The evaluation of the knowledge management process in the ferro-metallurgical industry in South Africa

by

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Mini-dissertation submitted in partial fulfilment of the requirements for the degree *Masters of Business Administration* at the North-West University

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POTCHEFSTROOM

November 2009

PREFACE

A project of this nature is seldom, if ever, carried out by one person alone. I would like to hereby give credit where it is due, to all those who helped, in ways large and small, to make this project the success that it is:

- First and foremost, to my Lord and Heavenly Father, without whom there is nothing good,
- To my family, for putting up with all my issues and giving up quality time with Dad,
- To my employer, without whom this research would not have been possible in this form,
- To Mr JMC Fonseca, who drew me from engineering into management, and also managed to push me into the direction of studying an MBA,
- To the Human Resources departments at ArcelorMittal Vanderbijlpark and Newcastle, for supporting me especially with the distribution of the questionnaires. This work would have been a lot more difficult without that help,
- To the employees of ArcelorMittal Vanderbijlpark and Newcastle, for patiently and (hopefully) enthusiastically filling out the responses. This report is based on the findings of your opinions,
- To my study leader, Mr Johan Coetzee, for his enthusiasm, patience and support, and
- To the members of my syndicate group, who have supported me in various guises throughout the three years of our MBA. I could not have designed a better group myself, and
- Lastly, but certainly not least, to our Group Leader and my friend, Jennifer Cronje, who has been a source of inspiration and a tower of strength to all of us, but to me especially. Thanks, Jen!

ABSTRACT

The aim of this study was to conduct a thorough theoretical study on the relevant aspects involved in knowledge management and organisational learning, and thence assess the level of organisational learning within the ferrometallurgical industry. From the outcomes of the assessment, recommendations to improve the state of affairs were to be made.

Knowledge can be defined as actionable information. The creation, acquisition, sharing and leveraging of knowledge in today's industries are critical. Knowledge is now termed the fourth productive resource, and some authors claim, with some justification, that the widespread knowledge within a company is the only source of sustainable competitive advantage. With this in mind, it is obvious that companies need to nurture knowledge creation and effective utilisation thereof in order to meet organisational goals. Knowledge can be codified if it is explicit, but needs to be transferred using personalisation if it is tacit. Implicitness of tacit knowledge further confounds the issue. Knowledge management practices underpin the process of organisational learning.

The level of organisational learning within the ferrometallurgical industry in South Africa was assessed, using a survey questionnaire obtained from the Harvard Business School. The results show that the industry lags behind the medians in the ten constructs measured, and much work will be required to significantly improve the situation. Key areas of concern are in the areas of psychological safety, time for reflection, education and training, and collection of information. As a consequence, a practical strategy for improving the state of knowledge management and organisational learning in the ferrometallurgical industry was developed.

Key words: Knowledge creation, knowledge acquisition, knowledge sharing, knowledge leveraging, knowledge management, organisational learning, organisational learning strategy, knowledge maps, explicit knowledge, tacit

knowledge, implicit knowledge, knowledge stocks, knowledge flows, supportive learning environment, concrete learning processes and practices, leadership that reinforces learning.

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LIST OF ABBREVIATIONS

ASHEN	Artefacts, skills, heuristics, experience, natural talent
BP	British Petroleum
CALL	Centre for Army Lessons Learned
CEO	Chief executive officer
COD	Concise Oxford Dictionary
COO	Chief operating officer
CoP	Communities of practice
GM	General manager
HBR	Harvard Business Review
HQ	Headquarters
HR	Human Resources department
IDC	Industrial Development Corporation
ISCOR	South African Iron and Steel Industrial Corporation
IT	Information technology
KM	Knowledge management
KMP	Knowledge management program
KMS	Knowledge management system
KPA	Key performance area
KPI	Key performance indicator
OL	Organisational learning
PM	Plant manager
POW	Prisoner of war
R&D	Research and development
ROI	Return on investment
RONA	Return on net assets
SECI	Socialisation, externalisation, combination and internalisation
SOP	Standard operating procedure
SWOT	Strengths, weaknesses, opportunities, threats
TKI	Tacit knowledge index
TPS	Toyota Productivity System
US	United States of America

USCO	Union Steel Corporation
VPN	Virtual Peer Network
WM	Works manager

CHAPTER 1

ORIENTATION AND PROBLEM STATEMENT

1.1 INTRODUCTION

The management of knowledge in an organisation is critical to gaining and maintaining competitive advantage (Davenport & Prusak, 2000:xxiv; Liyanage, Li, Elhag & Ballal, 2008:1-2). Knowledge must be institutionalised, in order for the company to be able to improve its operations and performance. In order for an organisation to be a real learning organisation, its employees must be skilled at creating, acquiring and sharing knowledge (Garvin, Edmondson & Gino, 2008:109).

1.1.1 Organisational learning and knowledge management

Senge (2006:3) defines the learning organisation as one where employees continually develop their knowledge and abilities; improved, more open ways of thinking are encouraged and practised; collective aspiration is set free, and where people are always learning how to learn together. The requirement is that all employees in the organisation will work, learn and develop together. The organisations that will truly be at the forefront of industry will be those that can really harvest the commitment and learning capacity of all employees (Senge, 2006:4).

Learning organisations actively infuse themselves with new ideas and information. Scanning the external environment, hiring new talent and expertise when required, and training and developing its own staff are but the start. New knowledge must be shared throughout the organisation. Structural, process and interpersonal hindrances to knowledge transfer must be broken down. But learning organisations do not stop there. They actively seek results from new-found or shared knowledge, supporting the organisational goals (Kreitner & Kinicki, 2007:549).

The knowledgeable organisation is one in which there is recognition that knowledge is crucial to business success, a strong focus on getting and using knowledge for increased corporate value, yet appreciation of the fact that there are tensions present

that can make all of this difficult. Furthermore, in the knowledgeable organisation there is an understanding that an integrated management approach is required, flexible enough to bend when the environment changes (McKenzie & Van Winkelen, 2004:1).

Knowledge management, defined as the capabilities by which organisations capture the knowledge they need, improve upon it and effectively make it available to those that require it, so that it can be creatively utilised in the creation of value in the firm (Chaffey & Wood, 2005:227).

The European Framework for knowledge management defines five core processes that will be investigated in some depth in Chapter 2, namely, identifying, creating, storing, sharing and using knowledge (Chaffey & Wood, 2005:228). This is especially relevant in the field of explicit knowledge because of the current focus on making codified knowledge available and actionable.

Tacit knowledge, which can be further split into *real tacitness* and *implicitness* (Li & Gao, 2003:8), is rather different. Experts generally agree that the transfer of tacit knowledge cannot be effectively done through repositories and the like, but requires extensive face-to-face contact. This is generally only really achieved through the building blocks of the learning organisation: a supportive learning environment, concrete learning processes and practices, and leadership (Garvin *et al.,* 2008:111-112). Dr W. Edwards Deming stated that humans are born with built-in motivation, self-respect, dignity, curiosity to learn, and joy in learning. Present management systems have destroyed these traits (Senge, 2006:x). Thus, management processes should be altered in order to right this imbalance.

There is no reason for a firm not to want to become a learning organisation. The question is: How do they accomplish this? That is the subject matter that is discussed in Chapter 2.

1.2 PROBLEM STATEMENT

The skills shortage in South Africa (Thornton, 2009:1), and, indeed, the entire world, requires a re-evaluation of the methods used to retain and develop knowledge within any industry. No longer is lifetime employment a given in an industry. Skills migration

leads to a potential loss of knowledge and experience on an ongoing basis. A company may lose valuable intellectual capital every time an employee resigns, unless the tacit knowledge that the individual has developed over their length of tenure is retained in some useful manner (McQuade *et al.*, 2007:759). It is thus imperative to evaluate the present methods for creating, acquiring, sharing and leveraging knowledge within a global organisation.

The objective of this research was to assess the level of learning at ArcelorMittal South Africa's Vanderbijlpark Works, and compare it with other units within the ferrometallurgical group of industries.

1.3 RESEARCH OBJECTIVES

1.3.1 Primary objective

The primary objective of this study was to assess the level of organisational learning (OL) and knowledge management practices (KMP) within the ArcelorMittal Vanderbijlpark Works. This entailed the assessment of various constructs pertinent to the creating, acquiring and transferring of knowledge.

1.3.2 Secondary objectives

The specific objectives of this study were:

- To investigate the theory of knowledge management;
- To carry out an empirical study, which allowed the:
  - Investigation of the state of organisational learning within the ArcelorMittal Vanderbijlpark Works and other ferrometallurgical units, and
  - Comparison of the Vanderbijlpark Works to other units.
- Propose improvements to the learning processes in use at Vanderbijlpark, in order to:
  - Improve retention of specialised knowledge;
  - Allow more effective learning in the organisation; and
  - Improve the cross-centre transfer of knowledge and learning.

1.4 SCOPE AND LIMITATIONS

The study was aimed at the ferrometallurgical industry of South Africa. Operational departments, with its high reliance on process expertise based on specialised equipment and processes, were the main focus area. Typically, the management and engineering teams that operate these departments were the target of the empirical study. The high level of tacit knowledge (based on experience, whether augmented or not) was a prime reason for the study.

The study was limited to primary sources of information gained from the ferrometallurgical industry in South Africa, with specific reference to the Vanderbijlpark site of ArcelorMittal South Africa available up to October 2009. Secondary sources of information were limited to those generally available on the Internet, in the form of English language documents, and generally available literature sources.

1.5 RESEARCH METHODOLOGY

Primary sources of information in the form of data generated from questionnaires circulated among the ferrometallurgical units within South Africa were used. Strict confidentiality in the use of this data was maintained.

Secondary sources of information were also used, mainly in the form of the base knowledge management best practice investigation. Publications and textbooks as explained in paragraph 1.4 were utilised in this regard.

1.6 DIVISION OF CHAPTERS

Chapter 1

The aim of chapter 1 is to outline the research objectives for this study. Additionally, a short background to knowledge management and organisational learning is presented, together with the research methodologies, scope and limitations of the study.

Chapter 2

Chapter 2 focuses on a literature study of knowledge management, specifically the readiness of an organisation for knowledge sharing and management, the effect of knowledge management on a company, knowledge management strategies, and the

development of the learning organisation. The retention of tacit knowledge in an organisation is researched.

Chapter 3

The methodology used in the empirical study is put forward in chapter 3. Factors such as questionnaire design, sample sizing, results analysis, and data processing and evaluation are discussed.

Chapter 4

Chapter 4 presents the summary of the state of knowledge management within the ferrometallurgical industry. A comparison is drawn between the other units, and the Vanderbijlpark Works of ArcelorMittal. A summary of the readiness of the key personnel at Vanderbijlpark, according to the results of the questionnaire, is put forward. Recommendations for the improvement of specialised knowledge retention within the industry are also put forward. Finally, opportunities for future research are listed.

1.7 CONCLUSION

The main conclusion drawn from chapter 1 is that the retention of specialised tacit knowledge is critical to the development and sustaining of a competitive advantage in the ferrometallurgical industry. The research objectives have been laid out, and the research methods used, explained. A chapter overview has also been provided.

1.8 CHAPTER SUMMARY

The aim of this study was to assess the level of learning within the Vanderbijlpark Works of ArcelorMittal South Africa, and compare this with that of other units of the ferrometallurgical industry. Subsequently, a proposal is to be put forward to improve the level of retention of specialised process knowledge within the organisation.

Chapter 2 evaluates the literature available about the subject researched.

CHAPTER 2

LITERATURE STUDY

2.1 INTRODUCTION

The Greek philosopher, Heracleitus (535 BC – 475 BC), is credited by Plato (428 BC – 348 BC) with saying that all things are in a constant state of flux, or change (Anon, 1974:IV, 1036). John F. Kennedy, the late President of the United States of America (USA), perhaps paraphrased him when he said, "*There is nothing more certain and unchanging than uncertainty and change*". Change, however, is not something that people readily embrace. US Attorney-General Robert F. Kennedy stated, "*Progress is a nice word. But change is its motivator and change has its enemies*" (Anon., 2009a).

By accepting and combining these views, it can be postulated that progress is precipitated by change, and change is constant. Thus progress must also be constant. But the US writer Eric Hoffer (1902-1983) stated that, "*In times of profound change, the learners inherit the earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists*" (Anon., 2009a). This implies that, in a world of constant change, progress can only be achieved by continual learning.

Indeed, the global economy of the present day is characterised by change. The events of the past decade have seen the world and economies change almost beyond recognition. 9/11 and the US financial crisis (which quickly spread throughout the world) are but two of the more profound changes that people have witnessed in the recent past, the consequences of which are still being felt today, and will be felt, probably, for some years to come (Haugh, Ollivaud & Turner, 2009:5; Roberts, 2009:2-5).

In industry, change is also constant. Processes change, technologies, customers, competitors, raw materials, all of these factors change, and not always advantageously for the industry involved. In the new global economy, change can often hold dire consequences for a company. For example, a new, low-cost competitor emerges from the Far East. The company ignores this change at its peril. A Royal Dutch / Shell study in 1983 found that over 30% of the firms that had been on the Fortune 500 in 1970 had

vanished. These companies could not recognise the threats they were facing, could not understand the implications of the threats they were facing, or they could not devise alternatives to the threats (Senge, 2006:17).

Davenport and Prusak (2000:xxiv) state that the only sustainable competitive advantage a firm has comes from what it collectively knows, how efficiently it uses what it knows, and how readily it acquires and uses new knowledge. This is a powerful statement, and throws out many "old" notions of sustainable competitive advantage. Knowledge is now termed the fourth great productive resource, but differs from land, labour and capital (Carbaugh, 2007:7) where use generally reduces the resource, in that every [knowledge transaction] increases the total knowledge in the organisation; that is, knowledge use generally creates more knowledge (Davenport & Prusak, 2000:49).

As mentioned above, Hoffer (Anon., 2009a) stated that learners inherit the earth in times of change. Organisations can only learn through individuals. A lack of individual learning will mean a dearth of organisational learning. However, and this is arguably the crux: organisational learning is not guaranteed by individual learning. Knowledge sharing is thus critical to organisational learning (Senge, 2006:129).

This chapter will focus on the ways in which organisational learning can be developed, and the role that knowledge management (KM) has to play in supporting learning. Specifically, the following concepts will be explored:

- What is knowledge, and knowledge management?
- Knowledge creation or generation;
- Knowledge codification and co-ordination;
- Knowledge transfer, sharing, institutionalisation,; and
- Organisational learning.

2.2 WHAT IS KNOWLEDGE?

Ash (n.d.:1) informed that information is not knowledge. Unfortunately, it is easier to define what knowledge is not, rather than what it is. According to the Concise Oxford Dictionary (COD) (Thompson,1995:753), knowledge is "*awareness or familiarity gained by experience*", "*a theoretical or practical understanding of a subject*", and "*the sum of*

what is known". Fowler (2008:20) provides a brief but sensible definition of knowledge: "*information in context to produce actionable understanding*".

Where does knowledge originate from? Mekhilef, Kelleher and Oleson define the hierarchy of knowledge as that data, given context, becomes information. Information, transformed through expert opinion, skills and experience, becomes knowledge. Knowledge, in turn, becomes expertise by an enrichment process which involves putting knowledge into practice. The fact that knowledge lies between information and expertise can be clearly seen (Chaffey & Wood, 2005:223).

Davenport and Prusak (2000:6-12) recognise that knowledge (as opposed to data or information) is closer to action, the actual leveraging of knowledge. They identify some key components of knowledge, as in:

- Experience: derived from the Latin *experiri* – to try (Thompson, 1995:474). Experience is gained through actual doing. An experienced person has the advantage of being able to recognise patterns, and remember what worked (or did not) in previous situations.
- Ground truth: This was borrowed from the US Army's CALL (Centre for Army Lessons Learned), and is based on the idea that the people on the ground, in the action, can better tell the story than somebody who was back at HQ listening in on the radio. Rational analysis often leaves out critical (for the troops at the 'sharp' end) information, that ground truth would capture.
- Complexity: Knowledge is valuable because it allows the knowledgeable to deal with complex situations, without having to oversimplify the uncertainties. Knowledge engenders an awareness of what one does not know. It is ultimately humbling, as the deeper one delves into a subject, the more one realises what one does not know. That sort of awareness is important, as it prompts the acquisition of knowledge (either by research or consultation) that would help fill the gap.
- Judgement: Knowledge contains judgement. Living, evolving knowledge allows the possessor to evaluate a situation, and, even though the answer may not fit completely, the possessor's judgement can be used to "fit" the knowledge to the situation.
- Rules of thumb and intuition: This falls back heavily on experience. Rules of thumb and intuition are based, essentially, on pattern-recognition. The benefit is

that, for a new situation that looks partly like an experienced one, one already has part of the answer. The full solution does not have to be determined from square one.

- Values and beliefs: Knowledge is heavily influenced by the person's values and beliefs. These influence the way the things that the person sees or experiences are absorbed, and internalised.

The above helps illustrate the extent to which knowledge goes beyond information, or data, in allowing us to utilise it to produce action and results that add value.

2.2.1 Explicit and tacit knowledge

There are two widely recognised areas of knowledge: explicit and tacit. From Nonaka (1998:27), explicit knowledge is easily written down, as in standard operating procedures (SOPs), product specifications, computer programs and safe working procedures. This is the ideal form of knowledge to keep in a knowledge repository (Fowler, 2008:20).

Tacit knowledge, on the other hand, is much more difficult to articulate. It is often rooted in the expert's head, from years of experience and trial-and-error experimentation, and cannot easily be committed to a repository (Sanderson, 2001:9). One important reason for this difficulty is that the mental models, beliefs and perspectives underlying this knowledge are so ingrained, that the person holding them does not even realise that these are important to that knowledge (Carlile & Rebentisch, 2003:1184). This makes it very difficult to effectively transfer tacit knowledge to another individual (Nonaka, 1998:27). Tacit knowledge is exemplified by the frustration, "*If only we knew what we know!*" (Davenport & Prusak, 2000:xxi)

Tacit knowledge (know how) is required to put explicit (know what) knowledge into context and practice. Davenport and Prusak (2000:xxi) state that tacit knowledge is required to improve the efficiency of making decisions, serving customers as well as producing goods. Finally, they arrive at the conclusion that the effective diffusion of tacit knowledge in an organisation helps prevent the "reinventing of the wheel" in an organisation when somebody leaves the company (McAdam, Mason & McCrory, 2007:55).

Tacit knowledge itself can be further split with regard to tacitness and implicitness. Tacitness describes (much as Nonaka does) knowledge that is difficult to articulate (artistry, riding a bicycle). It is typically knowledge gained by doing, not by being taught alone. Implicitness, in contrast to this, is defined as the reluctance of an individual to share the knowledge that he/she possesses, due to various constraints such as lack of a sharing culture, or a non-conducive reward system (Li & Gao, 2003:8).

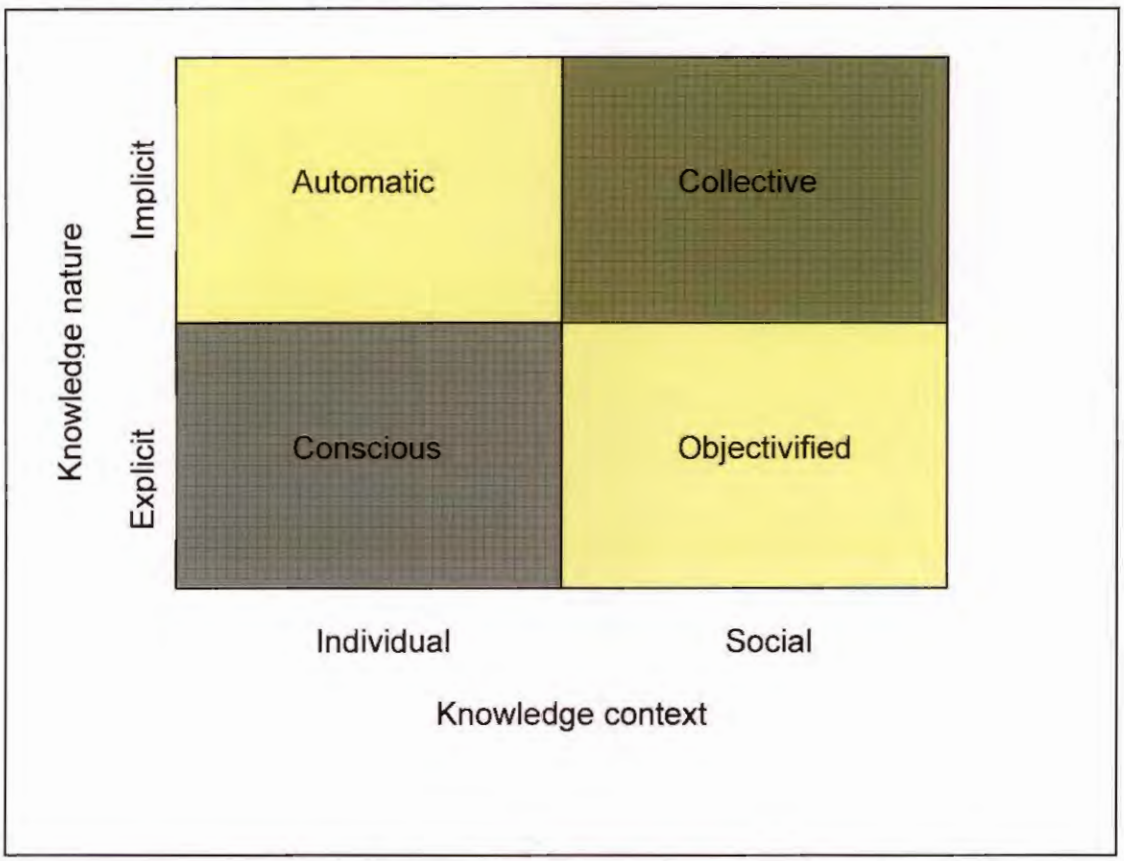
The organising of activities to facilitate the sharing of true tacit knowledge would be close to useless, as these forms of knowledge need to be passed on through mentorship and apprenticeship, for example. For implicit knowledge, however, these activities would be very useful (with the necessary incentives) in allowing the conversion of implicit knowledge into explicit knowledge, for the reuse by the larger organisation (Li & Gao, 2003:8).

2.2.2 Knowledge functions

Zack (1999:132) defines knowledge in terms of its application, and in applying knowledge to an intellectual resources map, identifies five functions of knowledge: declarative knowledge (know about), procedural knowledge (know how), causal knowledge (know why), conditional knowledge (know when) and relational knowledge (know with or who).

Spender (in Chaffey & Wood, 2005:226) suggests the following framework for four different types of knowledge:

Figure 2-1: The knowledge framework



(Source: Chaffey & Wood, 2005:226)

Referring to figure 2-1, conscious knowledge is the knowledge that an individual knows, and knows he/she knows. The fact that the electrician knows how to wire a plug is an example of conscious knowledge. Objectivified knowledge is when the procedure that the electrician uses to wire plugs is written up as a standard, and disseminated and internalised throughout the electrical maintenance department. Automatic knowledge is the knowledge that the master artisan has, that enables him to repeatedly produce high-quality work, with no recalls. It is highly experience-based, and often quite personal. Collective knowledge would be developed when the artisan is put to work teaching and coaching a class of apprentices, and they spend sufficient time with him to be able to master the tasks. Collective knowledge is the widespread tacit knowledge that most companies possess but find difficult to encode and thus disseminate (Chaffey & Wood, 2005:226).

Zack (1999:128) states that organisations would value collective-type knowledge more than any other, as it would be more difficult for a competitor to duplicate, and thus serve as a better basis for sustainable competitive advantage. In this regard, Zack (1999:133)

cautions that knowledge must be rated according to the competition in a field of industry; one has to analyse one's stock of knowledge *relative* to the knowledge that the competition is using. He further defines three categories of knowledge critical to competitive advantage:

- Core knowledge, as the entry-level required to allow the firm to exist in the given segment, for example, the base knowledge of steelmaking;
- Advanced knowledge allows a firm to compete within the industry. Firms may compete head-to-head, in the hope that the knowledge in a field is better than another firm's, or it may differentiate itself based on knowledge of, for example, blast furnace operation on cheaper, lower-quality coke; and
- Innovative knowledge is knowledge that a firm has that allows it to be a class-leader in its field, and significantly differentiates itself from its competitors. A new steel-from-iron-ore process may qualify here.

Figure 2-2 illustrates a firm's competitive position relative to its and the competitors' knowledge level.

Figure 2-2: The strategic knowledge framework

Your organisation				
	Innovative knowledge	Innovator	Leader	Viable Competitor
	Advanced knowledge	Leader	Viable Competitor	Laggard
	Core knowledge	Viable Competitor	Laggard	At risk
		Core knowledge	Advanced knowledge	Innovative knowledge
		Competitors		

(Source: Zack, 1999:134)

With reference to figure 2-2, if company X, competing in the market, possesses only core knowledge (the basics of iron manufacture in the steel industry, for example), then it would be a viable competitor only if the competition (Company Y) possessed no more than that knowledge. If Y possessed some knowledge of blast furnace optimisation strategies, this would make Y a leader in respect of the market, and specifically with respect to X. If Y then went on (with no change in competitive knowledge development

from X) and developed a knowledge base of customers and / or downstream products, together with the capability to manufacture said products, then X would be at a distinct competitive disadvantage to Y in the market. X would be at risk, according to figure 2-2. It is clear that, competitively, a firm must possess and utilise at least the same level of knowledge than its competitors, in order to survive.

2.2.3 Blackler's "five images" of knowledge

Blackler (1995:1023) developed five images of knowledge:

- Embrained knowledge (dependent on conceptual skills and cognitive abilities), also known as "know about". In the West, this is often focused on abstract, higher level abilities to develop complex rules and understand complex problems.
- Embodied knowledge (only partly explicit due to its action orientation), or "know how". This is typically illustrated by a "hands-on" kind of problem-solving, relying not on rules, but deep knowledge of a situation.
- Encultured knowledge (process of achieving shared understandings). This form of knowledge depends on language, and culture. For example, the personnel operating a blast furnace must first pick up the language used in everyday operations, and develop the "culture" of the blast furnace operators before they will be able to understand "how we do things around here".
- Embedded knowledge (residing in systemic routines). This is knowledge that the operators and workers have developed that they use in their everyday work in order that the organisation may reach its goals.
- Encoded knowledge (conveyed by signs and symbols). This includes books, manuals, the internet, knowledge management system (KMS) documents, and more.

Each of these views of knowledge is important to take into account when devising a knowledge management program (Chaffey & Wood, 2005:227).

2.2.4 Knowledge management

Fowler (2008:20) defines knowledge management (KM) as "*the systematic processes by which knowledge needed for an organisation is created, captured, shared, and leveraged*". This definition is quite encompassing, covering the knowledge generation

and sharing, but also stressing the fact that knowledge unused is useless. It must lead to action – a decision that is made and carried out.

Parkinson (2008:58) concludes that knowledge management is not something that an organisation does. It is the result that is achieved when a number of other things are done correctly.

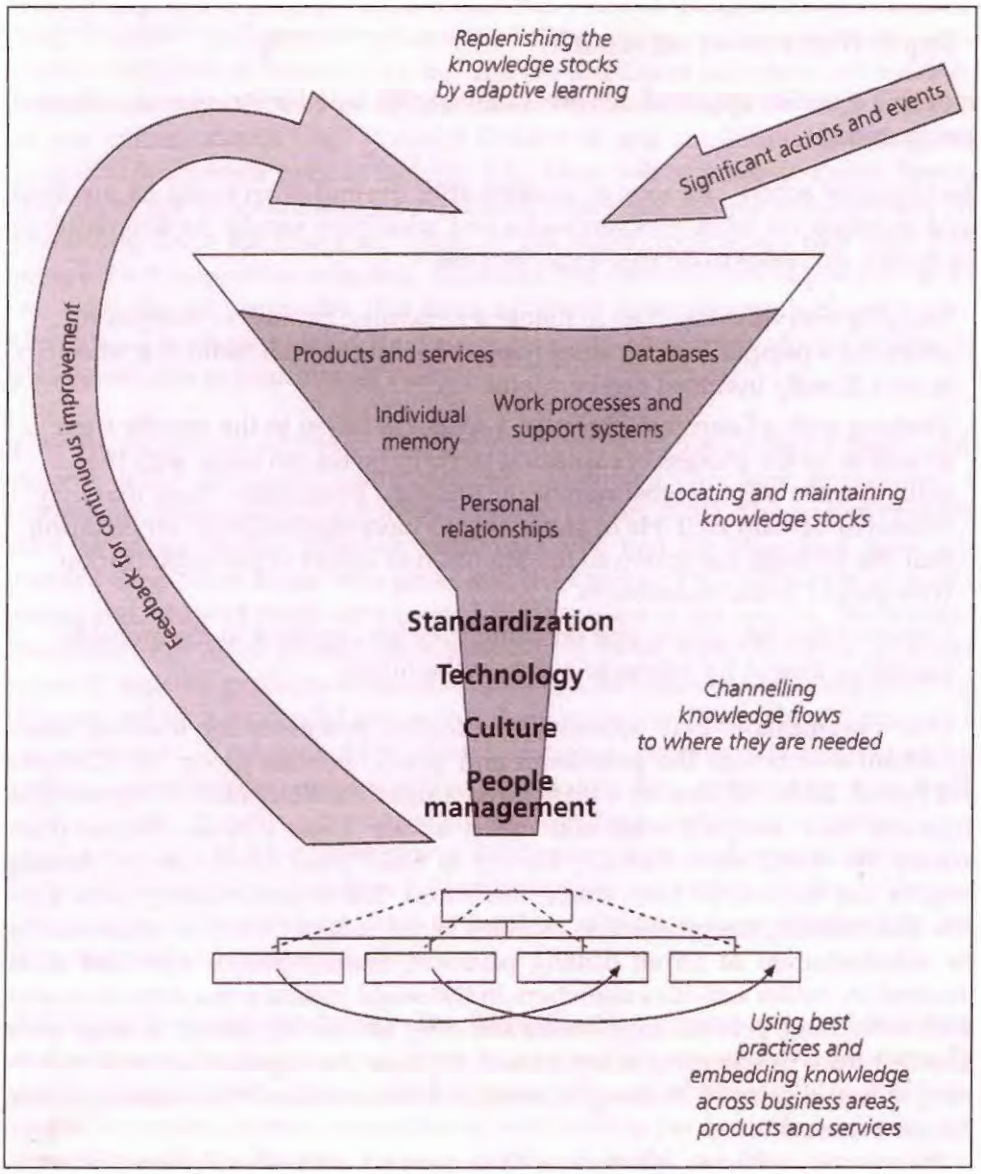
According to the European Knowledge Management framework (Chaffey & Wood, 2005:228), the following five core processes are at the heart of KM:

- Knowledge must be identified (what is important to know, and why, coming from the business's strategic goals);
- Knowledge must be created (if there is a gap, new knowledge must be developed by learning, training and problem-solving);
- Knowledge must be stored (either in documents or databases, or memorised)
- Knowledge must be shared (distributed timeously to the right people); and
- Knowledge must be used (applied to further the business goals).

The retention and sharing of explicit knowledge is often viewed as a simple push strategy in the majority of cases (procedures, standards, specifications) and can be achieved by using a knowledge repository, or document management system. Care should be taken, however, not to confuse the availability of information with the internalisation and sharing of knowledge.

McKenzie and Van Winkelen (2004:34), in their discussion of knowledge exploitation, speak of the importance of understanding knowledge stocks and flows. Figure 2-3 illustrates the concept. The management of these is critical to the success of the firm.

Figure 2-3: Knowledge exploitation mechanisms



(Source: McKenzie & Van Winkelen, 2004:35)

Knowledge stocks are defined as the existing knowledge resources of the firm (McKenzie & Van Winkelen, 2004:33). These are what we know. Knowledge stocks must be located, built and developed. This forms part of the utilisation of existing knowledge in the firm. Typical sources of these stocks (sometimes merely needing identification and locating) are products and services, databases, individual memory, work processes and support systems, and personal relationships. Referring to Figure 2-3, these stocks are "in" the funnel.

The replenishing of these stocks (which must be a continuous process, in order to keep learning and benefiting from the latest knowledge) forms part of what McKenzie and

Van Winkelen (2004:34) call adaptive learning. This typically takes place through the methods of what they term significant actions and events, and continuous improvement.

Significant events can be learned from in three ways (McKenzie & Van Winkelen, 2004:34-36): *learning before action*, where research, simulation and discussion with experienced colleagues come to the fore, *learning during action*, which the US Army uses as an After Action Review (Darling, Parry & Moore, 2005:85). Five questions are asked, namely, What was the intention? What happened? What have we learned from the experience? What do we do about it? Who do we tell about it? *Learning after action* involves bringing together everyone involved in the action, so that their perspectives can be gathered, drawing the most significant findings out, determining who should find out about this new knowledge, and documenting the results in a searchable electronic format for future reference.

People in and around the process can contribute to the knowledge stocks by utilising many methods. Three of the more successful methods used are suggestion schemes, whereby workers are encouraged to suggest incremental methods of improvement, publishing to shared databases, where solutions found in one area are disseminated to other areas of use (the Xerox photocopier repair program 'Eureka' and the BP VPN are two examples), and communities of practice, whereby people with similar areas of interest throughout the firm (be it local, national or global) could be connected to discuss improvements or findings they had made, and have these improved upon by discussion until a real benefit had been created (see section 2.3.2).

There are four requirements to enable knowledge flow (McKenzie & Van Winkelen, 2004:40-44). These are:

- Using the standardisation of interfaces and practices, such as ensuring that there are rules, procedures, policies and common language to ensure that knowledge flow is facilitated;
- technology solutions that allow knowledge sharing. Two types are recognised: push and pull types. Pushing knowledge is risky in that there may be value perception differences between the sender and the receiver, but pull strategies risk not using knowledge through ignorance;

- a supportive culture is crucial to ensuring that knowledge flow takes place (this is discussed at length in section 2.5.2); and
- conducive people-management practices such as internal hiring to make the most of the internal knowledge sources, on-the-job training to facilitate knowledge transfer, job rotation and shadowing, and proper performance management that focuses individuals on the benefits of effective, meaningful knowledge transfer.

Whilst by no means exhaustive, the above can help the organisation to ensure that the knowledge stocks contained within the organisation flow to the right areas.

Tacit knowledge needs to be carefully managed to ensure the widespread dissemination of the material. The Toyota Total Productivity System (TPS) is a case in point. The basic flaw that most companies make when trying to copy the TPS is that it is a system of production. They come away with kanbans and various other entities, but fail to improve their own systems appreciably. Why? The TPS is a way of thinking. It is the sum total of Toyota's tacit knowledge and attitude, a culture of performance (Leonard & Swap, 2004:97). This amounts to gaining a sustainable competitive advantage that is not easily copied. Indeed, Von Krogh, Ichijo and Nonaka (2000:vii) state that knowledge cannot be managed, only enabled. This concept is discussed further in section 2.3.

2.2.5 What is knowledge worth?

Knowledge is a difficult concept to measure, in terms of its worth to a company. KM return on investment (ROI) has, in the past, often missed the point. Measures such as the number of documents on a repository, or even the number of times a document was downloaded, do not address the key question of how much value was created by the process (Cohen, 2006:28).

Some firms can actually pin a number on its KM investments. Oil companies have demonstrated the savings in time and effort on drilling new wells. Xerox has claimed a 10% saving by sharing copier repair tips between its technicians. But other firms still struggle. Cohen argues that this is because companies are requiring inappropriate measures – hard numbers when softer indicators may be more useful. Typical

indicators may be anecdotes about successful (or unsuccessful) knowledge use and reuse, stories of successful or unsuccessful projects – a lessons learned type approach, and surveys of employee and customer satisfaction (Cohen, 2006:28).

As mentioned in section 2.1, knowledge is nowadays recognised as the only sustainable competitive advantage. It is the corporate asset *par excellence*. Widespread tacit, internalised knowledge is one of the most difficult things to copy, simply because it is not easily articulated. It will also not easily die out, because of its widespread nature and redundancy, and thus provides the sustainability that most organisations strive for.

The changing global economy means that firms have to compete in markets hitherto unknown to them, and they have to be able to adapt at a pace unknown in even the recent past. This makes knowledge, and more specifically the creation, storage, sharing and leveraging of knowledge, ever more critical to survival (McKenzie & Van Winkelen, 2004:1).

The information age precipitated the end of the line for proprietary competitive advantage. There are very few firms (Coca-Cola is one) that have a genuine trade secret. The science of steelmaking can be picked up almost anywhere on the internet, in technical bookshops, and other places. In general, it is impossible to prevent a competitor from getting a helping hand up the competitive ladder by copying and improving on original products or services. However, the true knowledge-creating company will always be able to keep a step or two ahead of non-creator companies. In this way, the competitive advantage will be indefinitely sustainable. To really catch up, the competition will have to also become a knowledge-creating company (Davenport & Prusak, 2000:15-17).

Knowing what one knows, to coin a phrase, becomes more critical as the size and complexity of a company increases. In smaller firms, everyone knows who the experts are, but in bigger, and especially multinational firms, the complexity of the tacit knowledge 'repository' is such that these firms need an effective knowledge management system (Davenport & Prusak, 2000:17-18).

The developing sophistication of computer networks guarantees the possibility to effectively share created knowledge. The richness of the transfer is being enhanced

continually with tools like webcams, sound, e-mail, intranets and the like. The reality is that information transfer, in theory, has never been easier. The technology, however, does not guarantee that the transfer and sharing of knowledge will take place. Unfortunately, the same human beings that create the knowledge may not exhibit a knowledge-sharing culture, and no amount of technology can overcome that hurdle (Davenport & Prusak, 2000: 18).

While tacit knowledge (as measured by the Tacit Knowledge Index, (TKI)) has a positive correlation with organisational outcomes, and a positive correlation with the degree of innovation, it has a lower correlation with financial outcomes. Thus, tacit knowledge has higher value to the firm valuing innovation, than to the firm emphasising financial outcomes (Harlow, 2008:158).

In summary, one can say that the knowledge-creating and sharing company has at its heart an asset that should contribute immensely to the bottom line. Contrary to the traditional return on net assets (RONA), this return is on improved services and products, processes, efficiencies, research and development (R&D), marketing and sales to mention but a few aspects.

2.3 KNOWLEDGE CREATION OR GENERATION

The first step in the knowledge management framework must be knowledge creation. Without the creation of knowledge, there would be very little point in managing it. The knowledge creation discussed here is the conscious and intentional generation or creation of knowledge – for a purpose generally aligned with the strategic intent of the business. But knowledge creation can take numerous forms. One form is knowledge acquisition, which is the gaining of useful, applicable knowledge, even if it was gained from outside. BP's "thief of the year" award, and Texas Instruments' "Not invented here but I did it anyway" award, emphasise that the usefulness of acquired knowledge should outweigh the nobility of new idea generation for its own sake (Davenport & Prusak, 2000:53).

Acquiring knowledge can be accomplished in many ways (Davenport & Prusak, 2000:53-67):

- by buying it (the takeover of an organisation that possesses the knowledge);
- leasing or renting it (for example, an industry funding research on the understanding that the first commercial rights of a useful product would be theirs, or hiring a consultant skilled in ways that the company isn't – project management or cleansheet process redesign);
- establishing and funding a R&D team or institute;
- fusion, whereby persons of differing backgrounds and perspectives (such as finance, engineering and marketing) are teamed up and forced to come up with a new solution for a problem (This often leads to very creative results);
- adaptation, or reacting to the changes imposed upon a firm by the outside world. These changes force a firm to alter the way it does things, or die trying; and
- networks, which allow people bound by similar interests to interact, both face-to-face and using technology, and thus share their knowledge with one another. In the process, existing knowledge is strengthened and new knowledge is often generated.

Most companies would also like to utilise the resources they already possess to create knowledge. Thus, they would like to share the knowledge that individuals have around the organisation, in order to bring everyone up to the level of the "*experts*" in the group. However, the most useful (and sticky) knowledge to be shared is exactly the tacit knowledge that is apparently so difficult to share. How would one go about creating and sharing this knowledge?

Nonaka (1998:28) suggests a framework for the creating of knowledge in an organisation. He makes mention of the "*spiral of knowledge*":

- Tacit to tacit (socialisation): Generally, a one-on-one mentoring, or apprenticeship that allows one person (or, sometimes a small group) to carefully watch and learn from a "*master craftsman*". The problem is that the organisation does not really benefit on a large scale from the transfer.
- Explicit to explicit (combination): The development of a new sales report for an organisation, based on the amalgamation of the sales reports from different

divisions, represents new knowledge. The organisation, again, does not gain any real insights from the summarising of data.

- Tacit to explicit (externalisation): When the apprentice, with the benefit, perhaps, of a more technical background, can start to articulate the tacit knowledge gained from the master into a set of standards or instructions that helps the organisation as a whole improve.
- Explicit to tacit (internalisation): The internalisation of the new explicit knowledge throughout the company (for example, from a plant visit) leads to a new way of doing things at the organisation. This improves the performance of the organisation.

One must be aware that the 'enriching' of the organisation's knowledge is typically across the tacit-explicit or explicit-tacit boundaries. Nonaka (1998:30) states that the articulation and internalisation steps are the critical ones for moving up the 'spiral of knowledge'. Note, however, that these are also the hardest steps, articulation requiring much effort from a team of people to develop the right language to allow them (and others) to understand the new knowledge, and internalisation requiring the sharing, embracing and effective utilisation of the created knowledge.

Care must be taken applying Nonaka's so-called SECI model to diverse organisations. This is due to especially the management style and organisational design of Japanese companies. The role of the middle manager in Japanese companies is more empowered than in Western companies, which are much more top-down oriented. The Japanese middle manager plays a tremendous role in applying learned knowledge to work. The other aspect, organisational design, relies on two long-standing, but recently changing tenets of Japanese companies: lifetime employment, and a seniority system for pay and promotion. Lifetime employment ensures a stable workforce. The seniority system, "further maintains cultural heritage, organisational memory and centre of authority, hierarchy and loyalty needed for discovering hidden talent within each team". In fact, research shows that Nonaka's socialisation, externalisation, combination and internalisation model (SECI model) ceases to be effective even with Japanese industries that closely relate to basic sciences (steel, chemical, IT, and others). It is also, due to the nature of Japanese culture, not easily ported to Western-style organisations (Li & Gao, 2003:10).

2.3.1 Enabling knowledge creation

As mentioned, knowledge is regarded by some as being unmanageable. Managers who would manage knowledge can only really enable the creation of knowledge. Von Krogh *et al.* (2000:viii) identify the five most important knowledge enablers with respect to knowledge creation, *viz.*:

2.3.1.1 Instilling a knowledge vision

This is the knowledge equivalent of an organisation's strategic vision. Thus, it includes a mental map of the world the organisation lives in, a mental map of the world the organisation believes it ought to be living in (the knowledge gap), and thence it should specify what knowledge the organisation's people need to seek and create (Von Krogh *et al.*, 2000:103).

2.3.1.2 Managing conversations

Conversations need to be encouraged in organisations to allow for the confirmation of existing knowledge, or the creation of new knowledge. Von Krogh *et al.* (2000:130-140) identify and expand upon four guiding principles for conversations in organisations, namely:

- actively encouraging participation;
- establishing conversational etiquette;
- editing (directing) conversations appropriately; and
- fostering innovative language.

They acknowledge the idea that conversations are the source of a huge body of human knowledge, yet state that managers are often guilty of underutilising this relatively cheap, effective method of knowledge creation and transfer, in favour of much less effective IT investments.

2.3.1.3 Mobilising activists

Activism is defined as "*a policy of vigorous action in a cause*" (Thompson, 1995:14). Thus, an activist is a person pursuing that policy of vigorous action, and the cause, in

this case, is knowledge creation. Von Krogh *et al.* (2000:149) identify three possible roles for knowledge activists, namely that they can be:

- the catalysts of knowledge creation. As a catalyst of knowledge creation, an activist triggers the knowledge creation process. Questions such as where, what, how, why, and when are typically asked of a particular business situation. Then, these process triggers are used to alert the organisation's leaders to the potential effect of the situation (which may be positive or negative), and the change process is started. The catalyst also helps create the enabling context for knowledge creation. Nonaka speaks about 'Ba' – a Japanese word meaning a virtual or physical space in which trust, care, love and commitment are present and protected – as a prerequisite for the exchange and development of implicit knowledge (Li & Gao, 2003:10);
- the co-ordinators of knowledge-creation initiatives. Co-ordinators are responsible for tying together the relevant expertise and creativity to allow knowledge generation. Von Krogh *et al.* (2000:153-156) recognise three levels of co-ordination. These are:
    - the microcommunity perspective, whereby people in an organisation (not necessarily geographically constrained) are teamed up to help solve a particular issue or problem. The co-ordination of this community must take into account perspectives, tacit knowledge and culture, to ensure effective knowledge creation. Not only the teaming up in one microcommunity but also the cross-linking of multiple communities, are the work of the knowledge activist. This helps prevent the "*reinvention of the wheel*" syndrome, so prevalent in many aspects of organisational life.
    - Imagined communities are communities who share certain values and traditions or culture. Countries are typically imagined communities. One citizen may not know another, yet they may go to war together in order to protect "their" culture and traditions. Organisations are no different. In many microcommunites, there may be knowledge workers who share a common background. The goal of the knowledge activist, inter alia, is to ensure that these workers are aware of one another, and thus facilitate their "connection" with regard to knowledge creation (see also section 2.3.2 on communities of practice).
    - The citizens of a country, while not perhaps knowing other citizens personally, merely have to look at a map of the country to see with whom

they share their traditions and culture. The same should be true of an organisation. Thus, shared maps of cooperation must be developed by an activist, in order that the organisational members can see who they can team up with in order to help solve a dilemma or problem.

- Merchants of foresight. The knowledge activist as a merchant of foresight needs to be able to guide the direction of the different microcommunities, even as he/she guides a particular microcommunity. Thus, a wider vision of the business strategy as well as focus is required.

So, it can be seen that the knowledge activist is critical in the whole process of knowledge creation, be it by catalysing, co-ordinating or guiding the direction of the knowledge creation process.

2.3.1.4 Creating the right context

As mentioned in section 2.3.1.3, trust and security are critical to effective knowledge sharing. Creating the right context is exactly about creating those organisational structures that help nurture good relationships, which, in turn, will help promote effective knowledge sharing and creation. Nonaka's "Ba" (section 2.3.1.3), and Von Krogh *et al.* (2000:178) come into its own here, as this is exactly what the term encompasses. Thus, the shared knowledge space is created where the following four interactions are encouraged:

- Originating. This is where individuals and teams can share tacit knowledge face-to-face, to allow the richness of the experience to be shared and captured.
- Conversing. Using a common language, a group is allowed to share the skills and mental models of an individual. Conversing allows the participants to bounce ideas and concepts off one another, analysing their own and other thoughts and feelings around certain topics.
- Documenting. Mainly utilising the combination and sharing of explicit knowledge, this sort of interaction is often based in an IT environment like groupware and intranets.
- Internalising. This is the individual process of taking the knowledge derived from the various forums, and making it one's own. This is a critical step, in that the tacit knowledge that has been gained is made tacit again, ready for re-use. This concept drives the sustainable competitive advantage of the firm.

Thus, management cannot enforce knowledge sharing. They should focus on the creation of a culture, or context, in which knowledge sharing is encouraged and rewarded (Von Krogh *et al.*, 2000:206).

2.3.1.5 Globalise local knowledge

The main benefit of globalising local knowledge is two-fold. One, the advances made at one division can be spread to others, but potentially greater than this is the fact that the division to which the knowledge is spread can also come up with something unique and even better. However, the old problem of "not invented here" comes back with a vengeance, and resistance to change is again a factor in the spreading of local knowledge. Often, the intended recipients pervert the knowledge (knowingly or not) to suit their own environment. So how does a firm go about globalising developed local knowledge? Von Krogh *et al.* (2000:213-223) suggest a three-stage process involving triggering, packaging and dispatching, and re-creating.

- Triggering is the process (analogous to Davenport and Prusak's (2000:25) knowledge market) of getting the "seller" to the attention of the "buyer". Von Krogh *et al.* (2000:213-223) suggest the use of electronic bulletin boards, knowledge conferencing, or the previously mentioned use of knowledge activists to achieve this.
- Packaging and dispatching can be thought of as analogous to the sending of automobile parts to a licenced producer.
    - The first question here that needs to be asked is "What knowledge needs to be packaged?" The automobile parts example holds up here, for only explicit knowledge can be packaged and dispatched without its owner. Tacit knowledge (due to the difficulty of articulation) would need to be transferred from the knowledge owner, via a personal visit, typically. Thus, the concept for a design cannot be packaged and sent to the car manufacturer; only the parts.
    - Once the "What?" has been answered, the next question is "In what sequence?" Can the entire vehicle be sent, and the team at the other end relied upon to accurately re-assemble? Or should the engine, chassis, interior, and the rest be sent in separate batches once confirmation of success of the previous assembly is received?

- Managers should also assign local experts to the knowledge sent. Again, the car assembly process helps clarify. An experienced engine mechanic or designer will more easily make sense of the assembly of the engine and gearbox. The marketing director will probably not. The knowledge packaged will, as mentioned, be explicit in nature, and will require local expertise to understand the tacit background of how it got to be explicit in the first place. The choice and training of such local experts will help in the effectiveness of the knowledge transfer.
- Appropriate storage methods for the knowledge must be sought. These storage methods must be linked to certain experts, who help with the relating of the knowledge back to the greater scheme.
- A knowledge-exchange policy should be developed. The exchange policy should be based on the needs of each division, in terms of competitive advantage. Simply because an advantage has been gained at division A, doesn't necessarily mean that the same, or indeed any, advantage can be gained at division B using the same technique.

– Re-creating is regarded as the most important of the three steps. This is because of the fact that the recreation of knowledge can trace many paths. A pure reproduction is one path, where the idea of the parent is blueprinted onto the child (this was typically what Benetton did with its distributed production system (Camuffo, Romano & Vinelli, 2001:47)). This is sometimes feasible. However, if a vehicle is going to be imported into China, and the plan is to use Chinese-produced engines, some modification may need to take place. It may in any respect be more rewarding to the division concerned to allow its own inputs into the process, to help the internalisation process.

It is often advantageous (for reasons of economy or expertise) to centre production or R&D in different parts of the country, or globe, even. Distribution centres abroad can improve marketing to new or emerging markets, and thus help the firm become more globally competitive. The re-creation of knowledge in various global sectors can be expensive (both to develop and as a result of failing to heed already-known lessons). The globalisation of local knowledge outlined in this section is a method of preventing such costly knowledge re-creation (Von Krogh *et al.*, 2000:207-8).

2.3.2 Communities of practice

What is a community of practice (CoP)? Wenger and Snyder (2001:2) describe these as "groups of people informally bound together by shared expertise and passion for a joint exercise". They propose that communities of practice add value to their organisations in six main avenues:

1. They help drive strategy, due to their focus on transferring usable knowledge throughout the group (and ultimately the organisation).
2. They start new lines of business, which come from the innovative way in which problems are tackled, by sharing knowledge between them.
3. They solve problems quickly, because they are connected to the experts, and they know who to ask, how to ask, and how to interpret the answers.
4. They transfer best practices, by acting as a forum on which to build the best knowledge of a particular facet of the organisation's business.
5. They develop professional skills, by being available and willing to share knowledge and skills with more junior members.
6. They help companies recruit and retain talent, by being vehicles for personal and professional development. Often, a lack of personal and professional development is the reason people leave companies. By being involved in a community of practice, the member is challenged and stimulated in exactly the way that keeps them interested in staying at the firm.

McKenzie and Van Winkelen (2004:117-126) note that the stickiness of knowledge (that is, the tendency for knowledge not to be shared) is something that can be dismantled through the use of communities of practice (CoPs) (2004:120). They state that a CoP will only function if value is derived from the community for both the individual and the organisation, and that individuals' values must be aligned with those of the organisation.

Motivation for individuals to participate in a CoP is varied, but include own expertise development, sense of achievement, status, influence, competence improvement, sharing with other with similar interests, satisfaction from helping others, recognition, confidence, relationship-building, greater sense of belonging, and material benefits due to better organisational or personal performance (McKenzie & Van Winkelen, 2004:121).

Successful CoPs have been found to require four areas that are a recurring theme throughout the knowledge management / organisational learning discipline: *appropriate subject area* (something perceived as adding value), *a clear purpose*, the *fulfilment of certain roles* (a respected leader is critical), and *appropriate organisational support* (integrating the CoP into other business activities and technology facilitating communication and collaboration). Two enabling factors are a *culture of trust and openness*, and *organisational acquiescence* (at least neutral to the functioning of the CoP) (McKenzie & Van Winkelen, 2004:121-122). Thus, functioning in a CoP allow individuals to put their knowledge on the workplace "map", as it were, and facilitate the flow of knowledge through an organisation.

2.4 KNOWLEDGE CODIFICATION

From Davenport and Prusak (2000:68), the transforming of knowledge into an organised, explicit, portable and easy-to-understand form is known as codification. From the previous discussion of tacit knowledge, this may not be possible, for example in the case of the knowledge, experience and craftsmanship of an experienced master tradesman.

Successful knowledge codification (that which *can* actually be codified) rests on four pillars, according to Davenport and Prusak (2000:69). These are:

1. Relevance: Codified knowledge must serve certain identified business goals. It may be less useful codifying knowledge that serves no real purpose in the strategic sense.
2. Availability: The existing knowledge (in its various forms) as needed must be identified.
3. Suitability: The usefulness of the knowledge to the goals, as well as the suitability thereof to codification, must be ascertained.
4. Media: Appropriate media for the codification and distribution of the knowledge must be identified.

Relevance is paramount. The codification of especially tacit knowledge can be an extremely time-consuming and expensive exercise, so only the most important information should be tackled, particularly as a first step. Just making knowledge

generally available would be a waste of corporate resources, with little potential for return. The knowledge to be codified should serve the business's goals (Davenport & Prusak, 2000:69).

Availability is also very important. What is not there, will not be available to codify. *Whether* the knowledge exists, however, is only part of the problem. Ascertaining *where* it exists is another problem altogether. So, the availability issue is really two-pronged: do we have it? And where do we find it? Some methods are discussed in sections 2.4.2 and 2.4.3 (Davenport & Prusak, 2000:69).

Suitability, the third tenet, is also a potentially sticky issue. Having ascertained that the knowledge is within the company, finding out where it can be found (i.e. with whom), and that it is relevant to the business goals of the organisation, it should be determine whether or not the knowledge can be codified. This is typically an issue with subtle, slowly grown tacit knowledge (Davenport & Prusak, 2000:70).

Once relevance, availability and suitability have been established, the best media for the codification process must be selected. If one is codifying knowledge about the specifications of a particular product, pure text may be all that is required. For more complex knowledge, a richer form of media could be used (Steed & Mrazek, 2000:1194). Take as an example a science experiment: The old textbook-type codification is practical, as in aim, background, apparatus, method, observations, and conclusions. How much more effective would the presentation be if one could place a multimedia file on a repository with all of the above information coupled audibly to a video file showing the experiment itself, where the experiment can be safely seen in a much richer form.

One of the highest forms of media adaptation is probably the flight simulator. This equipment is a means of imparting extremely rich knowledge to pilots by projecting them into a moving cockpit of an aircraft on the ground, and allowing them to experiment with various flight manoeuvres without fear of death in the event of making a critical mistake (Lee, 2005:73). This kind of experience would not be suited to a drab, report-style presentation.

2.4.1 Knowledge codification dimensions

Davenport and Prusak (2000:70) have identified a number of continua, which help determine the suitability of knowledge to codification. Some continua are:

- Tacit to articulable;
- Teachable to not teachable;
- Articulated to not articulated;
- Observable in use to not observable in use;
- Rich to schematic;
- Complex to simple; and
- Documented to undocumented.

It is important to understand that almost all knowledge will fall somewhere in the middle of the particular continuum, meaning that there are very few situations where there is purely tacit and completely non-articulable knowledge. Something will be able to be explained. Similarly, few things can be explained purely via a schematic. But, by ascertaining approximately where on the various continua a knowledge situation lies, one can develop a better "feel" for the suitability of the knowledge to codification, and the best sort of media for that codification (Davenport & Prusak, 2000:70).

2.4.2 Tacit knowledge codification

It has been established in section 2.1 that widespread, embedded tacit knowledge (relevant to the business goals) is the only sustainable competitive advantage a firm can really have and develop. So how does the firm get into the position of having such widespread tacit knowledge, considering the difficulty of encoding such knowledge?

Generally speaking, the richest, most complex tacit knowledge in the organisation will only really be able to be codified to the extent that the person(s) possessing the knowledge / experience are identified and "pointed to". If these persons are willing to share their knowledge (and the company provides the time / incentive for them to do so), then their knowledge *may* be spread through the company. *May*, because, in the knowledge market, as in a traditional market, there must be sellers and buyers. There must be a pull demand for the knowledge (Davenport & Prusak, 2000:71).

2.4.3 Knowledge mapping

A knowledge map is exactly what it says it is. It is a map of the organisation, which allows knowledge-seekers to find the person(s) that can satisfy their requirement for knowledge. It has been found that knowledge-seekers (buyers) would rather spend less time and effort getting less-than-the-best knowledge from a close colleague, than going to lengths to get the best knowledge available. This is typically the case with computer software. Facing a problem, a person will generally ask a "knowledgeable" colleague for the solution, instead of working through the help file (a codified knowledge base, if there ever was one!) him/herself. Given a knowledge map, the person will be able to identify the individual(s) in the company that could best help solve the problem (Davenport & Prusak, 2000:72-74).

Microsoft has developed a methodology to help develop effective knowledge maps. It is a five-step process:

1. Develop a structure of knowledge types and levels.
2. Define knowledge required for particular jobs.
3. Rate the performance of individuals in particular jobs in the knowledge competencies.
4. Populate an on-line system (database) with the knowledge competencies.
5. Link the knowledge map to training programs.

In this way, the individuals who possess relevant knowledge are identified and pinpointed. Others, requiring that knowledge, will be able to contact them and request help. Provided that the company's culture promotes knowledge-sharing, the knowledge will then be able to spread through the organisation (Davenport & Prusak, 2000:75).

2.5 KNOWLEDGE SHARING AND TRANSFER

The main objective in knowledge management is to get people who possess knowledge, or knowledge sellers to share ("sell") their knowledge to people who require the knowledge to help them to achieve organisational goals. They are the knowledge buyers (Davenport & Prusak, 2000:28). This is termed knowledge sharing. Marks, Polak, McCoy and Galletta (2008:62) identify three variables that affect the level of sharing between individuals in an organisation. These three variables are:

1. Managerial prompting, also known as "nagging" whereby management periodically reminds the group or individual of the need to share knowledge. This has been found to improve the level of contribution to a knowledge management system.
2. Group identification creates bonds of co-operation between individuals. The reinforcement of this identification has been seen to help even uncooperative individuals improve their level of contribution to the process of knowledge sharing.
3. Social value orientation. Three profiles can be used to identify individuals: Collectivists (prosocial, typically Eastern cultures support this type) try to ensure equal sharing of returns with others; competitors try to maximise the distance between themselves and others, even if that means they do not maximise their own position. Individualists attempt to maximise their own position, regardless of what happens to colleagues or others. Competitors and individualists are regarded as proself. It can be logically deduced that prosocial persons would naturally contribute more to a KMS than proself persons. The ability to coax proselfers to contribute can be seen to be critical to the overall success of a knowledge sharing programme.

Marks *et al.* (2008:65) discuss tactics that can be used to get proselfers "on board" with regard to knowledge sharing. Typical of these are to assign individualists to teams and incentivise the teams. That way, being on the winning team may help to promote knowledge sharing from the individualist. Competitors need to be constantly reminded of the fact that the organisation is the main competitor that should be focused on, and emphasising the importance of a strong competitive position in the market may help to prompt sharing from the competitor.

There are a number of barriers to effective tacit knowledge transfer, such as stickiness (the ease with which knowledge can be transferred from sender to recipient, in terms of context and practice); reluctance to share (due to fear of losing knowledge "power", insufficiently rewarding climate, or simply being unaware of the demand for his/her knowledge); the ambiguity of the knowledge needed; lack of absorptive capacity (or savvy) of the receiver, difficult relationships between sender and receiver; or lack of motivation. Other factors are the unreliability of the sender; the organisational structure;

overemphasis on technology to the detriment of the human factors; power; trust; likes and dislikes (Alvis & Hartmann, 2008:142-143).

The best way to transfer knowledge is to hire clever people and allow them the freedom to talk to one another at length. However, especially in Western organisations, this is seen as somewhat anathema. The bottom line, however, is that people do talk to one another, and they do share information and knowledge, whether this process is managed or not. The main problem that may be present in this sort of scenario is that the person sharing the knowledge (the seller, in this case) may not be the best, most knowledgeable person on the subject available. That person may simply be the closest best bet. The question is: How does an organisation go about effectively managing or enabling the process? Alternatively, how does the organisation go about ensuring that the right information gets from the best source to the needy team / individual at the right time in the most cost-effective manner, in order that the sustainable competitive advantage is developed and grown? (Davenport & Prusak, 2000:88)

Psychologist Edgar H Schein is of the opinion that learning only happens when survival anxiety is greater than the learning anxiety. Because of this, there are two ways to increase (or even start) organisational learning: increase survival anxiety, or reduce learning anxiety. Increasing survival anxiety can be achieved through, *inter alia*, threatening to fire a person, or withdrawing rewards (demotions, variable pay / bonus). This is often done in organisations today, as it is an easy way to achieve the goal. Reducing learning anxiety, through, as we have seen, improving trust, becoming failure-tolerant and allowing people to "connect" with one another, is the more difficult route, and according to Schein, is easily derailed when the going gets tough, for example, in a downsizing environment. Management credibility (the trust that many authors have spoken about) is the cornerstone for reduction of learning anxiety (Coutu, 2006:105).

Schein's work with Korean War US prisoners of war (POWs) led him to develop the theory that, in order to survive, the POWs had to be resilient. This meant (usually) becoming passive, or going "underground". This is similar to a knowledge "seller" withdrawing his / her "product" from the market. The right sort of encouragement and safety must be present in an organisation to prevent such things from happening (Coutu, 2006:105).

2.5.1 Strategies for effective knowledge transfer

It has been shown that the mere presence of knowledge does not guarantee its use, much less its effective use. Some strategies that can be used to help foster knowledge transfer (Davenport & Prusak, 2000:89-95) are:

- Water coolers / coffee machines. A poorly utilised resource for useful knowledge transfer is the water cooler or coffee-machine. People, when allowed by management, often gather together to discuss all manner of topics face-to-face here. While there will, no doubt, be some "small talk" (just as there is at the CEO's budget meeting), the talk will, almost inevitably, turn to work and issues facing the staff. Talking through these issues and general discussions are often some of the better ways of getting knowledge transferred between people. Management often restricts the flow of knowledge because of the faulty assumption that the talk is *all* petty (Davenport & Prusak, 2000:90-91).

- Talk rooms. Due to the rather arbitrary nature of knowledge transfer at the water cooler, many companies (especially in Japan) have invested in talk rooms. These are areas set aside specifically for the purpose of encouraging the transfer of ideas and knowledge. Dai-Ichi Pharmaceuticals actually expects its knowledge workers to spend at least twenty minutes a day in these chat rooms, where there are no organisers, no formal meetings, just tea, and attractive lighting that helps set the tone for people to get together and discuss work (Davenport & Prusak, 2000:92).

- "Informal" after-hours socialising. Japanese managers spend many hours after work together at group dinners or nightclubs. This helps them to talk about the business environment, while not interfering with their day-to-day responsibilities. It also helps develop trust between the management, and helps promote the venting of criticism. Part of Japanese culture, this may not be well taken in the West, where the emphasis is often on more "quality" time with family (Davenport & Prusak, 2000:92).

- Knowledge fairs are another way of encouraging knowledge transfer. Within ArcelorMittal, the knowledge management program (KMP), is the premier vehicle. It brings together people with varying cultures and backgrounds (with a

process as a common thread, for example, coke-making), and allows them almost a full week per year of presentations, get-to-know-one-another events, and mutual discussions that allow network building and knowledge dissemination (Davenport & Prusak, 2000:93).

- Mentoring is a time-honoured method for the sharing and transfer of the tacit knowledge that people possess. A mentor is someone who takes a less experienced or knowledgeable colleague under his/her wing, so to speak. This allows the younger colleague to learn from the "wiser" individual, so shortening learning curve. A trust relationship develops, that is not easily broken throughout the lifetime of the relationship (Davenport & Prusak, 2000:95-96).

- Electronic technology can be used to facilitate the spread of knowledge. Knowledge maps, repositories, intranets and various other means can be employed to help spread the explicit knowledge available around the organisation (Davenport & Prusak, 2000:96).

Note that most of the abovementioned strategies require extensive face-to-face contact. This, according to the Japanese method, is the only effective way tacit/implicit knowledge is transferred. The notion of geographical location is a potential promoter and inhibitor of effective knowledge transfer. Co-location is seen as being of benefit by many authors, and this is, in fairness, beyond dispute for the transfer of tacit knowledge. The problem arises when knowledge needs to be transferred to the outside of the particular cell, or CoP. Then, co-location can be regarded as promoting silo-thinking. This must be guarded against when trying to expand local knowledge (Søndergaard, Kerr & Clegg, 2007:430).

2.5.2 Cultural factors in knowledge transfer

Davenport and Prusak (2000:97) and Haldin-Herrgard (2000:361-363), together with Du Plessis (2008:286) and Jashapara (2005:143), discuss a number of potential problem areas in tacit knowledge transfer.

- *Trust* is critical in a knowledge transfer process. Søndergaard *et al.* (2007:431) illustrate that trust can be a "double-edged sword" in this regard. Trust, built up

over time, is vital to allow people to share knowledge. A trustworthy, knowledgeable person is more likely to share knowledge, and be asked to share knowledge. The knowledge shared or transferred is also more likely to be acted upon, fulfilling the "leveraging" definition. However, if the information is ambiguous, and not fully understood by the buyer, the transfer of knowledge can range from sub-optimal to disastrous. Implicit trust in the "expert" could lead to incorrect decisions being taken.

- *Language* is obviously a critical link in the organisational learning chain. One would not even think of trying to converse with somebody who shared no facet of language with oneself. Thus, a person speaking only English would not be very successful in communicating with a Han Chinese who had no exposure to English. In the same way, a blast furnace expert would not find knowledge sharing very effective if he/she were trying to explain the intricacies associated with blast furnace operation to a mill operator who had never been exposed to the terminology of a blast furnace. People tend to struggle to articulate, especially their tacit knowledge (Haldin-Herrgard, 2000:361).

- *Time / opportunity resources.* In some instances, knowledge cannot be effectively transferred without what the US Army calls "face time", the actual interpersonal sharing of the what, how, why, when and who of the critical factors affecting the performance of the organisation. Management must then ensure that the time and opportunity for such required interventions are provided (Haldin-Herrgard, 2000:362). Nonaka's concept of redundancy is important here in the sense that redundancy allows the quicker comprehension of the issues facing the organisation. This is because of the wider spread of responsibility and knowledge resources. Redundancy is anathema to Western management, who views it with distaste due to the connotation with wastefulness. The Japanese, however, seem to make good use of it (Nonaka, 1998:36).

- *Organisational status and rewards.* Due to the pressures of everyday operations, senior staff can often not be spared to take part in knowledge transfer actions. Junior staff is often sent, and then, when they make recommendations on their return, the very reason they were sent (because of their lack of seniority) becomes the reason that their learning is not espoused in the wider organisation.

Furthermore, organisational status is often bestowed upon knowledgeable people (the stocks), instead of on those transferring their knowledge effectively (the flows). These people are often highly regarded in the organisation, and as such, are rewarded for their status, rather than rewarding the transferring of knowledge. Organisations should focus on rewarding (with status and other incentives) the effective transfer of knowledge (Davenport & Prusak, 2000:100).

- *Readiness of "buyers" and motivation of "sellers".* Davenport and Prusak (2000:25) make mention of the knowledge "market". Implicit in this is the notion of buyers and sellers, analogous to an actual goods market. The motivation of the participants, according to Søndergaard *et al.* (2007:430) plays a role in the effectiveness of knowledge sharing. Some people are naturally inquisitive, tending to seek knowledge actively. Others are not. Some individuals are, as seen, pro-social, and willing to share knowledge. Other, more proself, individuals may tend to "hoard" their knowledge, believing it confers upon them a competitive advantage in itself.

- *Snobbishness.* This refers to the notion that an organisation can do things better than the competition, and tends to foster a culture of wheel reinvention. Organisations should realise that there are numerous individuals / organisations that have contributed to the world body of knowledge, and that this knowledge can be utilised for further knowledge creation. The "not-invented-here" syndrome has no place in the modern competitive world. The quality of ideas should transcend its source, in the business world, provided the sourcing is ethical to start off with (Davenport & Prusak, 2000:53, 100).

- *Mistake intolerance.* The old adage "he who makes no mistakes makes nothing" should be applied to today's organisations. The fear of making a mistake and being chastised for it is probably a major reason for the presence of *learning anxiety* (Coutu, 2006:104). Organisations that foster mistake-intolerance are shooting themselves in the foot, as far as learning is concerned. Reducing mistake-intolerance is one of the steps Schein advocates to reducing learning anxiety, and Davenport and Prusak (2000:97) go as far as to say that creative mistake-making should be rewarded, as it contributes to the organisation's body of knowledge.

2.5.3 Velocity and viscosity of knowledge transfer

Velocity of knowledge transfer refers to the speed at which knowledge is transferred through an organisation. The above factors will influence this speed. The extent to which the knowledge is transferred relative to the intention of the sender is termed the viscosity of knowledge transfer.

Viscosity can be thought of as the amount of knowledge transferred relative to that which was intended. Thus, a master tradesman who spends a few years teaching and training an apprentice is likely to impart high-viscosity knowledge in his young protégé. The apprentice will have, due to the time and painstaking manner, coupled with his high degree of "hands-on" learning, developed a rich and effective knowledge of the subject matter. Knowledge gained from the quick perusal of a memo will be much less viscous. This can be seen together with the codification dimensions discussed in section 2.4 (Davenport & Prusak, 2000:103).

2.6 ORGANISATIONAL LEARNING

Garvin (1998:51) defines the Learning Organisation as "*an organisation skilled at creating, acquiring and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights*".

Edmondson (2008:61) identifies four approaches that the learning organisation needs to adhere to in order to improve:

1. Use the best knowledge available, with the understanding that this is not a static target.
2. Enable the workforce by making information available when and where it is needed.
3. Routinely capture process information to determine how the work is really being done.
4. Study the data in order that better ways of working may be discovered.

She also shows that the execution-focused organisation (as opposed to the learning-focused one) suffers from a number of problems, some of which are that critical

information stays where it is, instead of getting to the management's attention. This is mainly because the workers are afraid to waste their manager's time with new ways of doing things. People have insufficient time to learn, because they are too busy getting the daily things done. Unhealthy internal competition arises from the general practice of rewarding the best performing units, thus inhibiting the sharing of ideas. Perhaps most tragically, the companies often see their success as evidence of their wisdom. This can blind them to new opportunities. Edmondson sees learning as a function of psychological safety and accountability as exhibited in figure 2-4.

Figure 2-4: Psychological safety / accountability matrix

Psychological safety	High	Comfort zone	Learning zone
	Low	Apathy zone	Anxiety zone
		Low	High
	Accountability for meeting demanding goals		

(Source: Edmondson, 2008:64)

It can be seen that when an organisation has low psychological safety and accountability (P_lA_l) , the workers tend to fulfil their functions (just), but try to look better than their cohorts, rather than genuinely act for the betterment of the company. P_hA_l leads to workers being in a comfort zone, where not much is demanded from them, but they have a good relationship with one another. P_lA_h gives rise to tension in the organisation, as there is a lack of trust, but stretched targets are the norm. The workers realise that they need to bring in new ideas, try new things or share knowledge with colleagues, but are afraid to do so. Thus, the organisational goals suffer. P_hA_h leads to empowered, sharing employees working together in order that the organisation's goals are met and exceeded. This epitomises the true learning organisation.

Lapré, Mukherjee and Wassenhove (2000:609) go further in showing that, in manufacturing organisations, only what they termed *operationally validated theories,* learning was inclined to reduce waste, that is, improve manufacturing efficiency. Looking at companies, they came up with the following types of learning, based on the interaction between conceptual learning and operational learning:

Figure 2-5: Impact of induced learning

Conceptual learning			
	High	Non-validated theories (increase waste)	Operationally validated theories (reduce waste)
	Low	Firefighting (no significance)	Artisan skills (no significance)
		Low	High
		Operational learning	

(Source: Laprè *et al.*, 2000:609)

Conceptual learning is defined as developing a better cause and effect knowledge (know why, in Blackler's terms), using statistics and other scientific methods. Operational learning (know how), is the implementation of a theory and observing positive results. The authors, studying a manufacturing company, found that, in the sense of reducing waste on the shopfloor, a low level of conceptual learning, coupled with a low level of operational learning, had no effect on waste produced. This makes sense in as much as the organisation cannot expect to improve if any meaningful change did not occur in the process. Oragnisations end up firefighting, but never get to the cause of the fires. Often the problem is solved, but resurfaces a little later (Laprè & Van Wassenhove, 2002:109).

Similarly, a high level of operational learning, with low conceptual learning, also has no significance. Organisations do not understand the process any better, they are simply trying out different things to see if it works. This form of operation is termed artisan skills. The problem is solved, but only works for that specific instance. There is no real value in the solution (Laprè & Van Wassenhove, 2002:109).

Worse are the unvalidated theories. Here, there is a high level of conceptual learning, but little or no operational learning. Thus, solutions to a problem are devised, but the solutions are not checked with plant data. This generally worsens the situation (Laprè & Van Wassenhove, 2002:110).

Only the combination of high conceptual learning with real verification on the shopfloor gives satisfactory results. The so-called operationally-validated theories are real

scientific solutions, proven on the shopfloor to have the desired effect. These were the only types of projects that the authors could prove reduced waste (Laprè & Van Wassenhove, 2002:110). Thus, they discovered that conceptual learning had to be linked with operational learning in order to be effective.

Argyris (1998:82) proposes that, in spite of the necessity of learning, and the efforts put into learning, the persons that an organisation most requires learning from do not know how to learn. He further defines single-loop and double-loop learning in order to investigate why this might be so. Single-loop learning is the learning that allows people to solve real-world problems. The ability of learned people to accomplish this is not really in doubt.

However, Argyris goes on to show that double-loop learning, or the ability to learn from failure, to adapt one's organisational practices in the face of changing requirements, is where the problem mostly manifests itself. He claims that "defensive reasoning" is the answer to the question of why people are not very good at double-loop learning. In order to improve the situation, Argyris argues the case for a more internal locus of control from the top down, and frank discussion of the issues that affect the organisation's performance.

In allowing a company to get its employees to become skilled at double-loop learning, Garvin *et al.* (2008:111-114) propose that companies focus on three building blocks for learning:

1. A **supportive learning environment**. Similar to what other authors propose, Garvin *et al.* reinforce psychological safety, appreciation of differences, openness to new ideas and time for reflection as necessary for a learning climate.
2. **Concrete learning processes and practices**. Experimentation, information collection and analysis, education and training, and information transfer, all as performed in the US Army's CALL system (Darling *et al.*, 2005:84-92).
3. **Leadership that reinforces learning**. Leadership is critical to learning. Leaders who actively question and listen to their employees encourage people to learn.

They have proposed a diagnostic tool questionnaire that helps analyse the learning position of an organisation. In each subsection, 'benchmark' scores are provided, in

order that a firm can measure how it performs relative to the norms of the companies already measured.

It is appreciated that most firms do not perform well over all three building blocks, or even over the sub-components. This is taken as evidence that there are distinct activities required to improve the performance of the firm. They suggest that there are four principles that should be taken into account in order to help improve organisational learning (Garvin *et al.*, 2008:115-116). These are:

1. **Leadership alone is insufficient**. Leadership behaviour is very important, but is not the only aspect needing attention in firms struggling with organisational learning. The cultural and process aspects of learning require more focused action. Formal learning processes and installing a supportive learning climate require concrete steps of their own.
2. **Organisations are not monolithic**. It is rarely effective to utilise one method to change an organisation's learning ability. Different departments will have different characteristics, and these should be taken into account in the designing of the learning strategy. Specifically, one can analyse a performing department for ways in which to learn.
3. **Comparative performance is the critical scorecard.** High scores do not necessarily indicate strength areas. One must score against competitors or benchmark data.
4. **Learning is multidimensional**. Due to the complex nature of organisations, and humans, the improvement of the overall organisational learning score precludes focus in only one area (say time for reflection). Management will have to ponder over how to modify the organisation in order to best improve the situation.

The tool is thus a mirror, designed to allow an organisation to assess itself, and learn from the results. This should help foster introspection and improvement across the organisation (Garvin *et al.*, 2008:116).

2.7 CONCLUSION

From the literature study it can be concluded that the management of knowledge, and the development of real learning organisations, are the key to a sustainable competitive advantage. Knowledge, in turn, is seen to be information in context that produces

actionable understanding. Knowledge has many facets, such as experience, complexity, judgement, values and beliefs.

Knowledge can be split into explicit and tacit knowledge. Explicit knowledge is knowledge that can be easily codified, or written down. Standard operating procedures (SOPs), product specifications and the like fall into this category. Tacit knowledge, on the other hand, is much more difficult to encode. Tacit knowledge is much like the mastery that a violinist demonstrates over his field. It cannot easily be explained. It must be taught, generally face-to-face, one-to-one. The spreading of tacit knowledge in an organisation is critical to the development of a sustainable competitive advantage. Tacit knowledge can be further subdivided into levels of implicitness, or the degree of reluctance with which a "knower" shares his tacit knowledge.

It was seen that, strategically, it is imperative that a firm possesses (and uses) at least a level of knowledge that allows it to compete in the chosen sphere. This knowledge, termed advanced knowledge, is at a higher level than the core knowledge required merely to be in the sphere, but the true advantage is gained when innovative knowledge is developed and shared within the organisation.

Knowledge management has at its core five processes, namely identifying, creating, storing, sharing and using knowledge. If any of these five core principles is not used, the knowledge management process is doomed to fail. The first three processes are linked to the *stocks* of knowledge within a company. Sharing and using are all about knowledge *flows*. Unfortunately, many companies are more preoccupied with creating knowledge (or worse, information or data) stocks, than enabling its flow. This creates silos that undermine the organisation's drive towards becoming a learning organisation. The identifying of key knowledge practitioners, and thence the encouraging of them sharing their knowledge with others, is a vital step that must be enabled to allow a firm to really learn.

The value of knowledge can be difficult to calculate. Methods range from hard numbers like call-centre data usage, to softer facets like customer satisfaction surveys. Perseverance with knowledge management will produce improvements in many Key Performance Indicators (KPIs) if the five core processes are properly adhered to.

Ways to improve or enable the creation or acquisition of knowledge were discussed in detail, as was the codification of such knowledge. Codification is the documenting of what the firm knows. This can only be carried out once the knowledge that a company has is mapped out, so that the firm knows where to find what it knows. This is often termed a knowledge audit. Once the knowledge audit has been successfully completed, then the process of knowledge sharing and transfer can be improved upon. This requires much change in the way traditional management thinks, as the ways in which effective knowledge transfer takes place are often anathema to management. Talk rooms, water coolers, knowledge fairs, mentoring and socialising are but a few methods.

There are barriers to knowledge transfer, unfortunately. These were discussed at length. Factors such as trust, common language (cultural and technological), time and opportunity, organisational status, rewards, willingness to share and receive, snobbishness and mistake intolerance of management are some of the major barriers to effective knowledge transfer.

In organisational learning, many of the previously mentioned tenets come to the fore. It was seen that, for effective organisational learning, high psychological safety has to be coupled to high accountability for meeting goals. Furthermore, in order to improve the process, conceptual and operational learning must be utilised together to reach value-adding operationally validated theories.

Three factors (at a minimum) must be focused on to enable the learning organisation. A supportive learning environment, coupled with concrete learning processes and practices must be present, overseen by leadership that reinforces learning.

In addition to the above, it was seen that leadership is a necessary but insufficient condition. Furthermore, a blanket approach over an entire organisation will probably not work, as different departments will have different dynamics. The real test of a learning organisation must be the comparative scorecard, in order that the learning can be shown. Lastly, it was found that learning is a multidimensional activity. Thus, all three of the above factors must be worked on concurrently to achieve success.

Focusing on these factors will lead to an improvement in the skills of the workforce at the key aspects of creating, acquiring and sharing of knowledge.

2.8 CHAPTER SUMMARY

In this chapter, the literature was reviewed with reference to knowledge, knowledge management and organisational learning. Section one was used to give a brief background as to the importance of knowledge and the study in general.

In section two, knowledge *per se* was discussed. Knowledge was defined, and the explicit, implicit and tacit forms of knowledge were discussed. Various types and forms of knowledge as found useful by various researchers were highlighted and discussed, as was the concept of knowledge management, and the actual value of knowledge. The fact that knowledge is regarded as the only sustainable competitive advantage was highlighted, underlining the importance of this study.

Section three was committed to knowledge creation and generation, with a discussion of how knowledge can be obtained, created or generated. The enabling of knowledge creation, as opposed to the management thereof, was highlighted, and the value of communities of practice (CoP) in the knowledge management program was brought up.

Section four was used to highlight the various aspects of knowledge codification. Without codification, knowledge cannot be made explicit, and explicit knowledge has an important role to play in organisational learning and knowledge management. The relevance of, availability of, suitability to, and media needed for, knowledge for codification was discussed.

As the most critical dimension of knowledge management / organisational learning, the transfer and sharing of knowledge was discussed in section five. The various requirements for a culture conducive to knowledge sharing, barriers to knowledge sharing, as well as ways of overcoming the pitfalls to enable the organisation to share knowledge effectively were discussed. The concept of learning anxiety was introduced as a way of understanding the reluctance of individuals to learn or share knowledge. Strategies to overcome this issue were promulgated, notably the developing of trust and psychological safety in the workplace.

Section six was reserved for a discussion of organisational learning. Ultimately, knowledge management *per se* counts for very little if the organisation as a whole does not learn and benefit from it. Thus, the importance of high levels of psychological safety coupled with high levels of accountability for meeting demanding goals was highlighted as a prerequisite for organisational learning. The combination of high levels of conceptual as well as operational learning was stressed for more efficient performance. The reduction or elimination of defensive reasoning is proposed for the improvement of double-loop learning, which is underpinned by a supportive learning environment, concrete learning processes and leadership that reinforces learning.

Chapter 3 deals with the empirical component of the study.

CHAPTER 3

RESEARCH METHODOLOGY AND FINDINGS

3.1 INTRODUCTION

In Chapter 2, numerous sources indicated that there are factors in the workplace that promote or hinder the effective management of knowledge, and organisational learning. In this chapter, the focus will be on the research methodology used to help meet the research objectives as laid out in section 1.3. In addition, the findings from the survey will be presented.

3.2 A BRIEF OVERVIEW OF ARCELORMITTAL SOUTH AFRICA

The history of ArcelorMittal South Africa can be traced back to the early days of the 20th century. Even before the turn of the century, Mr Sammy Marks obtained a concession to produce iron and steel in South Africa. The real start came in 1927, when the South African government (the so-called "Pact" government) tabled legislation that led to the formation of the South African Iron and Steel Industrial Corporation – Iscor (Anon., 2009b).

Iscor developed the Pretoria steelworks in 1934, and in 1943, the construction of a heavy plate mill at Vanderbijlpark was undertaken. 1947 saw the greenfields establishment of an integrated steelworks in Vanderbijlpark. This plant, which has seen much development throughout its years, is the main focus of this study (Anon., 2009c).

In 1971, an integrated long products steelworks was erected in Newcastle. Here, billets and sections for the construction and rail industry were manufactured. Meanwhile, the operations at Pretoria were given a boost in 1988 with the commissioning of the world's first commercial Corex primary iron furnace (Anon., 2009c).

After privatising in 1989, Iscor embarked on a program to expand its influence in the country's iron and steel sector. USCO's Vaal Works were acquired, and renamed Iscor Vereeniging. 1994 saw the upgrading of Pretoria's plant to produce stainless steel, but

the venture was ill-timed and led to the closure of the Works in 1997, save for the coke battery. On a more positive note, Iscor launched a joint venture with the Industrial Development Corporation (IDC) to develop a minimill at Saldanha, commissioned in 1999. Iscor acquired the IDC's share of Saldanha in 2002 (Anon., 2009c; Anon., 2009d).

In order to unlock shareholder wealth, Iscor was split in 2001 into Iscor Steel and Kumba Resources (the mining section). This coincided with a time of tremendous upheaval for the company, in which a massive re-engineering programme was undertaken, with personnel drastically reduced, and operations trimmed. A Business Assistance Agreement was signed with LNM, the parent company of the second biggest steel producer in the world, Ispat. LNM subsequently increased shareholding to 51%, and Iscor was renamed Ispat Iscor in September 2004 (Anon., 2009c; Anon., 2009d).

A change to Mittal Steel South Africa followed a branding exercise which led to the merging of LNM and Ispat. In 2007, Mittal and Arcelor, then the largest steel producer in the world (based mainly in Germany, France, Spain and the Benelux countries), signed a joint venture, and the once Iscor became ArcelorMittal South Africa. ArcelorMittal became the largest steel producer in the world, with over 320,000 employees on five continents – truly a global steel company (Anon., 2009b).

3.3 QUANTITATIVE RESEARCH DISCUSSION

The tool decided upon for the study was non-random purposive sampling. The idea was to get the maximum number of responses possible within the timeframe available. A questionnaire taken from Garvin *et al.* (2008:112) was used and distributed to all D, E and F role managers and engineers at ArcelorMittal's plants at Vanderbijlpark and Newcastle (these being the largest centres). The reasoning behind this as a sample frame was that the processes at Vanderbijlpark and Newcastle are broadly comparable (both are integrated steelworks), and the D to F categories represent the bulk of the specialised knowledge workers within the South African context of the Group.

Sample sizing is critical for the accurate representation of the data from a survey. From Levine, Stephan, Krehbiel and Berenson (2008:303), can be seen that the sample size is determined as follows:

Equation 3-1 : Sample size determination

$$n = \frac{Z^2 \pi (1-\pi)}{e^2}$$

Where:

n = sample size required for given parameters

Z = number of standard deviations for given accuracy (1.64 for 5% two-tailed, that is 90% confidence level)

π = proportion of sample of interest (a value of 0.5 maximises the sample size, thus minimising the error)

e = error allowable, in this case, 10%

In terms of the study, there are 375 D, E and F role personnel at ArcelorMittal Vanderbijlpark and Newcastle. Equation 3-1 results in a figure of 67.24 surveys required in the sample. Rounding up (in order not to increase the error made to greater than allowable) gives 68 surveys required. This is the maximum number required, due to the choice of π at 0.5. In total, 73 responses were received, which is greater than the minimum required, and thus it can be assumed that the survey would have given dependable results.

The internal consistency of a survey is typically measured using Cronbach's alpha value (Bowerman, O'Connell & Oris, 2006:354). The variable measures the level of consistency that responses generated deliver with respect to questions designed to address the same construct. Grau (2007:1) offers a suggestion that a value of 0.7 for alpha gives a good indication that the internal consistency is high. The equation used for the calculation of Cronbach's alpha is given as:

Equation 3-2: Cronbach's alpha coefficient

$$\alpha = \frac{k}{k-1}\left[1 - \frac{\sum_{1}^{k} S_i^2}{S_T^2}\right]$$

Where:

α = Cronbach's alpha coefficient

k = number of items in the analysis

S_i = item standard deviation

S_T = total standard deviation of all items in the construct

In order to test the internal consistency from both centres, the Cronbach alpha values for eight questions were determined, four each from Vanderbijlpark and Newcastle. The summary is seen in Figure 3.1 below.

Table 3-1: Cronbach's alpha values for selected constructs

Centre	Construct	Cronbach's α
VB	Psychological safety	0.5252
NC	Appreciation of differences	0.3486
VB	Time for reflection	0.6652
NC	Experimentation	0.6164
VB	Analysis	0.6676
NC	Education and training	0.7869
NC	Information transfer	0.8373
VB	Leadership that reinforces learning	0.8107

Bearing in mind the previously mentioned suggestion of 0.7, it can be seen that with the exception of Newcastle's 'Appreciation of differences', all of the constructs give reasonable to good internal consistency. Even the value of 0.3486 for 'Appreciation of differences' lies some halfway between 0 and 0.7, which indicates some degree of internal consistency.

Based on the above discussion, the findings as reflected in the survey can be used to draw meaningful conclusions. These findings are summarised and analysed in section 3.4.

3.4 SURVEY FINDINGS

In the literature study, a number of recurring themes were found that indicated how knowledge management and organisational learning could be promoted or hindered. These factors are neatly summed up in Garvin *et al.* (2008:110) as

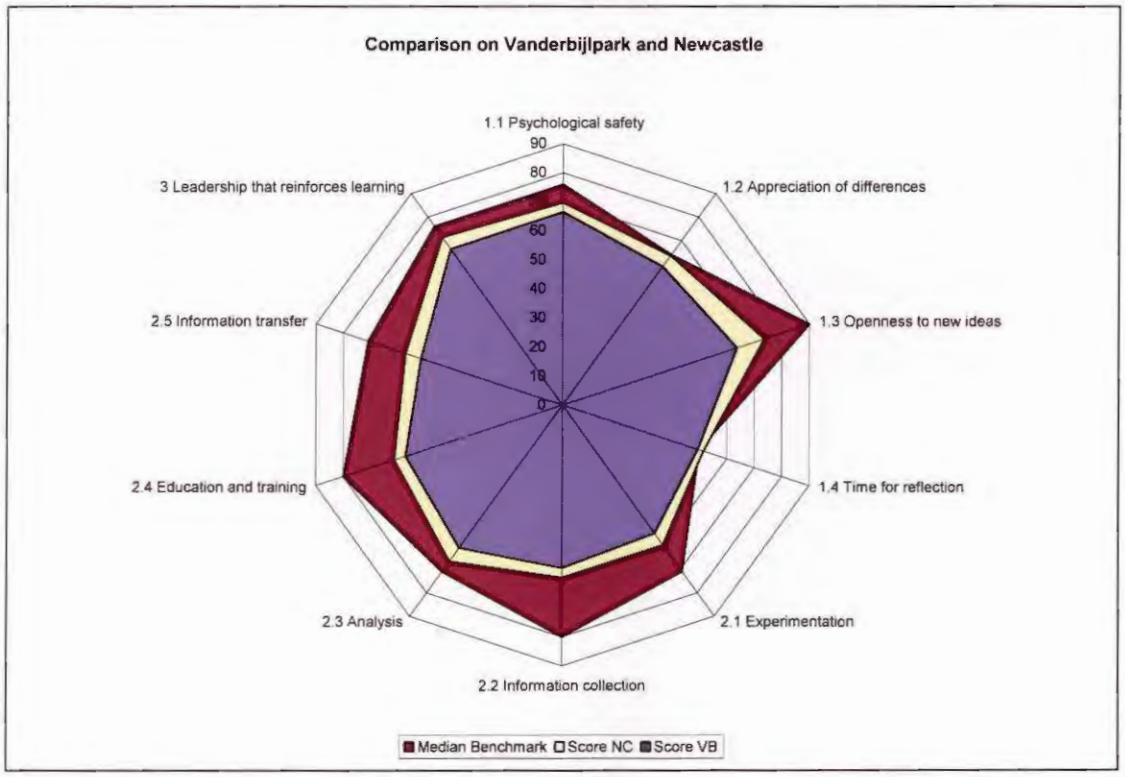
- A supportive learning environment, consisting of
    - Psychological safety (the freedom to express oneself without fear);
    - Appreciation of differences (the ability to recognise the value of competing and diverse outlooks);
    - Openness to new ideas (the tendency toward risk-taking and novel solution creation); and
    - Time for reflection (the availability and utilisation of time to sensibly reflect on work undertaken, in order to improve the process).
- Concrete learning practices and processes, consisting of
    - Experimentation (the use of the process for discovery and fine tuning of new ideas);
    - Information collection (acquiring of knowledge from competitors, customers, and other areas);
    - Analysis (the utilisation of information to find causal factors affecting processes);
    - Education and training (the development of staff to allow them to perform better in the workplace); and
    - Information transfer (the management of knowledge flows – as opposed to the generation of knowledge stocks above).
- Leadership that reinforces learning (leadership that values the creation and use of knowledge to further the business' goals).

With such a tool available, it was decided to assess the Vanderbijlpark Works and compare divisions within the Works, as well as the Works as a whole with Newcastle Works. At the same time, the level of learning within both organisations could be compared to benchmarks available in Garvin *et al.* (2008:114). The responses are all based on a 7-point Likert-type scale ranging from "strongly disagree" (1) to "strongly agree" (7). These were scored (some items are reverse-scored, reflecting undesirable

behaviours or attributes) and then each section normalised to percentages. These percentages were then compared to the benchmark.

Below can be seen a figure depicting the graphical relationship between Vanderbijlpark, Newcastle and the median benchmark from Garvin *et al.* (2008:114). This will henceforth be simply called the 'benchmark'.

Figure 3-1: A comparison between Vanderbijlpark, Newcastle and the HBR median benchmark



Based on the survey results received from the ArcelorMittal units at Vanderbijlpark and Newcastle, it can be seen that the general state of affairs at Newcastle appears to be marginally better than that perceived at Vanderbijlpark. In both cases, block 1: A supportive learning environment, can be improved upon substantially.

In terms of psychological safety, the Works falls between the bottom and second quartiles. This indicates that the knowledge workers do not feel safe in freely advocating their (sometimes conflicting) ideas. It is important to understand that this safety is based on being put down, or rejected, rather than on job security and the like.

As far as appreciation of differences is concerned, the personnel have indicated a reasonable level of awareness and acceptance of opposing ideas. This is a good sign, as it indicates a willingness to embrace alternative outlooks and learning. There is room for improvement, as the score attained is still below the benchmark (which is well below the 'best in class' scores).

Openness to new ideas is a particular area of concern. Vanderbijlpark, especially, is lacking in this area. This area covers aspects such as the creation of novel solutions, risk aversion, and experimentation. The scores obtained would indicate a lack of fault tolerance in management, which is at least partly a legacy of the past, but which will have to be addressed in the future.

Time for reflection yielded the lowest score. It would appear that ArcelorMittal South Africa is on par with the benchmark in this regard, illustrating that time is a major issue in most companies globally. However, in order that real organisational learning can take place, this will need to be addressed.

Both units are lacking in block 2: Concrete learning practices and processes. This would indicate a general failure to acquire, create and transfer knowledge within the organisations. As seen in section 2.2.4, knowledge management is concerned with the creation, capturing, sharing and leveraging of knowledge, and organisational learning (section 2.6) with an organisation modifying its behaviour to reflect the realities of the new learning. Obviously then, the processes and practices used for learning are critical to the development of the learning organisation. ArcelorMittal South Africa can be seen to be deficient in all of the five areas, with the worst areas being information collection, and education and training. The best area was analysis, although this is also significantly below par.

Interestingly, both units score reasonably highly on block 3: Leadership that reinforces learning. This would seem to indicate that there is no fundamental leadership issue, as far as organisational learning is concerned. However, this is a "necessary, but not sufficient" condition for effective knowledge management and organisational learning.

The question is thus posed: How much better are the processes in Newcastle, than at Vanderbijlpark? A statistical test for significant difference between the means of the two

groups is employed to determine if significant differences exist. For the sake of simplicity, ten major constructs, rather than each individual question, are considered.

The pooled-variance t-test for the difference between two means is used to determine whether there is a significant difference between the means of two populations, based on the differences between the statistics of the two samples representing the populations. According to Levine *et al.* (2008:371), this test is valid, provided that the following assumptions are made:

- Samples are randomly and independently selected;
- Populations are normally distributed (or, according to the Central Limit Theorem, n_1 and n_2 are both greater than or equal to 30); and
- Population variances are equal (thus $\mu_1 = \mu_2$).

The null hypothesis is:

$$H_0: \mu_1 = \mu_2 \text{ or } \mu_1 - \mu_2 = 0$$

Against the alternative that the means are not the same, thus:

$$H_1: \mu_1 \neq \mu_2 \text{ or } \mu_1 - \mu_2 \neq 0$$

The pooled-variance t-test tests the null hypothesis with the following test statistic of t.

Equation 3-3: T-test

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Where:

$S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{(n_1 - 1) + (n_2 - 1)}$ and is termed the pooled-variance,

$\bar{X}_1$ is the mean of the sample from population 1

S_1^2 is the variance of the sample from population 1

n_1 is the size of the sample from population 1

$\bar{X}_2$ is the mean of the sample from population 2

S_2^2 is the variance of the sample from population 2

n_2 is the size of the sample from population 2

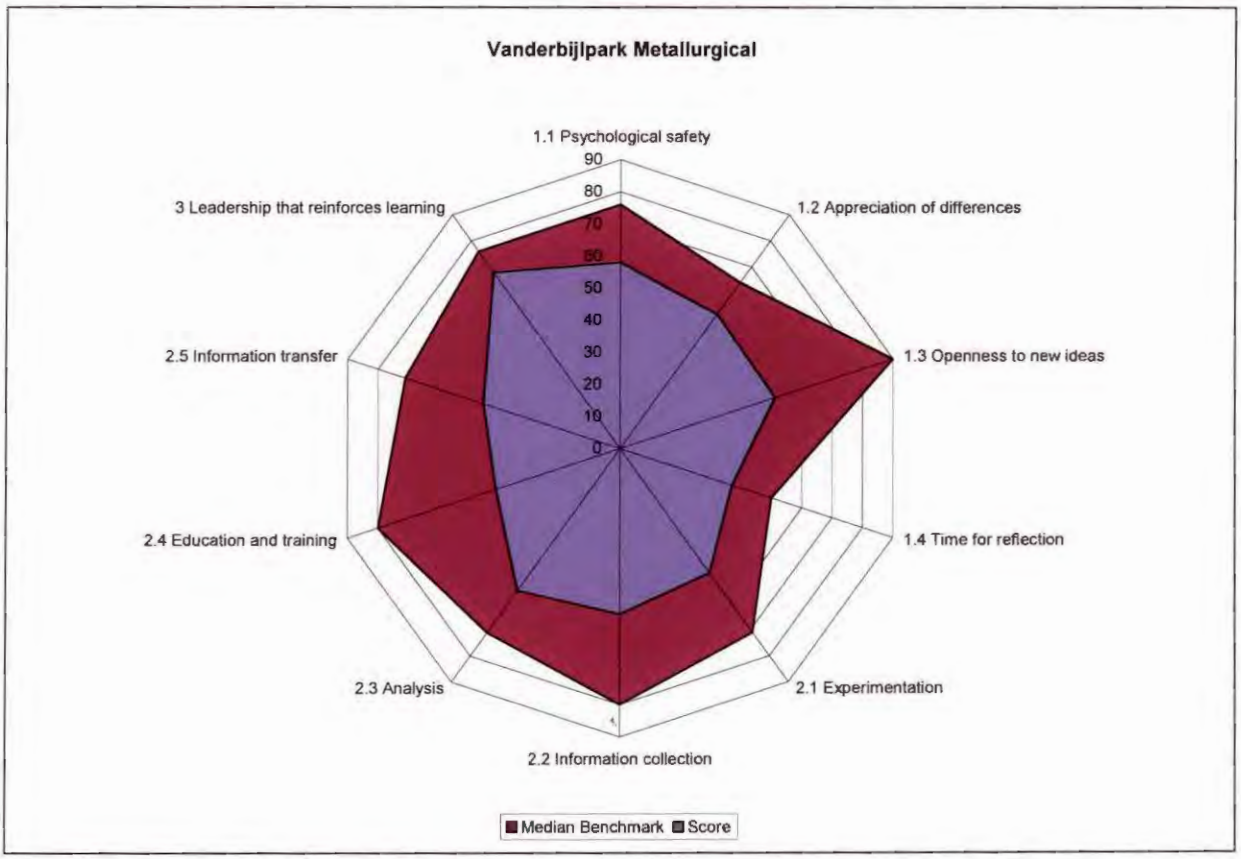
The test statistic, t, follows a distribution with n_1+n_2-2 degrees of freedom

In this case, the sample sizes are 30 and 43 respectively. This requires a two-tailed t-test with 71 degrees of freedom, and using $\alpha=0.025$, correlating with a 5% level of significance. The critical value for t can be seen to be 1.9939 (Levine *et al.*, 2008:794-5). Thus, we would reject H_0 if t lies outside the area of $-1.9939>t>+1.9939$. In table 3-2, it can be seen that all 10 of the constructs' t-values lie within the described area, and thus it can be concluded that there are no significant differences between Newcastle and Vanderbijlpark.

Table 3-2: T-test results

Construct	X_1	S_1^2	X_2	S_2^2	t
1.1	4.88	2.496	4.65	2.733	0.5925
1.2	4.46	2.872	4.12	2.681	0.8509
1.3	5.13	2.430	4.45	2.355	1.8278
1.4	3.60	3.248	3.47	2.829	0.3273
2.1	4.20	2.766	3.83	2.691	0.9392
2.2	4.21	3.226	3.93	2.778	0.6632
2.3	4.66	1.608	4.26	1.960	1.2462
2.4	4.33	2.972	4.01	2.829	0.7959
2.5	4.05	3.584	3.62	2.219	1.0764
3	5.00	2.339	4.65	2.404	0.9477

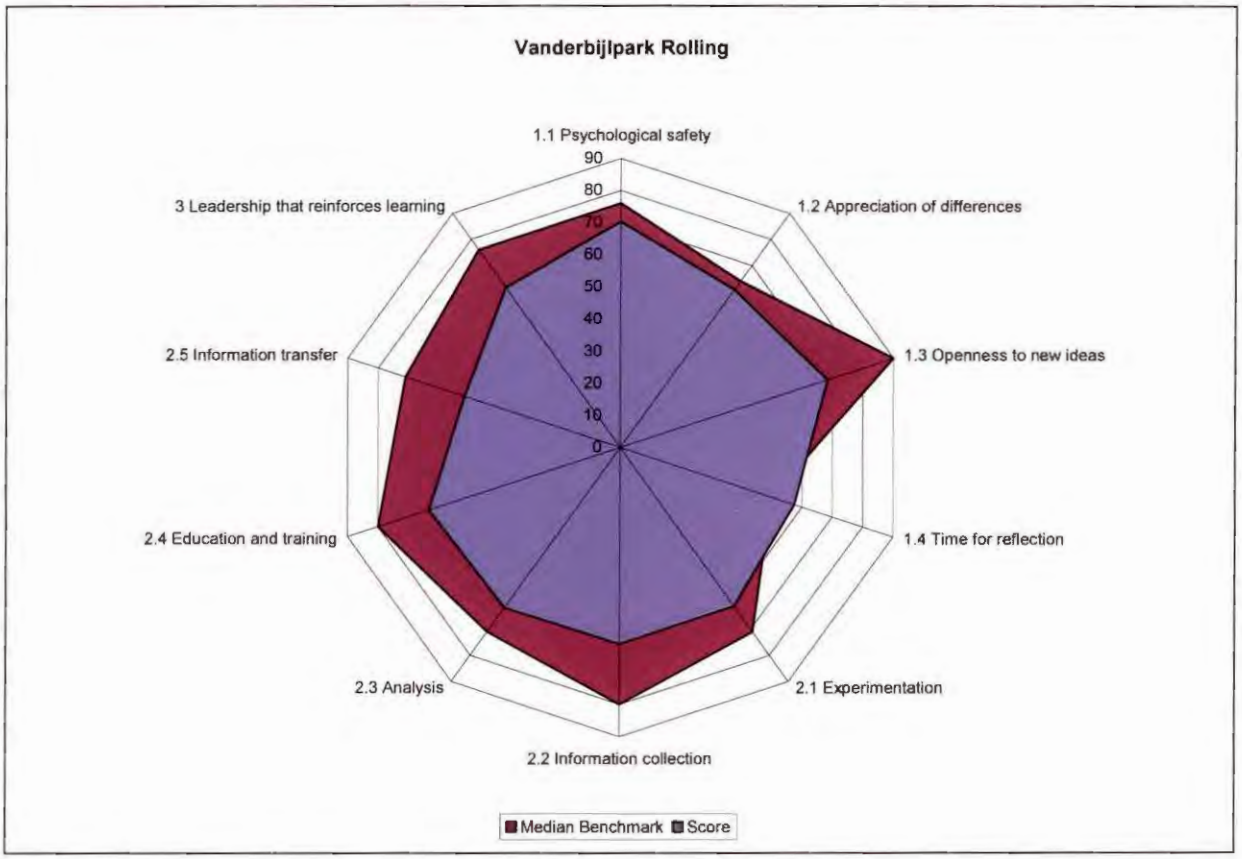
Figure 3-2: Vanderbijlpark metallurgical units against HBR median benchmark



As reflected in figure 3-2, the metallurgical units at Vanderbijlpark are in most respects far below the benchmark. Only block 3: Leadership that reinforces learning can be regarded as within the ballpark. Both the environment and processes required for learning are lacking. A large focus will have to be placed on the learning environment

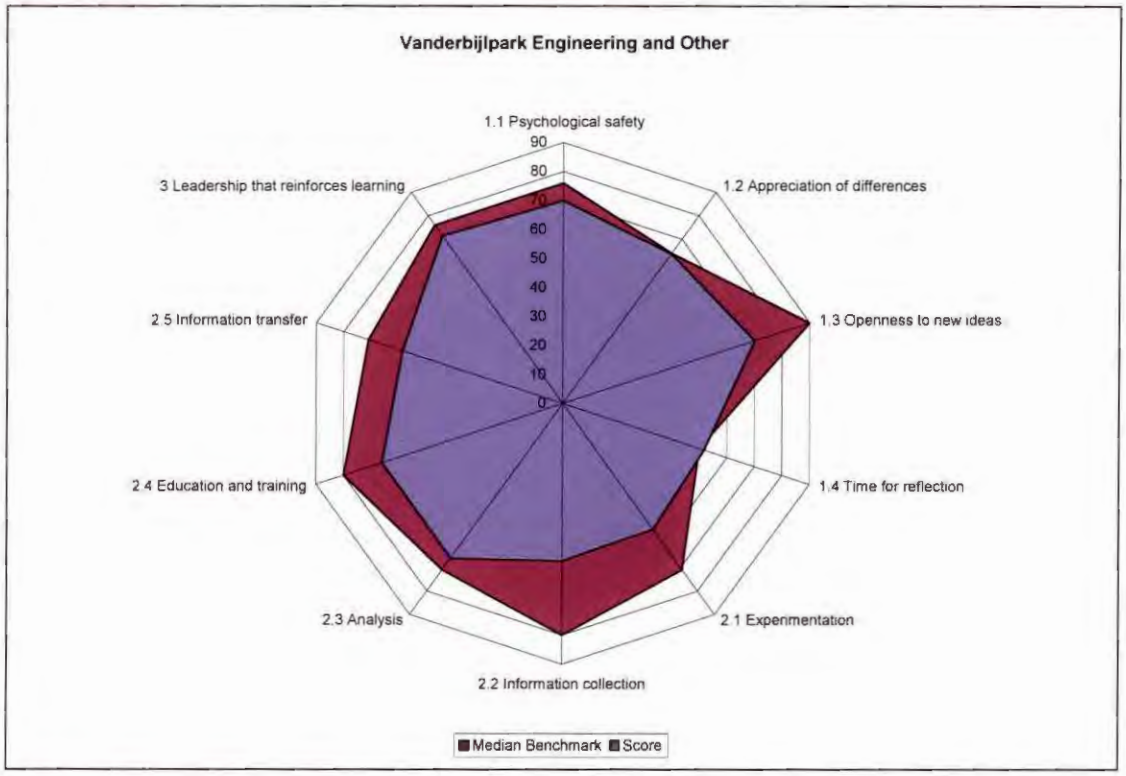
and processes within the metallurgical areas. No real focus area can be identified, as there appears to be a general failure to learn in this key area within the Works.

Figure 3-3: Vanderbijlpark Rolling units against HBR median benchmark



Here, the tendency of the Rolling units toward higher levels of learning can be seen. Significantly better performance than the metallurgical units in terms of supportive environment and concrete learning processes can be seen. Significantly, there appears to be more time for reflection than in the benchmark, or indeed, the rest of the group. Ways in which this is managed should be looked at to determine how the other sections can learn from the Rolling Department.

Figure 3-4: Vanderbijlpark Engineering and other units against HBR median benchmark



As shown in figure 3-4, the supportive environment and leadership aspects are relatively well covered. The concrete processes, disturbingly, fall far behind the other blocks in this division. Considering that the engineering and other units cover typically the higher-level shared functions, this is not a desirable state of affairs. Experimentation and information collection can be seen to be well below par, and much effort will need to be expended in these areas.

3.5 CONCLUSION

The survey was analysed from the point of view of the Vanderbijlpark Works of ArcelorMittal South Africa. The data gathered in the survey, based on the statistical analysis of sample size versus accuracy required, as well as looking at Cronbach's alpha values for various constructs, were deemed to be a reliable indicator of the true state of affairs within the organisation.

It was seen that, with the help of the pooled-variance t-test, there was no significant difference between the Newcastle Works and the Vanderbijlpark Works, as far as the level of organisational learning was concerned.

The results indicate that the level of organisational learning within the Vanderbijlpark Works varies from department to department. The Rolling and Engineering departments are somewhat better off with regard to its learning environment, but all three departments need to work on the facets of concrete learning processes and practices. Leadership, it can be seen, is close to the median. The Vanderbijlpark Works of ArcelorMittal South Africa should be able to gain much from applying the tenets of knowledge management and organisational learning found in this study.

3.6 CHAPTER SUMMARY

Chapter 3 was devoted to the research methodology and presentation of results. An overview of ArcelorMittal's operations in South Africa was given. The background to the quantitative research approach used by the author to assess the level of organisational learning within the centres of Vanderbijlpark and Newcastle was presented. The population used was the D, E, and F role management and technical specialist group at both centres. Of the 375 members of the population, 73 complete responses were received. These were analysed and used to draw conclusions with regard to the level of organisational learning in the company. The internal consistency of the answers received was tested and found to be, in general, fairly good.

Analysis of the received questionnaires highlighted a number of issues. While Newcastle fared slightly better than Vanderbijlpark in the scoring, analysis revealed that there was no significant difference between the two population groups. Within the framework of the research, it was found that the respondents felt that the supportiveness of the learning environment could be improved upon. Furthermore, it was seen that the development or improving of concrete learning processes and practices is important to the improvement of organisational learning at both centres. An important fundamental, the level of learning-reinforcing leadership, appears to be present and quite healthy at both centres.

Chapter 4 presents the conclusion of the study and makes recommendations to achieve the objectives of the study.

CHAPTER 4

CONCLUSION AND RECOMMENDATIONS

4.1 INTRODUCTION

As stated in section 1.6, Chapter 4 is devoted to drawing conclusions from the survey, and putting forward recommendations for the more effective creation, acquisition, and transferring of knowledge. From the knowledge gained in Chapter 2, and the findings in Chapter 3, recommendations are made to improve the areas of learning environments, learning processes and leadership. Furthermore, a strategy is proposed that will help lead to the improved level of knowledge management and organisational learning within the confines of ArcelorMittal's Vanderbijlpark Works. This will be portable to other sections suffering from similar situations. The chapter concludes with the identifying of possible further avenues for research within the field of study.

4.2 FINDINGS

The findings noted in section 3.4.1 can be summarised as follows:

- **Psychological safety**: Workers do not feel comfortable putting forward their ideas, for fear of being belittled or treated as insignificant.
- **Appreciation of differences**: There is room for improvement in the acceptance of opposing ideas, and competing outlooks.
- **Openness to new ideas**: Knowledge workers are not really open to new ideas, probably due to a lack of fault-tolerance in management.
- **Time for reflection**: Time is a major constraint in the pursuit of improvement.
- **Experimentation**: There is a lack of experimentation and inadequate processes for driving evaluation of new methods of doing things.
- **Information collection**: Inadequate levels of information collected across the board exist, the exception being "best-in-class" organisations. This is mainly driven by the Global Technical and Cost Benchmarking process.
- **Analysis**: This was the best area of learning processes, although it was noted that an improvement is both possible and desirable.

- **Education and training**: This proved to be one of the poorer areas of performance, and one in which the company will have to improve.
- **Information transfer**: This was found to be significantly lower than desired performance, although the Operational Excellence leg is making a difference.
- **Leadership that reinforces learning**: This was on par with the Harvard Business Review median score, but can and should also improve.

In summary, the Vanderbijlpark Works (and by extension, Newcastle as well) has a rather poor level of organisational learning, although there is a significant element of leadership that supports and reinforces learning within the organisation.

4.3 RECOMMENDATIONS

Garvin *et al.* (2008:115) put forward four principles that need to be considered when looking at improving organisational learning. These were discussed in paragraph 2.6, but broadly, can be stated as follows:

- Leadership alone is insufficient;
- Organisations are not monolithic;
- Comparative performance is the critical scorecard; and
- Learning is multidimensional.

Thus, care must be taken approaching this topic. Leadership is important, critical, even. The company must cultivate real leaders who will encourage and reinforce learning in the workplace.

The organisation has many sub-sections. It cannot all be handled in the same way. Certain areas have different requirements in terms of information gathering, for example. These need to be carefully analysed, so that the workload on the individuals is not unnecessarily increased.

A scorecard (similar to the scorecard developed from this tool) must be standardised and used to track the progress of the organisation with respect to organisational learning. Goals should be set up, with relevant timeframes, in order that the Works has a plan to improve. This plan must be driven from the highest echelons in the company.

It must be recognised that the fixing of one area of concern will not allow a significant improvement in the level of learning within the company. Multiple areas of concern will have to be tackled simultaneously to ensure that the organisation improves.

The recommendations that can be put forward are broken down under the ten constructs that form the basis of the survey. Unfortunately, the behaviours illustrated by the scores obtained for each of the constructs cannot always be rectified by a simple program. Specifically with the "supportive learning environment", the culture that has led to this environment being prevalent is probably long-lived and quite well entrenched. This will take a commitment from top management to change, together with support from a critical mass of upper and middle management.

4.3.1 Psychological safety

This is a cultural issue that will need to be improved over time. It is about identifying and grooming the right sort of person for leadership roles and then allowing them to function so that trust and respect can be built up within the organisation. Necessarily, it starts right at the top. Trust in the leadership is a vital piece of the puzzle, and it takes time to build. Unfortunately, it can be easily destroyed.

4.3.2 Appreciation of differences

Appreciation of differences is another facet of culture. As such, it must be modelled by senior management, and cascaded down throughout the organisation. This should be facilitated by using the "talk rooms" and other tools discussed by Davenport and Prusak (2000:85-95) in section 2.5.1. The element of trust comes into play here, as the workforce must be allowed to develop their skills in putting forward ideas and discussing them in an informal setting. One cannot expect miracles at the opening event.

4.3.3 Openness to new ideas

In section 2.5.2, the cultural factors in knowledge transfer were discussed. The reduction of mistake-intolerance was identified by Coutu (2006:104) as being one of the ways in which learning anxiety could be reduced. Openness to new ideas requires low levels of learning anxiety, and thus, management should foster a culture of mistake-tolerance within the organisation.

4.3.4 Time for reflection

Time is always an issue in the modern workplace, but if it is allowed to become an obstacle to learning, then the focus will always be on the urgent rather than the important. Laprè *et al.* (2000:609) show that the resultant firefighting prevents learning, as there are low levels of both conceptual and operational learning (section 2.6). Time must be made to encourage and allow learning to take place. As such, much as is done with safety, the author advocates a program where time is allocated for learning. This can be coupled with the talk rooms, or more formal events to develop and share knowledge. Relevant tools such as knowledge repositories should be made available to all, in order that people can be exposed to information that can help them develop their knowledge.

4.3.5 Experimentation

Where relevant, the use of experimentation should be facilitated to allow for the low-cost analysis of alternative ways of doing things. Within the ArcelorMittal group, there are numerous plants that utilise experimental rigs for product or process modification. A database of these should be built up, and where duplication is required or desirable, this should be investigated.

4.3.6 Information collection

A systematic process for collecting information on competitors, economic and social trends, customers (both internal and external) and technological trends should be put in place. This information should be in the knowledge repository, and the relevant personnel should be encouraged to use and expand upon it. Performance comparison with competitors and best-in-class organisations should be done regularly. The object of this should be to promote lively debate about how to improve the systems, products and processes within the South African group. The results of these debates must be recorded and published.

4.3.7 Analysis

It should be realised that analysis is not merely number-crunching, but the whole process of analysing data, ideas, information and viewpoints. This necessitates face-to-face interaction. Management must ensure that the assumptions that are used in any situation are challenged, to ensure the maximum benefit is gained from these analyses. Preconceived ideas should be challenged, and healthy discussion of these should be encouraged.

4.3.8 Education and training

It is realised that in the difficult economy of 2009, cost control should be a high priority. The return on investment of relevant education and training should not be underestimated, however. The knowledge workers within the company need to be exposed to new ideas and materials from across the globe, in order that the company can best benefit from these. The present training system is perceived as being quite inadequate. Education and training must be fitted to the organisation's goals.

4.3.9 Information transfer

A strategy to improve information transfer must be developed and actioned. This will be elaborated on in the next section.

4.3.10 Leadership that reinforces learning

The leaders in the different departments should be encouraged to support the initiatives noted in sections 4.3.1 - 4.3.9, and to take part in useful discussions with their peers and subordinates with an eye on improving the learning processes and environment in their own areas. The leaders in the organisation must internalise the whole concept of the learning organisation so that the company can benefit from the creation, acquisition, sharing and leveraging of knowledge.

4.4 A sample strategy to improve organisational learning at ArcelorMittal South Africa

Table 4-1: Strategy for improving organisational learning

WHAT	HOW	RESPONSIBLE	COMMENT
Establish a sense of urgency (the "Case for change"	Benchmarks KPAs/KPIs	CEO / COO / Department heads	Physical data mining
Create the guiding coalition	Ensure cross-functional group with enough power to lead change	CEO / COO / GMs	Between centres and units / functions
Develop a vision and strategy	Create vision and strategic plan to guide process	COO / HR / Finance	• OL Culture audit • Knowledge audit / map • Gap analysis • Rectifying measures • Monitoring process
Communicate the vision	Ensure that all employees are aware of the rationale behind the new program	GMs / Finance	• Intranet • Posters • Roadshows • 'Spoednik'
Empower broad-based action	Use Garvin, et al to develop employees	CEO / COO / GMs / WMs / PMs	• Supportive learning environment • Concrete learning processes and practices • Leadership that reinforces learning • Learning across boundaries • Multidimensional learning
Generate short-term wins	Analyse a product for improvement potential (pain is real - cost based)	GMs / Finance	• Collect data • Analyse data • Identify problem • Develop cross-boundary solutions • Implement and tweak solutions • Monitor
Consolidate gains and produce more change	Ensure that the results of the short term wins are communicated throughout the organisation	All Management	• Communicate success • Celebrate the win • Launch other projects • Remember the failures • After Action Reviews
Anchor new approaches in the culture	Ensure connection is made between new behaviour and organisational success. Ensure leadership development and succession	All Management	• Communicate success • Celebrate the win • Launch other projects • Remember the failures • After Action Reviews • Develop / entrench methodology • Train leaders and future leaders in methods

Since the entire effort to get the organisation to become a learning organisation entails the shift of people's frames of mind, change management will be a critical part of the process. The action plan is based on Kotter's eight steps for leading organisational change (Kreitner & Kinicki, 2007:588). Intertwined with this, are the critical aspects of an organisational learning audit, and a knowledge strategy. The knowledge strategy looks as follows (Chaffey & Wood, 2005:231):

- Organisational priorities (What do we want to achieve?);
- Business analysis (core aspects, changes in industry, differentiation of competition);
- SWOT analysis which requires a knowledge audit (areas benefiting from applied knowledge, areas lacking knowledge, opportunities to exploit knowledge, competitive threats to knowledge aging or being lost);
- Action plan to address gaps (technical infrastructure, training, metrics, incentives, communication); and
- Plan for integrating OL with organisational strategy.

The knowledge audit is critical, in order to find out "who knows what". It would take the following form (Chaffey & Wood, 2005:234):

- Define audit objectives.
    - Assessing factors that inhibit knowledge sharing (from the organisational learing study);
    - Assessing factors that promote knowledge sharing;
    - Identifying bottlenecks;
    - Identify sources of knowledge creation / innovation (stocks);
    - Map informal networks;
    - Map knowledge flows; and
    - Assess the impact of supplier / client knowledge.
- Identify ideal state.
    - Business objectives should be mapped against declarative (know about), procedural (know how), conditional (know when), causal (know why), and relational (know with) knowledge (Zack, 1999:132).
- Define audit sample.

    - Ensure that the sample takes into account all levels critical to the process, as well as cross-boundary functions.
- Select audit assessment tools.
    - Questionnaires, interviews, focus groups, ASHEN tool.
- Build employee profiles.
    - Each employee must be mapped in terms of, *inter alia*.
        - Core expertise;
        - Project history;
        - Document authoring;
        - Previous experience;
        - Training attended;
        - Interest areas; and
        - Opinion in terms of expertise.
    - Team profiles (action- or people-oriented, cerebral); and
    - Learning styles (activists, reflectors, pragmatists, theorists).
- Develop knowledge map.
    - Network model (degrees, betweenness, closeness).
- Develop knowledge value chain (Zack, 1999:133).
    - Core knowledge (critical but minimum required to compete);
    - Advanced knowledge (differentiates between competitors); and
    - Innovative knowledge (industry leaders).
- Determine key issues and conclusions.
    - Key knowledge assets;
    - Employee skills and competencies;
    - Areas of high and low connectivity;
    - Barriers to knowledge sharing; and
    - Levels of work-based learning.
- Discuss key findings to test conclusions.
- Highlight good practices and expand upon these.

Based on the findings of the audit, the knowledge management strategy (KMS) can then be chosen (the KMS underpins organisational learning). In the case of ArcelorMittal (the processes, especially), an 80:20 split of Codification vs Personalisation would probably be the best fit, as there are high levels of

standardisation and re-use of knowledge. The key areas of the codification strategy are (Chaffey & Wood, 2005:245):

- Re-use of knowledge assets;
- Structured approach to creating explicit knowledge objects (knowledge books and documents);
- High IT investment;
- IT literate workforce; and
- Reward systems for contributing to databases.

Personalisation has the following features:

- Highly customised solutions;
- Moderate IT investment;
- Key competencies are dealing with ambiguity and problem-solving;
- One-on-one mentoring; and
- Rewards for sharing with others.

In terms of the strategy, thus, one can say that the majority (unit process descriptions, fault-finding strategies, SOPs, and product specifications, for example) of the knowledge required could be codified. The other 20% would have to take the form of personal transfer, implying face-to-face interaction and discussion / dialogue time. This includes novel problem-solving (changed raw materials and their effects on the process, novel approaches to cost reductions in times of financial stress and the like).

4.5 CONCLUSION

The aim of this work was to assess the level of organisational learning at the Vanderbijlpark Works of ArcelorMittal South Africa, to compare this with other members of the group, and to make recommendations as to how to improve the situation. To this end, an in-depth study of the processes of knowledge management and organisational learning has been undertaken. A survey was conducted to determine the organisational learning level at both the Newcastle and Vanderbijlpark Works of ArcelorMittal South Africa, and this was used to draw conclusions and put forward recommendations to improve the situation within the Group. Thus, it can be concluded that the research objectives set out for this study have, in large part, been met.

Further research in this regard can, however, be fruitful. Future research in this field could include topics such as a comparison between the best practices of organisational learning within the process industries in South Africa, or the development of a concrete measure of the value of organisational learning in the South African context.

4.6 CHAPTER SUMMARY

In this chapter, the findings of the survey were summarised, and recommendations were made to improve the level of organisational learning within the Vanderbijlpark Works. It was seen that the Works has much that needs to be done in order to allow the effective creation, acquisition, sharing and leveraging of knowledge. Each of the ten constructs put forward in Garvin *et al.*, were analysed and recommendations were made. A sample strategy was put forward by which this improvement could be facilitated. Finally, it was concluded that the research objectives as set out in paragraph 1.6 were satisfactorily met, and possibilities for future research within this field were suggested.

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APPENDIX A: QUESTIONNAIRE

Knowledge management questionnaire

Pleese fill in this questionnaire to the best of your knowledge. Do not answer what you think the questioner wants to here. We are interested in YOUR opinion.
Simply mark the relevant box with an x, save the file and return it. Thank you for your effort, it is highly appreciated.
Higher is more relevant, with 7 being a "definite", and 1 being a "definitely not". Try not to score 4s, as these are effectively "unsure"

Please answer the following questions:

Your BU (NC, SAL, VB, VRN)	
Your department (Ironmaking, Steelmaking, Rolling, etc)	
Your grading (D, E or F)	
Work environment (Maint, Prod, Services)	

Number	Question	1	2	3	4	5	6	7
1	In this unit, it is easy to speak up about what is on your mind							
2	If you make a mistake in this unit, it is often held against you							
3	People in this unit are usually comfortable talking about problems and disagreements							
4	People in this unit are eager to share information about what does and what doesn't work							
5	Keeping your cards close to your chest is the best way to get ahead in this unit							
6	Differences of opinion are welcome in this unit							
7	Unless an opinion is consistent with what most people in this unit believe, it won't be valued							
8	This unit tends to handle differences of opinion privately or offline, rather than addressing them directly with the group							
9	In this unit, people are open to alternative ways of getting work done							
10	In this unit, people value new ideas							
11	Unless an idea has been around for a long time, no one in this unit wants to hear it							
12	In this unit, people are interested in better ways of doing things							
13	In this unit, people often resist untried approaches							
14	People in this unit are overly stressed							
15	Despite the workload, people in this unit find time to review how the work is going							
16	In this unit, schedule pressure gets in the way of doing a good job							
17	In this unit, people are too busy to invest time in improvement							
18	There is simply no time for reflection in this unit							
19	This unit experiments frequently with new ways of working							
20	This unit experiments frequently with new product or service offerings							
21	This unit has a formal process for conducting and evaluating experiments or new ideas							
22	This unit frequently employs prototypes or simulations when trying out new ideas							
	This unit systematically collects information on:							
23	Competitors							
24	Customers							
25	Economic and social trends							
26	Technological trends							
	This unit frequently compares its performances with that of							
27	Competitors							
28	best-in-class organisations							
29	This unit engages in productive conflict and debate during discussions							
30	This unit seeks out dissenting views during discussion							
31	This unit never revisits well-established perspectives during discussions							
32	This unit frequently identifies and discusses underlying assumptions that might affect key decisions							
33	This unit never pays attention to different views during discussions							
34	Newly hired employees in this unit receive adequate training							
35	Experienced employees in this unit receive:							
36	Periodic training and training updates							
37	Training when switching to a new position							
38	Training when new initiatives are launched							
39	In this unit, training is valued							
40	In this unit, time is made available for education and training activities							
	This unit has forums for meeting with and learning from:							
41	Experts in other departments, teams or divisions							
42	Experts from outside the organisation							
43	Customers and clients							
44	Suppliers							
45	This unit regularly shares information with networks of experts within the organisation							
46	This unit regularly shares information with networks of experts outside the organisation							
47	This unit quickly and accurately communicates new knowledge to key decision makers							
48	This unit regularly conducts post-audits and after-action reviews							
49	My managers invite input from others in discussions							
50	My managers acknowledge their own limitations with respect to knowledge, information or expertise							
51	My managers ask probing questions							
52	My managers listen attentively							
53	My managers encourage multiple points of view							
54	My managers provide time, resources and venues for identifying problems and organisational challenges							
55	My managers provide time, resources and venues for reflecting and improving on past performance							
56	My managers criticise views different from their own							

APPENDIX B: RESULTS FOR ARCELORMITTAL VANDERBIJLPARK

Question	Mean	Stdev	Totally disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Totally agree
1	4.767	1.571	2.3%	11.6%	9.3%	7.0%	30.2%	32.6%	7.0%
2	4.698	1.389	9.3%	16.3%	44.2%	0.0%	25.6%	4.7%	0.0%
3	4.651	1.703	4.7%	11.6%	14.0%	2.3%	23.3%	39.5%	4.7%
4	4.512	1.791	11.6%	7.0%	9.3%	4.7%	27.9%	37.2%	2.3%
5	4.628	1.839	16.3%	20.9%	27.9%	2.3%	14.0%	14.0%	4.7%
6	4.419	1.547	7.0%	7.0%	16.3%	2.3%	41.9%	25.6%	0.0%
7	3.767	1.797	7.0%	11.6%	23.3%	4.7%	27.9%	14.0%	11.6%
8	3.721	1.563	2.3%	18.6%	9.3%	16.3%	27.9%	23.3%	2.3%
9	4.581	1.500	2.3%	9.3%	18.6%	4.7%	27.9%	37.2%	0.0%
10	4.651	1.557	2.3%	14.0%	9.3%	2.3%	39.5%	27.9%	4.7%
11	4.535	1.369	4.7%	18.6%	39.5%	9.3%	18.6%	9.3%	0.0%
12	4.651	1.689	4.7%	11.6%	14.0%	0.0%	27.9%	37.2%	4.7%
13	3.977	1.456	7.0%	2.3%	32.6%	16.3%	25.6%	14.0%	2.3%
14	3.233	1.674	0.0%	18.6%	7.0%	2.3%	39.5%	16.3%	16.3%
15	3.674	1.686	4.7%	27.9%	25.6%	2.3%	16.3%	23.3%	0.0%
16	3.140	1.612	0.0%	9.3%	18.6%	7.0%	23.3%	25.6%	16.3%
17	3.651	1.850	0.0%	23.3%	20.9%	2.3%	20.9%	16.3%	16.3%
18	3.628	1.574	0.0%	14.0%	25.6%	4.7%	27.9%	20.9%	7.0%
19	4.070	1.624	9.3%	11.6%	14.0%	11.6%	37.2%	14.0%	2.3%
20	4.163	1.526	4.7%	14.0%	16.3%	7.0%	46.5%	7.0%	4.7%
21	3.721	1.723	9.3%	20.9%	18.6%	14.0%	16.3%	18.6%	2.3%
22	3.372	1.619	9.3%	25.6%	27.9%	9.3%	14.0%	11.6%	2.3%
23	3.465	1.667	11.6%	23.3%	18.6%	16.3%	16.3%	11.6%	2.3%
24	3.721	1.623	7.0%	23.3%	16.3%	16.3%	18.6%	18.6%	0.0%
25	3.442	1.548	11.6%	16.3%	27.9%	18.6%	11.6%	14.0%	0.0%
26	4.186	1.592	4.7%	14.0%	20.9%	4.7%	30.2%	25.6%	0.0%
27	4.000	1.704	11.6%	11.6%	11.6%	18.6%	25.6%	18.6%	2.3%
28	4.791	1.552	2.3%	11.6%	4.7%	14.0%	30.2%	27.9%	9.3%
29	3.860	1.473	4.7%	11.6%	34.9%	7.0%	25.6%	16.3%	0.0%
30	3.907	1.171	2.3%	7.0%	32.6%	18.6%	34.9%	4.7%	0.0%
31	4.581	1.180	2.3%	16.3%	46.5%	11.6%	18.6%	4.7%	0.0%
32	4.140	1.489	4.7%	11.6%	18.6%	14.0%	34.9%	14.0%	2.3%
33	4.814	1.452	4.7%	34.9%	30.2%	9.3%	11.6%	7.0%	2.3%
34	4.070	1.944	16.3%	11.6%	11.6%	4.7%	23.3%	30.2%	2.3%
35	3.674	1.686	11.6%	16.3%	23.3%	7.0%	27.9%	11.6%	2.3%
36	3.721	1.594	9.3%	14.0%	25.6%	16.3%	16.3%	18.6%	0.0%
37	4.186	1.708	4.7%	16.3%	20.9%	4.7%	25.6%	23.3%	4.7%
38	4.535	1.502	0.0%	11.6%	20.9%	7.0%	27.9%	27.9%	4.7%
39	3.884	1.562	7.0%	16.3%	20.9%	7.0%	34.9%	14.0%	0.0%
40	3.419	1.367	9.3%	9.3%	46.5%	7.0%	20.9%	7.0%	0.0%
41	3.558	1.517	11.6%	14.0%	25.6%	11.6%	30.2%	7.0%	0.0%
42	3.628	1.431	9.3%	9.3%	34.9%	9.3%	30.2%	7.0%	0.0%
43	3.930	1.595	11.6%	4.7%	27.9%	7.0%	32.6%	16.3%	0.0%
44	4.023	1.354	0.0%	14.0%	30.2%	11.6%	27.9%	16.3%	0.0%
45	3.326	1.410	7.0%	27.9%	25.6%	7.0%	30.2%	2.3%	0.0%
46	3.535	1.609	11.6%	18.6%	20.9%	16.3%	18.6%	14.0%	0.0%
47	3.535	1.594	7.0%	25.6%	20.9%	16.3%	16.3%	11.6%	2.3%
48	4.837	1.308	0.0%	9.3%	9.3%	7.0%	39.5%	32.6%	2.3%
49	4.628	1.528	2.3%	11.6%	11.6%	9.3%	27.9%	34.9%	2.3%
50	4.977	1.504	4.7%	2.3%	14.0%	2.3%	30.2%	39.5%	7.0%
51	4.744	1.560	2.3%	11.6%	9.3%	7.0%	32.6%	30.2%	7.0%
52	4.837	1.557	7.0%	2.3%	9.3%	11.6%	25.6%	39.5%	4.7%
53	4.302	1.698	9.3%	7.0%	18.6%	7.0%	27.9%	27.9%	2.3%
54	4.093	1.616	9.3%	7.0%	23.3%	7.0%	34.9%	16.3%	2.3%
55	4.767	1.525	11.6%	25.6%	25.6%	11.6%	16.3%	9.3%	0.0%