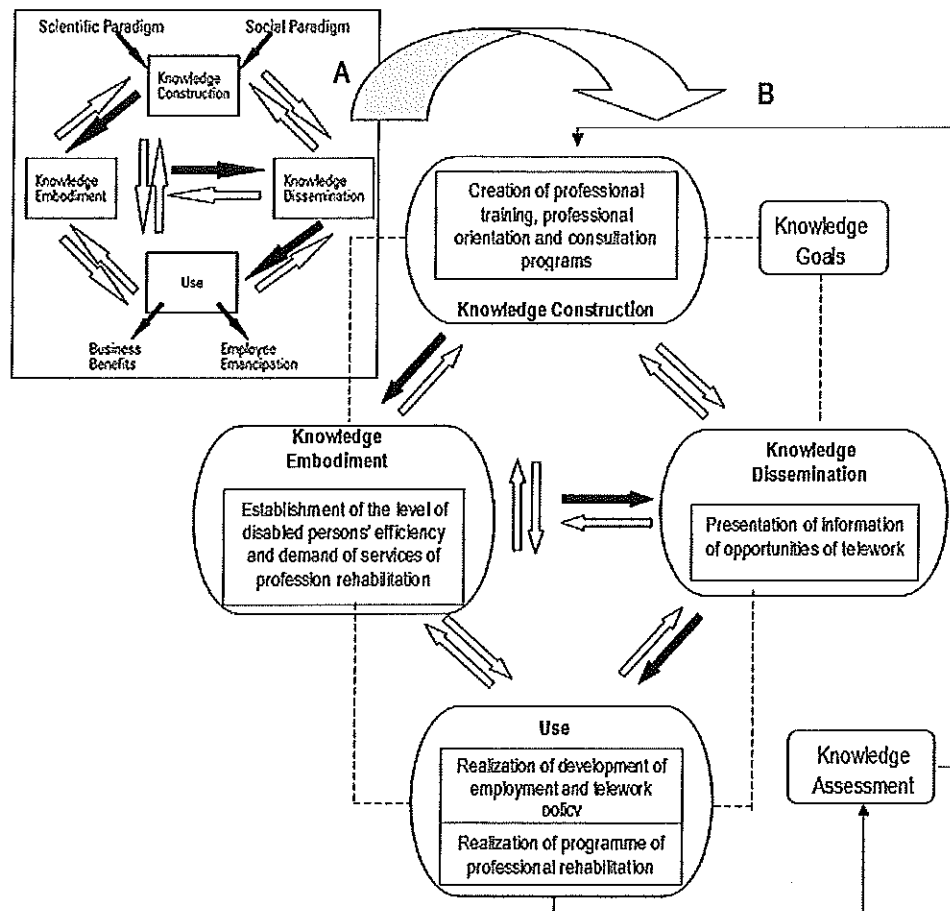
Source: McAdam and McCreedy, 1999:98)

McAdam and McCreedy (1999) explain how the Demerest's KM model is constructed. According to McAdam and McCreedy (1999),

- The model assumes the creation of knowledge as being important;

- Its construction is not only dependent on scientific input, but also includes the "*social construction of knowledge*";

- Once knowledge is constructed, it is contained within the organisation by explicit means, for example through codification, and social interchange. Once this knowledge is embodied in the organisation, it must be disseminated throughout it;

- The disseminated knowledge is then used in the production of organisational outputs.

The analysis of Dermerest's Knowledge Management model presents some interesting assumptions: It suggests that the knowledge cycle starts with the initial path in which knowledge processes flow (represented by solid arrows); while recursive flow (represented by plain arrows) reveals the complexity of the flow. Both the plain arrows and the bold arrows point to knowledge-creation, because knowledge is itself a product of both scientific and social processes.

It is also important to note that all these processes, listed above, do not occur in isolation of one another, i.e. each one of them is important in completing the knowledge cycle. Therefore, the model is important in exploring knowledge-management practices in the fuel-production industry, particularly in the PetroSA refinery in Mossel Bay.

2.4.6 Understanding knowledge-management processes

The four processes defining knowledge, that have been discussed above are: knowledge creation, knowledge storage, knowledge distribution and knowledge retrieval. Others include: transfer, which defines how knowledge is shared by different people, and innovation, which underpins the application of knowledge.

The fact that knowledge is produced, stored, distributed, retrieved and applied, confirms its cyclical configuration. This cyclical configuration generates sub-processes like transfer, sharing, archiving, indexing and continuous improvement; and this finally, leads to innovation. It was stated earlier that these processes do not occur in isolation, but are systemic. This allows us to view knowledge as a complete cycle. Also, this interaction of the various processes allows knowledge to be diffused easily, and for the process of sense-making to occur in a meaningful way. The production of knowledge – and the integration thereof is an integral part of knowledge management process. Knowledge management process can be depicted by the three-tier framework proposed by Firestone and McElroy (2004). Figure 2.7 is an illustration of the model.

Figure 2.7: Three-Tier KM Reference Model
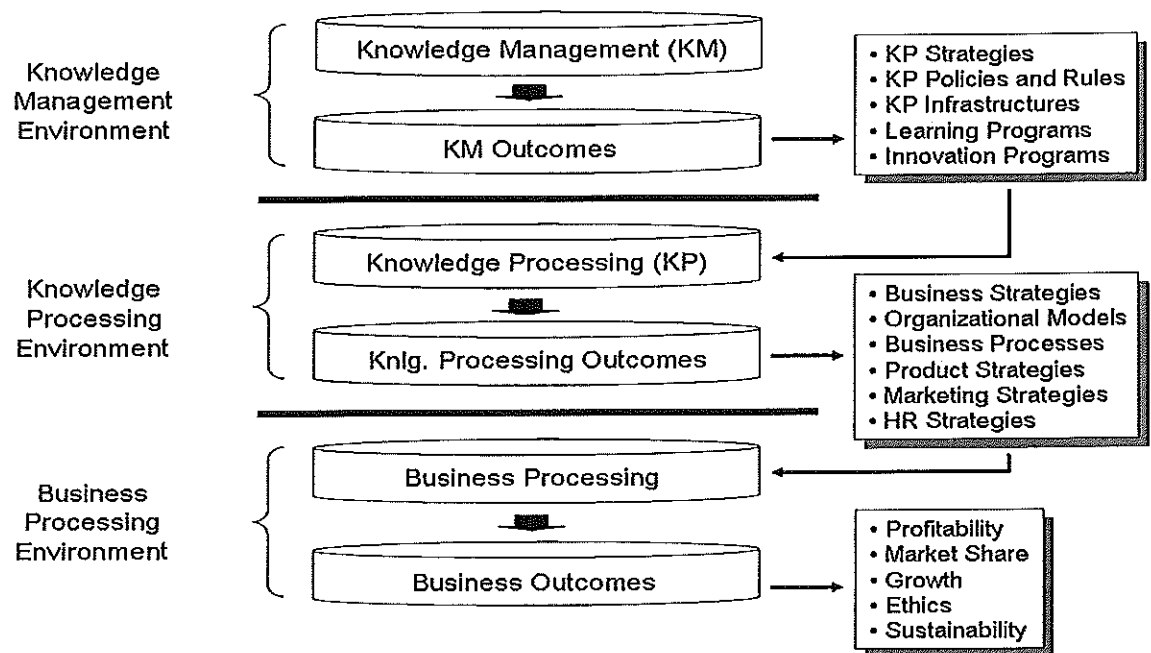
Source: Firestone and McElroy, 2004:2

The author seeks to use the above three-tier framework, as proposed by Firestone and McElroy (2004), in order to explain the process of knowledge management. This model identifies the production of knowledge – and the integration thereof – as being key processes. Knowledge management as a set of processes or a type of activity raises the question of exactly what knowledge management is.

Although a definition of knowledge management has been given, there is a need to redefine knowledge management, because such a redefinition would help to highlight its processing and its outcomes.

McElroy and Firestone (2004) define knowledge management as "set of processes that seeks to change the organisation's present pattern of knowledge processing to enhance both it and its outcomes". The argument in the definition of KM by Firestone and McElroy (2004) is that KM should seek to change the pattern of knowledge processing. This definition is lacking in some aspects, because it asserts a different role played by KM in setting organisational processes.

It further asserts that agents (operational) only impact knowledge processes. These, in turn, affect knowledge outcomes (Firestone and McElroy, 2004).

Von Krogh and Roos (1996); and Alavi and Leidner (1999), offer a more comprehensive definition of Knowledge Management. They refer to it as "identifying and leveraging the collective knowledge in an organisation to help the organisation compete". Organisations are in a dilemma of tapping into knowledge management, because of the belief that many organisations have in regard to the existence of knowledge.

According to Alavi and Leidner, (1999), "*Organisations believed that much of the knowledge they needed existed inside the organisation, but that identifying that it existed, finding it, and leveraging it remained problematic*". There are also problems in maintaining, locating, and applying knowledge.

It is problems of this sort that have led to the need to apply systematic approaches in the management of knowledge (Alavi and Leidner, 1999).

This new definition of knowledge management ties in with two major aims of knowledge management projects: making knowledge conspicuous, and establishing it as a way of connecting people within an organisation to customers in differentiated geographical environments.

This allows individuals to build new knowledge on the foundation of existing knowledge. Alavi and Leidner (1999) assert that knowledge management is a process involving various activities; these processes are: the creation, storage/retrieving, transferral, and application of such knowledge (see Table 2.2). Alavi (2000) argued that these major processes can be further subdivided. Examples cited include aspects such as, the creation of external knowledge, the acquisition of external knowledge, the storage of such knowledge in documents, and the up-dating of the knowledge – and how such knowledge can be shared internally and externally.

Having discussed knowledge management as a set of processes the discussion now moves to the "Generic Knowledge-Management Process" – as defined by Alavi (2000:7); and Alavi and Leidner (1999). The concepts explored are that the knowledge process (which has already been described) comprises four processes: Knowledge Creation, Knowledge Storage and Retrieval; Knowledge distribution and Knowledge application. Figure 2.8 is an illustration of the generic knowledge management processes by Alavi (2000).

Figure 2:8 Generic knowledge-management processes:
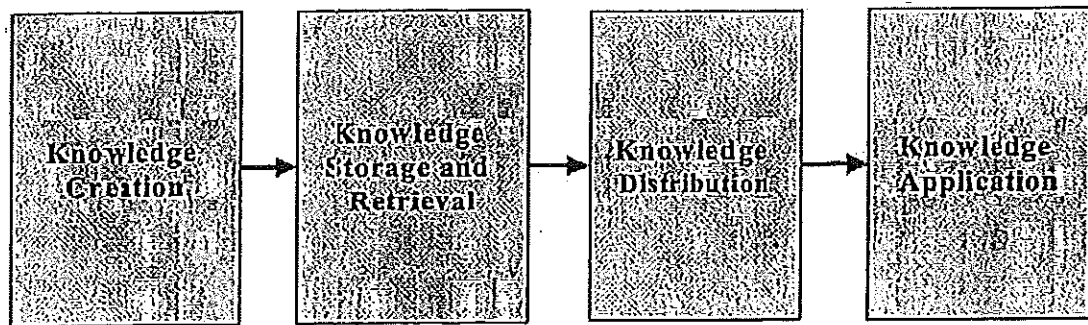
Source: Alavi, (2000)

Davenport and Prusak, (1998) challenges readers on the subject of knowledge management to view knowledge systems and knowledge in relation to the environment in which these occur. As analysed by Davenport and Prusak (1998), knowledge management is an effort to improve the efficiency of knowledge markets.

Knowledge management is important, because as the organisation interacts with its environment, it absorbs information, turns it into knowledge, and takes some action – based on the past usage thereof (Davenport and Prusak, 1998).

Nonaka (1994:14-37) maintained that dialogue plays an important role in developing tacit and explicit knowledge. The argument presented here is that organisations and individuals act in tandem in the development and articulation of knowledge. The assumption is that individuals develop knowledge, while organisations amplify and articulate it. It is important to understand how knowledge-management processes work, as this is essential in undertaking any careful analysis of knowledge-management systems.

As explained by Alavi and Leidner (1999), knowledge-management systems (KMS) refer to, "a class of information systems applied to managing organisational knowledge". Writers, such as Alavi and Leidner (1999), conceded that knowledge-management systems are Information Technology (IT-) based systems developed to support and enhance the organisational processes of knowledge in the course of creating, storing/retrieving, transferring, and applying such knowledge.

The only challenge to the relationship between IT and knowledge management is that IT does not apply to all the issues of knowledge management (Dretske, 1981). IT enhances knowledge management by acting as an enabler in codifying, distributing and archiving knowledge – and in establishing knowledge portals and sites that broadcast certain knowledge.

IT application to knowledge management includes: (1) the coding and sharing of best practices; (2) the creation of complete knowledge directories; and (3) the creation of knowledge networks (Alavi and Leidner, 1999). Further research on this topic and its relationship with IT shows that IT acts as an enabler in key knowledge-management processes. Knowledge management has been used effectively in the creation of databanks and portals.

The knowledge management processes are incomplete without a discussion on complex adaptive systems (CAS), Decision Execution Cycle (DEC) and learning. Many writers including Argyris and Schon, (1978), Argyris, (1991) and Senge, (1990) dealt with CAS inputs and CAS outputs. These authors deliberations on the inputs and outputs popularised the "Decision-Execution Cycle (DEC)" which includes planning, acting, monitoring, and evaluating behaviours (Firestone, 2001).

CAS consists of many different interrelated elements. Figure 2.9 illustrate such related elements. It should be bone in mind that the elements have non-linear relationships and feedback loops, hence making them difficult to understand and predict. From figure 2.9, it is clear that there is large number of individuals, teams and socio-technological sub-systems that have non-linear interaction and capability to make local decisions (Bennet and Bennet, 2000). According to Bennet and Bennet (2000:4), "the word adaptive implies that the organization and its subcomponents are capable of studying and analyzing the environment and taking semi-autonomous actions that internally adjust the organization and externally influence the environment in a manner that allows the organization to fulfill local and higher-level goals while concomitantly adapting to environmental shifts and perturbations."

Figure 2.9:   Organisational Complex Adaptive Systems
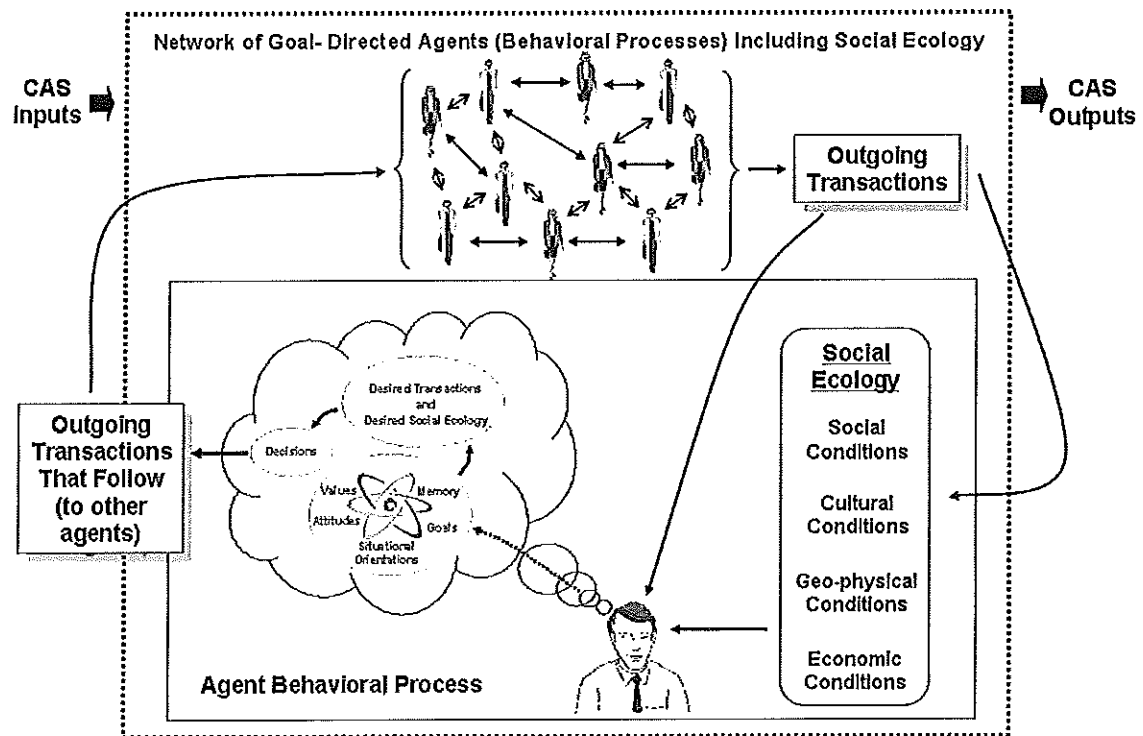
Source: Adapted from Firestone and McElroy (2004)

The use of previously existing individual-level knowledge to arrive at decisions and actions is important in understanding Decision Execution Cycle (DECs) (Firestone and McElroy, 2004). Figure 2.10 portrays the Decision Execution Cycle. From Figure 2.10, it is evident that DECs use "Single-Loop learning (SLL), and are responsible for 'initiating' and 'performing' "Double-Loop Learning" (DLL).

The assumption that is put forward by the authors (Firestone and McElroy, 2004) is that learning takes a complex and chaotic trajectory, and should be best understood through an understanding of systems thinking and complexity theories.

Figure 2.10 Decision-execution cycle


```
                              Monitoring
   ┌──────────────────┐       (Knowledge Use)
   │  The DEC applies to │           │
   │ any business process │          │
   └──────────────────┘             │
         Acting          Previous      Evaluating
      (Knowledge Use)  ◄── Knowledge ──►  (Knowledge Use)

                        Planning &
                      Decision Making
                       (Knowledge Use)
   ....we adjust our plans              If and when instrumental
   and behaviors accordingly            gaps arise between what
                                        we have and what we want....
```
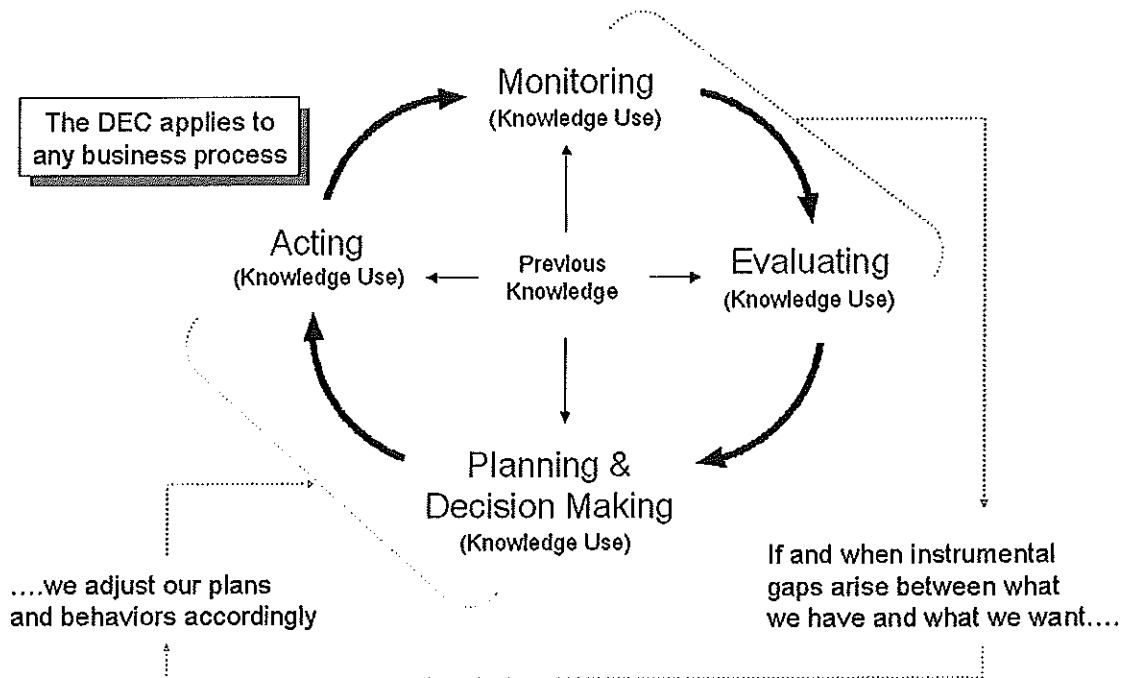
Source: Firestone and McElroy,(2004)

Firestone and McElroy (2003, 2003b) and Firestone (2001) describe how routine Decision Execution Cycle (DECs) give rise to Double-Loop Learning (DLL). The explanation that they put forward is that DEC decisions and actions are accompanied by expectations. DEC decisions relate to 'epistemic knowledge and 'problem' recognition, which starts with relying on the individual to make decisions on learning. DLL is viewed by the authors as an emergent, non-deterministic three-stage knowledge process composed of problem formulation, developing alternative solutions and error elimination (Firestone and McElroy, 2004).

Having analysed the Double-Loop Learning (DLL) problem-solving model (McElroy, 2003a; Firestone and McElroy, 2004) these authors proposed a detailed framework, which they labelled the Knowledge-Life Cycle (KLC). The KLC is derived from problem-claim formulation to the integration of knowledge in the Distributed-Knowledge Base (DOKB). According to McElroy

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(2000:7), the KLC does not deal with knowledge management in its reality, but it serves as a framework for conceptualising other KM models and approaches.

Besides the fact that the KLC is regarded as a conceptual framework for understanding how knowledge is produced and integrated in the organisation, McElroy (2000) asserts that the KLC reflects a particular orientation.

The KLC, as shown by Figure 2.11, represents knowledge processing in all its forms and it includes the following:

- A model that depicts organisational knowledge as being contained in individual minds or in groups. This, he called the Distributed Organisation Knowledge Base of the Enterprise [DOKB].
- Knowledge held by businesses.

Figure 2.11: The Knowledge Life Cycle (KLC)
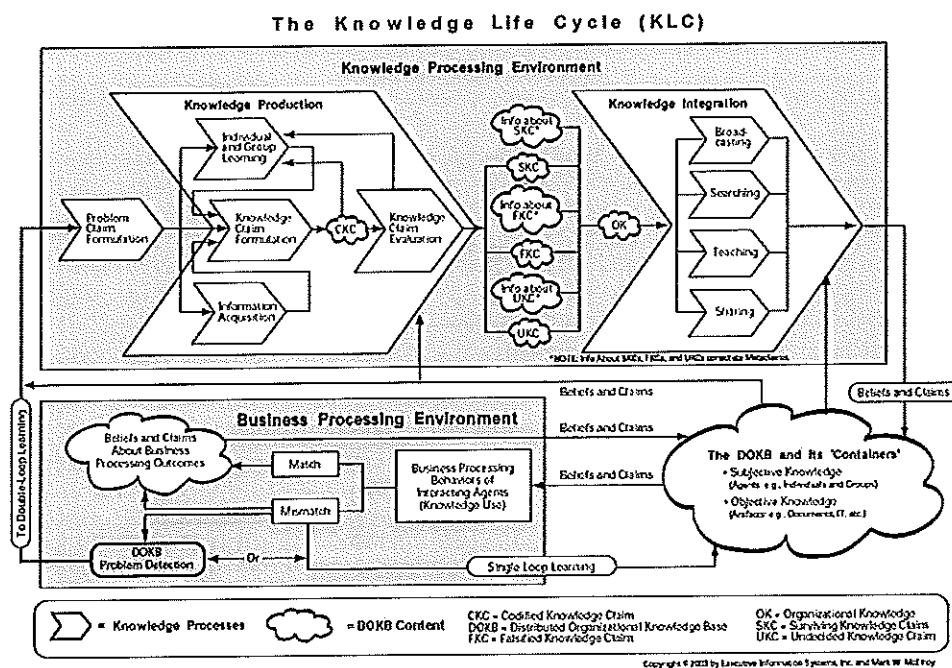
Source: McElroy, 2003)

McElroy (2003a) emphasises the need to draw a distinction between the business-processing environment and the knowledge-processing environment, as depicted in the diagram, Figure 2.11.

McElroy (2003a) conceded that in the business environment, knowledge is expressed in the day-to-day work performed by people, e.g. business processes. Thus, work may be considered "knowledge in use" or procedural "know-how", informed by declarative, "know-what" knowledge, for example strategies and expectations (Vlok, 2004). From time to time, people at work are faced with problems and/or opportunities; and they are facing uncertainty about what course of action to take; and this uncertain state of affairs prompts people to step outside the business-processing environment in search of a solution.

This solution is one that is needed for an "epistemic problem" (McElroy, 2003a). Firestone and McElroy (2004) argues that at the stage of uncertainty, people who have detected the epistemic problem, gear themselves up for learning, as they enter the knowledge-processing environment to participate in producing knowledge – in an attempt to solve the epistemic problem.

The learning process, in consequence, triggers an iteration of the KLC, starting with problem detection to problem formulation, and going on to knowledge production (including the sub-processes, such as individual and group learning, acquiring information, formulating knowledge claims, evaluating various knowledge claims) and deciding on an appropriate course of action to be integrated into the organisation and its business processes via a range of sub-processes (McElroy, 2003a).

2.5 Conclusion

Second-generation knowledge management and its variant, TNKM, are pivoted by the Complexity Theory, Complex Adaptive Systems (CAS), Organisational Learning, Intellectual Capital and other disciplines. Central to this type of argument is the notion that knowledge is created as part of a social process (people talking to each other, testing each other's arguments and knowledge claims).This all happens automatically, and without involvement from management. The assertion that is being put forward here is that people learn because they want to learn and not because management says that they must do so.

Thus, knowledge created in the process is created by employees, because of problems that persist in the business environment, for example business processes, and individuals' eagerness to solve such problems (Vlok, 2004). Individuals associate in informal groups, "Communities of Practice", to share their thoughts collectively. Organisations cannot manage such processes. They must be self-managed, since this is basically a social process.

It is the understanding of these social processes in knowledge processing and production on which this dissertation focuses in the next chapter (understanding Communities of Practice in sharing knowledge, thereby resulting in intellectual assets). It should be highlighted that it is on this theoretical framework that this research study purports to explore the knowledge management practices in the fuel production industry using the PetroSA Mossel Bay Refinery as a case study.

CHAPTER 3

Communities of Practice and Intellectual Assets within Knowledge-Management Context

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"Communities of Practice are of relatively recent coinage, even though the phenomenon it refers to is ages old."

(Wenger, 2004)

3.1. Introduction

This chapter presents the theoretical background to Communities of Practice and the intellectual assets within a knowledge-management context. The chapter focuses on learning systems within organisations, with the emphasis on the theory of action, Communities of Practice and Epistemic Communities. The chapter provides a baseline for exploring knowledge practices in the fuel-production industry – using the Mossel Bay PetroSA Refinery as a case study.

3.2 Learning systems within organisations

Organisations engage in learning throughout their functional lives, and together with the individuals comprising that organisation, strive to improve their knowledge performance. They improve this knowledge through Communities of Practice. Communities of Practice are the result of cultivating learning systems within organisations.

The formation of Communities of Practice comes from the active social processes of knowledge production (Wenger and Snyder, 2000). This view is supported by Brown and Duguid (1998). They asserted that through the social-knowledge process, knowledge, which is inextricably communal, can be honed through Communities of Practice. CoPs encourage learning and the generation of knowledge. This learning and generation of new knowledge is facilitated by fast changes in operational environments of business organisations which compels businesses to find adequate ways to adapt to such changes. The rate of learning by individuals and organisations has become the sustainable competitive advantage (Garvin, 1993). Garvin (1993) points out that in the absence of learning, organisations and individuals simply repeat old practices, some of

which are retrogressive to company knowledge development. So the increasing need for learning and sharing knowledge has raised the interest towards understanding CoPs.

Learning is very important in understanding CoPs. CoPs have been foundational tenets in social learning theory, theory of situated learning (Argyris and Schon, 1978; Lave and Wenger, 1991; Wenger, 1998). Learning is *"a process by which lasting change in potential behaviour occurs as a result of practice or experience"* (Lave and Wenger, 1991). Learning creates meaning whether shared or individual and generates knowledge which serves to reduce uncertainty. Such learning which is a characteristic of CoPs describes how skills, knowledge, attitudes, behaviour and habits are acquired and shared.

This is important in understanding CoPs – which are formed from the epistemological assumption of the knowledge dimension that knowledge cannot be simply parcelled up and passed from those who know it to those who need to learn it. Knowledge is attained when an individual learns new knowledge, and such learnt knowledge is then shared by members of the Community of Practice (Cangelosi and Dill, 1965 cited by Boyd and Robson, 1996). The practice of sharing such attained knowledge differs from just belonging to a community, where individuals need to share knowledge that is common amongst them.

This is because members do not only share knowledge that is common amongst them; but they share knowledge that is diverse, and may not be known by everyone in the Community of Practice.

Communities of Practice produce knowledge by engaging in the social-knowledge creation-and-production process. These communities arise because of the need to socialise and create knowledge networks. These knowledge networks assume a social character. The social character of Communities of Practice assumes that a certain value is shared – as people work together in creating a social practice which is characteristic of Communities of Practice (Brown and Duguid, 1991:42).

This view of Communities of Practice, as resulting from a social process departs from the earlier view of Polanyi (1966) or that of Nonaka and Takeuchi (1995). It assumes that individuals are not the only place from which knowledge originates, but that knowledge and knowing are collectively produced, and then held in Communities of Practice.

Knowledge is produced through a process of sense-making, social engagement and dialogue, as well as shared practice (Haas, 1992). Engaging others through social processes cements the notion of knowledge sharing and develops shared assumptions; and it also creates methods to validate knowledge.

The author is of the view that 'developing' practices change a community's world. This, in turn, provides new perspectives on practice, as is supported by the view of Brown and Duguid (1991; 1998). This process is a dialectical one, with the new practice being shaped by the community's assumptions and vice versa, Brown and Duguid (1991); Cook and Brown (1999).

In a parallel context, the community shapes the practice; while, reciprocally, the practice shapes the community (Cook and Brown, 1999). Some authors (Cook and Brown, 1999, on "Organising knowledge – Inside knowledge") argue that the practice and the community are mutually defining, inseparable and dynamic in their interaction with one another.

Having dealt with the social dimension of knowledge, it now becomes necessary to define Communities of Practice, their origin and their link to knowledge-sharing production. A Community of Practice is *"not just a Web site, a database, or a collection of best practices. It is a group of people who interact, learn together, build relationships, and in the process develop a sense of belonging and mutual commitment"* Wenger et.al. 2002). This means that members of a Community of Practice show overall view of the community's domain while they bring their individual perspectives on any given problem, thus creating a social learning system that goes beyond the sum of its parts. The sharing of knowledge through engaging in Communities of Practice result in knowledge being realised as intellectual assets, as explained by Wenger (1998); Wenger *et al.* (2002); Wenger and Snyder (2004).

Communities of Practice come about as a result of continuous engagement in collective learning and the sharing of common knowledge by a society - for example, tradesmen who share the same knowledge and practice, or professionals who have a common knowledge identity and interact in the workplace or meet socially. The aim of engaging in Communities of Practice is to improve the community's knowledge base, its know-how and practice (Wenger *et al.* 2002; Wenger and Snyder, 2004 and Wenger 2004).

For a further understanding of the concept of Communities of Practice, the author brings in the assumption of organisational learning, as proposed by Argyris and Schon (1978); ; Lave and Wenger, 1991; Wenger, 1998) which is discussed earlier sections of this Chapter. They asserted that learning consists of understanding complex knowledge practices. The argument put forward here is that learning is a collective process amongst individuals who share a common goal and vision. Organisational learning is considered an aggregate effort by members of an organisation who are grouped into Communities of Practice.

To understand the whole principle of Communities of Practice, the author also draws from the concept of 'deteuro-learning' from single-loop learning and double-loop learning, as suggested by Nonaka and Takeuchi, (1995) and Amin and Cohendet (2004).These concepts come from the theory of Learning discussed in earlier sections of this Chapter. It is essential that the writer defines Single-loop learning (SLL), Double-loop learning (DLL) and Deteuro- learning (DL) and re-emphasises the importance the importance of these concepts. All these concepts are part of the theory of Learning, which some writers have defined as a technical processing of information but also a social act of sense making (Argyris and Schon, 1978; Argyris, 2003). Learning which includes asking questions and engaging in dialogue in order to continuously improve the capacity to process existing knowledge and creating knowledge is a collective activity.

Single- loop learning is the kind of learning that occurs when people attempt to correct the mismatches between actions when the governing values or assumptions that underlie those actions are not open to change (Argyris and Schon, 1996: 92).Single-loop learning asks a one-dimensional question to elicit a one –dimensional answer. The weakness of Single-loop learning is that it ignores the basic problem, i.e. why the mismatch or error existed in the first place.

Double-loop learning which is also discussed in Chapter 2, (section 2.4.6) is learning that when the organisation is involved in questioning and modification of existing norms, procedures, policies and objectives. Double-loop learning provides opportunities for discontinuous improvement when reframing a problem and usually brings radically solutions. Double-loop learning increases the organisational problem solving capability.

Deutero-learning is called 'learning to learn' (Argyris and Schon, 1996: 92). This type of learning refers to the organisational capacity to set and solve problems and to design and redesign policies, structures and techniques in the face of constantly changing assumptions about self and environment.

'Deutero-learning' is important in the learning of the organisation. The concept of 'Deutero-earning' arose because of the limitations found in the traditional theoretical approaches, which were anchored in theories that encourage individual learning. Unfortunately, these theories fail to explain the concept of 'double-loop learning' or 'unlearning'; and organisations find it difficult to implement double-loop learning on their own (Nonaka and Takeuchi, 1995).

The creation of Communities of Practice is a renewed approach to organisational learning – in an attempt to transcend the limitations presented by earlier methods of learning. Reasons given for the emergence of Communities of Practise include the following:

- Firms comprise different individuals who make their own learning ways, and have different capabilities. This composition of individuals makes it difficult to understand the complex nature of organisational learning. Amin and Cohendet (2004) agreed that although firms consist of different individuals who are constantly learning, the knowledge that these individuals have overlaps – thereby, creating 'communities'. These communities could be work teams, Epistemic Communities or project teams, which exhibit distinct learning characteristics and collective behaviour.

- The actual process of the production and circulation of knowledge within a firm is the cornerstone in the formation of organisational learning. The assertion here is that the 'cognitive architecture' of knowledge within the firm, the way knowledge is produced, stored, exchanged, transmitted and retrieved, between the different communities, strongly influences the process of learning itself (Amin and Cohendet, 2004).

These views on organisational learning were summarised by Brown and Duguid (1991:5) who argued that "within an organisation, perceived as a collective of communities, not simply of individuals, in which enacting experiments are legitimate, separate community perspectives can be amplified by inter-changes among the communities".

The assumptions put forward here are that Communities of Practice engage in a learning process which yields innovative processes, in order to be autonomous and independent. This independence by Communities of Practice helps them to deal with discontinuities and to accelerate innovation which is brought about by different individuals sharing their critical knowledge.

The earlier discussion assumes that organisational learning has a close relationship with individual learning, but cautions those who assume that individual learning occurs only when there is organisational learning.

3.3. The theory of action by Argyris and Schon

Argyris and Schon (1996) asserted that organisations adopt learning as a process when a gap exists. This gap indicates that the process should be supported by senior management. Organisational learning assumes that organisations adopt knowledge, which theorists call 'single-loop learning', but they also learn by reconstructing what they know (double–loop learning) and by reflecting on the existing social knowledge.

3.3.1 Critical Analysis of the theory of action

This theory of action of Argyris and Schon, (1978) has been criticised by various authors in knowledge-management (KM); firstly, because the theory does not explain the association between people who comprise the firm and the cognitive maps. This framework does not include socio-cultural aspects that are linked to how knowledge is exchanged. The transfer and sharing of knowledge with a firm is only made possible through the use of the 'ba' and Communities of Practice (Nonaka and Konno, 1998; Brown and Duguid, 1991; Blackler and McDonald, 2000; Amin and Cohendet, 2004).

The critique offered by these authors is that there remains some scepticism on how organisational knowledge can close the gap that exists between theory and practice.

Another concern is that there is no accurate explanation of how other forms of knowledge processes help in closing the gap which is created when knowledge is transferred. A further concern is that the theory places less importance on the role played by tacit knowledge. The weakness of the model conceived by Argyris and Schon (1996) is that the firm only functions in "information processing' rather than as a 'knowledge-processing' firm.

Amin and Cohendet (2004, citing Bateson, 1977) argue that mechanisms need to be developed in order to close the gap between organisational learning and individual learning, as these two seem different. The argument here is that when organisations learn, one cannot assume that individuals also learn. Weick (1991) also supports this view by arguing that organisational learning is rare within organisations; thus making a presupposition that the bridge between individual learning and organisational learning needs to occur in a regular or a systematic manner.

This bridge can assist in integrating all aspects of knowledge distribution, sharing and transfer. The model of Argyris and Schon (1996) only addresses the hierarchical nature of organisations, but fails to address the effect of double-loop learning, which acknowledges that knowledge is exchanged and created by communities that exist as sub-systems of an organisation.

In concluding this critical analysis of Argyris and Schon's theory, the researcher agrees with authors like Huff (1990); Amin and Cohendet (2004) that Argyris and Schon (1996)failed to link individual learning and organisational learning, and did not demonstrate clearly whether knowledge production, processing and usage is a 'social' process or simply an individual action.

Having analysed the theory of organisational learning and its pitfalls, it is important to investigate the different forms of cognitive entities (communities) within a firm. This is important, because it is the understanding of these entities that will enable the reader to understand the dominant cognitive activity and the way knowledge is produced, including the most outstanding modes that bind all these entities together.

The departure point in the discussion of various forms of cognitive entities is the analysis of teams and formal groups. The latter do not have learning as a dominant mode, simply because they learn by doing and any production of knowledge during the course of action is unintended.

Teams consist of different agents who have disciplinary knowledge that integrates the knowledge held by others. Amin and Cohendet (2004) defined routines existing among agents in a community that make them work as a unit without them entering into any formal negotiations. Amin and Cohendet (2004, citing Lundvall, 1992) assert that members of a community owe their recruitment to the leader of that group and are bound together by specific job requirements, which they share amongst themselves. Such members involuntarily and almost spontaneously create common knowledge that is useful to the group as a whole in the future.

Various authors have discussed networks as comprising another structure that binds individuals together in knowledge-sharing communities, although no clarity is attained on whether the knowledge produced or shared is produced on purpose. This issue is not the focus of this research, however.

3.4. Communities of Practice and epistemic communities

The existence of codes that are understandable by the communicating actors is clearly of paramount importance. An epistemic community is one that enables knowledge to be codified (Lave and Wenger 1991, as cited in Amin and Cohendet, 2004).

Epistemic Communities often deliberate on common knowledge between members of the group. This knowledge is shared through knowledge zones and other media of broadcasting (Amin and Cohendet, 2004, citing Haas, 1992).

Epistemic Communities usually operate beyond the boundaries of the firm in which they are employed – and they are not bound or limited by their own membership.

There is a procedure for how these members act in facilitating knowledge transfer. For a community to function properly there should be some sort of procedural authority that binds agents together into a functional whole. Agents often commit to increasing a particular area of knowledge. Epistemic Communities spawn knowledge formation, thereby enhancing connection between individuals (Ashby, 1956, cited in Amin and Cohendet, 2004).

The accumulation of knowledge by individuals is done in accordance with their function in the community. The quality of this functioning depends on two factors: firstly, the variety of individual experiences in interaction; and secondly, by the fact that experience is not accepted as a factor in knowledge creation'. Procedural authority plays a bigger role in creating and monitoring the activities of Epistemic Communities. Epistemic Communities form a document with codes that can be used by members as their primary form of existence.

Table 3.1: The analysis of epistemic communities

	Objective	Agents	Cognitive Activity	Recruitment rule	Knowledge Production and Dominant Learning mode	What holds the Community together
Functional Group	Ensure a given function	Homogeneous	Disciplinary Specialisation	Hierarchical	Unintended Learning by doing	Education Task definition
Team	Realise a given task	Heterogeneous	Integration of functional knowledge	Team's leader	Unintended learning by interacting	Job requirements Common goals
Network	Mutually negotiated specialisation	Heterogeneous	Knowledge exchange	Mutual trust	Intended or unintended depending on the network Learning by exchanging	Need to access complementary knowledge
Community of Practice	Increase the skills in a given practice	Homogeneous	Accumulate knowledge about a given practice Circulation of best practices	Members who select themselves	Unintended Learning in working	Common passion for the practice
Epistemic Community	Produce knowledge	Heterogeneous	Construction of knowledge or messages Circulation of codified knowledge	By peers	Intended Searching	Respect of a procedural authority

(Source: Amin and Cohendet, 2004)

In understanding organisational learning and epistemic communities, one is faced with the need to understand the architecture of organisations. From the architecture of organisations, some conclusions may be drawn. These conclusions essentially show how organisational learning is structured. Organisational learning needs to be linked to the structure of the firm. This is true, in particular, when one analyses how knowledge has evolved within the firm (Amin and Cohendet, 2004).

From the cognitive architecture of the firm, one can distinguish two aspects related to the evolution of communication within a firm. Firstly, Communities of Practice need to feel that they are in control of their knowledge production, and the modes of production that they knowledge (Amin and Cohendet, 2004). The central point of organisational learning is that it is based on the connectivity of communities, workgroups and multi-disciplinary teams.

There is also a dimension which emphasises that there is little difference in output between those that produce new knowledge and those who are responsible for transferring it. This statement assumes that for communities to exist efficiently, knowledge needs to be produced and transferred. This production and transfer of knowledge describes the epistemic process in knowledge management.

One central proposition of this study is that organisational learning is anchored in the interaction between non-hierarchical communities, the Communities of Practices and Epistemic Communities.

The understanding of interactions between hierarchical communities and functional teams underpins any work on organisational learning (Argyris and Schon, 1978; Amin and Cohendet, 2004). This interaction is referred to as 'Mode One'. The crux of understanding Mode One lies in an understanding of the literature on communities that are specialists, and of those that integrate that knowledge within communities.

Lam (1996; 1997) and Amin and Cohendet (2004) asserted that the fundamental problem in Mode One lies with the diffusion of knowledge. They argued that the diffusion of knowledge incorporates the retrieval and distribution of knowledge held in teams. Incorporating knowledge held in teams, means that the distinction between epistemic communities responsible for making new knowledge and those that are tasked with using such knowledge should be recognised.

There is some confusion on the structure of Mode One; the process of transformation of knowledge resides in different and separate departments from that in which new knowledge is produced, handled and distributed. As explained by Amin and Cohendet (2004), the production of new knowledge is assumed to be a non-deliberate form of production that emerges as a by-product of production – through learning by using or learning by doing.

From Mode One, the natural existence of Communities of Practice can be traced, since it explains how community members who have a view of sharing the same common interests for a given practice are located together. These can be located within teams or functional groups. These functional groups circulate best practices within a given community; and the circulation of such best practices within the group remains local. The drawback is that these agents do not fully circulate; and neither do they exchange information easily.

The connection between epistemic communities and CoPs' is emphasised in Mode Two. The basic argument in Mode Two is that there is a thin line separating the 'deliberate and non-deliberate' forms of knowledge production. Amin and Cohendet (2004, commenting on the work of Argyris and Schon, 1978) argued that the integration of existing knowledge in a firm depends on those that are responsible for the production and the circulation of such knowledge. These are the Communities of Practice, together with the epistemic communities, or other groupings.

Research by several authors on knowledge management, like that done by Atefeh, *et al.* (1999); Alavi (2000); Vlok (2004); Erickson, and Kellogg (2006) offers a new explanation of Mode Two, by suggesting that the evolution of experimental learning provides the differentiation between 'on-line' and 'off-line' learning activities. This, they argued, calls for an overall reconsideration of the separation between epistemic communities and Communities of Practice.

Lundvall (2000) also challenges the earlier assumption by Argyris and Schon (1978) by asserting that in Mode Two, experimental learning happens 'on-line', that is during the process of producing a good, and consists of deliberately experimenting during the production process.

During the 'on-line' process, there is a creation of a variety of new options. On-line learning is based on a strategy, whereby experimentation allows for collecting data, from which the best strategy for future activity is chosen (Lundvall, 2000; Cohendet and Llerena, 2003). Lundvall (2000) argues that "as long as an activity remains fundamentally based on learning processes that are routine adaptation procedures; and it leaves no room for programming experiments during economic activity, there remains a strong dichotomy between those who deliberately produce knowledge and those who use and exploit it".

In summarising Lundvall (2000)'s argument, one may assume that knowledge is produced more surely when there is an increase in learning by individuals. The argument is extended to

incorporate the notion that experimental learning (online) processes contribute extensively to the production of knowledge.

Online learning – using intense forms of communication – contributes to the improvement of the specific roles of Communities of Practice, because it triggers organisational re-alignment. Lundvall (2000) and Cohendet *et al.,* 2004) argued that proper management of distributed knowledge within an organisation enhances the development of epistemic communities and Communities of Practice.

This management of distributed knowledge increases the development of knowledge within defined areas; and it does so by emphasising learning and the group sharing of information.

This view is complemented by that of Nooteboom (1999), who discussed the role of the 'go-betweens' as being paramount in cementing trust, the maintenance of group secrets, and helping in the resolution of conflicts within groups. Nooteboom (1999) asserted that if these systems are kept over time, a balance could be struck between development and the replication of knowledge. Haas (1992) and Cohendet *et al.* (2004) agreed that replication, selection and imitation assist in explaining the learning paths that exist.

However, the shortcoming is that this does not explain the process of how such learning occurs in these defined paths. This view is shared by Gibbons *et al.* (1997) and Cohendet *et al.* (2004), who argued that language replication does not help show the process through which learning occurs. It also does not highlight the learning process. Cohendet *et al.* (2004) argued that firms do not effectively utilise experiential learning. Firms use a combination of knowledge from groups and individuals, which may be recursive or procedural. The basic argument here is that practice, social interaction and action should all play a vital role in the generation and distribution of knowledge.

This view on Communities of Practice as interacting with the environment is shared by that of Brown and Duguid (1991:76) in their anthropological analysis of the organisation. They argue that it is the 'organisation's communities' that act as sub-systems with the environment, in which the organisation exists through "sense-making, congruence finding, and adaptation (Brown and Duguid, 1991: 76-84)". It is from these interactions that new insights can be produced.

Organisations are urged not to overlook or curtail the existence of Communities of Practice, because this may threaten their own survival. This threat can come about in two ways. Firstly, it may destroy the practice of collective learning and the sharing of ideas, culture and practices relating to a profession. It may destroy the fibre which makes it survive. Secondly, it could stifle innovation which is the result of learning and working together.

3.5 How to distinguish Epistemic Communities from other groups

The discussion on Communities of Practice has shed some light on how they are made. From the configuration of Communities of Practice the author feels that it is important to explain what epistemic communities are, and that their members share important secrets and craft common policies for their enterprise. The sharing of knowledge in CoPs helps to overcome cultural barriers that may exist in an organisation because such knowledge is shared by a group with a common craft and work identity (Mc Adam and McCreedy, 1999b; McDermott and Dell, 2001). It is now vital to distinguish epistemic communities from other groups – with the emphasis on intellectual capital.

Intellectual capital is distinct from other existing accounting categories which comprise the following: Good will and saleable intangible assets (Loverde, 2001). Intellectual capital (IC) is the value of knowledge assets and how they can be converted into value which helps to create wealth and profits. Intellectual assets are defined in the knowledge management context in terms of profitability because:

- Firstly, an intellectual capital investment should create profits in the firm's value chain.
- Secondly, there is an assumption that an organisation which values its intellectual capital maximises it – in order to compete effectively with competitors - resulting in the possible death of that particular competitor. Intellectual capital metrics should be linked to profitability, or there will be nowhere in the organisation to apply the measure of intellectual capital.

Intellectual assets cannot be used to explore the concept of epistemic knowledge. The knowledge residing in individual heads is intangible, but the value that such individual knowledge brings is of vital importance to the organisation.

3. 6 Communities of Practice in the fuel industry

Communities of Practice in the Petrochemical industry exist, but their existence has been stalled by the segmentation of industry processes. In a refinery, processes are set up in such a way that mechanical fitters, work independently of any other fitters who might work in the plant. Yet, in terms of knowledge, these could have the requisite knowledge, but this would not necessarily be shared amongst them. This failure to share knowledge clearly undermines any attempts to unite all the knowledge that the fitters could have. This can have a significant impact on innovation.

A parallel example could be drawn from the practices of research scientists and process engineers, who though they work in different environments, work with the same products, researching new technology to improve product specifications and the optimisation of production processes but have different bodies of knowledge and in many instances do not share knowledge that is common to them.

In a typical knowledge environment, scientists and process engineers should have Communities of Practice to share knowledge on processes, corrosion and acid levels of products passing through a system. The challenge is how to integrate these skills using the knowledge format. Communities of Practice are not utilised fully in Group Supply Chain Management; yet the structure of the department is ideal for Communities of Practice to be utilised. PetroSA's supply chain department consists of units involved in tenders, contracts and capital projects, strategic sourcing, warehouse and materials management, commodity management and supplier management.

All these units have a common function, which is procurement. However, with a closer look at the way in which common knowledge spanning the department is shared, one gets a sense that the distribution of knowledge is still in its infancy – or else, there is no knowledge flow at all. It is important that, in order to utilise a knowledge system, Group Supply Chain Management together with Information Systems should establish sites where knowledge can be created, enabled and distributed.

The lack of knowledge creation and distribution creates a challenge to the effective use of Communities of Practice within PetroSA.

Another problem is that the organisation under study executes projects, but there is no visible team producing knowledge. Hence, knowledge is not created per project. The challenge is that there is a lack of any distinctive 'social infrastructure' to enhance knowledge practices. Knowledge within the Group Supply Chain, which can help the processes of knowledge creation, sharing transforming and distribution, is quickly lost.

3. 7 Understanding the strategy of managing knowledge

Although the research project is pivoted on discussing knowledge-management systems, Communities of Practice, epistemic communities and knowledge as an asset in the Petro-chemical industry, it is important that some explanation of the strategy of managing knowledge should be discussed. Understanding the strategy of managing knowledge assumes the planning, leading and organising of knowledge as a valuable resource.

From this assumption, one can draw conclusions that managing knowledge-based capabilities is essential in any knowledge-based economy. Knowledge-based capabilities can be understood more clearly by first understanding the strategy for managing such capabilities. This understanding of a strategy for managing knowledge as a factor of production, borders on knowing how epistemic communities generate, share, distribute and store knowledge. This view is confirmed by Landon and Landon (2001), and Vlok (2004). These authors argued that understanding the knowledge-management strategy is a prerequisite for managing the digital firm. A digital firm is one which utilises technology to enhance human knowledge development and working.

Managing the digital aspect of knowledge involves an understanding of the social networks within an organisation.

Business strategies for managing resources frequently result from a paradigm shift, particularly in the 21st century. This has happened when firms emphasise the management of knowledge as a factor of production and using it for competitiveness in areas in which they operate. The new epoch of managing knowledge as an important factor of production, gathered force in the 1990s, when business moved from emphasising natural resources to emphasising intellectual assets – thereby, maximizing their competitive advantage. Furthermore, there has been a rapid

development in computer networks that have facilitated faster knowledge transfer, storage and retrieval.

The need to manage knowledge as intellectual capital caught those in management unprepared, and they had no models for their use, as was pointed out by Laudon and Laudon (2001) and Vlok (2004). Consulting firms took the initial step when they recognised that knowledge is an asset, like land, labour and capital, and that this capital could be managed by using social networks.

There are generally two strategies utilised by organisations to manage knowledge. The first strategy is called codification, which is centred on a computer. The fundamental assumption in . this strategy is that knowledge can be codified, and stored in databases where it can be accessed and easily used by anyone in the organisation. The other strategy is called 'personalisation'. The codification strategy assumes that knowledge is associated with the individual who created it, and is shared mainly through direct person-to-person contact. Computers assist in the communication of knowledge in this type of strategy.

Computers enable knowledge to be codified and to be retrieved. This view is confirmed by Hansen *et al.,* (1999). They argued that for any strategy to work there have to be enablers. The argument that is put forward here is that computers are necessary as enablers of knowledge. It is through computers that knowledge sites can be accessed; and it is through computers that critical knowledge can be distributed. In crafting a knowledge strategy, practitioners should include a strategy where enablers, like computers, can be used.

The challenge is that for knowledge workers to manage knowledge as an asset for organisations, and in particular, for a knowledge executive, there is a need to understand the two strategies of codification and personalisation. There is also a need to assess and understand the strengths and weaknesses of each strategy. As explained by Hansen *et al.* (1999), this would help knowledge executives to understand and appreciate the importance of investments in knowledge, and how to make meaningful decisions based on such investments.

In dealing with the discourse on knowledge-management strategy, the author will discuss briefly why organisations would choose – either the codification strategy or the personalisation strategy. The premise of the argument is that organisations that use the codification strategy have people to codify, store and re-use such knowledge. In this form of strategy, people are considered to be

pivotal. However, a clear distinction should be made between the individual who develops the strategy and those that use it.

The codification strategy is considered important by the author because it brings in a measure of objectivity in dealing with such knowledge. There is a clear separation of knowledge interpretation between the originator and the user of knowledge.

3.8. WHY ORGANISATIONS MANAGE CODIFIED KNOWLEDGE

Organisations manage codified knowledge in order to remain competitive (Zack, 1998). Because businesses exist in a competitive environment, organisations need to share, store and transfer internal knowledge. In exploring knowledge management, it is important to understand how organisations leverage what they know. Managing codified knowledge should be one of the strategic balancing acts of any organisation.

Further to developing knowledge as a competitive tool, organisations often find that their existing knowledge is fragmented; and there is a resulting need to understand how that knowledge can be managed.

The codification of knowledge helps firms to configure their resources and capabilities. Managing a firm's resources and capabilities also helps it manage its codified knowledge. This may be referred to as, "Knowledge-management architecture" (Zack, 1998). Managing codified knowledge is born out of the need to understand what codified knowledge is – and given its complexity – how firms can manage it. Also, the call to manage codified knowledge is forthcoming from the need to understand the role that information technology (which is an enabler) plays in managing such codified knowledge.

The author acknowledges that general knowledge is easily codified and exchanged among individuals, but asserts that it is difficult to find and to share specific knowledge. This assertion is based on codifying the specific knowledge required by organisations – in order to understand both the contextual categories and the relationships that exist within the knowledge communities. Organisations are continuously handicapped in "explicating tacit" knowledge to share the same meaning and to be re-applied outside the original source.

It is important to stress that keeping and sharing tacit knowledge outside its boundaries, without it losing its meaning, is one of the least-understood areas of knowledge management, and is still a challenge to most organisations. Organisations need to deal with the fear of losing tacit knowledge, when dealing with it outside its boundaries. This, however, does not mean that an organisation should not share and leverage specific knowledge.

Following an earlier statement, the author suggests that the real challenge to organisations is how to decide which knowledge should be made explicit and which should remain tacit. Codifying knowledge helps organisations articulate knowledge beyond its social and political constraints. One understands that the organisational way of distributing knowledge depends on its culture, or intellectual constraints, particularly in instances where organisations have an inadequate "formal language or model" for its articulation.

The other challenge is that given their history, organisations do not normally challenge the way knowledge is kept in repositories, or how it is distributed and transferred. This failure to challenge the storing mechanisms, calls on managers to challenge the "apparent tacitness of knowledge" (Zack, 1998).

3.9. KNOWLEDGE ARCHITECTURE IN THE CONTEXT OF MANAGING CODIFIED KNOWLEDGE

In Chapter 2, the author mentioned that the research project focuses largely on explicit knowledge, because this type of knowledge provides a basis for discussing knowledge Communities of Practice and epistemic communities. Managing explicit knowledge is done through the primary resources and the repositioning of explicit knowledge, which discusses knowledge as an object (Zack, 1998), and then talks about its structure and content.

This knowledge repositioning allows varying views of the content of knowledge to be devised from a particular structure. This allows users to dynamically alter and combine views interactively and to apply knowledge easily. Knowledge from this platform changes from being an object to being a process. A knowledge unit is "an atomic packet of knowledge content that can be labelled, indexed, stored, retrieved and manipulated" (Zack, 1998).

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Although the format, size and content include its structure, it also includes features for joining and cross-referencing knowledge units.

These links usually depict the depth of the conceptual configuration of knowledge, ordered sequences, causality and other associations – in accordance with the type of knowledge in the repository. Knowledge in these repositories is either declarative or procedural. Repositories help to store and retrieve knowledge. These repositories should focus on declarative knowledge and procedural knowledge. Procedural knowledge and casual knowledge deal with process actions and sequences of events, while causal knowledge deals with the rationale or the conclusions. Declarative knowledge, on the other hand, deals with meaningful concepts, categories and definitions.

There is also contextual knowledge, which focuses on circumstances and intentions, whereby something was developed and applied. Included in the repository structure is the need to deal with specific-contextual knowledge, which allows knowledge to be indexed, in accordance with defined categories, and which subsequently give access patterns that can be used by the organisation.

Repositories are designed in such a way as to accept any variations on stored knowledge, by linking annotations, or by allowing knowledge for use in additional contexts. Several repositories may be combined to form a knowledge platform. These repositories may have a structure, which stores some particular knowledge content.

Organisations also utilize knowledge systems to gather, refine, manage and transfer knowledge. The refinery defines the process of how knowledge is contained in the repository, how it is processed, and how it is distributed. The process in the refinery includes:

a) Acquisition – which assumes knowledge creation or acquisition from internal and external sources;

b) Refining – deals with gathered knowledge that is processed to find its value before being stored. This includes processes such as cleaning, labelling, indexing, sorting, abstracting, standardizing, integrating and re-categorizing;

c) Storage and retrieval; these factors link knowledge creation and distribution.

d) Distribution that accounts for mechanisms that enable users to access repository content; and

e) Presentation, which deals with understanding the value of the knowledge.

Organisations should not sacrifice management's role and responsibilities. Organisations should clearly define what management's roles are – by acknowledging knowledge as a "cross-organisational process". The assumption is that knowledge must be owned and managed. Organisations should consequently strengthen the role of the Chief Knowledge Officer.

Organisations should use technology and infrastructure as enablers for knowledge capture, storage, indexing, searching and presentation. The effective use of information requires organisations to develop policies that can deal with knowledge sharing. Such policies would enable organisations to effectively utilize Communities of Practice, since these communities utilise knowledge technology to create electronic repositories.

3. 10 INTEGRATIVE AND INTERACTIVE PROCESSES: Understanding knowledge-management applications

The knowledge-management architecture for the processing of integrative and interactive processes addresses diverse knowledge-management objectives. Integrative applications allow explicit knowledge to be understood from an input and output basis. Here, producers and consumers use the repositories as a medium for knowledge exchange, allowing members of Communities of Practice to contribute their views and knowledge. The emphasis is on knowledge storage facilities, and the explicit knowledge contained in them, rather than on the contributors, users, or the tacit knowledge they may hold (Zack: 1998).

Integrative applications allow both producers and authors to integrate "collective knowledge". This is called the "integrated-knowledge basis". An example of these includes establishing a database of common knowledge – to be shared and used by all employees who are confronted by similar problems.

Interactive applications are hinged on providing support to tacit knowledge. Interactive applications focus on the transfer of explicit knowledge, through distributed learning. Distributed learning occurs in forums, where individuals search and retrieve knowledge through discussions.

In the context of understanding how knowledge is codified, the author concludes that both integrative and interactive applications use indexing and content to structure a knowledge repository. Interactive applications assist integrative applications by, for example, linking a forum to an electronic-publishing application.

Another strategy used to manage knowledge is the use of personalisation. Dialogue amongst personnel is considered an important concept in personalisation. This differs substantially from using knowledge in the databases. Conversations between individuals help to transfer knowledge. Organisations utilising the personalisation strategy invest a lot of money and other resources; and the emphasis is on constructing social networks comprising people.

The advantage of using the personalisation strategy is that it brings people in contact with each other; and the knowledge is then communicated face-to-face. Sharing can also occur, by using enablers like the telephone system, personnel broadcast channels, as well as through e-mails and video conferences.

This is important, particularly with organisations that have dispersed areas of operations, and can easily be used to link with suppliers who may be located in geographically dispersed locations, but provide essential services to the organisation.

3.11 Social networks and Communities of Practice

From the analysis of the two knowledge-management strategies, it became clear that the building of social networks is important in understanding the link between knowledge strategies and building Communities of Practice. From the personalisation strategy, it is clear that by creating social networks, people are allowed to communicate at a personal level. The use of a telephone system - which can link people between offices; thereby, encouraging the culture of return phone calls from colleagues and suppliers, and providing an electronic document system -- helps to cement the culture of developing social networks, as employees can share knowledge by using these devices without incurring any meaningful cost (Hansen et al., 1999).

Also, from the literature review, it becomes clear that most organisations use both codification and personalisation strategies with social networks. Organisations also need to choose one form of strategy and not to attempt to use both.

The basic argument in this research project is that whether an organisation uses the codification or personalisation strategy does not really matter. The challenge is that the organisational choice of strategy should enhance its competitive strategy. Also, a closer look at both strategies shows that the codification strategy hinges on investing once in a knowledge asset, but then utilising it for longer.

Of paramount importance is the utilising of computers and social networks as enablers to codify, store and distribute knowledge for subsequent re-use.

The personalisation strategy advocates that firms should not over-invest in information, but should rather create and use social networks, which would enable tacit knowledge to be transferred between individuals.

The codification strategy seems appealing to organisations that have invested a lot in information technology, because knowledge can be stored in repositories, and can be re-used by the personnel for different jobs. This has a huge impact on cost reduction, which can enable a firm to recognise knowledge as 'intellectual capital'. It is the view of the author that organisational needs should dictate which strategy to use. Firms using the codification strategy have to understand that codification uses social networks to store and to retrieve knowledge.

This view is shared by authors, such as Davenport and Prusak (1998:187-199). They argued that codification allows the organisation to utilise social networks to tap into the knowledge that may be stored in individuals. It is important to note that codifying knowledge allows such knowledge to be stored, shared, and mixed – and to be subsequently worked on. The only challenge is that when codifying knowledge, some essential properties of that knowledge could be lost, thus causing it to lose meaning. Another challenge is that it becomes extremely difficult to codify such tacit knowledge.

3.12 The challenges of choosing a knowledge-management strategy

It is the intention of this research project to explicitly highlight the challenges faced by knowledge workers and organisations alike when choosing suitable strategies for managing such knowledge. The assumption given earlier is that social networks are important in deciding which

strategy to use, but social networks also call for organisations to choose the right technology that will enable such networks to be enhanced thereby.

Technology is important in diffusing any strategy, because it acts as an enabler to knowledge transfer, storage, archiving, editing, distribution and sharing. Organisations engaged in knowledge-management often find it difficult to implement the strategies of knowledge-management. The failure by organisations to utilise an appropriate technology to enhance social networks highlights the assumption that there is a need to develop a framework to implement strategies that use technology to utilise the existing social networks.

This view is echoed by writers, Al-Ghassani *et al.*, (2004); Scarabough *et al.*, (1999); Kazi *et al.*, (1999); and Kanter, (1999), who argued that choosing the right technology which will work with social networks should be the key focus for organisations dealing in knowledge. They further argued that social networks represent a major conduit to share, transfer and distribute knowledge effectively in organisations.

It is the intention of this research project to show that the sharing of knowledge and knowledge-strategy choosing are linked. It also calls for the need to understand which knowledge strategy should be used to enhance business goals.

3.13 UNDERSTANDING KNOWLEDGE AS INTELLECTUAL CAPITAL

The fundamental theories of knowledge-management, second-generation knowledge management, tacit and explicit knowledge and Communities of Practice, as well as Epistemic Communities have been explored at length in earlier sections of this research. This section deals with the understanding of knowledge as intellectual capital. In order to understand knowledge as capital there has to be some change in the way in which knowledge is viewed. Most people would probably argue that capital is something that can be accounted for by using accounting principles. In other words, it can be quantified; but this is not the case with intellectual capital.

Viewing knowledge as capital helps one to see the value of knowledge beyond what accounting balance sheets and income statements could reveal about the assets of any business. This view is largely emphasised by authors, such as Edvinsson (1997), who divided intellectual capital into three facets: human capital, organisational capital and customer capital.

Edvinsson (1997) further argued that the development of methods to measure intellectual capital has steered management thinking away from pivoting organisation business successes on tangible assets only. The major argument presented in this section of the research is that knowledge-as-capital is able to influence business in ways that value and manage people and the knowledge that resides in them. The measure of such capital is via intellectual capital statements which show the intellectual worth of individuals and their knowledge creativity.

Reports of intellectual statements can be presented in numbers, as well as in narratives and visualisations (Bontis, 2004: 13-39).

A study of intellectual capital shows how it is related to knowledge. Intellectual capital, like knowledge, can be best understood through practice. The intellectual capital statements of an organisation should reflect assets like the knowledge that exists within employees and their creativity. It can also be shown how the efficiency and skills possessed by such individuals could make the organisation more competitive, provided they are effectively implemented by the right decision-making in the organisation.

In understanding knowledge as capital, it is important to note that intellectual capital should not be measured by trying to use conventional accounting standards. The analogy is not set to confuse anyone about measuring knowledge assets, nor is it meant to distort the facts on the accounting measurement of capital. Moreover, there is also a need to assess knowledge assets, in order to appreciate knowledge as an asset and its economic value (Bontis: 2001: 41-60).

It is also important here to bring in the concept of measuring assets. These models underpin the theory of the firm and the knowledge-based view, which effectively tackles approaches, intellectual agility, competence and attitudes.

There is considerable discussion in the literature on the dichotomy between intellectual capital and human capital – with concepts like knowledge capital, organisational learning, information and data, knowledge epoch, information assets, intangible assets, intangible management, hidden value (Bontis, 2001: 41-60). The link between intellectual capital and knowledge capital is important in explaining knowledge assets. Intellectual assets convert knowledge into value, while knowledge capital views knowledge from a philosophical perspective – in which the value of knowledge is categorised into a financial asset (Bontis, 2002: 621-642).

Value is described as the attribute or weight the knowledge asset has. Organisations turn knowledge into assets which ultimately display the value of human creativity.

The assumption underlying all these terms, is that society can find new economic value by effectively harnessing knowledge — and that with the advent of knowledge as an asset, a new epoch is unfolding, which will define the competitiveness of organisations. It also sets a new paradigm, in which organisations should move away from basing value only on fixed capital, land, labour and money, in addition to managerial know-how.

Having given the background on knowledge assets, it is important to define what knowledge assets are. The definition below shows what the research takes knowledge assets to be.

3.13.1 Knowledge assets defined

An asset is a factor of production that enhances output. Knowledge assets represent the value of information mapped and stored for competitiveness. Sveiby (2001, citing Penrose, 1959) cemented the concept of knowledge assets as being something more than mere data. This view comes from sense-making, together with the understanding knowledge as a factor of production. Theorists on knowledge management argue that knowledge assets enable information to be translated into higher-order objectives. Knowledge assets represent the wealth-creating aspect of information.

The underlying argument of knowledge as intellectual capital comes from the understanding and analysis of explicit knowledge. Explicit knowledge unravels knowledge, as being objective and easily expressible in words and sentences — and something that can be housed in databases and trade manuals. Knowledge, in its essence, can be transferred through a spiral process: For example, tacit-to-tacit through socialisation, explicit-to-explicit, through combinations, tacit-to-explicit through externalisation, and explicit-to-tacit through internalisation.

Knowledge, as an asset, stems from the recognition of it as a factor of production, cementing the need for a paradigm shift in society's view of factors of production. This paradigm shift supposes that knowledge is the most critical resource that enhances a firm's competitiveness. Skryme and Amidon (1997) emphasised the importance of knowledge as an asset, as this creates wealth and calls for some re-thinking of the organisation's understanding of knowledge. They further argued

that the profitability and efficiency of an organisation is now measured by using knowledge endowment and the honing thereof for increased competitiveness.

The discourse on knowledge as capital depicts it as being social, and entrenched in social practices, cultures and networks, while still emphasising the role of social networks. The author's view is that since knowledge is an intangible asset, its value lies in it being an agent for change. There are, however, other divergent views on knowledge as an asset, but like the earlier view, these focus on value-creation. The assertion that knowledge creates value sees it as a change factor, and something that organisations can use to improve their competitiveness.

The discussion on knowledge as an asset fits the logic of thinking that knowledge is a factor of production, which is not affected by the law of diminishing returns. This understanding of knowledge means that one understands the dialogues in Communities of Practice and Epistemic Communities or work groups and how knowledge can be rendered valuable. The dialogue is in the form of knowledge articulation by members of a Community of Practice and by demonstration, talking and showing the knowledge that such communities have.

This understanding further calls on knowledge practitioners to understand the value of knowledge work, the value of social networks, and the value created in conversations, to understand the value in shared information and ideas. Organisations also need to understand the importance of the trust, care and responsibility embodied in the whole knowledge debate. In order to follow and appreciate the debate, practitioners and students of knowledge management and organisations need to agree that knowledge is the only tool that can unleash the real creativity of organisations, since it recognises the power of individuals in whom such knowledge resides.

The realisation of knowledge as an asset comes from understanding the aggregate knowledge that sits in Communities of Practice, and individuals within an organisation, and how this knowledge comes to be shared. The fact is that in many organisations, knowledge is improved through re-learning, and with practice yields results. This sets knowledge up as intellectual capital. The author, however, warns that the debate about knowledge as an asset should not be confused with information technology, which many writers suppose it is.

Knowledge as an asset should mean the value of knowledge in an organisation that makes the organisation grow. In the knowledge economy, knowledge has become a very important factor of production alongside land, labour and capital. Knowledge as an asset assumes more than just sharing and codifying; for example, it looks beyond the value of computers as enablers for knowledge transfer; instead, it focuses on connecting people through knowledge.

The value of knowledge as an asset is understood by using the transferred knowledge to yield results – rather than just moving that knowledge from person to person. It is the view of this writer that there are dangers when knowledge used as intellectual capital creates barriers to entry, since it creates standards which block the effect of one's competitors. This enables the organisation's returns to increase instead of diminishing.

In order to understand knowledge as an asset, one has to view it from a strategic perspective. This means that those viewing knowledge as an asset, should focus beyond the 'internal organisation', and more on why that organisation exists and how it can utilise its existing knowledge to further its business goals. The question to be asked is: "What is our business? Not the question: What is our organisation?"

From the above, it now becomes clear that knowledge is intangible, but the question still being asked is: How can knowledge be considered an asset, since it is intangible? It is an asset because it translates to profits when it is implemented.

3.13.2 KNOWLEDGE AS CAPITAL - The Classical view

In order to understand knowledge as capital, it is imperative to define what capital is. The premise of comprehending knowledge as capital is drawn from the classical view of knowledge as a factor of production. Stewart (1997:225-226) suggests that information and knowledge are the 'thermo-nuclear' competitive weapons of our time; and those that manage intellectual capital wisely are more likely to be successful in business. Organisations are further challenged to manage intellectual capital effectively in order to drive down costs, replace inventories, cut down on requirements for having expensive physical plant and improve corporate agility.

Stewart (1997) conceded that recognising knowledge as being intellectual capital is the fundamental problem of all knowledge and economic societies. The other problem he cites is that it is difficult to locate these knowledge assets because most of them are intangible, and need to be explicit before they can be improved, examined and shared.

Knowledge is considered capital because it requires intelligence and exhibits brain power. When viewed as capital, like land, it stands out because it is utilised from an input perspective – to yield better outputs. Knowledge from known sources, like databases, mailing lists and meetings has meaning and form, which permit it to be shared, explored and distributed. This above analogy suits knowledge as capital, by assuming that since knowledge can be packaged, it becomes easy to use and to store.

Those who are keen on the natural sciences and economics view capital as something tangible, but the classical knowledge view holds that intelligence resides in people's heads and can turn ideas into substance. This helps in creating competitive advantage. This definition of knowledge as capital was reinforced by Sveiby (1997) and Stewart (2001), by their agreement that 'Intellectual capital is the collective ideas, imagination and know-how of the organisation'.

It is intangible, elusive, mobile and hard to pin down (Sveiby, 1997). The challenge though, is that organisations find it difficult to determine the worth, and how to assess intellectual capital, because the bulk of intellectual capital consists in knowledge, which sits in people's minds, and is consequently both invisible and intangible.

The other challenge is that although knowledge assets provide lucrative returns, measuring and quantifying such capital is still problematic for many organisations. Organisations generally do not have the ability to measure skills and competencies; and they are challenged to develop systems, which would enable them to evaluate intangible assets. Such systems should complement the financial system. Also, organisations need to realise that the business requirements of the 21st century dictate that they pay close attention to human capital as a competitive tool.

This view is shared by Sveiby (2001), who argues that because of business needs in the 21st century, it has become imperative for organisations to craft business advantage around resource

efficiency. Knowledge is one of the resources that need to be managed efficiently. The underlying argument is that business's invisible assets, such as skills, learning and knowledge have become strategic resources.

Also included in this argument, are the changing patterns of valuing business resources. Currently, most viable businesses are moving away from being labour-intensive or capital-intensive or energy-intensive. Instead, they have become knowledge-intensive. Stewart (1997) asserted that knowledge assets have become indispensible for any organisation; and they need to be managed more carefully and much more effectively.

It is the purpose of this research, to show that using knowledge assets assists in the management of organisations. This view is echoed by Stewart (1997) and Sveiby (2001) citing the works of economists, like Teece (2000) and Levinthal (1997), who concluded that the emergence of knowledge capital has altered the ratio configuration of material to knowledge. These writers suggested a 70 percent/30 percent split in favour of knowledge, something that contradicts the past view, where costs used to be seen as 80 percent on material and 20 percent on knowledge.

From the new configuration, it becomes clear that knowledge should be more easily managed.

3.13.3 CONVERTING INTANGIBLE ASSETS INTO VALUE

Practitioners find it difficult to convert intangibles into value. Intangible assets, like human knowledge, internal structures' ways of working, organisational reputation and business relationships need to be translated into value. There are various models that can be used to understand the conversion of intangibles into tangible assets. The most popular method is the "value-network analysis".

Businesses usually convert tangible assets into intangible ones. Sveiby (1997) agreed that intangible assets that include relationships, employee know-how, competency and trust forms are more important for business performance than are tangible assets. Trust is also mentioned, although this is actually part of social capital.

Practitioners of knowledge-management need to understand networks and their role as value-conversion mechanisms, in order to understand intangibles. The big question that is raised in this research is: 'How can organisations create value from intangibles'. Intangibles, such as social

citizenship and environmental responsibility are leveraged through continuous interaction of the organisation's spheres (Allee, 2008).

Intangibles create value by exchanging knowledge for money in the knowledge market; intangibles can be converted into deliverables, like knowledge passed from person to person; and by converting tangible and intangible assets into values that usually enhance business.

The other issue for organisations is to understand value conversion, which is central in understanding intellectual assets. "Value conversion is the act of converting or transforming financial to non-financial values, or transforming an intangible input or asset into a financial value or asset" (Allee, 2008). The following two questions need to be asked:

(1) How does one realise the value-knowledge inputs, and how are these inputs converted into financial value?

(2) How does one utilise tangible and intangible assets to create value for customers and other participants in an internal or external value network?

Following these question, two sub-questions from each of these two main questions need to be addressed:

From Question One:

(a) How do value inputs help one build or manage tangible and intangible assets?

(b) How do value inputs affect one's financial picture?

From Question Two:

(a) What kind of intangible value outputs can one create from both tangible and intangible assets?

(b) What kind of tangible outputs can one create from intangibles, and how can intangibles directly create revenue?

The assessment of inputs and outputs is a necessary step in value conversion. Value conversion assessment usually assists organisations in understanding knowledge. It is important to undergo a value-conversion exercise in order to understand the value created from intangibles. The

greatest challenge of the 21st century concerning value from intangibles as assets is coming to realise the socio-economic configuration of interactions and resources in the value-conversion ethos.

3.13.4 MEASURING INTELLECTUAL CAPITAL

Roos (1998); Marr and Spender (2004) discussed intellectual capital as a strategic resource. The discourse then moved to understand how knowledge assets can be measured. The need to understand why knowledge assets can be measured may be assumed to be forthcoming from recent corporate thinking. This is that organisations need to understand the value of these assets for their competitive advantage. Knowledge assets are important, because they represent the ideas of the people in an organisation. Marr and Spender (2004), citing Raich (2000), agree that the discourse on knowledge as an asset is incomplete, if there is no discussion on how these assets are to be measured.

Sveiby (2001) reinforced the need to measure human capital. This he called "knowledge validation". Knowledge as an asset represents what is in people's heads (human capital) and what is left in the organisation when people go home after work. This, he called "structural capital".

Intellectual assets are measured by analysing customers, processes, renewal and developments, human factors and finance. The measuring of intellectual capital assumes that organisations will disclose their non-financial assets, which are not captured in traditional financial statements. These assets are essential for the maintenance of the organisations. Organisations need to understand that it is only intellectual assets that can deliver growth and profitability. Marr and Spender (2004); Skryme and Amidon (1998) and Scherer, 1999; agree that there are many models for measuring intellectual capital. Taking accountability of intellectual assets has become a new measure of organisational success.

This seems confusing, but all the models have a common basis for the understanding of assets, as well as the need to invest in them. Marr and Spender (2004), citing Spender, (1996) and Stewart (1997), agree that the need to measure intellectual assets challenges organisations to focus their performance management on value-creation.

Davenport and Prusak (1998), cited by Marr and Spender (2004), argue that with knowledge not only in documents or in tangible repositories, there is a need to evaluate organisational routines, processes, practices and norms. The measuring of knowledge assets should focus on epistemological knowledge.

The positivistic view assumes that organisations can value their existing stock of knowledge-assets and account for them in a similar manner as that used to calculate financial assets. Known methods include the "Human-resource accounting (HRA) method", and the "Economic value-added method" (EVA).

Included in this discussion is the interpretive view of organisational knowledge assets. This allows organisations to build causal relationships on "how information is an input for other higher-level objectives" (Marr and Spender, 2004). This view further reinforces the idea that data combined with meaning constitute an important factor of production. Another pointer is the Balance-Scorecard (BSC), which this research project will develop further.

Nonaka and Takenchi (1995) discussed the organic view of organisational knowledge assets. Here, knowledge was classified as a dynamic and tentative combination of data, meaning and the ability to generate a productive practice. The organic view assumes embedded skills, organisational routines and dependency to be core aspects in the analysis of knowledge assets. This view is shared by Roos and Roos *et al.* (1997) and Lev (2001). These authors suggest the inter-dependability of all knowledge-based assets.

Lev (2001) emphasises the fact that knowledge assets are those that reside in labour, representing tacit knowledge. Physical assets should be combined with intellectual assets to create value.

Conclusion

Communities of Practice exist in order to share and transfer knowledge within an organisation. Communities of Practice are loosely coupled and others are more tightly bound by an underlying problem. As people become more connected through teams, functions disciplines, business units etc, there is proclivity for relationships to develop. Once CoPs exist, organisations face a challenge to sustain the CoPs. These are aided by social practices that enable the firm to transfer skills, knowledge and technology. Communities of Practice articulate the description of knowledge as a 'social activity' which can be facilitated via networked environments, such as

group communication and other sources. It is through such Communities of Practice that knowledge assets can best be understood. CoPs accumulate knowledge by developing 'champions of practice' which comprise of individuals from the learning alliances that have been made. These learning alliances act as an active *know-how* platform to provide advice pertaining issues of 'best practice' that have been accumulated through time and involvement in previous projects.

CHAPTER 4

Research Design and Detailed Justification of the Research Methodology

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4.1 Introduction

The purpose of this chapter is to explain in detail the research design and to demonstrate the methods used to collect the data to be presented and analysed in Chapter 5. The chapter centres on the research methodology and approach emphasising the data collection techniques as well as giving a justification of the research methods used. The chapter also highlights aspects on the sample population and also discusses how ethical issues were handled. Since the research is done using interviews (structured, semi-structured, and unstructured) to interrogate the themes deliberated on, it is also the intention of this chapter to show the importance of using structured interviews; as well as, the steps and processes whereby the interviews occurred. The steps in evaluating the interview design process: that is defining the questions; and designing follow-up questions to responses, will also be explained in considerable detail. To interrogate the facts, the researcher only interviewed a sample of those who effectively deal with knowledge management. The methods used also include the observations made. All these are discussed in detail in the relevant sections of this chapter.

4.2 Research methodology and approach

There are several methodological approaches to research. These include the qualitative, quantitative and mixed method research. The mixed method research is a method that includes one quantitative method design to collect numbers and one qualitative method to collect words. Therefore it is clear that qualitative research has to deal with words to describe course of events while quantitative research approach has to deal with the collection and use of numbers to present information. Leedy (1997:106) and Ehige and Ehige (2005) summarised the differences between the two major research approaches, that is, qualitative and quantitative. Table 4.1 is a summary of the differences between the two.

Table 4.1: Differences between Qualitative and Quantitative research approaches

Question	Quantitative	Qualitative
What is the purpose of the research?	To explain and predict. To confirm and validate and test theory. Outcome oriented	To describe and explain. To explore and interpret and to build theory. Process-oriented.
What is the nature of the research process?	Focused Known variables Established guidelines Static design Context free Detached view	Holistic Flexible guidelines Emergent design Context bound Personal view
What are the methods of data collection?	Representative, large sample Standardised instruments	Informative, small sample Observation, interviews
What is the form of reasoning used in analysis?	Deductive analysis	Inductive analysis
How are the findings communicated?	Numbers, statistics, aggregated data, formal voice, scientific style	Words, narratives, individual quote, personal voice, literary style.

Source: Leedy (1997:106)

All these three approaches (mixed method, qualitative and quantitative) employ several techniques including questionnaires to collect data. Ehige and Ehige (2005) agree that although questionnaires form part of the qualitative approach, their use has been limited to qualitative methods, while Guba and Lincoln (1989) gave a historical overview of the paradigm shift from quantitative to qualitative research designs. They argue that this has been fuelled by the dissatisfaction or the inadequacy of using quantitative approaches alone in observing and measuring human behaviour.

Critiques on quantitative techniques have questioned the superiority of the technique for dealing with human behaviour. Quantitative analysis is full of ambiguity and vagueness, since it fails to tackle complex human problems. These issues are frequently subjective and intangible – and usually escape the quantitative research approach. Thus, for that reason, this research project will not use the quantitative approach.

Qualitative research methodology uses observation interviews, ethnography, questionnaires and documents. Although theory allows for the use of observations, together with interviews to conduct qualitative research, the researcher mainly used interviews, because observation requires that one should monitor the behaviour of the personnel and transform that into a transcript.

Nevertheless, observations were used to a limited extent only in this research, to deal with biases inherent in interviews, particularly in the responses of the interviewees.

The research used interviews, because they provided an in-depth analysis of the issues that need to be addressed. Interviews also provided both the researcher and the interviewee with an opportunity to revisit questions and answers – in order to get an in-depth understanding of these issues. Interviews also allowed further engagement on the questions, in instances where both parties were not clear. The answers given by the interviewees were non-predictive or not anticipated; they thus provided the researcher with an opportunity to ask further questions. Interviews also allowed random samples to be drawn, and for the standardisation of questions to be done. A full critique and analysis of the interviews follows in later sections of this chapter.

Thus, this is an exploratory and descriptive research study that uses PetroSA Refinery as a case study. The research approach used was therefore, qualitative in nature centred on interactive oral interviews which were complemented by observations to uncover a unique variance that might not have appeared with a single method investigation. The research project suggested a multi-disciplinary methodology and approach requiring several types of expertise and sources of information. It thus lent itself to the use of a series of complementary methods in order to gain insight into the research problem. All the methods used to conduct this research were meant to eliminate any bias and to interpret the data correctly.

The methods used were meant to interrogate and explore the use of taxonomies; to explore how knowledge is produced, shared, stored, retained, retrieved and also to evaluate the effectiveness of knowledge enablers like information technology and knowledge portals in managing knowledge.

The case-study approach shows the use of qualitative research in helping to understand the process, and the meaning of concepts. Qualitative research uses the research as the primary instrument for data collection and analysis. In this instance, the exploration of knowledge-management is used as a method to discover how such research should be conducted. The research study shows that the researcher is exploring knowledge-management usage in a refinery, through Communities of Practice, and also exploring taxonomies within a knowledge-management framework.

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4.3 Data collection techniques

As stated earlier, information in this research project is based on interviews with several key informants, including Refinery management, employees in different categories, as well as on the information collected during the author's observation and site visits. Thus, the primary data gathering techniques were interviews and observations.

The analysis of the effectiveness of the interviews and observations is dealt with decisively in below, and although the researcher occasionally refers to other methods, this is not meant to undermine the importance of using interviews as research instruments. It is also imperative to note the importance of the literature (reviewed in earlier chapters), as well as the survey, in answering questions and sub-questions posed by this study.

4.3.1 Interviews

The research study used informative interactive interviews to interrogate the issues in knowledge management in the PetroSA refinery. The use of PetroSA Refinery as a case study is justified, and meant to limit the study to the refinery only. These interviews were both semi-structured (formal) and unstructured (informal); and furthermore, they were conducted with the primary purpose of examining knowledge practices at PetroSA refinery in Mossel Bay.

Interviews as the core method for collecting primary data in this research provided a personal interaction between the interviewer and the interviewees. Also interviews provided the author with the opportunity to interview and interact with different groups at PetroSA; particularly interacting with people at all levels in the organisation. This provided diverse responses which were representative of the views of the various individuals in the organisation.

Moreover, interviews were used in this research, because academic researchers use interviews to acquire an in-depth understanding of the topic being researched. Interviews were used in this research to gain and understand PetroSA employees' experiences, observations and thoughts on knowledge as intellectual capital, the use of knowledge portals and Communities of Practice, as well as the existence of Epistemic Communities.

The study was dependent on in-depth intensive interviews with one hundred diverse people who work for PetroSA (see the population sample below). This method of using semi-structured (formal) and un-structured (informal) interviews was supported by Edwards and Talbot (1999).

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They argued that in analysing case studies, interviews are useful tools because they provide face-to-face contact with the respondents. A detailed interview guide (Appendix A) was used to generate responses and outcomes. The advantage is that it enables the author to adapt the working and sequence of the questions to the kind of information received, and also made it possible to pursue information that was raised during the interview – even if the questions were not among those originally specified.

The interviews were conducted in an open environment, with the participants being made aware of their voluntary participation in the interview process, as well as the length of the sessions. Participants were also made aware that these interviews are for academic purposes only, and that there is no financial gain to be found when in participating in these interviews. The interviews gave the author a chance to explain to the respondents more explicitly the investigation purpose and just what information was wanted.

The use of interviews enabled opinions, networks of relationships and ideas to be presented and qualified. The interactive informant interviews proved to be an essential data-gathering device, because once the author had gained rapport with the respondents, certain types of confidential information were obtained that the respondents had not been willing to disclose at the beginning of the interview process.

The use of interviews also allowed the author to observe the respondents' non-verbal gestures; and that proved helpful and important in assessing the validity of the response and the intensity of feelings on controversial issues. As stated earlier in this chapter, follow-up questions were asked – especially in situations where the respondents indicated signs of not having understood the question. The disadvantage of using this technique was that some of the respondents did not want to be seen as not understanding the questions asked; or else, they simply did not trust the author, particularly when asked to give answers to controversial questions. The problem was further compounded by issues of loyalty on the part of the respondents who could not – or would not – answer certain questions or to give opinions on the organisation's processes.

Thus, the interviews proved important in acquiring the necessary data, because they gave the researcher a chance to explain to the managers, as respondents, more explicitly the investigation's purpose, and just what information was sought. In addition, as earlier intoned, they enabled opinions, networks of relationships and ideas to be presented and quantified

wherever possible. Therefore, interviews proved an essential data-gathering device, because once the researcher had gained rapport with the managers, certain types of confidential information were obtained that the managers would have been reluctant to put into writing.

The researcher partly used structured questions in areas where there was a need to ask direct questions. In using interviews, the researcher became part of the measurement instrument. A general interview guide was used to collect specific information for the study. Even though the general interview guide was used, the respondent was still allowed a degree of freedom in answering the questions; and the researcher could use follow-up questions to get more information from the interviewee.

Although, the nature of the topic/study allowed for the use of telephonic interviews, the researcher opted not to use them – because of the shortcomings of telephonic interviews. The length of interviews poses a constraint on using telephones. Some of the respondents were uncomfortable about being called at home, and some felt uncomfortable in giving their home phone numbers for the purpose of the interview.

Research interviews are normally divided into three categories: structured interviews, semi-structured interviews, and unstructured interviews (Fontana and Frey, 2005, cited by Zhang 2006). The difference between the interview types has been discussed in earlier sections of this chapter. It is important to note that the approach of using any interview type depends on what the interview is intended for, the relationship between the interviewer and the respondent, the conditions in which the interviewee finds himself or herself, as well as the sensitivity of the topic under investigation.

Unstructured interviews were used to get additional information, and to give the respondent the opportunity to clarify and explain certain information arising from the answers given. The questions and structured interviews focused on knowledge portals, Communities of Practice and the utilisation of knowledge as intellectual capital in the refinery at Mossel Bay.

The following steps were used during the interviews.

STEP 1.

1.1	The researcher drafted structured-specific questions on knowledge management, Communities of Practice and Epistemic Communities and codified knowledge.
1.2	An application clearance with the questions was made to the Ethical Clearance Committee, explaining the requirements for the research project.
1.3	A letter to undertake research with PetroSA premises was obtained as a requirement by the university.
1.4	A consent letter was drafted which explained the participants' right to participate in the interview process and their right to withdraw at any time.

STEP 2. The time needed to conduct each interviewee is communicated in the letter of consent. The interview is scheduled to last for forty-five minutes only.

A particular clause in the letter indicating that there is no financial gain is enclosed in the letter.

STEP 3. An appointment was made with the respondents, and a sheet containing the questions to be asked during interview, was enclosed. All the interviews and responses were detailed.

4.3.1.1. The interview process

As stated earlier, the nature of the research dictated that only specific respondents should be interviewed. Thus, one hundred (100) PetroSA participants (see Table 4.2), comprising top managers, middle management and artisans, as well as various professionals participated in the interview process. The individuals interviewed were mostly people who understand the operations at PetroSA, the organisation being studied. Most of these people had long-service records with the company.

All the interviews were based at the Mossel Bay Refinery. Hence, all the interviews were conducted on a face-to-face basis (one to one with the five top managers and focus group interviews for the other groups as discussed in section 4.4). The structured questions were presented to the respondents (See Appendix A: Copy of the interview guide).

The writer communicated the following to the respondents during the interview process:

- The confidentiality of the interview process;
- The voluntary participation of the respondents in the interview process;
- The respondents were made aware that the research was to be done on company, PetroSA's premises;
- The average time needed to conduct each interview;
- Explanation of the 'no financial gain' clause to the respondent;
- The time allocated for the interview was from forty-five minutes to an hour;
- The researcher would not ask a respondent to disclose any organisation's intellectual capital or any company's secrets during the interview process;
- The researcher provided a brief background to the study, in order to give an overview of the topic;
- The interview would seek only opinions and perspectives on the issues important to the success of the research;
- The researcher's aim was to understand the current knowledge management by means of the interview process;
- The role of the results/study and the contributions thereof to PetroSA;
- Confirmation that the information from the respondents included in the study would be kept in archives for some years, before being released to the public.

The purpose of the interviews was to capture the experiences and the stories on knowledge-management and knowledge taxonomies from the different respondents at PetroSA. Various questions were asked of the different respondents. Through the different questions, the researcher interrogated knowledge-management issues. This was the reason why only one hundred (100) participants were interviewed.

The interview process was a collection of individual responses on knowledge-management practices and attitudes that the participants had on the current knowledge practices at PetroSA. These included how people feel, and how they perceive knowledge management as a subject and as a culture.

The setting and the location of the research enabled the researcher to conduct the interviews, since the respondents were available within the plant (refinery).

The researcher forwarded the request for an interview, in which he detailed the background to the study. Some respondents even requested a letter/permission to undertake the research by PetroSA before they would agree to be interviewed. The purposes for forwarding the formal request for an interview were the following:

- To allow the interviewee to understand the background and purpose of the interview;
- To allow the respondents to prepare themselves to be interviewed and to set aside the requested time for the interview;
- To enable the respondents to understand that the interview was only for academic purposes, and that permission to undertake such interviews within PetroSA's premises was sanctioned by the authorities;
- Confirmation of the respondents' availability and time was done by the researcher.

Face-to-face interviewing was conducted with all the one hundred (100) participants. Initially, there was a lack of enthusiasm from some of the respondents, because some felt that their participation might threaten their employment, while others still had racial bias, and yet others did not understand why an academic research could be carried out by someone who works for the PetroSA refinery.

Others felt that they were chosen because they were being targeted, or they might be considered for targeting, or they might be considered for retrenchment. Others felt that, as managers, nobody should know that they had participated in the interviews. Those who were more intellectually inclined welcomed the interviews, because they felt that they constituted a platform from which to share their experiences and tell stories about knowledge-management at PetroSA.

Appendix A provides a summary of the questions asked of the respondents. The researcher tabled all the questions, including the follow-up questions for each respondent, and their responses were noted in writing. There were some questions that were not answered by some interviewees, as they felt that these questions were irrelevant, or that they had no answers, or that they had no knowledge - or some felt that these questions put them in the spotlight.

4.3.1.2. THE LIMITATIONS IN USING INTERVIEWS

Although the earlier analogy on the issue of interviews, and their use in this study, tends to depict them as effective methods for data collection, the researcher cautions on the excessive use of interviews, because of the limitations discussed herein. One of the limitations of using interviews is that the researcher's epistemology and research objectives limit the formulation of a hypothesis that can be used to benchmark and test it. Face-to-face interviews intrusive and caused reactions from some respondents as discussed above.

The respondents' demographics could present some bias to the interviewer. For example, the interviewer may have some prejudice towards certain races, gender(s) or ages - leading to biased results. At times, the interviewer might approve or disapprove of the responses. The other limitation is that the interviewer might not have enough practical skills to obtain honest and detailed responses. Thus, the researcher had to guard against all these, some thing that was taxing in terms of time.

The interviewer needs to be trained on how to take notes, to listen and to ask probing follow-up questions. Also, the interviewer could not interview a large sample. The smaller the sample, the less representative it will be of the larger population. Nevertheless, the research had to use the interviews to generate data for the research project.

The selected participants were assumed to be representative of the larger population. The selected respondents included a mixed bag of people – in order to avoid any bias by either management or other professionals in the employ of PetroSA in Mossel Bay. For more details refer to the population sample.

The categorisation of participants ensured that all members representing the key-focus group were interviewed. As stated earlier, the researcher needed to understand the views of senior refinery management, middle managers, various professionals (engineers, scientists, geologists, process engineers, quantity surveyors, accountants) and artisans who represent employees at the coalface. These individuals were to be representative of the whole group and their views.

PetroSA refinery in Mossel Bay employs more than two thousand (2000) people, who could be interviewed by the researcher, but the researcher avoided using a larger group, because larger groups are often unmanageable, since the spread then becomes too wide; and this makes it difficult to undertake a study. It was also important that the size and composition of the participants could be accurately defined.

For the purpose of this research, only selected personnel working at PetroSA refinery were interviewed. The nature of the topic required that only people who have a certain educational background would be interviewed, because knowledge-management is by its very nature still in its infancy.

A total of one hundred (100) people – mainly middle and senior managers, various professionals (engineers, scientists, geologists, process engineers, quantity surveyors, accountants) as well as artisans who have access to PetroSA's network, were interviewed for this research. For more details on the selection of respondents, see the population sample below.

4.3.2. Observations

The researcher also utilised observations to a limited extent to understand the behaviour of the employees – with a view to understanding whether communities of practice exist, and how these communities function. The site visits and observations entailed collecting all the data through occurrences that could be observed visually. The author became a participant observer, in order to formulate research questions for further inquiry. By knowing what behaviour pointers there were in Communities of Practice, and by recognising such behaviour when it occurs, the author gained an understanding of a phenomenon that could not be acquired in any other way, as suggested by Treece and Treece (1986).

During site visits and observations, the author used photographic and video coverage to facilitate and capture the behaviour and conversations of members of a community of practice. The behaviour was observed over a period of time. Such specific behaviour patterns exhibited by the members of a community of practice were observed and recorded, and a comparison was made between the actual behaviour observed and that recorded in the literature.

Using site visits and observation entailed visiting all the departments at the refinery. The site visits and observations served two purposes: (a) Familiarisation with the general characteristics and appearance of the work areas to be observed; and (b) Providing specific information on the composition of the individuals to be observed. During the site visits and observations, the author also assessed the pointers that members of a community of practice exhibit.

This was done in conjunction with interview schedules with some managers of the different departments. Hence, site visits and observation became a necessary tool to check what participants reported about knowledge practices and knowledge culture at PetroSA during interactive interviews.

Emphasis was put on certain key issues, such as the following:

- How employees who share common knowledge interact and behave towards each other;
- How Communities of Practice are organised, and how they function in sharing and distributing knowledge;
- How organisations utilise Communities of Practice to diffuse information and enhance business goals;
- The determinants of Communities of Practice norms and standards; and
- How social dialogues within communities of practice occur.

To collect information on such key issues and also to uncover other factors important for any thorough understanding of knowledge practices and Communities of Practices, as earlier intimated, the author became a participant observer. A rapport was established with the participants and when establishing relations with key informants during the process. The author participated in the participants' daily-work schedule; and he recorded what was seen and heard, as was suggested by Mac an Ghaill (1996).

To counter any bias that old employees' responses might bring, the researcher also observed the behaviour of young and new employees in relation to knowledge practices. These usually provided a true reflection of the organisation's culture.

The researcher observed how distinctive members of a community of practice shared knowledge on a specific area. These observations revealed any voluntary or involuntary tendencies to share such knowledge. At times, the observations showed that even though there was no formal structure, yet participants still shared meaningful knowledge amongst themselves.

In order to achieve fair and unbiased results from the observations, the researcher participated in some of the knowledge-sharing - for example with other technical people - together with specific knowledge on how to manage and prepare the 2009 Plant Shutdown project. It is important to note that the researcher bracketed his preconceived ideas about the expected behaviour of the participants during the observation period, in order to observe their natural and spontaneous behaviour. This is important to avoid the introduction of any bias into the findings.

Therefore, observations could be said to have involved visiting all PetroSA departments included in the study. The observations served two purposes: (a) Familiarisation with the general characteristics and appearance of the PetroSA departments involved; and (b) Providing specific information about knowledge-sharing practices at PetroSA. This, as earlier observed, was done in conjunction with the interview schedules with managers at PetroSA.

Hence, observations became a necessary tool to check what the managers reported on the knowledge-sharing practices in PetroSA.

The researcher used "emic" and "etic" approaches to observe behaviour. An 'emic' approach reinforces knowledge derived from the participants' understanding of their own culture and its relationship with particular patterns of behaviour. An "etic" approach allows the researcher to place his perspective in understanding the culture of the participants by benchmarking it against the established norms of behaviour.

It is important that the researcher should justify the use of observations, as the research instruments used such observations because the topic being studied was complex and required the understanding of complex behaviour of work teams. The observations made required the researcher to understand and focus on 'artefacts'. An artefact may be defined as, "a material object that is created by people specifically to facilitate culturally expressive activities" (Ehige & Ehige, 2005).

Through observation, the researcher was able to understand the norms of members of Communities of Practice, and the language that these members used. The stories that were told by the respondents reflected the true experiences that the respondents had had on knowledge-management. Observation also helped to understand the socialisation of the respondents. Thus, the researcher could state that he had become a participant observer – in order to formulate research questions for further inquiry.

By knowing what to look for, based on knowledge-sharing practices at PetroSA, and by recognising them when they occurred, the researcher gained an understanding of phenomena that could not be acquired in any other way.

4.4 The sample population and sampling procedures

The interactive informative interviews were centred on the interview guide questions provided in Appendix A, as well as the follow-up questions arising from the conversations between the author and the interviewees. To get a broad response that was representative of the views of various participants at PetroSA, the author interviewed respondents in the categories of senior refinery management, middle management, various professionals, artisans and suchlike. The people that were interviewed were grouped into ten key-focus area groups. Table 4.2 illustrates the focus area groups and the total number of employees involved in the interviews. From the key focus areas groups, the author derived the sample population, which accordingly became the target group from which the author found information.

From these ten key-focus area groups, key informants or participants were identified and selected for the interview process. Key senior refinery managers and the general workers from the various focus groups were selected through the positional and reputational approaches, which are based on formal leadership positions and a reputation for knowledgeability (Branch et al. 1984; Mengwe: 2010) of PetroSA processes respectively. In using the positional approach, a list of five people holding positions that make them likely to be knowledgeable about the processes including knowledge management practices in the PetroSA refinery was prepared. This was based on the PetroSA company hierarchy and consisted of the company's top management (see Table 4.2 for detail).

The remaining ninety-five key informants were selected using the reputational approach (eighty-four) as well as the invited residents' technique (eleven respondents) as discussed below. The reputational approach was used to cover sources that might have been excluded in using the positional approach because the sources of information were not holding any leadership positions as suggested by Mengwe (2010). In using this approach, a list of persons from the ten key focus areas with a reputation for knowlegeability or influence in the PetroSA refinery was developed. The list was based on the names of those who were mentioned frequently though some were mentioned less frequently. Thus, nine focus groups were generated for face to face group interviews excluding the refinery's top management focus area group.

Table 4.2: The focus area groups for the sample population of the research study

Key informant focus area group	Description of representative	Number of respondents
Senior Management	Senior Refinery Managers including the vice President Operations	Five
Middle Management	Middle Managers representing SHEQ, Engineering, Production, Plant Reliability, Human Capital, Information Systems, Communication, Projects and Design, Audit and Inspection and Metallurgy	Ten
Engineering Department	Electrical	Five
	Mechanical	Five
	Process	Three
	Shutdown	Two
	Design and Projects	Two
	Reliability	Four
	Instrumentation	One
Research and Development	Research Scientists	Five
Group Supply Chain	Tenders and Contracts	Four
	Warehouse Buyers	Two
	Materials Management	Two
Geo-Physics	Geo-Physicists	Five
Artisans	Instrumentation	Four
	Mechanical	Four
	Electrical	Three
	Civil	Two
	Process Controllers	Four

Accountants/ Finance	Accountants	Four
Information Systems	Information Systems Professionals who service Operations, Production, Refinery Optimisation, Finance and Human Capital	Four
Human Capital/ Resource	Recruitment Specialists	Two
	HC Business Partners	Two
	Organisational Development/ Talent Management	One
	Payroll	Two
	Employee Wellness	One
	Employee Relations	One

In order to avoid the deleterious effects of personal biases, the author employed the idea of Becker *et al.* (2004) to make use of ten invited respondents. The invited respondents, who in essence comprised general workers and artisans, represented diverse groups of the respondents. The artisans and general workers, as well as the other professionals included were from Refinery Production, Engineering, Instrumentation, Blending and Storage, Fabrication and Workshops and Civil engineering staff members at PetroSA. The invited residents were selected using the snowball sampling in which the author used some of the key informants to name other prominent employees who could be interviewed.

Thus, this research study is exploratory, because a case study was used to explore knowledge management practices in a refinery set-up. The use of a case study shows the exploratory nature of this research – by exploring the effective use of Epistemic Communities and Communities of Practice. Exploration asks questions like: "What issues are present in the case study?" And: "What is the relationship between the concepts being studied?" The case-study approach shows the importance of using of qualitative research in understanding the concepts being studied, and the meaning of the concepts.

In this instance, exploration was used as a method to analyse the data and reach conclusions about knowledge-production, sharing, distribution, storage, transfer and retrieval and how best knowledge can be utilised within Communities of Practice when using PetroSA as a case study.

4.5 Data presentation and analysis

Data presentation for the research project was based on descriptive information obtained through the interviews and observations. The data from the various key informants (respondents) were examined, compared, conceptualised as well as categorised in terms of properties and dimensions such as words, phrases, sentences and other expressions emanating from the data as suggested by Strauss and Corbin (1990:61). The data were then divided into manageable groupings or themes according to the questionnaires constituting the interview schedule (Appendix A). The data are thus basically presented in prose (continuous writing) according to the themes derived from the interview schedule.

4.6 Ethical considerations

For ethical reasons and respect for confidentiality, in presenting the results of the interviews, the names of the key informants (respondents) are not used although the author has such names. For the same reason advanced above, the information is generalised to refer to a large population. The author thus protected the anonymity of the respondents since the respondents were assured that no physical or emotional damage would occur. Therefore, the research conform to the ethical requirements of the University of KwaZulu Natal (See Appendix B)

4.7 CHAPTER SUMMARY

The research project provided the researcher with the opportunity of discovering people's personal experiences in using knowledge-management with PetroSA. Through the stories and narratives, the researcher discovered the respondents' views on the knowledge of the existence/non-existence of Communities of Practice.

The research also provided a personal learning experience for the researcher, and learning for the respondents, as will be shown in Chapter Five. The role of the respondents as representatives of a distinct population is acknowledged. The researcher also explains that the topic under research is 'a single case-study' evaluation; hence, the beneficial use of structured interviews and observations. The researcher concedes that structured interviews were used as research instruments, and also to access the data from the respondents.

The rigour that the qualitative approach brings gives meaning and form to the topic being studied. The results obtained – via this methodology described above – will be presented in Chapter Five.

CHAPTER 5

RESEARCH OUTCOME AND ANALYSIS

5.1   Introduction

This chapter presents the research findings on knowledge-management practices in PetroSA, using its refinery located in Mossel Bay. The focus is on PetroSA's policy governing knowledge-management and the practices associated with knowledge-management practices. The research results presented in this chapter are products of the methodology formulated in Chapter Four. The presentation of the results is centred on the broad questions presented in the interview guide (Appendix A).

The presentation of the results of the case study is followed by the discussion of the findings. At the end of the presentations and the discussion, concluding statements for the whole chapter will be done. The conclusions drawn from the case study are the author's and should not necessarily be associated with the various key informants involved in the research study.

5.2 Presentation of the findings

This section is concerned with the presentation of the research study results. The results presented are based on the outcome of interviews with five top managers, all other interviewees as shown in table 4.2 as well as the ten invited residents as discussed in Chapter Four. Although the results presented in this chapter are the outcome of applying the methodology discussed in Chapter Four, the author will reference the empirical work, whenever the need to do so arises. Referencing is essential because the methodology used is multi-faceted. Therefore, for reference purposes, the researcher will refer to the interviews with the respondents. The results are presented following the sequence of questions used for the interviews (see Appendix A). Accordingly, the results were unpacked as follows:

- The existence of a structure for knowledge management: Knowledge-management department, knowledge-management framework, and policy and procedure for knowledge management.

- Knowledge processes: Knowledge creation, knowledge storage, knowledge sharing, and distribution: the retrieval and transfer thereof. This work has dealt with the cyclical configuration of knowledge. This cyclical configuration generates sub-processes like transfer, sharing, archiving, indexing and continuous improvement. These, in turn, lead to innovation. It is essential to note that these processes do not occur in isolation, but are systemic; and this allows us to view knowledge in its totality.

- Knowledge-management culture: Promoting organisational knowledge through continuous learning, developing platforms for the online exchange of knowledge, creating networks for sharing knowledge.

- Knowledge-quality standards: The creation of a Group-knowledge management Framework and Knowledge-auditing review standards.

- Assessment of Communities of Practice: Existence of Communities of Practice and epistemic communities – in addition to the codes that govern their functionality.

- Organisational Learning: Understanding the social processes of knowledge production and how organisations utilise knowledge management through the learning process. The link between organisation's learning processes and the establishment of Communities of Practice was analysed. Organisational learning occurs when a gap in the knowledge development exists. This occurs through organisations adopting knowledge – through a process called 'single-loop learning' or by reconstructing what they know as 'double-loop learning' which are discussed in Chapter 2.

- Intellectual Assets: Viewing the value of knowledge beyond the accounting balance sheet. Knowledge, as capital, is divided into human capital, organisational capital and customer capital. The strength of knowledge capital enables information to be translated into higher-order objectives.

5.2.1 The existence of a structure for knowledge management

The key question was to find out whether PetroSA has an effective knowledge-management culture, or whether they have any policy and in addition to discovering whether the practice matches the policy. The essence of the question was thus to find out if there was an existence of a structure for knowledge management in terms of Knowledge-management department, knowledge-management framework, and policy and procedure for knowledge management. Hence this section attempts to provide answers to a number of questions as presented on Appendix A: including questions on the existence of structure or knowledge management and

company policy regarding knowledge management practices. The presentation herein is based on interviews with the five senior managers and the other staff selected for the interview.

The questions on the existence of knowledge management and a company policy generated mixed responses among the respondents. According to the five top managers and some middle managers, PetroSA has a policy governing knowledge-management. On the other hand majority of the interviewees including some of the middle managers said they were not aware of any policy for managing knowledge. When the author asked follow up questions to clarify such mixed responses, the respondents confessed that *"we confuse knowledge management policy with information systems policy and document management policy"*. This was further reflected by the views of some of the respondents when they claimed that there is a public folder containing policies on knowledge management. However, what they claimed to be a public management folder turned out to be a document management system folder. Above all, only a few respondents indicated that they knew the connectivity between knowledge management and document management with the majority of the respondents not being clear whether document management system is an integral part of knowledge management.

From the results of the interviews only thirty respondents agreed that they were aware of the existence of a structure for managing knowledge within PetroSA. Most of the respondents (seventy in number) claimed that they were not aware of any structure for knowledge-management in PetroSA. They also claimed *"we are not even aware of the existence of knowledge-management and its structure in PetroSA."* As put by professionals, like engineers, scientists and accountants *"we have heard of knowledge management, but only in group meetings. However we do know that a knowledge-management structure exists at the Head Office in Cape Town only."*

Similarly, eighty interviewees out the hundred interviewed said they did not understand what knowledge management is nor did they know the difference between those who work for Information Systems (IS) and those who are knowledge workers. Therefore, they further indicated that they did not understand whether knowledge workers existed at PetroSA in Mossel Bay. What they confessed they knew was that *"there are warm bodies in the knowledge management department in Cape Town whom nevertheless they did not know what their role was."* They also mentioned that they were aware of the existence of information-system administrators who managed e-rooms, document-management services and servers whose

function is to create a body of evidence that can be captured and stored. It was only twenty of the interviewees who said that PetroSA had suitable personnel to execute and enhance the development of knowledge management. However, as argued by such respondents, *"the problem is the willingness to embrace the knowledge culture."*

Moreover, the respondents showed that they were not aware of the existence of good information-system management, organisational change procedures and policies governing the usage of information in PetroSA. As argued by some of the respondents, although PetroSA has a policy that governs the use of knowledge its policies do not show any real efficiency in these policies and structures. Thus, as posited by some of the respondents particularly the lower cadre employees, *"management needs to educate everyone on the existence of knowledge-management policies within PetroSA."*

Engineers and scientists complained that PetroSA did not have any knowledge policy which supported continuous learning. They argued that the absence of any policy meant that there was no culture to promote knowledge creation using online mechanisms and networks. The lack of a policy stifled sharing or a culture of validating research practice.

According to the senior and middle managers (see table 4.2 for detail) *"the existence of an organisational structure and policies to deal with knowledge management are important – in ensuring that PetroSA deals with changes in the markets, technology, adapting to fast paced innovation requirements."* In addition, management (senior and middle) said that the current knowledge governance procedures enable PetroSA to deal adequately with the current challenges facing organisations in the Petrochemical industry.

However, the lower cadre (artisans) consisting of mechanics, electrician, civil engineers and process controllers, said that *"the policies and structures for managing knowledge at PetroSA are still very bureaucratic."* Thus, on the contrary, the policies and structures for managing knowledge do not enable employees to deal adequately with current challenges facing PetroSA as a Petrochemical industry organisation. This group of respondents further conceded that PetroSA operates in a very dynamic environment, where there are strong competitors like Shell, BP, Chevron and Sasol, and as a result, it cannot afford to have a knowledge-governance policy that is not well understood by its employees.

The respondents, particularly the middle managers, further intoned that like all companies operating in the fuel-production sector, PetroSA is affected by changing crude oil prices and technology, which require that employees need to be innovative, in order to deal with such changing scenarios in the market. However, as put by one of the middle managers, *"the bureaucratic nature of PetroSA inhibits employee creativity in as far as knowledge management is concerned."*

During focus group interviews, the respondents were asked to give their views on the existence of a structure for knowledge management. The respondents argued that *"PetroSA is a hierarchic-bureaucratic organisation, which does not allow for knowledge creativity, but is adequate for knowledge accumulation."* As argued by the respondents, *"such a structure may provide a platform for knowledge creation, but may not make transference of knowledge within the organisation any easier as is the case with their organisation."*

Almost all the interviewees expressed their opinion that there is a need for PetroSA to develop a hybrid knowledge-governance policy model and structure. As expressed by the respondents, the model should *"be hierarchic-bureaucratic, but allowing for working in teams, leadership changes, according to organisational needs, more delegation of responsibilities, and policies that allow the organisation to be in touch with its customers."* Most junior staff interviewed indicated that there should be a reduction in hierarchy, and the various teams should be supported by intelligent information systems that guarantee knowledge capture, codification, transference and easy access to knowledge accumulated by the organisation.

Seventy of the interviewees expressed their opinions on how the structure of knowledge management should look. As expressed by respondents, *"the structure should be a middle-up-down form which would enhance the creation of knowledge, since it places the middle manager in the centre of knowledge management and re-defines the role of senior management and the employees at the front line".*

In PetroSA's case, the author observed during the interviews, that the employees of the front line are the artisans, the technicians, and the general workers who man the production line on an hourly basis. These groups of PetroSA employees heavily criticised the current knowledge-management structure at PetroSA. According to some of such employees *"the current knowledge management structure is modelled along the Weber and Taylor division-of-work*

model which emphasised that senior management should create basic concepts," so that the workforce could implement these, but without having to test whether the models work or not.

It was further observed that the top-down model that is currently in place at PetroSA, can only adequately deal with explicit knowledge, but does not serve for knowledge creation, as it ignores the development of tacit knowledge. Thirty respondents advocated an improvement from top-down to bottom-up, arguing that this approach would enhance front-end employee participation.

However, as expressed by some of the respondents the bottom-up model – although adequate to deal with tacit knowledge, its emphasis on autonomy would render it ineffectual in ensuring the creation, distribution, and broadcasting of knowledge within PetroSA. Such respondents also voiced out that the middle managers played an insignificant role in the creation of new knowledge because they (middle managers and other professionals) only processed information. As expressed by this respondents such was inadequate for the organisation's productivity.

The majority of the respondents thus recommended that PetroSA should use 'the middle-up-down model which depicts that senior management's role is to create a knowledge vision, while middle management develops more concrete concepts which can be utilised by front-end artisans. Furthermore, the respondents said *"PetroSA should create a knowledge governance structure that is centred on middle management, because it is middle managers who solve the contradiction between what senior management hopes to create and what actually exists in the real world."*

5.2.2 Promotion of knowledge management and information systems

Information presented in this section was derived from interviews with all one hundred participants. A question was asked on how PetroSA promotes knowledge management and information systems. Promoting knowledge management involves developing a culture in which knowledge management is enhanced. It was discovered during the interviews that information systems that support for knowledge management needs to be regulated – in order to avoid an information glut.

Promoting knowledge-management practices assumes the viewing of knowledge as a social phenomenon. Ninety of the respondents interviewed articulated that *"knowledge promotion is essential for organisational growth."* As expressed by these respondents, *"the promotion of knowledge meant that PetroSA needed to promote the social process and the creation of Communities of Practice."* This dovetailed with all the ten respondents who work for human capital when they agreed that *"the promotion of knowledge management is essential, because knowledge itself is a social phenomenon, and knowledge lies less in its database than it does in its people."* All the ten respondents from human capital lamented that although human capital is the custodian of all human development policies, PetroSA was not doing enough to promote the social interaction of knowledge. They argued that PetroSA management did not create a viable social system to (people, and social processes) to promote knowledge. Although the ten respondents from Human Capital confessed that the role of their department was to give support to the core departments of the refinery and that their views on the existence and promotion of knowledge management at PetroSA would not be taken seriously like those of their technical colleagues, they still felt that the promotion of knowledge management should not only be the role of the Corporate Strategy & Planning division only. They said that *"Human Capital department was also strategically placed to promote knowledge in the organisation since it interacted with all employees in the organisation and that it was easy for their department to build up social processes"*

This view was echoed by other professionals who argued that *"knowledge is something that organisations can only digest after it has been given to them."* Such professionals acknowledged knowledge as information that is remembered, but whose value lies in the social context. Fifteen artisans who have worked for PetroSA for more than ten years agreed that the promotion of knowledge entailed looking at the meaning of information – in order to understand the complexities of learning and judgement.

Fifteen artisans further complained that PetroSA focussed on information rather than on its use. This they claimed affected teams; and even if PetroSA sent teams to external training, such value would not be recognised. Five artisans lamented that they did not see any vision of knowledge promotion at PetroSA.

All the five participants from Information Systems interviewed, argued that PetroSA management engaged in a culture of change, but placed individuals in unchanged and

unchanging environments. They argued that PetroSA changes leadership, but did not work on changing the context of working, and did not create any new settings conducive to the learning and sharing of that learning.

According to ten engineers out of twenty two interviewed (see Table 4.2), PetroSA invested a lot in technology and training, but did nothing in regard to knowledge sharing and creation. Thus, they claimed that even during project execution PetroSA found it difficult to share knowledge. This they argued is evidenced by the fact that *"all engineering departments at PetroSA cannot share best practice."* The other ten engineers argued that PetroSA identified practices, but failed to transfer and use knowledge effectively – because of the lack of a supporting culture. Other participants in the interview process cited the lack of a knowledge-sharing culture at PetroSA.

The views shared during the interviews reflect management's lack of understanding of knowledge management. Four of the five senior managers interviewed agreed on this contentious point, but argued that PetroSA had established a knowledge-management department within the Corporate Strategy and Planning Division. This they said was a sign that there had been an attempt to promote knowledge management.

On the contrary, up until the author's interview with all the respondents, the position of a Knowledge Manager within Corporate Strategy and the Planning Division was vacant; and nobody knew when it was to be filled. All the ten middle managers interviewed complained that the lack of promoting knowledge management and information systems was exacerbated by the top-down approach imposed by senior management.

5.2.3 Use of Search Engines

The following information came from the responses from the interviews with all the hundred respondents.

All the participants, except the Information Systems professionals failed to understand how search engines worked. Others mentioned that they did not understand fully how the search engines, which the organisation is now using, worked. All the interviewees agreed that search engines are needed, because they provide knowledge managers and organisations with the ability

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to access information and to achieve targeted search technology. Hence, they have quickly become popular.

Most of the engineers interviewed complained that the search engines that PetroSA has are not quick and powerful. They also complained that there was no training given to staff on how to use search engines, and that these search engines could only accesses limited sites. They expressed to the author the view that they felt that senior management should include training on the use of search engines to all employees in the company, because PetroSA operates in a knowledge economy.

Geologists in particular, complained that one could not do advanced search for data and information by using some of the current search engines.

5.2.4 Policy on knowledge management and the knowledge-management culture

Many of the respondents said they were not aware of any policy for managing knowledge and how document management system helped to manage knowledge. Most engineers complained that even the document-management system had failed to create assembly and store all documents. Follow-up questions revealed that documents were not filed properly, making it difficult to access filed documents. As put by the engineers, the poor filing of documents makes it difficult to access knowledge, and the imaging of knowledge is thus difficult. However, senior management interviewed said that *"the existence of a document-managing system was likely to create the evolution of a digitally based document-management system from a paper-based system – which, in turn, would ensure that all company documents were scanned, indexed and stored in a document-imaging system"*.

All the respondents interviewed reiterated that there is no knowledge-management culture in PetroSA. They based this statement on the fact that even at induction; the organisation does not talk about knowledge-management practices. They also stressed the need to have a feedback mechanism between employees and management on the importance of such a culture being nurtured. All the respondents concurred that even though a knowledge culture does not currently exist, the organisation was beginning to develop such a culture.

5.2.5. Knowledge structures

Fifty respondents (mainly middle managers, engineers, geologists and accountants) agreed that there were structures to organise and produce knowledge. They all stressed that they were structures which defined declarative knowledge which explained how and why the things work they do at the refinery. They argued that the structures explained the relationship between concepts and procedural knowledge details required to perform a job or task. They further stressed that these knowledge structures allow a task to be performed without conscious action. All the ten scientists said that they did not know whether any structures were in place to produce knowledge. They based their argument on the fact that in their department there were no structures to create structural knowledge which helps in basic problem solving. All the ten scientists argued that PetroSA should develop knowledge structures to hone structural knowledge. They argued that structural knowledge is basic to problem solving.

Only fifteen of the respondents - mainly engineers, scientists and Information Systems (IS) personnel who had worked for a period of more than five years at PetroSA - knew of the existence of a graphical representation of an individual's field of conceptual knowledge.

Engineers and geologists alike complained that PetroSA had no knowledge structure needed for proficient problem –solving. They argued that the existence of knowledge will enable the organisation to effectively understand conceptual knowledge, operational and procedural knowledge and problem state knowledge.

5.2.6. Management's attitude towards the critique of existing knowledge management procedures

This section presents data on management's action to promote knowledge entitlement, its awareness of any attitudes of staff concerning knowledge entitlement as well as whether management encourage criticism of the current company knowledge management practices

Ten of the respondents mainly from the middle management cadre felt that they had never bothered to ask employees to critique the knowledge-management policy, which management claimed existed. However, from the author's observations, there were signs that open critiquing of current knowledge management existed. This, as explained by some of the respondents has

been facilitated by PetroSA subscription to ISO 9001 Quality Standards. About eighty percent of the respondents (80 respondents out of a hundred) agreed that Even though most of the respondents indicated that they do not know whether a knowledge-management practice exists, they felt that ISO 9001 Quality standard helped to promote some improvement.

Forty respondents further stressed that the quality of information in the internal mail on knowledge procedures, was not truly informative. The respondents complained that the organisation does not engage its employees in discussions on such matters. Eight out of ten middle managers stressed that information in internal mail did not help employees on decision-making. They stressed the view that it was important that information in internal mail be helpful in decision making because (them) managers knew that there was correlation between knowledge and the ability to make decisions. They expressed the conviction, however, that management cared about knowledge management.

All the respondents felt that management did not care about those who claimed knowledge entitlement. This, according to the respondents, hampers the strengthening of any structure to manage knowledge properly.

In addition, ninety (90) respondents confirmed that they thought that senior management suppressed any move to improve knowledge entitlement. As claimed by the respondents, *"management does not care about company performance in improving knowledge."* For example, all the artisans complained that the price of crude oil is not shared with employees – something which they felt that they were entitled to know.

Most engineers, procurement consultants and geologists complained that most information on business issues could only be accessed by certain individuals, some of whom knew nothing about how to use it. Five scientists said that they did not know anything about knowledge entitlement and its improvement, while another five scientists chose not to comment on knowledge entitlement for employees.

5.2.7. Communities of practice and the existence of social networks

This section presents information concerning the question on the existence of communities of practice within PetroSA. The section also presents data on the management's input in enhancing community of practice, management's recognition of social networks including employee efforts

in creating community of practice and the existence of an organisational policy of developing and nurturing communities of practice and epistemic communities.

All the respondents said that they did not understand what Communities of Practice were. All cited the lack of knowledge zones and platforms, which would help in the sharing of knowledge. All the other employees (except senior and middle management) agreed that management was silent on the development and enhancing of Communities of Practice. According to the respondents reasoning *"it was not an established practice to share knowledge in this organisation."*

From the author's observations it was also clear that most people worked in silos – and many employees were satisfied to hoard whatever little information they possessed. According to the respondents, *"it was dangerous to share information, as it could reveal one's lack of knowledge and education."* All the respondents further stressed that *"there was no input or encouragement from management to develop and increase the role of Communities of Practice because management did not know anything about the existence of such communities."*

All the respondents agreed that social networks do exist, but they did not discuss business issues. In addition, the respondents said they were not sure whether management encouraged or even recognised their existence. Moreover, from the interviews, all respondents agreed that PetroSA does not have a policy to develop and nurture Communities of Practice (CoPs) and Epistemic Communities.

From the author observations which included observing practices involving artisans sharing working knowledge on their jobs, it was clear that through continuous interaction (as well as social and professional collaboration) individuals can communicate and share information. The author's observations also revealed there was no pronounced attempt by the teams to share knowledge and build Communities of Practice.

During the observations, the author also participated in discussions with the respondents in order to observe the practice of knowledge sharing. During the process the author realised that through storytelling, social networks are actually being built, even though this was happening in an informal manner.

Through the observations, the author realised that participants engaged face-to-face with each other, and communication was great amongst the team. It was also observed that participants, particularly engineers and accountants, engaged each other by organising social meetings with the aim of creating and leveraging specialist knowledge. Acting as a participant in the observations, the author found out most participants observed participated in unstructured discussion forums, but were unaware that this was a means to share knowledge.

5.2.8. Organisational learning

In this section, the author presents information on how effective the PetroSA utilise group and individual learning to build communities of practice and epistemic communities as well as how effective does the organisation utilise communities of practice to diffuse information and enhance business goals.

According to thirty respondents – mainly engineers and scientists, organisational learning does not exist in as much as group learning is not emphasised in this organisation. On the other hand, ten respondents, mainly artisans, said they did not know what group learning was. A further ten (10 percent) said that there were not sure whether PetroSA effectively promoted group learning.

Nonetheless, all the respondents concurred that PetroSA uses consultants. As explained by the respondents, the use of consultants has contributed to the lack of any proper knowledge sharing.

Based on the above responses on organisational learning, the author concluded that PetroSA might be a learning organisation, but that this has not been effectively communicated to all the employees. Organisational learning would continuously result in employees engaging in Communities of Practice. This would, in turn, increase knowledge sharing and production. This could be explained by the fact that organisational learning occurs through team learning, and when teams meet, new knowledge is produced, shared and distributed.

5.2.9. PetroSA knowledge production, processing, storage and distribution policies

This section presents responses from interviews on how PetroSA knowledge management effectively promote production, processing, storage and distribution. Included here is the promotion of information acquisition from internal and external sources as well as the role of management in claim formulation.

All the respondents said that even though they were not aware of company knowledge policies, they thought that these policies would, in any case, be ineffectual. As explained by the respondents this was because of the fact that knowledge production sits with individual employees. The respondents further posited that there is no functional repository to record and from which to distribute such knowledge, thence the possibility of the policies being ineffectual.

Regarding information acquisition, ninety respondents (90 percent) consisting largely of engineers, geologists, accountants and other professionals, who search the internet, said that the most useful external websites were blocked by PetroSA. As complained by the respondents, there was no attempt management to utilise existing internal knowledge sources. According to engineers, scientists and accountants, some departments' information was still inaccessible in the public folder.

Regarding the claim-formulation procedures and the role of management in such, all the respondents said that they did not understand what this was, even when clarification had been given to them. They argued that there was no claim-formulation policy in place.

5.2.10. Policy regulating knowledge and information search and retrieval

This section deals with interviewees responses on PetroSA's policy regarding knowledge – search and retrieval, including what documents and software procedures exist for knowledge retrieval and what technology exist to help distribute knowledge. Included also are responses on whether respondents feel that PetroSA utilises the existing knowledge databases as a field for the storage of data as well as the effectiveness of the organisation's knowledge broadcasting facilities. Furthermore, the presentation includes the responses on whether the organisation uses on-line discussion boards; document Library; search engine; email online browsing; personal databases links; e-paper and company website in the application of knowledge.

All the respondents agreed that there was a policy regulating knowledge and information search and retrieval. The respondents complained that the only drawback was that the organisation blocked some sites, which could be useful to other members of staff as earlier on posited. They also felt that the policy did not take care of specific business requirement needs.

Initially, all the respondents claimed that they had no knowledge of software to retrieve knowledge. However, when follow-up questions on the same where thrown to the respondents, they indicated that some software did exist to retrieve documents, but this was not known by most employees. Employees also claimed that they could not access useful folders; and this disadvantaged them in getting invaluable information on knowledge policies.

The respondents further complained that this also disadvantaged them in understanding how knowledge software could be loaded and operated. They claimed that that they could not easily retrieve information on strikes, company's strategy and current projects' data, which could be useful to project participants.

The interviewees also acknowledged the use of knowledge-management tools and knowledge portals, e-rooms and other technology. Nevertheless, eighty respondents interviewed said that the use of knowledge-management tools and knowledge portals, e-rooms and other technology greatly affected knowledge acquisition, search and retrieval. Ten artisans said that they did not know how information technology could assist in the acquisition, search and retrieval of knowledge. They cited the fact that the company did not bother teaching them on how to use information technology effectively as a tool to retrieve information, and that they could not understand how information technology could be an enabler in retrieving knowledge.

The other ten artisans interviewed complained that the company did not make information technology readily available to employees.

Through the interview process, the author discovered that the use of portals was not common. This allowed the author to draw the conclusion that the company did nothing to promote knowledge sharing among different categories of end-users; and as a result, could not provide access to stored structured data and could not even organise unstructured data.

All the respondents acknowledged the importance of search engines, e-rooms, chartrooms and video conferencing, the internet and portals in enhancing knowledge management. They also acknowledged that these could help users to distribute knowledge. As put by the respondents *"information technology could help create repositories, which are critical in distributing knowledge."*

Fifty respondents (consisting mainly of senior management, middle management engineers, scientists and procurement professionals) complained that databases were not properly managed while the other fifty respondents said that they were aware of the existence of databases in the system, but were not sure how these were linked to knowledge management. According to the engineers, *"it was difficult to find databases of vendors when one wanted to choose vendors to send tenders to."* Thus it became clear to the author that the lack of structured databases of vendors and services affected the procurement of services.

All this made the author conclude that the dubious existence of databases made access to stored data difficult and did not help to facilitate collaboration among the employees. Nonetheless, the general consensus from the interviewees was that as the company's business grew, there developed a need to have more accessible databases – in order to reach customers.

Regarding the knowledge structures all the respondents agreed that structures like imbizos and the intranet, e-mails, and public address systems which can aid in decision making and explaining how and why things work existed, but they could not confirm their effectiveness. The responses from the follow-up questions asked, confirmed that the employees normally used the above structures to get knowledge, but they did not give any clarity on whether these structures made it easier to find knowledge, or how these knowledge structures helped to create a platform for knowledge sharing and transfer. They further said that most employees on the oil rig did not know about the organisation's broadcasting facilities, when compared with their onshore colleagues.

Based on the nature and physical location of the production platform, many employees who worked on the rig did not have information on all broadcasting facilities. This was confirmed by Information Systems professionals who argued that *"employees who work at the oil-producing offshore platform did not have access to information on broadcasting – any more than did their onshore colleagues."*

However, management on the contrary to all views expressed by the respondents that the information structures were ineffectual, argued that the existing information-broadcasting structures are effectual for alarming, alerting, and broadcasting safety information and other public announcements. Nonetheless, all the artisans complained that even though public broadcasting of safety and other information was done on a regular basis, this was not enough, as

in many cases there was no background given which would enable employees to learn anything of importance.

Thus, one can posit that generally, all the respondents agreed that they did not think management had done enough to cultivate and enhance the culture of knowledge broadcasting. This is because sixty respondents complained that access to knowledge was difficult, because they could only access limited sites, even when they tried to browse for information. According to these sixty respondents, management deliberately blocked 'useful sites', where they could get more information about the status of the company's financial performance and organisational vision.

On the same footing, artisans claimed that they were not aware of knowledge sites which could add value to their work knowledge, but instead they resorted to viewing internet sites that dealt with cars and fashion or property – and could not consequently comment on the effectiveness of these facilities for knowledge broadcasting.

As for the on-line discussion, all the respondents said that they were not aware of any online discussion boards, and that there was no fixed time for knowledge application. As expressed by the respondents, although there was a possibility that electronic bulletin boards or discussion boards existed, these did not give employees the opportunity to capture and transfer knowledge. As explained by the respondents, this meant that employees could not collaborate and share knowledge. From these complaints, the author concluded that critical discussions could not be captured and stored for future reference.

5.2.11. Knowledge platform

Only the five senior management members provided answers to this question; while others said that they were not sure of the existence of a knowledge platform in practice. The five senior managers that responded asserted that the existence of a platform will add broad social networking capabilities to work processes.

Nevertheless, fifteen respondents (mainly engineers, geologists and accountants) agreed that if a knowledge platform existed, it would help locate the kind of information needed for sharing, and indicate where one could get such information. As expressed by the respondents, this would give easy access and easy location, storage and the sharing of information. They also argued that "*a*

knowledge platform would foster innovation by incorporating knowledge management into business processes so employees can share information and solve business problems more efficiently"

All the respondents said that they did not know whether a CKO (Chief Knowledge Officer) existed at PetroSA. They said even if they had seen on the Organogram that someone was responsible for knowledge management, they were not altogether sure of his role. Follow-up responses revealed that the person on the Organogram only dealt with intellectual property and patents. Thus, the author concluded that PetroSA does not seem to understand the critical role of the Chief Knowledge Officer (CKO).

All the respondents interviewed said that the CKO (if he existed) was ineffectual. Follow-up responses showed a consensus of opinion – that if he existed, he would ensure that knowledge-management procedures would be emphasised during employee induction; he would also ensure that all staff were made aware of knowledge-management tools in the organisation – and he would show employees that those tools were monitored on an ongoing basis.

5.2.12. Recognition of knowledge as intellectual capital

This section presents data on the question dealing with the organisation's recognition of knowledge as intellectual capital. Included here are aspects concerning whether knowledge management initiative like community of practice, intranet development and enterprise knowledge portals yield a return on investment in knowledge as intellectual capital.

Out of the one hundred PetroSA employees interviewed, thirty-five respondents said that they are not aware whether PetroSA recognised knowledge as intellectual capital. According to the interviewees, this is because the organisation's practice does not care about the collective knowledge that its employees have. Another reason given was that during the last three years PetroSA had lost a sizeable number of people to competitors like Sapref, Sasol, Engen, Shell and BP, but nothing had been done to deal with any further losses.

This had happened because no knowledge was kept detailing the loss of intellectual capital. They also said that no exit interviews had been done for some experienced staff that had left the

company. Fifteen respondents, however, felt the company was at last beginning to understand knowledge as intellectual capital, and to realise the value thereof.

All the respondents said, however, that they were not aware of any benefits to investments that had been brought about by recognising knowledge as capital.

In short the essence of this research was to explore knowledge practices in the fuel-production industry, using PetroSA's Refinery in Mossel Bay as a case study. Thus, the aim of this research was to assess the knowledge-management practices, like production, acquisition, broadcasting, entitlement, sharing and retention. In exploring knowledge-management practices in PetroSA, limiting it to the refinery in Mossel Bay, the researcher understood that most companies either claim to have functional knowledge-management practices - but without any proof thereof - or, some confuse information technology with knowledge-management. Therefore, the researcher aimed at finding out whether a knowledge-management approach actually exists in PetroSA.

In order to understand whether a formal knowledge approach exists, it is important to understand and analyse the responses from the respondents. The discussion of the research findings is based on unveiling the importance of knowledge-management in the PetroSA fuel-production industry. The focus is on the vehicle through which this knowledge is shared, distributed, and transferred. Therefore, now that the results have been presented, the author will discuss and analyse the research findings in the section that follows.

5.3. Discussion of the findings

The aim of this section is to provide an analysis of the findings achieved through interviews and observations. The discussion of the findings highlights the importance of understanding the tools of knowledge management, and how these tools can help management and the organisation to transfer and share knowledge. It would also help the reader to understand the current knowledge practices at PetroSA.

From the foregoing presentations, it becomes apparent that most respondents are not aware of any structure on knowledge management at PetroSA's refinery in Mossel Bay. Although most respondents acknowledged the presence of the library, the search engine and the existence of

information-systems management, of e-rooms and documents, there appeared to be little difference between information systems and knowledge management.

Nevertheless, the presence of mixed feelings on the existence of knowledge tools at PetroSA confirmed the claims of Egbu and Botterill. (2003) and Fouche (2006), that PetroSA – like most other organisations – used the internet more frequently, as well as having other technologies (as was discussed in Chapter One). It further confirms that knowledge-management culture and practice thrive where there are document repositories, fast search engines, electronic bulletin boards (which facilitate knowledge discussion) and broadcasting.

PetroSA should have software programs that can accept the web contents – which provide easy access to information. The results also show that there is a need to communicate online, as this would make the distribution of knowledge considerably easier and faster.

The findings revealed that PetroSA does not have a clearly defined culture of practising knowledge management, or to support continuous learning, to effectively use knowledge and to recognise knowledge as intellectual capital. This means that there is a need to create a knowledge culture that would:

- Ensure that management and staff discuss issues of knowledge management.
- Ensure that platforms exist for online discussion and the sharing of knowledge.
- Ensure that these online mechanisms create networks for sharing and validating knowledge practice.
- Ensure that the organisational structure is suitable for enhancing knowledge practices.

The overriding impression is that it appears there is unwillingness by the senior management to embrace the knowledge culture. This is nowhere more apparent than in the perceptions the respondents have on these issues. As explained by the respondents, the senior management is unwilling to embrace the knowledge culture – probably because the company does not recognise knowledge as intellectual capital, as it does not care about the collective knowledge that they have.

Hence, PetroSA in Mossel Bay could not be said to recognise that intellectual assets could help realise its potential, as was argued by Johnson and Kaplan (1987),(See section 1.2.2).

Furthermore, the responses from the interviews indicated that knowledge management had not been fully developed in PetroSA. Knowledge assets were not at their peak, because learning is not being emphasised. The value of knowledge assets is still hampered, *inter alia*, by a huge dependency on information systems. PetroSA needs to make sense of all knowledge, in order to realise its potential as an asset.

The organisation needs to engage in serious introspection – to understand itself, and to understand knowledge assets and their enormous value to the organisation's existence and productivity.

Based on the responses, it is clear that PetroSA has a policy on knowledge management, but the problem is that the policy is not known or widely broadcast to all the employees. This reflects that the sharing and the transmission of basic knowledge is still a problem in PetroSA. Knowledge management, as a practice, is still in its infancy, although attempts have been made to develop its framework.

PetroSA has focused on hard technical skills, mechanical, electrical, and process engineering, rather than on something intangible like knowledge. This is evidenced by the fact that even the company's Information Systems, which are supposed to be seen as an enabler of knowledge management, are still not up to the challenge of helping the development of knowledge management.

In addition, many respondents still feel that there are no structures to promote knowledge management as a discipline. The responses from the interviews challenge the organisation to make the policy public, and to ensure that a knowledge-management culture is developed.

PetroSA is challenged to maximise the use of portals, e-rooms and information technology to increase its knowledge usage. The use of portals, the intranet and internet would help employees to understand better the dynamics of their organisation. It would also help employees to understand the financial status of the organisations. Even union organisations would then demand salary increases based on realistic information.

Most of the respondents interviewed acknowledged the importance of knowledge management. They also stressed the need for the organisation to improve the knowledge process, as a vital part of its business-process reconfiguration.

5.4 CONCLUSION

In conclusion, it is the author's opinion that although there are some signs of knowledge practices at PetroSA in Mossel Bay, that basically the organisation does not conform to the knowledge practices (as theory dictates in Chapters One, Two and Three). The reason behind such a scenario could perhaps be explained by senior management's 'I do not care' attitude. This sort of attitude renders it very difficult to record any progress towards an improvement in knowledge-management practices.

In addition, the fact that senior management is viewed as suppressing any move to improve knowledge management actually hampers the growth of good corporate knowledge-management practices at PetroSA Mossel Bay refinery. Testimony to such suppression, as expressed by the respondents, lies in the blocking of certain useful external websites. Hence, the PetroSA Mossel Bay refinery should embrace good corporate knowledge-management practices (as explained in Chapters Two and Three).

CHAPTER 6

CONCLUSIONS

6.1 Introduction

The purpose of this study was to explore knowledge-management practices in the fuel-production industry, using PetroSA refinery in Mossel Bay as an example. Therefore, the central theme of the research was an exploration of knowledge-management practices with the emphasis on understanding the current knowledge-management practices at PetroSA. With the findings of the research now available, a summary of the theoretical and conceptual framework on the theory of knowledge – including a summary on Communities of Practice and intellectual assets within a knowledge-management context, as well as a synthesis of the main findings, have become important.

Consequently, this chapter now offers a summary of the literature on knowledge-management practices and a synthesis of the main findings. Accordingly, recommendations relating to the main findings are made, before a concluding statement is formulated. It should be reiterated, as observed in Section 5.1, that the conclusion drawn is the researcher's own; and this should not necessarily be associated with any of the respondents who provided the researcher with the research information.

6.2 SUMMARY OF THE LITERATURE ON KNOWLEDGE-MANAGEMENT, PRACTICES, COMMUNITIES OF PRACTICE AND INTELLECTUAL ASSETS

The exploration of knowledge management has brought about several questions relating to what knowledge exactly is; in what way it is different from the mere data; and how it should be managed at organisational level. The challenges have, further, confirmed the claim that knowledge is the only factor of production that is not subject to diminishing returns (Liebowitz and Beckman, 1998: 47).

It has also brought about a need to realise that people and their skills are integral in any definition of knowledge, because the collective knowledge from individuals constitutes "Intellectual Capital".

Although the knowledge movement is still in its infancy, the landscape looks as if it is changing, because organisations are now beginning to look again at how they are managing knowledge and how they can develop and leverage it as a core competence. Knowledge, as such, needs to be studied, because it is one of the areas that is not well understood. But it is yet very crucial; since practitioners and organisations usually confuse knowledge with information technology or data.

There is, consequently, a need to understand the concept of knowledge as a means of production, one that is necessary for firms' competency in the 21st century.

There are many approaches that exist in the knowledge literature; and the research carried out by the researcher demonstrates the movement by organisations in managing knowledge, producing knowledge, sharing, distributing and archiving it in repositories. Archiving knowledge in repositories reveals the epistemic nature of knowledge. The use of Communities of Practice and Epistemic Communities as building blocks has already been dealt with extensively in this research.

Thus, several authors, including Alavi (2000), Davenport and Prusak (1998), Nonaka and Takeuchi (1995), have all agreed on the strategic importance of knowledge assets in the 21st century.

They have argued that successful companies need to develop successful knowledge practices, in order to compete in the global market and to avoid poor performance. From the literature consulted, it has become increasingly clear that there is a need to develop a knowledge culture, although it is not clear whether such a knowledge culture would necessarily lead to an improved business performance.

In exploring knowledge, the researcher also looked at the role of learning in an organisation. Learning in organisations must be continuous (Wenger, 2004); and it occurs through Communities of Practice. As asserted by several authors, including Wenger (2004), Communities of Practice are the result of enhanced learning systems within organisations.

In improving the functioning of Communities of Practice, the importance of social networks is noted, since it is through these social networks that knowledge flows. Social networks allow organisations to hone communal knowledge; and this process explains the epistemological nature of knowledge. Social networks allow organisations to share knowledge that is located in people's

minds – through a process of social interaction and narrative. Knowledge, in this case, is shared through a process of telling fellow employees about personal experiences, learning and insights. Social interaction also occurs when teams collaborate within an organisation – thereby, enabling them to share knowledge that exists amongst them. Social networks contribute enormously to the creation, distribution and implementation of knowledge. Social networks are important in ensuring that the link between knowledge strategies and the building of Communities of Practice is well understood.

This is true because from the literature on personalisation strategy, it has become evident that people can communicate at a personal level through social networks.

Communities of Practice and intellectual assets were explained in detail in Chapter 3 of this dissertation. Communities of Practice are the end-product of human intellectual interaction, through the social process that enables the production and sharing of knowledge. In this research, it is clear that Communities of Practice arise because of the diversion from the earlier theories on knowledge management by Nonaka and Takeuchi (1995), who claimed that individuals are the only knowledge source.

With regard to the literature, it can be seen that Communities of Practice play a significant role in the creation, the sharing, the transferring and the absorption of knowledge in an organisation. It has been evident from the literature that Communities of Practice constitute knowledge networks of people with a high interest in learning, developing and improving the knowledge subject matter – and in sharing common work goals.

Communities of Practice need to be supported – in order to grow and flourish as a vehicle for creating and disseminating knowledge. Support of the growth of Communities of Practice can be facilitated by the use of discussion-forum technologies. These allow community members to collaborate and have access to each other.

As a result of the emergence of Communities of Practice, organisations have been able to unearth more of the hidden and locked knowledge that has been residing in peoples' minds. Effective Communities of Practice enable members to manage and quickly leverage the knowledge that exists in the knowledge network.

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The existence of Communities of Practice has given birth to Communities of Interest (COI) through the social interaction of individuals. A community of interest (COI) is a knowledge network that is looser than a Community of Practice, but its membership is larger than that of a Community of Practice – and it is more focused. Communities of Interest (COI) are important in helping the knowledge worker in trying to find answers to knowledge needs.

Discussion forums, in turn, play a vital role in supporting Communities of Interest (COI).In similar vein, Wenger (2004) argued that the members of a community of practise sharing information on what they do in order to learn. Communities of Practice are all about what these individuals do with their capabilities, and how they function. These networks are collaborative and they engage in continuous communication. Continuous communication recognises the fact that knowledge can be shared through social interaction and 'face-to-face' communication. The effectiveness of social interaction and 'face-to-face' communication is brought about by the existence of knowledge forums, and knowledge cafes, which are social meeting places that are organised within and between organisations that have a special interest in creating and leveraging specialist knowledge.

Learning and capacity-building are at the core of Communities of Practice. There should be a platform for Communities of Practice to exist. As explained by Brown and Duguid (1991), Wenger (2004) and Nonaka and Takeuchi (1995), this existence of a platform explains the need for sharing knowledge, weaving social relationships and developing a sense of belonging.

Through Communities of Practice, personal stories and experience on knowledge management knowledge is shared. The researcher would thus conclude that the need to create Communities of Practice is an attempt by organisations to create a new identity for those with a common identity, and also for those with a common ideology, on how to share specific knowledge and to expose the limitations set by the earlier theories about organisational learning.

Story-telling has been identified in the literature as one of the most ancient but powerful tools of transferring knowledge from a person to a group. This view of the importance of story-telling assumes that human beings are wired for pictures and stories. Story-telling is important because it engages all the human senses and triggers a sense of imagination to see, hear, feel, touch and taste. The forthcoming experiences effectively enable humans to transfer and remember the important information and knowledge contained in well-told stories.

Communities of Practice create their own identity, character, internal direction and energy. The value of Communities of Practice as a measurement tool for knowledge sharing, creation, distributing and retrieval are anchored in the context of knowledge management. The complex learning process, which is a result of such social interaction, has also been explored. Learning is perceived not only to reside in an individual, but also amongst groups (Brown and Duguid, 1991).

The essence of studying knowledge-management practices is to deal with any existing discontinuities and to accelerate innovation. Innovation, though it does not form part of the knowledge discourse in this thesis, occurs when there is a gap and the need to create new knowledge.

Knowledge management, which is assumed to be a collection of several disciplines, integrates learning and knowledge through single-loop or double-loop learning. These loops explain the "Theory of Action", as suggested by Argyris and Schon (1996). However, caution should be exercised when dealing with how organisations deal with socio-cultural aspects and knowledge exchange. This is because there is nearly always a gap between theory and practice.

It is essential to note that in order to understand Communities of Practice, epistemic communities and knowledge, the strategy on how firms manage these issues should be comprehended. The research underlines organisational knowledge as a resource and the strategy of how organisations manage it as being of vital importance. Managing knowledge as a resource means that organisations should manage capabilities. This translates into managing the social networks that are pivotal in fuelling epistemic communities.

The research lists two strategies: codification which is centred on the computer; while the other is "personalisation", which centres on human interaction (direct contact: person-to-person). Organisations learn to manage codified knowledge in order to remain competitive (Zack, 1998), and because they want to share internal knowledge. This helps organisations to share, configure and transfer knowledge – thereby, enabling them to understand and actualise their capabilities. Personalisation allows organisations to deal with personal contact, which emphasises the social bonds between individuals.

The management of knowledge, whether codified or personal, through communities confirms the importance of knowledge as capital. The paradigm on knowledge as intellectual capital results

from the need to assess knowledge from its value (epistemic) and to appreciate the value of knowledge assets.

The recognition of knowledge as intellectual capital, as well as understanding its agility, competence and attributes was shown to be essential. The study of knowledge as intellectual capital makes it easy to understand its link with organisational learning. It also makes it easy to understand the value of intangibles and knowledge that has hidden value in human minds. Knowledge as an asset increases competitiveness. The value of knowledge as an asset is entrenched in social practices, cultures and networks.

The theory of knowledge as intellectual capital assumes that knowledge has value when it sits with epistemic communities and Communities of Practice. Understanding knowledge as intellectual capital requires that one should understand the social interactions and silent dialogues of members of a Community of Practice. Organisations grow if the value of value of knowledge that individuals collectively possess is put to good use.

Knowledge assets should not create barriers of entry, because this can stifle individual creativity, and the returns that knowledge brings would, consequently, be undermined. Knowledge as capital is summarised in the "classical view" of knowledge as a factor of production. The challenges that face this assumption is the exact location of knowledge assets, since most of them are intangible and need to become explicit before they can be improved, examined and shared.

The use of "value-network analysis" is that it helps to convert intangible assets into value. Allee, (2008) argues that intangibles need to be transferred from person to person; and hence, the realisation of the need for social networks.

It is from this background that the researcher investigated knowledge-management practices, the role of taxonomies, Communities of Practice; their meaning, formation, functionality; and how these can change knowledge into an asset. The value of social networks, as the means for improving knowledge transfer have been thoroughly investigated.

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6.2 SYNTHESIS OF THE MAIN FINDINGS

The purpose of the research was to study and explore knowledge-management practices in the fuel-production industry. The research used PetroSA refinery in Mossel Bay as a case study.

The use of a case study is justified in the research design chapter (see Chapter 4). Some fundamental questions were asked in the problem statement:

- What are the knowledge management approaches that PetroSA uses?
- Do the current knowledge-management approaches realise knowledge as having any value?
- How are the values of different knowledge approaches realised?
- What is the role of social networks in establishing Communities of Practice?
- What is the role of Communities of Practice in knowledge production, sharing and the transfer of knowledge?
- How do organisations like PetroSA manage knowledge as a valuable asset – realising the importance of intellectual capital?
- What is the role of information technology in helping knowledge-management growth?

This section will offer a synthesis of the main findings, based on the analysis of interviews with one hundred employees of PetroSA fuel-production industry in Mossel Bay. While the findings of the study do not pretend to offer a statistical representation of the fuel-production industries, they nevertheless present findings that allow the author to draw conclusions and lessons that could be applicable to other fuel industries in South Africa as well.

Accordingly, this permits the researcher to make some recommendations derived from the case study. These may be applicable to other fuel industries concerning knowledge-management practices.

Indeed, the interviews conducted by the researcher have confirmed that there are different approaches for knowledge management that organisations can use. It is evident from the empirical research that PetroSA needs to realise the value of knowledge as a key resource of the 21st century. The concept of knowledge management is still largely unknown in this organisation.

There is also some confusion between information systems and knowledge management; and those who claim to understand knowledge management do not seem to understand its true value. There is a non-existent culture of knowledge management at PetroSA. Organisational knowledge-

management policy is vague, resulting in inherent governance problems. The lack of a clear knowledge-management policy that can be understood by everyone at PetroSA was notable during the interviews.

Accordingly, this permits the author to suggest the need to have concrete policies that govern knowledge-management practice at PetroSA. Indeed, from the case study there are lessons learnt about knowledge policies at PetroSA. One of the things learnt was that PetroSA should do away with bureaucratic tendencies which hamper the effective enhancement of knowledge practices. PetroSA should be implementing knowledge practices that allow it to be competitive in a dynamic environment where it operates.

The results of the interview process highlighted the need for PetroSA to understand the effect of changing oil prices and technologies – and how these affect knowledge policies and structures. The need for PetroSA to have a hybrid knowledge governance model was highlighted in Chapter 5. This hybrid model should be hierarchic-bureaucratic, which would allow working in teams, and would also allow the organisation to be in touch with its customers.

It was also evident from the findings that a good knowledge-governance policy should be supported by intelligent information systems that guarantee knowledge capture, codification, transference and easy access to knowledge accumulated by the organisation. The results of the interviews reflect that the existence of a policy should be accompanied by an understanding of that policy. It is clear from the interviews that PetroSA might claim to have a knowledge-governance policy, but that the core and contents of that policy are not well understood by ordinary employees.

Observation shows that social networks do exist, but it is not clear whether such social networks help Communities of Practice to flourish – or not. Social networks exist, but the Company should improve the content of what is discussed in social networks. PetroSA should tap into social networks – in order to improve group learning and transfer knowledge between individuals.

Knowledge management tools, knowledge portals and e-rooms exist, but very few employees understand how they work, or their value. Many of those interviewed thought that these portals had not been updated for some time. It was also clear from the findings that PetroSA needs to fully utilise knowledge portals in order to promote knowledge sharing amongst diverse knowledge

users. Portals have become virtual workplaces which provide access to stored structured data and unstructured data.

PetroSA should develop portals which would simplify access to data stored in various application systems and facilitate collaboration among employees.

Therefore, learning should be an important aspect of PetroSA, because it is through learning, that knowledge may be optimised, monitored and stored. Existing gaps in knowledge need to be closed. Through learning, PetroSA can realise the true value of knowledge, and how it should be managed.

As was discussed in Chapters Two and Three, organisations use codification (operational) and personalisation (strategic) intents as knowledge-management blueprints. Therefore, PetroSA should engage in knowledge-management practices to share knowledge, information and to cultivate a culture of bringing knowledge workers together through social networks. These would enable knowledge workers to share valuable knowledge.

Social networks are the pedestal on which Communities of Practice are anchored, as was observed in Chapters Two and Three. It is through social networks that the person-to-person transfer of knowledge occurs. The sharing of information would enable PetroSA to change epistemic information to tacit information; and tacit to epistemic – and thereby create value. The creation of this value structure underpins knowledge as an asset.

A considerable part of the organisational strategy to manage knowledge should focus on recognising knowledge as intellectual capital, i.e. understanding the value of intangible assets and converting these assets into value – through a process of value-network analysis. Thus, from the analysis of the various responses collated from interviewing one hundred respondents, the researcher asserts that:

- Organisations, including PetroSA, should focus on learning as a means of sharing and distributing knowledge.
- Business should craft policies and strategies that aim to optimise the efficient use of knowledge as a factor of production.

- PetroSA should focus on knowledge enablers, i.e. technology, information systems, the intranet and the internet and other artefacts, which can enhance knowledge production, storage, indexing, retrieval and the re-use of organisational knowledge.

- PetroSA should develop a policy framework, which would help with the governance, usage and accessibility of knowledge.

- PetroSA should utilise the use of intranets, portals, e-rooms and document-management systems, as tools to enhance knowledge sharing and to facilitate its retrieval.

- The role of the Chief Knowledge Officer (CKO) as the champion of the knowledge-management policy should be emphasised.

It is also clear from the research (theory, interviews and observations), that organisations engaged in knowledge management should recognise the importance of Communities of Practice in sharing important knowledge. Communities of Practice have purpose and character in producing invaluable knowledge for organisations. Unlike intranets and portals, which use information technology, Communities of Practice evolve naturally in an organisational setting.

However, the hundred respondents interviewed felt that the organisation does not fully utilise the role of intranets, e-rooms and knowledge portals, document libraries and platforms to share valuable knowledge. Therefore, in an organisation like PetroSA, which has a diverse community of professionals (engineers, scientists, process engineers, accountants, and geologists), the sharing of knowledge through Communities of Practice should be emphasised.

Hence, organisations using Communities of Practice should develop a culture of shared values and a practice that increases learning.

The researcher categorically suggests that understanding the value of knowledge assets is the necessary prelude for understanding knowledge as intellectual capital. It also became clear from the findings that fewer employees engage in physical work – since so many people do brain work. This is called intellectual capital. Intellectual capital does not appear in organisation's balance sheets, but it has more value for organisations than do physical assets.

There are various challenges facing PetroSA in trying to understand the value of these assets:

- PetroSA fails to convert knowledge from its epistemic nature to one of value, because the concept of value is currently measured in monetary terms only.

- PetroSA still needs to engage in a paradigm where knowledge is seen as an asset; and it has to be valued as such.

- PetroSA still does not understand how to measure knowledge assets. It is evident from the research that the case study shows that the value of knowledge assets is still largely unknown or seriously underestimated.

- PetroSA still does not emphasise learning as a core function in realising the value of knowledge assets.

As was reasoned in Chapter Two, the research has emphasised that the theory of knowledge states that knowledge is no longer a public good, but an issue of 'intellectual capital". This means that organisations that succeed are those that manage knowledge by understanding its economic value. The economic value of knowledge comes from understanding social networks – and how they function. Moreover, from the findings it is apparent that PetroSA need to understand knowledge as intellectual capital.

It is clear from the findings that PetroSA is losing a lot of skilled manpower to competitors like BP, Sasol and Chevron; and this loss is not only individuals, but the aggregate knowledge contained by individuals leaving the company. PetroSA should be encouraged not to lose skills and knowledge because intellectual capital is the primary resource and driver of the information economy.

The very nature of the industry in which PetroSA operates, demands that knowledge (which sits in people's minds) needs to be managed as intellectual capital – in order to create a new source for increasing the Company's competitive edge. Organisations, that manage knowledge as intellectual capital, can increase their value by creating, capturing and leveraging this knowledge.

On the contrary, the results of the interviews clearly indicate that PetroSA does not have a strong social network, which could enable those who have knowledge to transfer it to others. Thus, as was observed in Chapter Two, PetroSA should realise that knowledge is process-driven, because it is a human process, as was asserted by Blacker (1995); Alavi and Leidner (1999).

Knowledge management is created out of the social process (people talking to each other, testing each other's arguments and knowledge claims) (Cangelosi and Dill, 1965; Boyd and Robson, 1996; Vlok, 2004). Social processes help the process of learning, because they foster interaction. Social processes help Communities of Practice to share their thoughts collectively. Knowledge management is revealed as a means of improving an organisation's performance, productivity and competitiveness, and also of acquiring, sharing and using such information as a tool for decision-making, and improving internal operations, as well as investing such knowledge in products and services.

From the research results, it becomes evident that PetroSA as an organisation cannot manage the process of knowledge management. Hence, there is a need for the organisation to make a concerted move towards learning how to manage this process – for its own benefits.

It has been observed throughout this research work, that Communities of Practice and intellectual assets are important aspects of the knowledge regime. In discussing Communities of Practice, the emphasis was on their existence, creation and function; and on how they can help in learning and knowledge transfer. It was also intimated that the value of knowledge to the business, and the value of people's actions in having that knowledge, are of vital importance. Hence, the importance of intranets, portals and other technology in helping Communities of Practice function has been consistently highlighted.

It is also clear from this research that PetroSA does not recognise the existence of Communities of Practice or the value of intellectual assets. The fundamental problem is that PetroSA, as an organisation, does not yet recognise the existence of knowledge as an emerging discipline. It is also clear that even though PetroSA has established a knowledge-management division in the Corporate Strategy, it has not yet fully recognised the importance of knowledge as an asset.

In order for the organisation to recognise knowledge assets, employees should recognise their own value and contribution to knowledge.

PetroSA has realised the need to enhance Communities of Practice as vehicles to produce, transfer and share knowledge. These Communities of Practice use portals, groupware and e-rooms to channel knowledge accordingly. This integration will break the culture of working in silos, and increase the effectiveness of social networks.

PetroSA has also realised that there is a need to shift from information management towards knowledge management.

From the literature consulted, it becomes clear that management and employees should realise the importance of knowledge workers as decision-makers who should have an insight into those issues that are generated through the access to data and information.

This can only be made possible by having access to people's knowledge and networks. PetroSA has also just begun to realise the value of social networks in sharing knowledge.

The interviews demonstrated the role of the Chief Knowledge Officer (CKO) in unlocking knowledge potentials in the organisation. The Chief Knowledge Officer (CKO) should ensure that organisations understand the integration of data, information and knowledge – thereby, dealing with dynamic and complex environments, as are found in the fuel industry. The role of the Chief Knowledge Officer (CKO) is to leverage knowledge networks and create organisational knowledge.

The Chief Knowledge Officer (CKO) also needs to identify knowledge networks, the identification of mediators in each network and their connection with other mediators in Communities of Practice. The respondents alluded to the fact that the Chief Knowledge Officer (CKO) needs to create a sustainable knowledge-sharing culture, by ensuring that departmental boundaries and professional silos are removed.

The Chief Knowledge Officer (CKO)'s role centres on his/her commitment to the learning and the development of all the staff, thereby enhancing organisational knowledge.

6.4 RECOMMENDATIONS

As earlier stated, the aim of this research was to investigate and explore knowledge management practices within PetroSA. Central to this research was the need to investigate the role of Communities of Practice and epistemic communities, as vehicles in which PetroSA, or any other organisation, can produce, share, transfer, codify, index and retrieve knowledge for business uses.

Through such Communities of Practice, businesses are able to recognise the value of knowledge as intellectual capital and its contribution to business. It also became clear from the research that

businesses like PetroSA should not overlook intellectual capital in the valuation of its assets and business. This is important because businesses need to understand that contrary to the industrial age where business assets were bolted to the floor of the company's facility, business assets in the information age lie in the knowledge, skills, and experience of the firm's employees.

Knowledge assets need to be developed and protected like the other assets in the business. During this *academic* research work, certain pertinent points were raised. These concern the definition of intellectual assets and how these assets are valued. The acknowledgement of the existence of intellectual assets at PetroSA is still a challenge. This lack of understanding knowledge as an asset was partially addressed in this research project, because the research project was to specifically assess the knowledge practices at PetroSA, yet the issue of acknowledging knowledge as intellectual capital remains critical in understanding organisational knowledge practice, and could constitute a viable research topic. This needs to be investigated separately, hence may form the basis for the author's further research.

The research also qualifies knowledge as a rich discipline, something that organisations should manage carefully as a competitive tool in the 21st century. The research qualifies knowledge transfer as a function of the informal "we" of contacts by employees through social networks as a medium. It is through the discovery of the effectiveness of these contacts that the hidden power of social networks can be realised.

It is from this background that the researcher makes the following recommendations:

- PetroSA needs to step up its use of knowledge management as a discipline, to ensure internal and external competitiveness.
- The organisation should recognise the value of knowledge management as a cutting-edge discipline that is above data mining or information expediting. The organisation should also develop a framework that would integrate all knowledge systems within it.
- As a learning organisation, PetroSA should understand and appreciate the value of social networks in enhancing Communities of Practices. In the knowledge economy in which PetroSA operates, there is a need to attribute great value to creating a culture of producing, sharing and the transferring of knowledge. This could be done through Communities of Practice.
- PetroSA needs to understand the explicit value of knowledge, and to translate that into intangible value.

- The promotion of knowledge management should not only be about establishing policies, but it should be concerned with creating an environment in which knowledge can thrive; and it should include the promotion of knowledge-management tools and knowledge portals. These portals would help employees to tap into the online knowledge through a web-based application. These portals are regarded as virtual communities that promote the sharing of vital knowledge amongst employees, customers and end-users.

- Portals would provide access to data (structured and stored in a database and in data warehouses, and would help in the organisation of unstructured data).

- PetroSA needs to accept knowledge as intellectual capital. Intellectual capital consists of employees' prior and current experiences which could enhance creativity. Intellectual capital encompasses the models, strategies, unique approaches and mental methodologies organisations use to create, compete, understand, problem-solve and replicate.

- As the company matures in the knowledge fraternity, it is important to emphasise the role of the Chief Knowledge Officer (CKO) as a specialist in optimising and maximising knowledge use and its supporting artefacts. As the organisation expands, there is a need to focus on people, on how these people are connected, and how essential knowledge is stored and transferred through Communities of Practice via informal networks. These challenges should oblige the organisation to emphasise the role of the Chief Knowledge Officer (CKO) in developing a new approach in managing existing knowledge.

6.5 Directions for Future Research

While this research suggests that organisations should take the view of developing Communities of Practice seriously in order to create, share and distribute knowledge, it also raises important questions. Firstly, how does an organisational learning strategy help to develop Communities of Practice? The research on Communities of Practice has progressed in parallel with that of organisational learning as a knowledge-management practice, but many questions still exist which link between Communities of Practice and organisational learning, and how this helps in knowledge transfer.

Communities of Practice help to cultivate learning systems within organisations. Secondly, this work has exposed the importance of group learning, which is linked to the involvement of emotions. It has shown that Communities of Practice engage voluntarily, but the role of the individual within the community has an emotional component.

We have long known that Communities of Practice are centred on group learning and knowledge transfer, but that learning is anchored in emotions which help them retain valuable knowledge. Assumptions should be made on how individuals in Communities of Practice retain and store knowledge. Individuals in Communities of Practice can retain knowledge that has an emotional component. This causes them to retain knowledge longer than when there are no emotions involved.

Thirdly, this research also indicates the importance of collective learning as a feature of Communities of Practice. Knowledge that is created collectively can be easily used again, and can connect people more directly than can knowledge created individually. In Chapter Two, the research dealt with knowledge theories and processes, and, in particular, knowledge creation and knowledge transfer; but it did not clearly define the relationship between the two. It should be noted that in the knowledge-management process categorisation done by Gold, Malhotra and Segars (2001), the relationship between the two sub-processes of knowledge *acquisition and conversion* needs further exploration and definition, if one is to fully understand practice.

The views of the authors, as expressed in Chapter Two of this study, suggest that when information is just data, and not knowledge, this relationship is fairly clear-cut, as data could easily be identified, organised and codified – and then given to those want to use it. When data becomes *newly created knowledge* formed by the cognition and emotion of groups of people, the development of standards and representations that both enable and support communication to flow across various boundaries (for example personal, functional, organisational) is much more complex and sophisticated, because of the human factor, mental maps, group processes, feelings about the creation of the knowledge or the learning, and so on.

Fourthly, this work has also exposed the importance of knowledge as intellectual capital. Managing knowledge as intellectual capital is important in organisational growth, and it is important in making us understand knowledge-management practices. The valuation of knowledge as intellectual capital is not well understood by knowledge practioners. Future research on intellectual capital should go beyond patents, copyrights and other forms of intellectual property. Knowledge has value when viewed as intellectual capital. It consists of human capital, structural capital, and customer capital.

This definition suggests that the management of knowledge (the sum of what is known) creates intellectual capital.

6.6 CONCLUDING STATEMENTS

This research offers insight into knowledge practices within the fuel-production industry. It further discusses the social, epistemological and philosophical nature of knowledge, which is anchored in the processes of knowledge creation, transfer, sharing and distribution. The research also allows us to understand the theory of knowledge, which gives substance to the importance of Communities of Practice and Epistemic Communities, as well as the relationship between learning and knowledge management.

Using the PetroSA fuel production industry in Mossel Bay as a case study, this research project has offered a holistic picture of knowledge practices in a fuel-production environment. Through the research project, the researcher has established, in clear and unequivocal terms, the problems faced by the PetroSA industry regarding knowledge-management practices.

Learning and other social processes have been discussed, and seen as pivotal in promoting the understanding of knowledge management. The social process of organisational learning helps to understand knowledge creation and transfer. Learning produces a social bonding which, in turn, defines a group boundary, which then develops from the emotional aspects of group learning. This *boundary* helps in transferring the knowledge to other settings.

This organisational analysis of knowledge transfer leads to new organisational learning – which has theoretical, practical and epistemological implications.

Based on the results of the research study, it could be concluded that PetroSA has a mammoth task of maximising the use of portals, e-rooms and information technology and to create a collaborative climate which will make the knowledge worker more productive and increase knowledge usage within PetroSA. In addition, it can also be concluded that the absence of any policy focusing on knowledge-management enablers, such as leadership, access to technology and the development of a learning culture, constitutes challenges on which the organisation should focus. Thus, PetroSA should seriously engage itself in knowledge-management practices, as described in Chapters Two and Three.

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APPENDICES

APPENDIX A: QUESTIONS THAT FORMED THE INTERVIEW SCHEDULE

APPENDIX B: ETHICAL CLEARANCE

APPENDIX A:

The various questions that formed the interview schedule

No	Interview Question	Response
1	Is there an existing structure for knowledge-management within the organisation?	
2	Does management promote knowledge-management within the organisation?	
3	What type of personnel does the organisation have to execute and enhance knowledge-management initiatives?	
4	Is there a company policy in place for knowledge-management practices?	
5	Does a knowledge-management culture exist within this organisation -- and how is it promoted and reviewed over time?	
6	Are there structures in place within the organisation to produce knowledge?	
7	a) Does management encourage criticism of current company knowledge-management practices? b) Is management open and positive about criticism on existing knowledge-management procedures? c) Is management aware of any attitudes of staff concerning knowledge entitlement? d) What is management's action to improve knowledge entitlement in the organisation?	
8	a) Are there any of Communities of Practice within the organisation? b) What is management's input/effort in enhancing Communities of Practice? c) Does management recognise social networks and employee efforts in creating CoP's? d) Is there an existing organisational policy of developing and nurturing Communities of Practice and epistemic communities?	
9	a) How effectively does the organisation utilise group and individual learning to build communities of practice and epistemic communities? b) How effectively does the organisation utilise CoP's to diffuse information and enhance business goals?	

10	a) How effectively do company KM policies promote knowledge production, processing, storage and distribution?
	How effectively does the organisation utilise social networks to improve knowledge-production, sharing and acquisition?
	b) Does the organisation promote information-acquisition from internal and external sources?
	c) Does the organisation promote information-acquisition from internal and external sources?
11	Does the organisation have claim-formulation procedures, and what is the role of management in claim formulation?
12	a) Is there a policy in place regarding knowledge-search and retrieval?
	b) What documents and software procedures exist for knowledge retrieval within the organisation?
13	a) How can information technology assist knowledge management, i.e. acquisition, search and retrieval?
	b) How can knowledge-management use information technology properly, i.e. Can it assist users to distribute knowledge?
	c) Does the organisation utilise the existing knowledge database as a field for the storage of data?
14	a) How effective (if any) are the organisation's knowledge-broadcasting structures/facilities?
	b) Has management enhanced the culture of knowledge broadcasting within the organisation?
	c) How do the company's internet resources/websites help in knowledge broadcasting?
15	What mechanisms exist for knowledge application within the organisation, i.e.
	1) Is there timing in the application of knowledge?
	2) Is there an online discussion board?
	3) Do mechanisms exist to upload and download from the Document Library, search engine, e-mail, online browsing, personal database, links, e-paper and company website?
16	a) Does the organisation use a knowledge-management platform,

and if so what are its functions?

b) Does the knowledge-management platform increase memory space, help in knowledge transfer, storage, and transformation?

17 How effectively does the organisation use the Chief Knowledge Officer (CKO) to promote knowledge-management measures?

18 How effective is the CKO in optimising the procedures of knowledge-management, creating channels, monitoring the learning cycle, and in the elimination of gaps in knowledge flow?

19 a) Does the organisation recognise knowledge as intellectual capital?

b) Do knowledge management initiatives like CoPs, intranet development and enterprise knowledge portals show a return on investment in knowledge as intellectual capital?

LQA
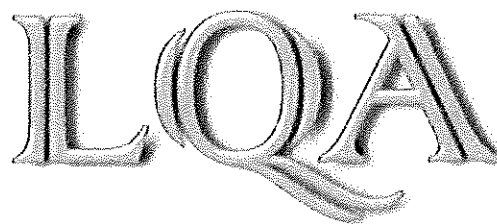
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31 March 2011

TO WHOM IT MAY CONCERN

We hereby certify that we have language-edited the treatise prepared by Mr
Bhekisipho Sibusiso Nedebele, entitled: KNOWLEDGE MANAGEMENT
PRACTICES IN THE FUEL PRODUCTION INDUSTRY: A CASE STUDY OF
THE PETRO SA MOSSEL BAY REFINERY, and that we are satisfied that,
provided the changes we have made are/were effected to the text, the language
is of an acceptable standard, and is fit for publication.

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Language Quality Assurance – Certification Statement

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15 OCTOBER 2009

MR. BS NDEBELE (941362134)
LEADERSHIP CENTRE

Dear Mr. Ndebele

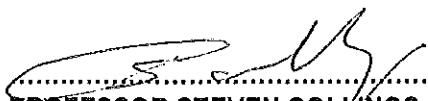ETHICAL CLEARANCE APPROVAL NUMBER: HSS/0565/09M

I wish to inform you that your application for ethical clearance has been granted full approval for the following project:

"Knowledge management practices in the Fuel Production Industry: A case study of Petro SA Mossel Bay Refinery"

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

PROFESSOR STEVEN COLLINGS (CHAIR)
HUMANITIES & SOCIAL SCIENCES ETHICS COMMITTEE

cc. Supervisor (SA Bodhanya)
cc. Mrs. C Haddon