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Knowledge sharing in new product development in SME's in South Africa.

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Knowledge sharing in new product development in SMEs in South Africa

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

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Abstract

Organisations are operating in an increasingly competitive environment that is marked by rapid technological development and shortened product life cycles. In this environment, effective knowledge management is becoming crucial because competitive advantage is now based on economies of expertise, rather than economies of scale. However, successful knowledge management initiatives, especially those that benefit new product development, depend on a number of critical success factors, which differ between large and small organisations.

This research sheds some light on the factors applicable to small- to medium-sized enterprises (SMEs) by identifying common themes from semi-structured interviews held with respondents involved with new product development in SMEs in South Africa. It was found that these initiatives should be based on a personalisation strategy because it will increase the efficacy of knowledge management activities. This will in turn, improve the organisation's new product development capability.

Declaration

I, Roelof Johannes van der Linde, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Roelof Johannes van der Linde

Signed at .....

On the ..... day of 2013

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Abbreviations

CoP Communities of practice

CFT Cross-functional-team

CSF Critical success factor

DOKB Distributed organisation knowledge base

HRM Human resource management

IDC International Data Corporation

IT Information technology

KM Knowledge management

KMS Knowledge management system

LO Learning organisation

NPD New product development

OL Organisational learning

SME Small- to medium-sized enterprise

VAT Value added tax

Definitions

Community A community "is a group of people who are willing and able to help each other" (Cothrel and Williams 1999:7).

Cross-functional team (CFT) A cross-functional team is comprised of members representing the groups most involved in the development effort, including design, R&D, engineering and manufacturing (Boyle, Kumar and Kumar 2005).

Knowledge Management (KM) "Discipline within an organisation that ensures that the intellectual capabilities of an organisation are shared, maintained and institutionalised" (University of Melbourne 2006).

Small- to medium-sized enterprise (SME) An enterprise can be grouped according to its value added tax (VAT) turnover in a specific year or its number of employees. small- to medium-sized enterprises (SMEs) are enterprises with VAT turnovers greater than R6 077 778 and less than R55 000 000 (Stats SA 2002), or have fewer than 250 employees according to the Department of Trade and Industry in the United Kingdom (Culkin and Smith 2000).

1. INTRODUCTION

1.1. Purpose of the study

The purpose of the research is to determine the preferred basis for knowledge sharing, specifically for small teams involved with new product development in SMEs in South Africa.

1.2. Context of the study

Firms are operating in an increasingly competitive environment characterised by rapid technological development and shortened product life cycles. It is therefore becoming increasingly important for firms to have effective knowledge management (KM) to gain and maintain a competitive advantage over their competitors (Yang and Yu 2002). The sources of competitive advantage are however, no longer based on economies of scale, but rather on economies of expertise, where this expertise is located in the knowledge distributed in the organisation (Subramani and Venkatraman 2003). The importance of KM is further asserted by Lin and Lee (2004), who contend that it is only with the support of senior management that knowledge sharing will be effective because they either encourage or discourage a culture that promotes the sharing of knowledge. The importance of KM is thus clearly established in literature.

Yang et al. (2002) contend that although the importance of KM is well understood, the convergence thereof with new product development (NPD) is not understood nearly as well or appreciated as much. This view is however, contradicted by Pitt and MacVaugh (2008) who believe that recent literature has clearly shown KM to be an important factor in NPD. These fundamentally different views, expressed a small number of years apart, serve to illustrate the substantial rate of change in the current business environment.

NPD is believed to be a complex innovative process that creates something new by combining tacit and explicit knowledge; knowledge that is distributed and possibly located in the minds of relatively few expert staff (Yang et al. 2002; Pitt et al. 2008). The methods for managing, generating and mobilising tacit knowledge therefore directly impacts the efficacy of the NPD activities in the company.

The implementation of a knowledge management system (KMS) is therefore imperative for companies that intend to gain competitive advantage by leveraging their knowledge resources. The successful implementation of a KM initiative is however, dependant on a

number of critical success factors (CSFs), which are probably dependant not only on the sector in which the organisation operates, but also on its culture and size (Wong 2005). The literature suggest that it is easier for larger firms to implement KM successfully, but Frey (2001) cautions that it is becoming increasingly important for SMEs to do so as well.

Moreover, SMEs have a number of unique characteristics that should be taken into account when implementing KMSs (Wong 2005) and Riege (2005) cautions that a number of individual, business and technology barriers may have to be overcome, which may complicate the implementation. The most often mentioned strategy in literature for implementing KM is to make use of on-line interactive technologies such as forums and newsgroups, which may be used to effectively share knowledge (Ardichvili, Page and Wentling 2003; Zhang and Watts 2008).

The context above provides the impetus to explore knowledge sharing in small teams for NPD in SMEs.

1.3. Problem statement

This research aims to explore the preferred basis for knowledge sharing within small teams involved with new product development in small- to medium-sized enterprises in South Africa.

1.4. Significance of the study

Research applicable to SMEs currently focus on KM or NPD and not the influence of one on the other. This research specifically fills this gap by exploring knowledge sharing practices for NPD in SMEs.

NPD has a number of criteria, such as the need for people of different backgrounds to work together and to limit access to confidential information, for example to limit the information accessible by sub-contractors. Teams involved with NPD in SMEs may therefore have unique perceptions on the feasibility of disseminating knowledge.

There are currently a number of studies that investigate KM in small business (Frey 2001; Wong 2005; Wong and Aspinwall 2005; Nunes, Annansingh, Eaglestone and Wakefield 2006), however, a limited number of them have a South African context. Fewer still approach KM for NPD in South Africa.

This study endeavours to determine perceptions to and practices of KM in the hope that this information will be helpful to SMEs who want to implement KMSs in a secure environment for groups who are involved with NPD.

Small business should have better understanding of employees' preferences of knowledge sharing. This will allow better selection of appropriate technologies and processes to

improve the probability of implementing a knowledge sharing initiative successfully. This should be especially beneficial to small business that may not have the resources or the luxury of time to experiment with a number of different paradigms.

1.5. Delimitations of the study

The study is limited to the Gauteng province in South Africa, with a specific focus on high-tech NPD in SMEs.

This study focuses on the creative activities of knowledge workers only, e.g. it ignores repetitive tasks and staff not directly involved with development, such as production.

1.6. Assumptions

This study is performed under the framework provided by the following assumptions: —

- The respondents' preferences and attitudes toward the sharing of knowledge were conveyed honestly and truthfully. Incorrect data will have a detrimental effect on the results.
- The respondents' experiences and preferences to knowledge sharing is representative of industries where small teams do high-tech NPD in SMEs.
- The total number of respondents does not constitute a valid sample size and therefore does not allow accurate inferences to be made with regard to the whole population. Therefore, the results are not expected to be generalisable beyond groups with profiles similar to that of the respondents.

1.7. Structure of the rest of the document

The rest of the document is divided into the following chapters: —

Chapter 2 contains a review of the literature pertaining to the stated problem and provides insight into some of the pertinent facets of organisational learning and how it relates to knowledge management. This then flows into a discussion of practical knowledge sharing mechanisms. Thereafter, the influence of knowledge management on new product development activities is introduced followed by a short discussion of some of the factors that influence new product development itself. The chapter is then finalised with a short discussion on the convergence of knowledge management with new product development and some conclusions that can be drawn from the literature review.

Chapter 3 describes the research methodology that was followed to conduct the research. It starts off with a discussion of the design, applicable population and sampling

techniques, the research instrument and procedure for data collection. This is followed by the method used to analyse and interpret the collected data as well as the known limitations of the study. The chapter concludes with a discussion on the techniques used to ensure validity of the research.

Chapter 4 presents the results of the research only as the interpretation of the results are discussed in chapter 5. It does this by providing the demographic profile of the respondents to put the results in perspective and then lists the concept maps derived from each interview. The maps are grouped according to respondent types.

Chapter 5 discusses the results presented in chapter 4. The discussion starts off with an overview of the influence the identified themes have on each other. Thereafter each theme as it impacts other themes are discussed in detail. This then flows into a discussion of the results relative to the research propositions after which the chapter is finalised with a few concluding remarks.

Chapter 6 concludes the research. It commences with some conclusions that can be drawn from the study, which is then used to infer recommendations for management. It concludes with a number of suggestions for additional research.

2. LITERATURE REVIEW

2.1. Introduction

It is common belief today that organisations should adapt quickly to a rapidly changing business environment to remain competitive. One of the ways this can be achieved is by being a learning organisation. This implies that, amongst others, an effective knowledge management system is in place, which is used audaciously by the members of the organisation.

This section provides the insight into this line of reasoning by discussing the ideas behind organisational development and how it requires organisational learning, which relies heavily on knowledge management, to be effective. Starting with section 2.2, organisational learning and knowledge management are discussed in more detail to highlight some of the current thinking regarding these matters. This discussion prepares the way for a discourse on knowledge sharing practicalities in section 2.4. The peculiarities of new product development, especially when using cross-functional-teams (CFTs), with its reliance on knowledge management are then discussed in section 2.5. Section 2.6 then explores the benefits of effective KM on NPD, after which this chapter is then finalised with a few concluding remarks in section 2.7.

2.1.1. Organisational development

"Change is a constant feature of organizational life and the ability to manage it is seen as a core competence of successful organizations" (Burnes 2004:309). This view on the need for change management is quite common in current literature and Burnes (2004) provides a succinct history of the changing thoughts and ideas on this subject over the last 20 years. He argues that it can be perceived as an incremental, punctuated or continuous process, which can be emergent or guided from the top down. He contends that these vastly differing views can be explained by the need to improve an organisation's competitive advantage through more and more drastic organisational changes necessitated by the ever increasing rate of change in the environment.

It is however, believed that change is only effective through institutional learning as put very eloquently by Ramnarayan and Reddy (1989:22): "Learning is the process which underlies and gives birth to change. Change is the child of learning".

2.1.2. Organisational learning

Senge (2006:3) defines learning organisations as "organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together". This definition is not the only one, but clearly captures the sheer scope of organisational learning.

Models that facilitate organisational learning have been proposed as early as the 1970s and is still actively researched. Early models focused on the integration of individual and organisational learning and distinguished between single-loop and double-loop learning (March and Olsen 1975; Argyris and Schön 1978). Later models differentiated "tacit knowledge" from "explicit knowledge" and proposed three layers of knowledge, that of the individual, team and organisation (Nonaka 1991; Bontis, Hulland and Crossan 2002).

There is definite interest in organisational learning in literature, but how useful is it in practice? In a recent publication, Ho (2008) investigated the causal links between learning, knowledge management and organisational performance. The research found that there was a statistically significant causality between these dimensions as illustrated in figure 2.1. There is therefore statistical evidence linking an organisation's performance to its knowledge management capacity.

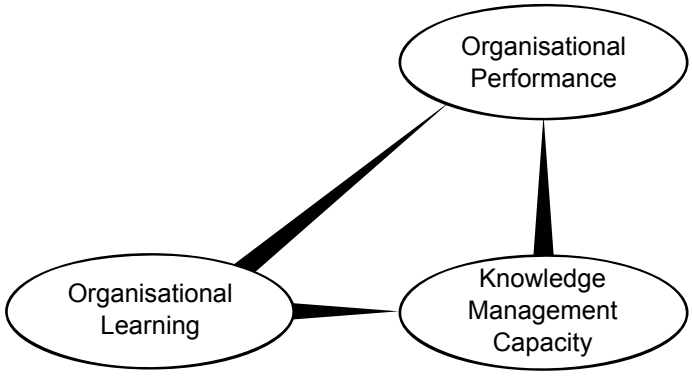


Figure 2.1.: Dimensions that influence organisational performance (adapted from Ho 2008)

2.1.3. Knowledge management

Knowledge management is a multidisciplinary field of study that is integral to most business activities and is therefore integral to today's economy where expertise rather than physical assets are valued (Dalkir 2005). For example, Kippenberger (1998) contends that the economy has transitioned from the Industrial Age where financial capital formed the basis for wealth, to the Information Age where wealth is the product of knowledge.

Dalkir (2005) believes that the major drivers behind the interest in KM today lie in the fact that business is more globalised and operating at increased pace. This combined

with a workforce that is more prone to leave the organisation as other opportunities arise, as well as advances in technology that have created an expectation of response times measured in minutes, rather than weeks, all contribute to the interest in KM.

Dalkir argues that KM is essential in this climate because it provides benefits to the individual employee as well as the organisation itself. The individual benefits because KM assists with, amongst others, decision making and problem solving as well as nurturing bonds with other employees to form a sense of community. While the organisation benefits because problems can be solved in less time because KM disseminates best practices and builds organisational memory.

2.2. Organisational learning

The concepts of organisational learning (OL) and KM are so closely related that the relationship between them has been described as intimate (Firestone and McElroy 2004). Yet, they deal with different aspects of learning in the organisation. For example, Firestone et al. (2004) describe a knowledge life cycle that consists of a number of business and knowledge processes as illustrated in figure 2.2.

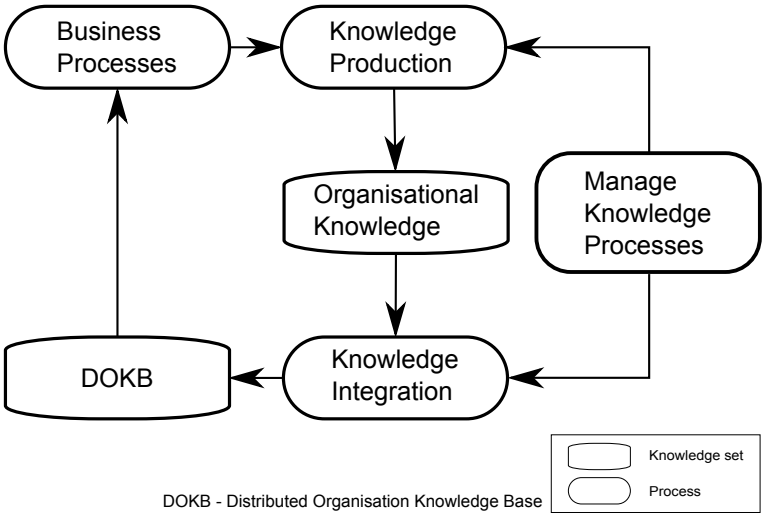


Figure 2.2.: The Knowledge Life Cycle — Business Processes (adapted from Firestone et al. 2004; Dalkir 2005)

In this cycle, the knowledge processes create new knowledge, which gets integrated with the distributed organisation knowledge base (DOKB) and used by the business processes. In this instance, *knowledge management* comprises those processes that manage the other knowledge processes (Dalkir 2005).

Organisational learning on the other hand, is not concerned with the knowledge processes *per se*, but rather with the increase in organisational knowledge through their use. It is by following this cycle that individuals, groups and the organisation learn

(McElroy 1999; Firestone et al. 2004; Dalkir 2005). OL is therefore the active search for new knowledge and critical appraisal of the continued relevance of existing knowledge.

The following aspects of the knowledge life cycle require further discussion: —

2.2.1. Individual learning

The relevance of individual learning to organisational learning is difficult to assess in practice. One the one hand, individual learning is seen as the entry-point for organisational learning as it represents knowledge production at the organisational level (McElroy 1999; Dalkir 2005). On the other hand, Stewart (2001) argues that individual learning will not automatically lead to organisational learning.

This begs the question: How relevant is individual learning to OL? A comparison of a number of organisational learning processes reveal that "they all consider learning as a generic cycle which starts and ends with individual learning" (Cegarra-Navarro and Sabater-Sánchez 2005:277). The suggested answer is that organisational learning cannot occur unless it is based on the learning of individuals (Kessels 2001).

2.2.2. Organisational knowledge

Individual learning is a social process that cannot occur in isolation. Group interaction is therefore needed to support the learning of individuals. It is this interaction that allows groups, and by extension the organisation, to learn from individuals and *vice versa*. This involves the assimilation of new knowledge and using what has been learned. Or phrased differently, it is the exploration and exploitation of new learnings (Crossan, Lane and White 1999).

Most of this knowledge, at individual, group and organisation levels is tacit and only 15%-20% of it has been captured explicitly. It appears that the Pareto Rule, i.e. the 80 / 20 rule, applies to the tacit / explicit knowledge divide (Dalkir 2005).

A strategy to manage organisational knowledge is therefore prudent. Such strategies typically fall into one of two categories, codification or personalisation. A codification strategy emphasises explicit codification of knowledge, whereas a personalisation strategy focuses on dialogue between individuals. That is not to say that knowledge strategies cannot have elements of both, but organisations should make use of one strategy predominantly. That is, 80% of knowledge sharing should make use of one strategy and 20% of the other (Hansen, Nohria and Tierney 2005); another example of the Pareto Rule in action.

2.2.3. Organisational learning

Organisational learning means knowledge gets reused, for example, solutions that worked previously can be used again or old solutions can be adapted to new challenges. It also

means organisations learn from mistakes. Experiential learning is a particularly effective way for organisations and individuals to learn from mistakes as it requires team members to reflect on the causality of their actions. They gain insight into their own behaviour, which allows them to identify the strengths and weaknesses in their efforts. This in turn, prepares them for future challenges. Mistakes and errors therefore provide valuable learning experience (Tjosvold, Yu and Hui 2004).

The traditional catalogue of isolated training programmes should therefore be replaced with a corporate curriculum that integrates the learning processes to achieve desired outcomes (Kessels 2001).

2.2.4. Learning organisation

OL has been discussed in previous sections and it is clear that it focuses on processes and the interaction between different levels of learning. In contrast, the learning organisation (LO) focuses on the practical implementation of these processes and provide specific recommendations on the way organisations should continuously and effectively learn. The LO can therefore be seen as the normative aspect of OL (Firestone et al. 2004).

The learning organisation therefore relies heavily on OL, which is closely associated with KM, to improve organisational performance. The next section discusses KM in more detail.

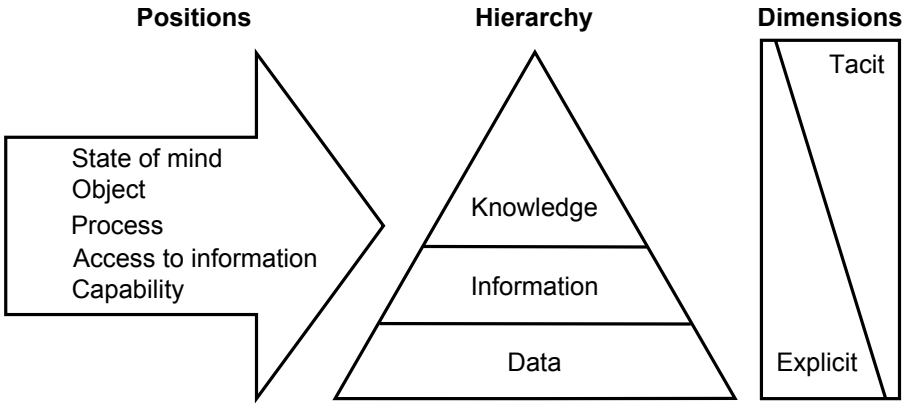
2.3. Knowledge management

KM is a vast field and covering it in its entirety here is nigh impossible and well beyond the scope of this text. However, it is useful to explore some perceptions thereof and how it can be modelled. These ideas will guide the reasoning behind the need for effective knowledge sharing and how it could be used by organisations.

2.3.1. Views of knowledge

Knowledge, in the broadest sense of the word, can mean many different things. For example, Ralph Waldo Emerson (1803–1882) said that "our knowledge is the amassed thought and experience of innumerable minds".

Clearly, the concept of knowledge is easy to grasp intuitively but difficult to define precisely. For this reason, many different views thereof can be found in academic literature as well. There, knowledge is commonly viewed as dimensional, hierarchical or positional. The *dimensional view* typically distinguishes between tacit knowledge and explicit knowledge (Alavi and Leidner 2001; Cegarra-Navarro et al. 2005; Dalkir 2005); whereas the *hierarchical view* of knowledge, distinguishes between knowledge, information and data (Dalkir 2005; Patrick and Dotsika 2007; Pitt et al. 2008). The *positional view*



Sources: Alavi and Leidner (2001), Cegarra-Navarro et al. (2005) and Dalkir (2005)

Figure 2.3.: Views of knowledge

is advocated by Alavi et al. (2001:109) who contend that "[k]nowledge may be viewed from several perspectives (1) a state of mind, (2) an object, (3) a process, (4) a condition of having access to information, or (5) a capability". They argue that the functions of KM will differ according to the preferred perspectives thereof.

It is therefore critical to choose the correct views of knowledge when embarking on a knowledge management initiative as this will impact not only the KM processes and choice of KMS, but also the way it will be perceived and used by the employees. There is danger in making an incorrect choice as too much credence may be placed on the explicit dimension, merely for being recorded, at the detriment of the tacit component because of its nebulous nature (Alavi et al. 2001).

2.3.2. Knowledge management models

Section 2.3.1 argued that knowledge as a concept has a nebulous nature and one's views thereon fundamentally influence its management. Commonly, such understanding is facilitated through the use of KM models that provide a conceptual framework to operate within, of which many can be found in literature. For example, Dalkir (2005) presents models from Choo, Weick, Nonaka and Takeuchi, Wiig, von Krogh and Roos, Boisot, Beer, and Bennet and Bennet in his discussion of the discipline of KM.

An exhaustive investigation into the merits of different models is beyond the scope of this text, but a short discussion of one such model, that of Nonaka and Takeuchi (Nonaka 1991; Dalkir 2005), is presented here as this research is based upon many of their inferences.

The model relies on the creation and conversion of knowledge and is explained here by way of an example based on that provided by Nonaka (1991). It starts of with the creation of knowledge, e.g. say an expert has acquired knowledge through years of experience in the field. Some of this knowledge gets transferred to an underling during an apprenticeship. The apprentice then documents the learnings, which allows

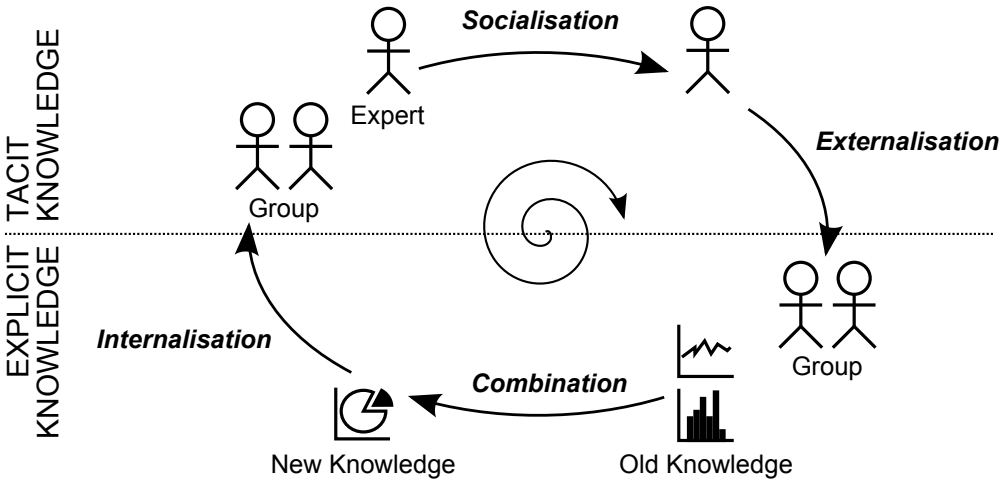


Figure 2.4.: Knowledge Spiral (adapted from Nonaka 1991; Dalkir 2005)

knowledge transfer to coworkers. This knowledge can now be combined with other pieces of knowledge to form new knowledge that can be distributed to other employees. This knowledge gets used it in a project thereby enriching the project team's own knowledge base. This starts the cycle of knowledge again, albeit at a higher level.

The four conversion processes shown in figure 2.4 and alluded to in the example above are (Dalkir 2005): —

- *socialisation* that converts tacit knowledge to tacit knowledge,
- *externalisation* that converts tacit knowledge to explicit knowledge,
- *combination* that converts explicit knowledge to explicit knowledge, and
- *internalisation* that converts explicit knowledge to tacit knowledge.

This model is simple to understand, yet has proven to be one of the more robust ones in business. It provides a coherent framework that is crucial to KM's ability to address business goals by ensuring that all the critical factors of KM have been addressed (Dalkir 2005).

KM models are therefore useful to ground practical KM initiatives in sound theoretical frameworks to ensure KM processes are congruent with the organisation's operational strategy.

2.3.3. The need to effectively share knowledge

One of the tasks of KM is to improve the access to knowledge in both tacit and explicit forms, but how useful is the effective sharing of knowledge really?

International Data Corporation (IDC) estimates that knowledge workers spend 15%–35% of their time searching for information and find what they seek no more than half

the time. This inability to find information could cost an organisation an estimated $6 million a year (Feldman 2004). A more recent study by IDC provide deeper insight on how knowledge workers spend their time, and considering that each earn an average salary of $75 000 per annum, table 2.1 clearly shows that searching for information and reworking it, is still very expensive (Ward 2010).

Table 2.1.: Breakdown of knowledge tasks versus cost (Ward 2010)

Task	Time[1]	Cost[2]
Email	13	$21 000
Searching for information	9	$14 000
Analysing information	8	$13 000
Communicating and collaborating with team members	6.5	$10 000
Creating content	6	$10 000
Publishing information	4	$6 000

[1]average hours per week [2]per year

These results, although imperfect, suggest that knowledge work could be cheaper if the search process was more effective and less time was used to rework inadequate information. This combined with the fact that up to 90% of the time spent in creating new information is wasted because it is used to recreate information that already exist, and only 1 in 5 workers consistently find what they are looking for (Feldman 2004; Ward 2010), suggest that existing KM practice is either inadequate to the task, or do not complement the way people work.

The reason for this may be that KM initiatives do not accord the social aspect of knowledge enough credence. For example, knowledge can be shared in a number of different ways, but people are seen as the most critical conduit of information and knowledge. This is because people are seen as a credible source and have the added advantage that they do not only provide the requested knowledge, but also "metaknowledge", e.g. where it can be found and what other avenues that could be pursued. This suggests why knowledge workers are five times more likely to turn to people for information rather than querying an impersonal source, such as a database or KMS (Dalkir 2005).

This emphasis on the social aspect of knowledge sharing is often associated with communities of practice (CoP) in today's organisations. These communities are gaining popularity because they foster relationships and the sharing of knowledge between people by for example, providing apprenticing situations over time (Thomas, Kellogg and Erickson 2001). The Internet has also enabled CoP to be established on-line, which, some may argue, have succeeded in spite of its limitations (Zhang et al. 2008).

The emphasis is therefore not on technology that implements KM, but rather as an enabler to share knowledge socially as it requires a unique combination of human and information systems to share knowledge successfully. The challenge therefore is to create

an environment where knowledge sharing is valued and people are willing to share ideas. This should be supported by a KMS that not only makes information available, but helps people think together. All this should occur against a social backdrop where CoP willingly share information and encourage thinking (McDermott 1999).

The implementation of such a system is fraught with danger however, and Fahey and Prusak (1998:265–273) warn against the following common errors: (1) "not developing a working definition of knowledge first", (2) "emphasising knowledge stock to the detriment of knowledge flow", (3) "viewing knowledge as existing predominantly outside the heads of individuals", (4) "not understanding that a fundamental intermediate purpose of managing knowledge is to create shared context", (5) "paying little heed to the role and importance of tacit knowledge", (6) "disentangling knowledge from its uses", (7) "downplaying thinking and reasoning", (8) "focusing on the past and the present and not the future", (9) "failing to recognise the importance of experimentation", (10) "substituting technological contact for human interface", and (11) "seeking to develop direct measures of knowledge".

The sharing of knowledge is thus vitally important for business today, but care should be taken to ensure the intended KM initiative does not only provide excellent explicit knowledge harvesting functionality, but a means to facilitate social interaction as well. Such implementation is not easy and requires deep reflection on the nature of knowledge itself.

2.3.4. Application of knowledge

It is clear from the discussion above that KM is vitally important to the knowledge organisation. It is also clear that knowledge should be managed to ensure knowledge resources are leveraged optimally. What is perhaps not so clear is that knowledge should not be pursued for the sake of knowledge *per se,* but rather business efficiency. "Too often knowledge workers limit themselves to the production and distribution of knowledge, without considering how it creates value for the organization. This key omission threatens the value of knowledge work — and the careers who perpetuate this way of thinking" Powell (2001:313).

Furthermore, the assumptions of the past, that all knowledge *could* be captured and explicit knowledge leads to understanding, are fallacy; understanding is a combination of documentation and conversation. Knowledge will therefore only be used correctly by the individual, for the benefit of both the individual and organisation, if it is accessible in usable form and the KM processes emphasise the need for knowledge to have business value (Dalkir 2005).

It is clear from the arguments above that effective knowledge sharing is vital to business success. The next section discusses this activity in more detail.

2.4. Knowledge sharing

It has been argued above that it is virtually impossible to capture all knowledge that should be shared. On the other hand, it has also been argued that not all knowledge can be shared without capturing some of it. Moreover, all these activities should make business sense. What follows is a discussion of a number of knowledge sharing strategies that endeavours to make sense of these contradictions and challenges. This leads into the reasoning why CoP are practical vehicles for knowledge sharing and a short discourse on how knowledge sharing activities can be improved.

2.4.1. Knowledge sharing strategies

Carrillo and Chinowsky (2006) aver that the initial understanding of KM, that began with much emphasis on the distinction between data, information and knowledge, has evolved to the point where it is now recognised that companies require a dynamic combination of these elements. They contend that the focus have changed from the characteristics of knowledge to the management thereof, for example the current focus is to distinguish between information management and knowledge management.

This definite change of focus is clearly illustrated by the following statements from articles published a few years apart: —

- "In this view ... knowledge management is nothing more than getting the right information to the right people at the right time" (Thomas et al. 2001:863),
- "The key focus of information systems has also changed from the management of information to that of knowledge" (Wong et al. 2005:64), and
- "All organisations need to take an equally hard look to ensure that the right knowledge is getting to the right people at the right time" (Riege 2005:32).

The implementation of knowledge management is currently done according to two main strategies. Firstly, the information technology (IT)-centric or codification strategy that focuses on technology to facilitate knowledge sharing that corresponds with the explicit view of knowledge, and secondly the human resource management (HRM)-centric or personalisation strategy that focuses on the motivation of knowledge workers to share their knowledge that corresponds with the tacit view of knowledge (Hansen et al. 2005; Carrillo et al. 2006).

This emphasis on knowledge sharing, as opposed to data or information sharing, corresponds with earlier research by Disterer (2003). This research found that knowledge sharing is a sociological, rather than a technical challenge with the associated barriers to effective knowledge sharing. He proposes that the reason why people are reluctant to share knowledge freely, may partly be due to societies' deep cultural traditions that tend

to discourage knowledge sharing. He gives the example of his memories of school that affirmed knowledge as a kind of treasure that needed to be protected and hidden away, e.g. during examinations where "the use of shared potentials is castigated as a 'crib' and as an attempt to deceive" (Disterer 2003:220). Disterer believes that a paradigm shift, i.e. one from 'knowledge is my own personal power' to 'knowledge shared is a competitive advantage for the organisation', is needed to enable the effective sharing of knowledge. He concludes that KM is not technical, but rather deeply social in nature and that the cultural aspects of knowledge sharing are more difficult to address than the technical ones. The challenges for firms therefore have more to do with changing people's behaviour than with IT. This is especially true for SMEs where resources are limited (Wong 2005). Hence, KMSs should combine both technological and sociological aspects of KM (Wong et al. 2005) because "IT is only a tool not an ultimate solution" (Wong 2005:269).

In related research, Riege (2005) posits that knowledge sharing practices need to become ingrained for companies to achieve continuous growth. He proposes that a knowledge-sharing culture should therefore depend on a synergy of (1) the encouragement by management to purposefully share knowledge, (2) an organisational structure that facilitates transparent knowledge flow, and (3) using modern technology that integrates knowledge sharing mechanisms and systems. Moreover, he contends that "knowledge sharing has no real value to individuals and organisations unless those people who are in need of useful knowledge receive it, accept it, and also (re-)apply it" (Riege 2005:32). In essence, organisations should ensure the timely flow of the correct knowledge between people.

However, Wong (2005:269) opines that organisations, especially SMEs, will benefit from an in-depth understanding of the CSFs applicable to KM. He cautions that much care should be taken when choosing these factors as the wrong ones can have a detrimental effect on the organisation's performance. Furthermore, Riege (2005) cautions that implementing a knowledge-sharing initiative is fraught with difficulty and proposes a number of barriers, including culture, that companies should be aware of when such an implementation is considered. Moreover, the impact of culture is emphasised by McDermott and O'dell (2001) as well, who argue that it is often seen as the fundamental inhibitor of effective knowledge sharing.

McDermott et al. (2001) believe that these 'cultural barriers' can be overcome not by trying to adapt the organisation's culture to the KMS, but rather adapting the KMS to the way the organisation functions. They aver that overcoming cultural barriers depend on visibly demonstrating the importance of knowledge sharing as well as building on invisible core values. Moreover, they contend that a culture of knowledge sharing requires a visible connection between knowledge sharing activities and practical business goals. They warn that organisations should not blindly copy practices developed by other organisations and

contend that the visible artefacts of knowledge sharing should match the organisation's style. They also believe that the sharing of knowledge should be linked to core values that people genuinely believe in.

Furthermore, McDermott et al. (2001) aver that human networks should be enhanced by enabling them with the correct resources and legitimisation as they are one of the key vehicles for knowledge sharing. People should also be encouraged, and even pressured where necessary, to share their knowledge. For example, knowledge sharing could be built into routine performance appraisals. They conclude that the best way to overcome existing cultural barriers, is to first match the organisation's current values and style and then build on it to achieve the desired change.

2.4.2. Communities of practice as vehicle for knowledge sharing

The previous section argued that knowledge sharing is much more effective in a business environment that supports and encourages it. It then stands to reason that a KMS should take both human and social factors into account in its design and operation (Thomas et al. 2001). However, KMSs are often designed with unapparent limitations on the types of knowledge that can be stored therein. For example, telephone operators may scribble additional instructions to delivery personnel in the address block of a paper-based system to accommodate special circumstances. However, an IT-based KMS that does not support such contextual information may result in misuse of the system, e.g. operators may enter special instructions in the address field and thereby compromise data validity. Alternatively, it may reduce the operational performance of the business, e.g. deliveries may have to be attempted more than once because special instructions cannot be communicated as needed (Thomas et al. 2001).

This example illustrates why Thomas et al. (2001) opine that knowledge work occurs in a social context where knowledge is shared among loosely connected communities of people and that one must identify the social practices and relationships functioning within this context in order to understand it. These social ties are strongly influenced by the virtual or physical work environment, which greatly influences how easily the ties can be established and maintained. It can therefore be argued that social context has large influence on the organisation's functioning and a KMS that only distributes information between people is inadequate (Thomas et al. 2001).

Effective KM is therefore vital for business and Wenger, McDermott and Snyder (2002) aver that using CoP is a practical way to manage knowledge because, they believe, it is difficult to keep abreast of the rapid pace of change without them. CoP do not only connect people from different areas within an organisation with each other, but also with people in other organisations. This loosely connected network maintains a knowledge system that supports the required knowledge work (Wenger et al. 2002).

As with any other expertise, knowledge workers cannot rely solely on information gleaned from impersonal sources. They need to be exposed to other practitioners' ideas and actively take part in familiar and unfamiliar activities to develop their craft (Thomas et al. 2001; Wenger et al. 2002). The importance of thereof is effectively illustrated by the following example given by Wenger et al. (2002:8–9):

> If a friend told you that he had read many books about surgery and was ready to operate on your skull, you would be right to decline politely. When surgeons operate on a patient, they do not blindly apply knowledge they have gleaned from books or procedures they have stored in their heads. They consider the patient's medical history, monitor vital signs, look at tissues, make incisions, draw conclusions, and possibly revise the plan to make sure that the procedure is constantly responsive to the evolving situation.

The role of CoP are therefore not to reduce knowledge to information, but rather to make it a built-in 'feature' of their activities by sharing it amongst their members. This results in knowledge that resides in, what Wenger et al. (2002) refer to as, a "living repository", as opposed to information stored in one or more databases. It is this tacit knowledge, consisting of ingrained expertise that enables dynamic responses to particular business problems, which are often most valuable because it is that *je ne sais quoi* that competitors struggle to duplicate (Wenger et al. 2002).

These arguments may lead the reader to conclude that tacit knowledge could or should be pursued to the detriment of explicit knowledge. This is not the case. Wenger et al. (2002) opine that it is in fact very useful to document tacit knowledge when it serves the needs of the specific community, which incidentally is ideally suited to the task because its members understand its needs intrinsically. They are therefore able to codify both the tacit and explicit dimensions of the community's knowledge.

It should also be noted that the argument for the use of CoP is not directed against individuals. In fact, Wenger et al. (2002) aver that individuals with strong personalities are highly valued by these communities because they encourage disagreements and debates. Such "arguments" breathe life into the community, making it more productive and effective. Multiple perspectives are therefore beneficial and required to solve the complex problems many organisations face now. Collective knowledge is what allows practitioners to stay abreast of change, i.e. practitioners need each other to develop their expertise sufficiently. The fact is the "days of Leonardo da Vinci are over" (Wenger et al. 2002:10).

2.4.3. Improving knowledge sharing activities

It has been argued that knowledge sharing in organisations is more of a sociological than a technical problem and that CoP are not only an effective means to manage knowledge,

but to share it as well. It is therefore useful to consider a few practical aspects of knowledge sharing in order to improve the organisation's chances of implementing such an initiative successfully.

Firstly, it has been argued that larger organisations or business units are less suited to share knowledge than their smaller counterparts because they are usually more bureaucratic in nature (Serenko, Bontis and Hardie 2007). The specific argument made by Serenko et al. (2007) is that an organisation's ability to effectively share knowledge, decreases as it's size increases because of the reduced effectiveness of its internal knowledge flows. They posit that a fundamental characteristic of knowledge communities, i.e. communities of practice, is that they include many forms of narrative between people who share professional interests. This creates a safe environment where comments can be made and understood in context. However, when communities grow to more than 150 members, the effectiveness of the knowledge flows, on which this environment is heavily depended, decrease dramatically and knowledge sharing is severely hampered (Serenko et al. 2007). This suggests that CoP should be structured to ensure they remain small enough to encourage effective knowledge sharing, a task that should be easier for SMEs because, per definition, they consist of a maximum of 250 people (Culkin et al. 2000).

Secondly, the importance of the correct environment. Usoro, Sharratt, Tsui and Shekhar (2007) contend that knowledge sharing is based on trust within CoP, which agrees with the allusions made above. The emphasis on the sociological aspects of knowledge sharing made by a number of researchers, e.g. Thomas et al. (2001), McDermott et al. (2001), Wenger et al. (2002), and Riege (2005), clearly indicate that the qualitative aspects are more important to practitioners. This explains why Usoro et al. (2007) maintain that management should promote knowledge sharing in such a way that practitioners can *feel* the effects of their efforts.

Thirdly, measuring the impact of KM. It has been argued above that the qualitative aspects of KM are crucial for effective management thereof. However, a recent study (Usoro et al. 2007) found that while qualitative aspects are more important to practitioners, it is quantitative measures that are of more interest to management. This need for measurable quantities is in accordance with the opinions of the well-known Lord Kelvin who contended that "to measure is to know" and "if you can not measure it, you can not improve it" (Wong 2005; Zapato 2010). However, it is difficult to measure knowledge because it is intangible (Usoro et al. 2007), which explains why Choy, Yew and Lin (2006) found that many organisations do not have well-developed performance measures to assess their knowledge assets. Moreover, financial measures by themselves are not adequate when measuring knowledge assets (Chong and Choi 2005; Wong 2005; Choy et al. 2006). One measure that attempts to address both the tangible and intangible aspects of knowledge was proposed by Choy et al. (2006) who suggested it should be measured according to the following dimensions: "(1) systematic knowledge activities;

(2) employee development; (3) customer satisfaction; (4) good external relationship; and (5) organisational success" (2006:922). Clearly, both qualitative and quantitative measures are needed when measuring knowledge assets in SMEs to achieve a more holistic understanding of the benefits of KM (Wong 2005).

Fourthly, the correct presentation of knowledge. Thomas et al. (2001) contend that knowledge, even factual knowledge, is strongly influenced by a community's inherent social and cultural assumptions. This means that participants have to actively engage with each other for knowledge to be transferred and shared (Thomas et al. 2001; Wenger et al. 2002). Clearly, knowledge does not get transferred merely by the fact that it is presented to people. The belief that more information will automatically address knowledge management issues is therefore fallacy (Thomas et al. 2001). The following excerpt from *The German Teacher* by John Thomas captures the need for the correct presentation of knowledge in an amusing, yet persuasive way (Thomas 2010):

> Dr. Thorvald[, a coarse and abrasive man,] taught my second year German class...
>
> One spring day, as Dr. Thorvald droned on about Medieval history, he spied something to his mind unbelievable. "Hah! Vat is Dis? Someone passing notes in MY class? I vill read note in front of entire class!" He snatched up the note and read it aloud. "Dr. Thorvald. Your fly is open." And so it was.

This leads Mr. Thomas to conclude that "knowledge management isn't just about what, who, and when... it's also about *how*" (Thomas 2010). The correct presentation of knowledge is clearly important and a number of practical methods to create and communicate knowledge can be found in literature, for example, the use of Bohm Dialogue, the systematic use of metaphor, strategy mapping, making use of stories and storytelling, employing expressive communication, and formalised communication methods (Thomas et al. 2001; Serenko et al. 2007). Furthermore, Rech, Feldmann, Ras, Jedlitschka and Decker (2007) suggest that the quality of knowledge can be improved by using software engineering principles. For example, KMSs could be structured in the form of "knowledge patterns" and their quality, as well as the knowledge they contain, can be improved through "knowledge refactoring". The importance of *how* knowledge is presented should therefore not be underestimated (Thomas 2010).

The discussion above leads to the following proposition:

Proposition 1. *A knowledge sharing initiative in SMEs should be based on the personalisation or sociological strategy that emphasises the qualitative aspects thereof.*

Up to now it has been discussed how KM benefits an organisation in general. The next section contains a discussion of how effective KM benefits and improves NPD activities.

2.5. New product development

NPD, if done well, provides a competitive advantage for the organisation. However, it can also quite easily have a detrimental effect on the organisation's performance if done poorly.

This section explores these views and commences with an examination of KM's role in NPD activities. It then clarifies how NPD is currently perceived in literature after which team dynamics in this environment is discussed. This leads to a discourse on the impact of a volatile environment on and the role of managers in NPD activities.

2.5.1. The role of knowledge management in new product development

The discussion above agrees with Yang et al. (2002) who argue that KM has been well examined in literature. However, they contend that the connection between KM and NPD has not been well understood or appreciated. Furthermore, related research by Pitt et al. (2008) found that factors that lead to efficient NPD have been researched for more than 30 years. It is therefore interesting to note that the reality that KM is crucial to effective NPD has only been asserted fairly recently in literature (Yang et al. 2002; Shani, Sena and Olin 2003; Pitt et al. 2008).

Yang et al. (2002) argue that efficient NPD relies on a high level of integration between R&D and marketing. They contend that this integration facilitates the recognition and consolidation of knowledge and information that pertains to the NPD process within the business context. This view is supported by Pitt et al. (2008), who caution that KM should be seen as an ongoing activity, rather than a one-time search for an idealised state. Furthermore, they assert that all NPD personnel have responsibility for effective KM, even when KM is addressed holistically with adequate support from senior management.

Moreover, Pitt et al. (2008) aver that much of an organisation's knowledge is distributed, quite possibly in the minds of relatively few, expert staff. Therefore, the KM processes employed by the organisation, directly determine how effectively the organisation is able to utilise its technical and procedural knowledge about NPD. Pitt et al. (2008) therefore argue that knowledge-enabling processes should not be confined to formal mechanisms in the pursuit of optimal performance in NPD activities.

2.5.2. Perspectives on new product development

NPD is difficult to define and can have several meanings dependent on the context where it is used. For example, Yang et al. (2002) describe NPD firstly, as a series of activities that include idea generation, product development and the commercialisation thereof. Secondly, as a complex process that employs both tacit and explicit knowledge to create something new. And thirdly, as a transformation of tacit knowledge to explicit

knowledge, or a transformation of explicit knowledge to explicit knowledge. A few years later, Pitt et al. (2008) describe NPD as a malleable activity that can be modelled with for example, the common "stage-gate" model that describes NPD as a sequence of as many as thirteen discrete "stages" separated by decision "gates". Another model mentioned by them, posits that NPD consists of three overlapping phases of knowledge activity. These are *discovery*, i.e. those activities that add to an organisation's knowledge from both internal and external sources, *realisation*, i.e. converting ideas into tangible outcomes, and *nurture*, i.e. the subsequent development resulting from reflection and learning. It is clear from these perspectives that the exact definition for NPD is elusive, yet its reliance on knowledge is well established.

Furthermore, Yang et al. (2002) posit that OL forms the foundation of knowledge acquisition in organisations. Learning is therefore vital to any NPD activity because it involves many functions in the organisation, for example engineering, marketing, manufacturing, finance, etc., with the specific goal of utilising knowledge gained from learning for creation and innovation (Yang et al. 2002). However, Shani et al. (2003) warn that an increase in the amount of readily available knowledge adds increased complexity to the design and management of NPD activities. This may explain why Pitt et al. (2008) contend that senior managers desire a high degree of formality and standardisation of knowledge based activities, even though staff may resist such formal approaches on the grounds that NPD is inherently chaotic and unpredictable. "It may therefore be necessary for opposing views to coexist in a state of tension" (Pitt et al. 2008:103).

Pitt et al. (2008) therefore contend that effective NPD is crucial to any organisation whose competitive advantage relies on its knowledge-intensive, technical capability. They additionally agree with concerns raised earlier that an over reliance on a codification strategy may stifle the complementary social processes that induce innovation. They therefore contend that no single KMS based on IT will effectively contribute to all forms of knowledge transfer and question whether such a system is able to improve tacit-to-tacit knowledge transfers. From the preceding discussion, one can conclude that effective NPD relies heavily on the quality of the organisation's KM processes and care should be taken to ensure optimal tacit-to-tacit knowledge transfers, as this will induce innovation.

2.5.3. Team dynamics in new product development

Shani et al. (2003) contend that organisations are increasingly dependent on teams and improving their performance is therefore of great interest. They argue this is especially true for NPD projects where CFTs are used most of the time. Such teams are used concurrently across various stages of the project (Wong et al. 2005) and often have very different functional backgrounds, for example in marketing, product design, engineering and finance (Qiu, Qualls, Bohlmann and Rupp 2009). However, Wong et al. (2005)

and Qiu et al. (2009) caution that team members often have competing loyalties, which hinders the team's ability to work together toward a common goal. Wong et al. (2005) therefore suggest that a shared project goal will justify the team's reason for being, which may result in the individual members committing to the team itself and its goals. Furthermore, Qiu et al. (2009) contend that diversity in CFTs can provide important inputs to NPD activities and be an effective generator of innovative ideas. They caution however, that such benefits rely on effective communication between and successful integration of team members.

2.5.4. New product development in a changing environment

Anecdotal evidence shows that manufacturers compete with each other to be innovative and capture consumer attention, it therefore comes as no surprise that Dayan and Basarir (2010) contend that NPD teams are working in a constantly changing environment where a team's performance is directly dependent on its ability to deal with such change effectively. This sentiment echoes that made earlier by Wong et al. (2005) who argue that NPD activities require a senior manager who is responsible for reducing ambiguity and uncertainty. They caution however, that these activities require more than just strategising and planning for innovation, as these plans and strategies should also be communicated to relevant employees. Moreover, they contend that uncertainty can be reduced by devising processes in the organisation that create potent product ideas and ensuring that such ideas are embedded in the design and manufacturing processes. These processes will then, for example, ensure integration and coordination from the early planning stages of the project. Practically, this will imply that project leaders who fix decision criteria in the early stages of the project, will ensure congruent decisions in later activities by all members of the cross-functional NPD team. The project leader will then become the guardian of the project concept and ensure that the team's choices are consistent with said concept by balancing conflicting points of view when they arise. Furthermore, Pitt et al. (2008) agree with formalising the processes as suggested by Wong et al. (2005) because they make NPD less improvised and therefore more efficient.

Formalising processes as suggested above is one way to deal with change, another is suggested by Dayan et al. (2010) who contend that NPD teams must be more reflexive in a volatile environment, for example where customers' needs change rapidly and where they have increased aptitude for technology. In this context, team reflexivity is defined as "the extent to which group members overtly reflect upon the group's objectives, strategies and processes, and adapt them to current and anticipated endogenous or environmental circumstances" (West 1996:559 as cited by Dayan and Basarir, 2010:19). Furthermore, Dayan et al. argue that improved team reflexivity goes hand-in-hand with improved collective awareness that entails aspects such as (1) who knows what, (2) what it is trying

to achieve, and (3) the authority to manage itself. This coupled with managers who are viewed as fair and who apply procedures that are deemed fair will create a climate where NPD teams can effectively deal with a turbulent environment. Dayan et al. therefore conclude that a product can be delivered successfully in an environment with increased volatility, when the reflexivity in the team is improved accordingly.

2.5.5. The role of managers in new product development

The role managers play in NPD has been alluded to in the sections above. This includes facilitating congruent decision making by the team (Wong et al. 2005), improving communication with and within the team (Qiu et al. 2009), formalising knowledge sharing processes (Wong et al. 2005; Pitt et al. 2008), encouraging tacit-to-tacit knowledge transfers (Pitt et al. 2008), and empowering the team by encouraging reflexivity in the team (Dayan et al. 2010). Broadly speaking, this implies that managers should concern themselves with the following activities: —

Firstly, providing a clear project target. Wong et al. (2005) and Dayan et al. (2010) contend that team integration will be enhanced when the project's target is clear and established early as this will minimise conflicts within the team. Wong et al. contends that this means that the project target should be defined unambiguously in an environment where team members have a common understanding of project goals, which in turn relies on prolific communication between them. Furthermore, this clarity may make the team more productive overall because it enables them to exploit resources more effectively, which leads to reduced time to market. In essence, providing a clear project target entails providing the team with a shared mission, i.e. a common *vade mecum*, and clear goals, i.e. clear milestones, which lead to the shared mission.

Secondly, guiding the team. Wong et al. (2005) caution that CFTs are often blind to their own tradeoffs, which frequently lead to conflict and incongruent decisions, which in turn has a detrimental effect on the team's performance. The project manager's role is therefore to bring the team members together by clarifying goals, providing definite direction and bring about synergies. Furthermore, Wong et al. found that a NPD team's performance is strongly influenced by their leaders and therefore urge that the project manager should have substantial technical expertise, e.g. be chief engineers, and have formal as well as informal influence in the project. Moreover, Dayan et al. (2010) encourage managers to create an environment where teams can be more reflexive and empowered. This can be done by for example, making team members aware of their own knowledge and skills, establishing a collective work environment and discouraging turnover within the team.

Lastly, aligning the project's NPD activities with business strategy. Wong et al. (2005) contend that the strategic agenda for the project should be set early. This means

establishing early on to what extent the organisation's business methodologies, product mix, and technological know-how will guide the project's development effort. Wong et al. therefore caution that poor alignment between NPD and business strategy may result in inadequate allocation of resources to the NPD activities, which may adversely affect the development process. This includes increased development time with the associated costs and delays in time to market, and even the possibility of product failure.

2.6. The convergence of knowledge management with new product development

Sections 2.4 and 2.5 discussed KM and NPD individually. However, the convergence of these concepts are beneficial and is discussed below.

Yang et al. (2002) and Shani et al. (2003) suggest that an organisation's ability to innovate and bring essential business products to market quickly is key to its success and long-term sustainability and will become increasingly important in future. However, Yang et al. believe that intangible knowledge-based assets add most value to these activities. Furthermore, their research found that NPD, a knowledge-intensive activity, requires effective tacit and explicit knowledge because the complexity of products and technologies increases monotonically. They contend however, that effective knowledge management is a great challenge with great rewards when done well. This is because it may result in more efficient NPD processes, especially when tacit knowledge is shared effectively between teams.

However, Wong et al. (2005) contends that it is the project manager's influence that leads to improved NPD performance, especially for projects with uncertainty and ambiguity. They argue that this is mainly due to the manager's ability to communicate across functions as this improves the transfer of knowledge between team members themselves and the rest of the organisation, including senior management. On the other hand, Dayan et al. (2010) maintain that increased team reflexivity benefits a number of project outcomes, such as shorter time to market and a greater probability to develop the product successfully. They believe this is partly due to the team's ability to recognise obsolete practices and adapt appropriately.

From a business perspective, Yang et al. (2002) found that where NPD was seen as an independent activity until quite recently, it is now more commonly managed as an integral business process.They also found that NPD is now integrated to the point where knowledge repositories, including the associated information interdependencies, are shared between all constituents of the value chain. Furthermore, companies that excel at NPD usually assign more resources to their KM processes than their competitors as it establishes their competitive advantage (Yang et al. 2002). These arguments are supported by Pitt et al. (2008) who argue that it's an organisation's capability for effective

KM that constitute the competencies crucial to its NPD activities. They believe these competencies are fundamental to its ability to innovate, which allows it to not only survive, but grow in a competitive environment.

These arguments are summarised in the following proposition:

Proposition 2. *Effective KM will improve the efficacy of NPD activities in SMEs.*

The discussion above highlighted some of the benefits NPD activities can enjoy when paired with effective KM. The next section finalises this chapter with a few concluding remarks.

2.7. Conclusions

An organisation should have a thorough understanding of the CSFs applicable to its KM initiative in order for it to be a success. However, care should be taken when determining these factors as those applicable to large firms are not wholly suited to SMEs (Wong 2005). Furthermore, knowledge processes based on IT should be complemented with informal ones. In other words, the knowledge strategy for NPD should integrate human and technical processes to facilitate enhanced formal and informal communication. Moreover, SMEs should realise that knowledge management is a dynamic and continuous process (Pitt et al. 2008).

On the other hand, NPD also benefits from a project manager of sufficient stature who should guide the NPD team's effort indirectly, i.e. not by way of autocratic authority. This will have a positive impact on the team's, and indirectly the organisation's, performance as the team will have a greater sense of shared purpose (Wong et al. 2005).

In essence, an SME's competence in NPD stems from its efficacy in KM (Yang et al. 2002). These observations lead to the research propositions made earlier, which are repeated here for convenience: —

Proposition 1. *A knowledge sharing initiative in SMEs should be based on the personalisation or sociological strategy that emphasises the qualitative aspects thereof.*

Proposition 2. *Effective KM will improve the efficacy of NPD activities in SMEs.*

3. RESEARCH METHODOLOGY

The methodology that was used to perform this research is described in this section. It starts off with a discussion of the research methodology itself and design thereof. This is followed by the definition of the population and a discussion of the sampling method that was used, which leads to a description of the research instrument itself. Thereafter, the procedures that was used to collect and analyse the data is discussed. This section concludes by identifying the limitations of the study and the steps that were taken to ensure the validity of the data.

3.1. Research methodology / paradigm

The research attempted to capture the views of knowledge workers involved with NPD in SMEs with the focus on the fundamental themes discussed in the literature review. The research endeavoured to deduce the views of knowledge workers with their regard to KM and the practical sharing of knowledge.

A qualitative research style based on a constructivist paradigm (Guba and Lincoln 1994) was adopted to help with capturing the variety and complexity of respondents' views on these themes. As such, the research paradigm comprised a relativist ontology that assumes "multiple ... and sometimes conflicting social realities that are the products of human intellects [exist], but may change as their constructors become more informed and sophisticated" (Guba et al. 1994:111). Hence the perceptions of KM in organisations are likely to differ not only from one knowledge worker to the next, but also between the same workers at different times.

The data was collected through semi-structured interviews. This allowed the respondents to relate personal opinions and experiences, while still ensuring the required data were collected. Furthermore, it was assumed that the respondents were forthright during the interviews.

3.2. Research design

The research was facilitated with qualitative interviewing techniques. Specifically, the interviews were based on the Responsive Interviewing model invented by Rubin and Rubin (2005). The questioning styles in this model are similar to the constructivist paradigm (Guba et al. 1994), in that they are influenced by the personality of the researcher

and adjust to the changing relationships between the researcher and respondents. The researcher therefore has to be wary of imposing their views on the respondents. The benefit, however, is that this allows questions to be adapted and elaborated on dynamically during interviews, to explore new lines of thought uncovered by the respondent (Rubin et al. 2005).

3.3. Population and sample

3.3.1. Population

The population for this research consists of all the knowledge members of small teams involved with the creative aspects of NPD in SMEs in South Africa.

3.3.2. Sample and sampling method

A sample of fifteen to twenty respondents were originally planned, however convergence of results suggested that further interviews were unnecessary. As a result, a convenience sample of fourteen knowledge workers involved with NPD was interviewed. The interviews were held with members of different functional areas to obtain a holistic view of the perceptions of knowledge sharing in these teams. The sample was taken from SMEs in Gauteng and every effort was made to ensure the respondents had diverse backgrounds as practicable to obtain results more representative of the population. The profile of respondents is provided in table 3.1.

Table 3.1.: Profile of respondents

Type of respondent	No. sampled
Designers	4
Engineers	4
Managers	4
Marketers	2
Total	14

The small number of respondents suggest that the results from this research are only generalisable insofar a larger group matches the profile of the respondents. Therefore, while these results may be shared by a larger group, no claim is made that they are generalisable.

3.4. The research instrument

A semi-structured interview was used during this research. The questions have been derived from the literature review and conclusions and were open-ended to allow the exploration of current and new ideas. The interview guide is provided in Appendix A.

3.5. Procedure for data collection

Each respondent was contacted by telephone or email. Interviews took place at a location convenient for the respondents and was recorded with the consent of the respondent. The interview guideline was designed based on the literature and research propositions and was used to guide the interviews.

Hand written notes that accounted for the main ideas during the interview were also taken as suggested by Rubin et al. (2005). The respondents were assured that their responses would remain confidential to encourage them to speak freely and state their honest opinions. This affirmed the assumption of confidentiality, if any, held by respondents prior to the interview and is consistent with other researchers' views (e.g. Grinyer 2002; Wiles, Crow, Heath and Charles 2008).

3.6. Data analysis and interpretation

The recording of each interview was analysed using concept mapping. An iterative process was followed that included listening to the interviews multiple times, taking notes, categorising spoken ideas and normalising the obtained concepts. This information was then used to generate concept maps that represent the interviews graphically.

Kinchin, Hay and Adams (2000p. 44) believe concept maps are suited to this type of representation because they intend "to reveal the perceptions of the map's author, rather than a reproduction of memorized facts". They also believe that a map's construction is unique to the author and reflects their understanding of the topic, including their experiences, beliefs and biases. However, the concept maps in chapter 4 were created by the researcher and not the respondents themselves. The fact that the respondents are not the true authors are mitigated by the fact that the maps were created directly from the interviews and therefore represent the views of the respondents and not that of the researcher.

These maps, which represent the views of the individual respondents, suggest a number of common themes. To reveal these, the individual maps were combined through an iterative process where common concepts were normalised. The linking phrases between concepts were retained and where possible, normalised as well. These normalised components were then combined and grouped hierarchically into recurring themes while

retaining the links between concepts. Care was taken to ensure a healthy balance between simplification and retaining the underlying themes.

However, the combined concept map is too complex to visualize effectively with concept maps. A tree structure could have been used, but space constraints made it impractical. A treemap was used instead to visualise the hierarchical data of the combined concept map for the discussion in chapter 5. Treemaps were originally created by Ben Shneiderman (Shneiderman and Plaisant 2009) as a means to visualize directory structures in limited space. That original idea has been generalised to represent hierarchical data in two-dimensional space (Shneiderman and Wattenberg 2001) and have been used in a number of fields, for example software metrics (Compton 2009), financial data (Wattenberg 1999) and the World Wide Web (Mukherjea and Foley 1995). A treemap is therefore suited to represent the hierarchical data of the combined map.

On the other hand, it is not only the hierarchical nature of the themes that are important, but also the way they interact with each other. A table was constructed that contains the high-level themes as column and row headings. This provides the framework that indicates the number of interactions between themes. However, the author believes that the table view of the data, although accurate, does not truly convey the intricacies of the interconnectedness of the concepts. This agrees with Krzywinski, Schein, Birol, Connors, Gascoyne, Horsman et al. (2009) who believes that tables are suited to store data but not display it. This lead to the development of Circos, a data visualization tool for biological data (Krzywinski et al. 2009). Fortunately, Circos has been used to visualize a wide range of data types, for example the names used by presidential candidates (Corum and Hossain 2007), the similarities between software projects (Kosti, Lazaridou, Bourazani and Angelis 2011) and the association maps for online communities (Carvalho, Fuks and Lucena 2012). Unfortunately, the Circos tool creates visualizations that contain a lot of information that complicates matters unnecessarily in this case. The data was therefore visualised using a simplified ideogram based on the more comprehensive ones generated by Circos.

3.7. Limitations of the study

The sample was taken wholly from two SMEs in Gauteng that recently merged into a single company. It was therefore assumed that respondents were sourced from two different companies for the purposes of this research. Even so, the sample remains small and will negatively affect the generalisability of the results.

Furthermore, the study focuses on *current* preferences for KM and therefore adopts a cross-sectional and not a longitudinal approach. In other words, the study does not examine the respondents' preferences for KM nor its influence on NPD over time.

3.8. Qualitative validity

Trochim (2006) compares criteria for the frameworks that ensure the rigour of quantitative and qualitative research. He believes that the common criteria for quantitative research, i.e. internal validity, external validity, reliability and objectivity has the following analogous criteria in qualitative research: credibility, transferability, dependability and confirmability. However, Morse, Barrett, Mayan, Olson and Spiers (2002) warn that the introduction of these analogous criteria in the 1980s has resulted in situation where the consumer, instead of the researcher, is now responsible for the validity of the research. They conclude their article with a plea for the academic community to return to the quantitative criteria. They believe that this will have a positive impact on the quality of research as the onus of ensuring the rigour of the research will then again rest on the shoulders of the researcher.

On the other hand, Trochim (2006) believes that the choice of framework is dependent on the philosophical perspective of the researcher. The author agrees therewith as he believes it is the primary concern of the researcher to ensure the validity of his own research. Either criteria, if applied during the research to ensure rigour and validity should result in trustworthy results. The following sections discuss how the criteria were used to ensure the rigour of the research.

3.8.1. External validity / transferability

External validity in social research is important when it is desired to generalise the research findings to other groups at other times (Johnson 1997). It may be difficult to generalise social research and Johnson (1997:290) believes that "the most reasonable stance towards the issue of generalizing is that we can generalize to other people, settings, and times to the degree that hey are similar to the people, settings, and times in the original study".

The external validity of this study relates to the comparison of the perceptions of KM of a small number of knowledge workers involved with high-tech NPD in SMEs in Gauteng in South Africa, and is as such relevant for senior managers that consider implementing a KM initiative in similar environments. Care should be taken to ensure the environments are sufficiently similar because the results of this research are not expected to be generalisable beyond the profile of the respondents.

3.8.2. Internal validity / credibility

"Internal validity refers to the degree to which a researcher is justified in concluding that an observed relationship is causal" (Johnson 1997:287). This implies that the data collection process is consistent from end-to-end.

This study ensured internal validity by duplicating the process followed for each interview as far as possible. The interview process could not however, be duplicated exactly between

interviews because of the fluid nature of the research paradigm. The researcher therefore ensured internal validity remains uncompromised. Furthermore, multiple respondents of the same type promoted internal validity.

3.8.3. Reliability / dependability

Research validity and reliability have distinct meanings in quantitative research, but these concepts revolve around the credibility of the research when it's applied to qualitative research. For this reason, qualitative research rather uses terms that cover both these concepts, such as 'credibility', 'transferability' and 'trustworthiness' (Golafshani 2003).

Reliability or dependability was achieved with the consistent application of the interview process.

3.8.4. Objectivity / confirmability

Each researcher brings a unique perspective to a study (Trochim 2006). Confirmability in the qualitative sense, "refers to the degree to which the results could be confirmed or corroborated by others" (Trochim 2006). The researcher will promote confirmability by making the anonymous research data available on reasonable request.

4. PRESENTATION OF RESULTS

4.1. Introduction

Concept maps, while capturing the essence of the respondents' understanding, are open to misinterpretation and misunderstanding, since they are visually similar to more familiar techniques. Section 4.1.1 therefore presents a few guidelines on how to read them. Readers familiar with concept maps may skip it without any loss in continuity.

4.1.1. Guidelines for reading concept maps

Concept maps are used to graphically represent knowledge and include concepts, usually indicated by circles or boxes, and relationships between them indicated by one or more connecting lines. The relationship between the concepts are made explicit by the words on the line, or linking phrases as they are commonly known. Concepts on the other hand, are defined as a perceived regularity in events and designated by a label inside the circles or boxes. Meaningful statements are formed when concepts are connected together by linking phrases. Furthermore, concept maps are represented hierarchically with the most general concept at the root and more specific concepts arranged hierarchically below (Novak and Cañas 2008).

Concept maps are constructed in the context of a focus question which provides the root of the map. In this paper *Knowledge Management* and *New Product Development* formed the roots of the interviews and are coloured differently to assist the reader in finding them and facilitate comparison of maps with each other.

4.2. Demographic profile of respondents

The demographic profile of the respondents closely match that which was originally planned. All respondents were from relevant SMEs in Gauteng and all were involved with NPD. However, only 14 of the planned 15 respondents were interviewed as shown in table 4.1. The backgrounds of respondents ranged from veterans who have been active in the industry for many years, to persons active in the industry for a few years only thereby covering the planned breadth of experience.

4.3. Concept maps

The concept maps constructed from the interviews follow. The interviewees are not named explicitly to ensure their anonymity. However, the context for each paper is provided by the section that contains it.

Each interview is presented in concept map form with no interpretation of the results. Where possible, the same label was given to similar concepts and linking phrases to provide continuity from one map to the next. Care was taken to ensure that each map represents the views of the interviewee and not that of the researcher.

Chapter 5 provides a depth discussion of the results.

Table 4.1.: Profile of actual vs. planned respondents interviewed

Type of respondent	**Planned no.**	**Actual no.**
Designers	4–5	4
Engineers	4–5	4
Managers	4–5	4
Marketers	3–5	2
Total	15–20	14

4.3.1. Concept maps — designer view

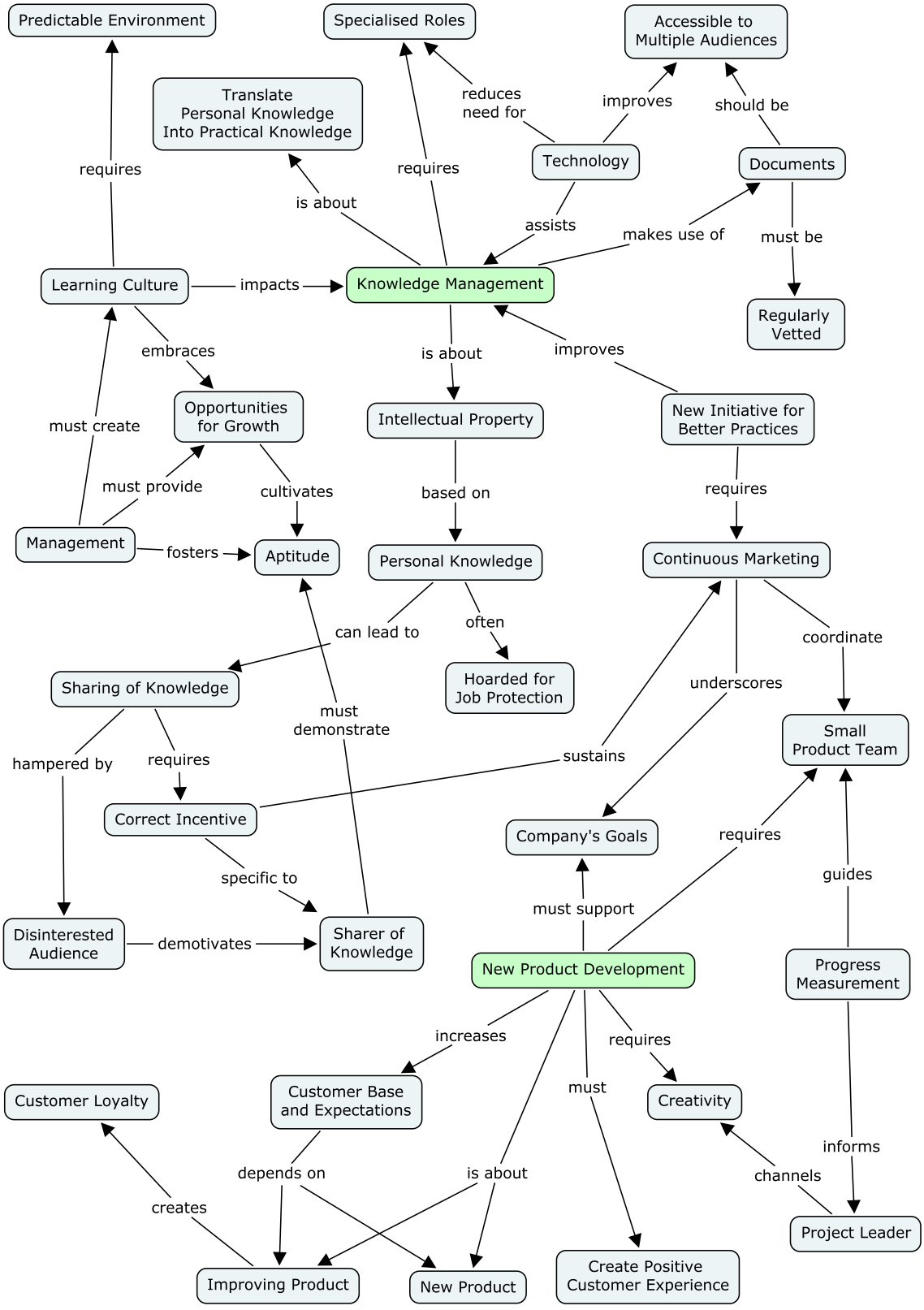


Figure 4.1.: Concept map for designer number 1

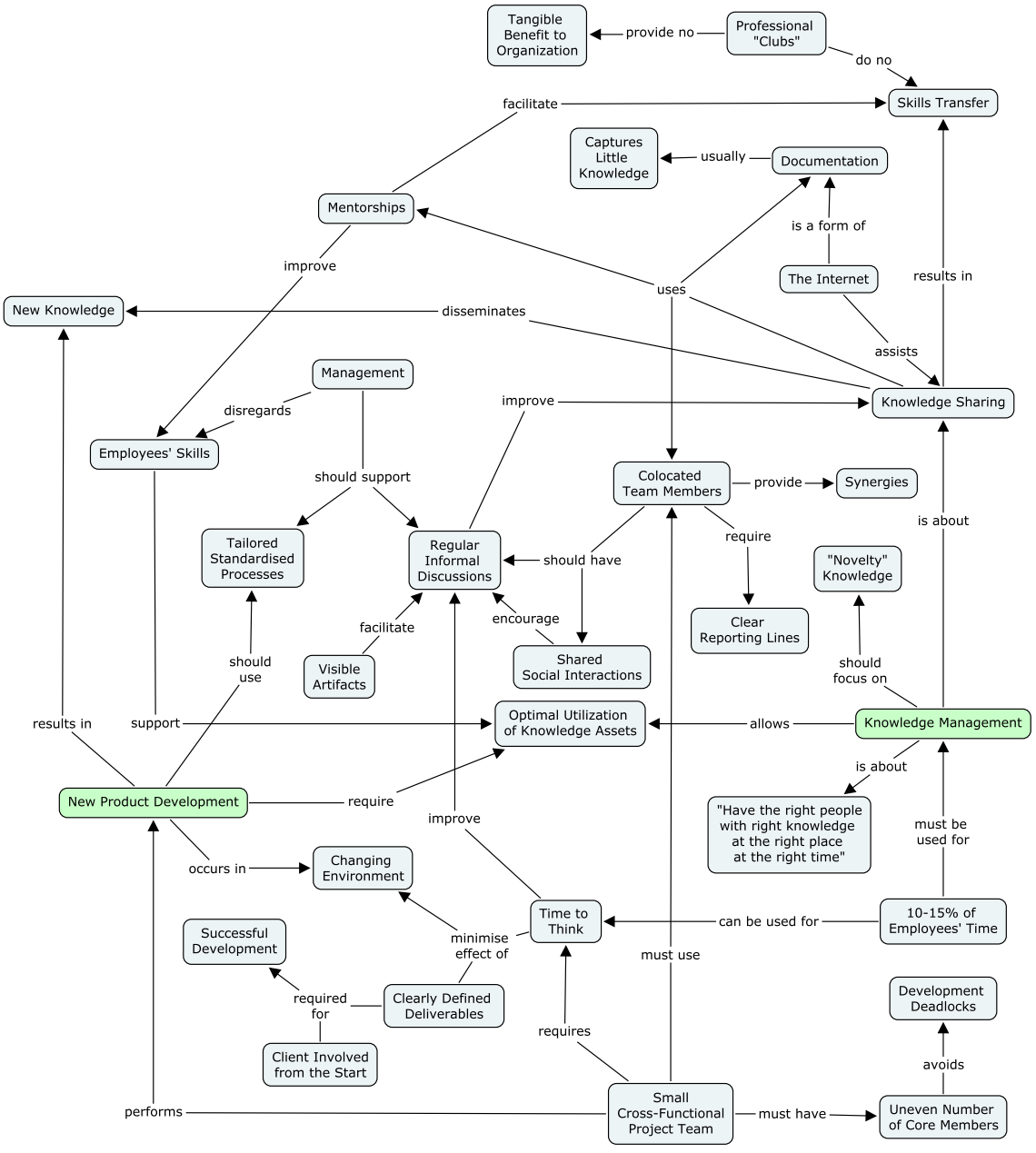


Figure 4.2.: Concept map for designer number 2

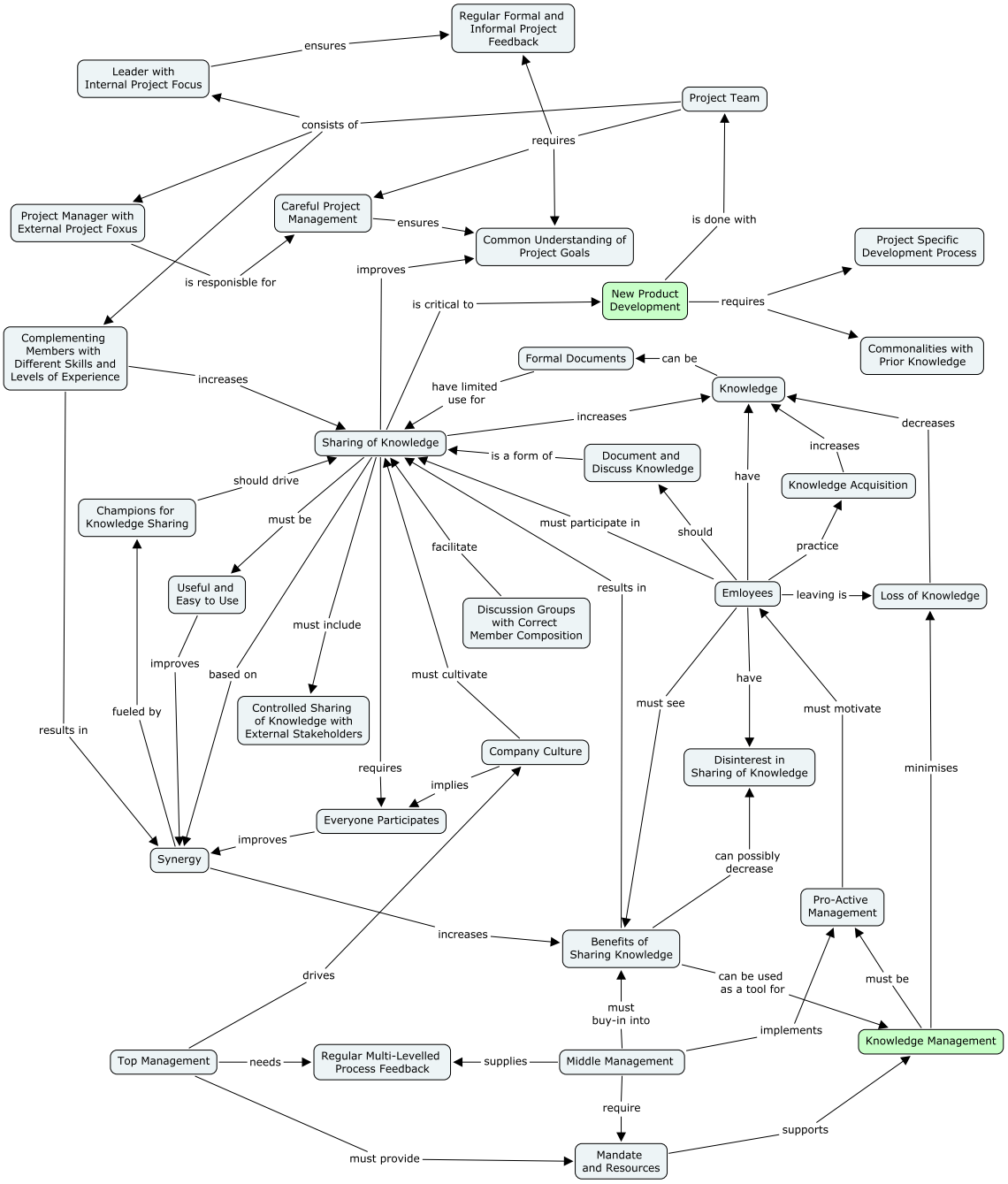


Figure 4.3.: Concept map for designer number 3

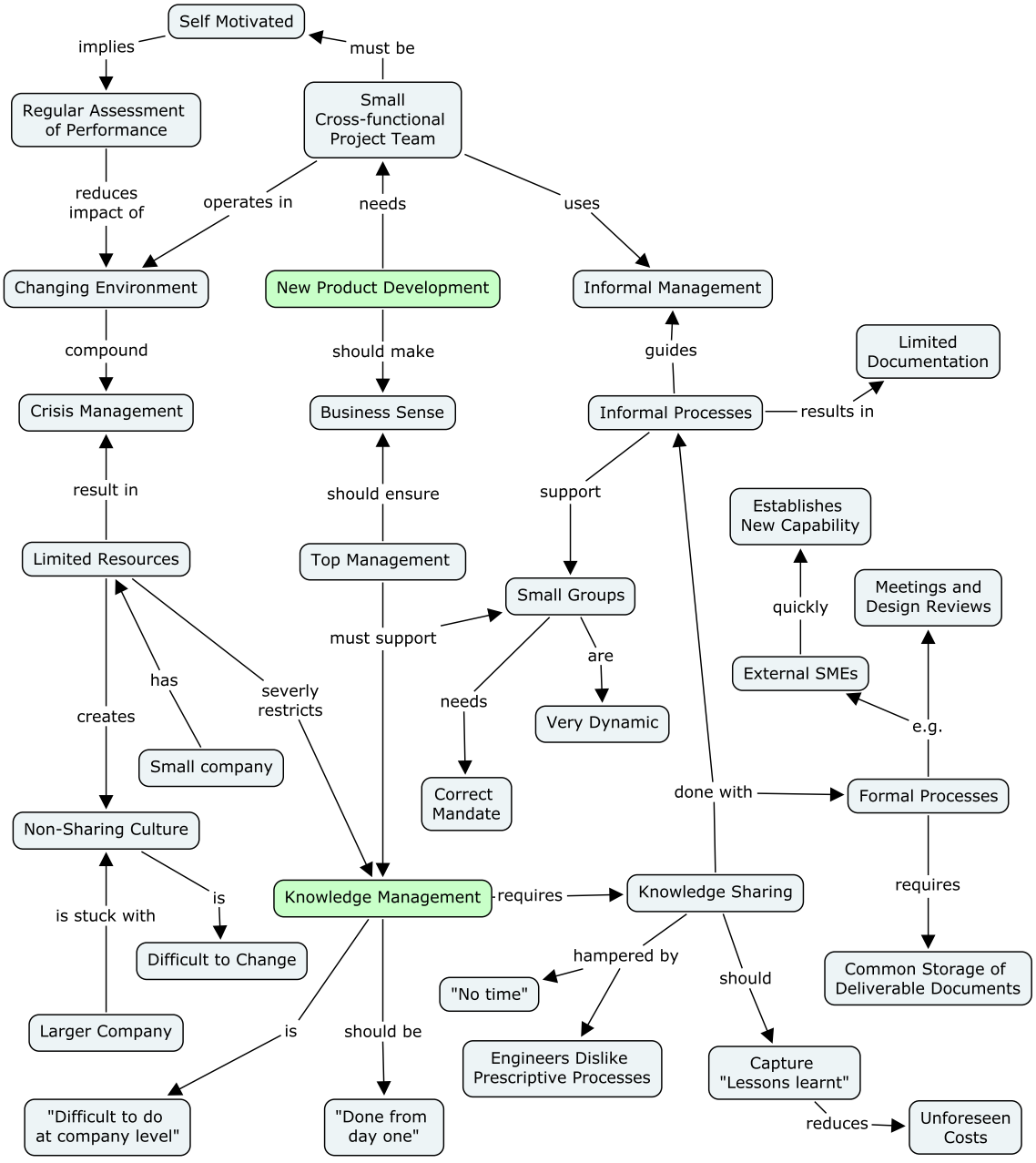


Figure 4.4.: Concept map for designer number 4

4.3.2. Concept maps — engineer view

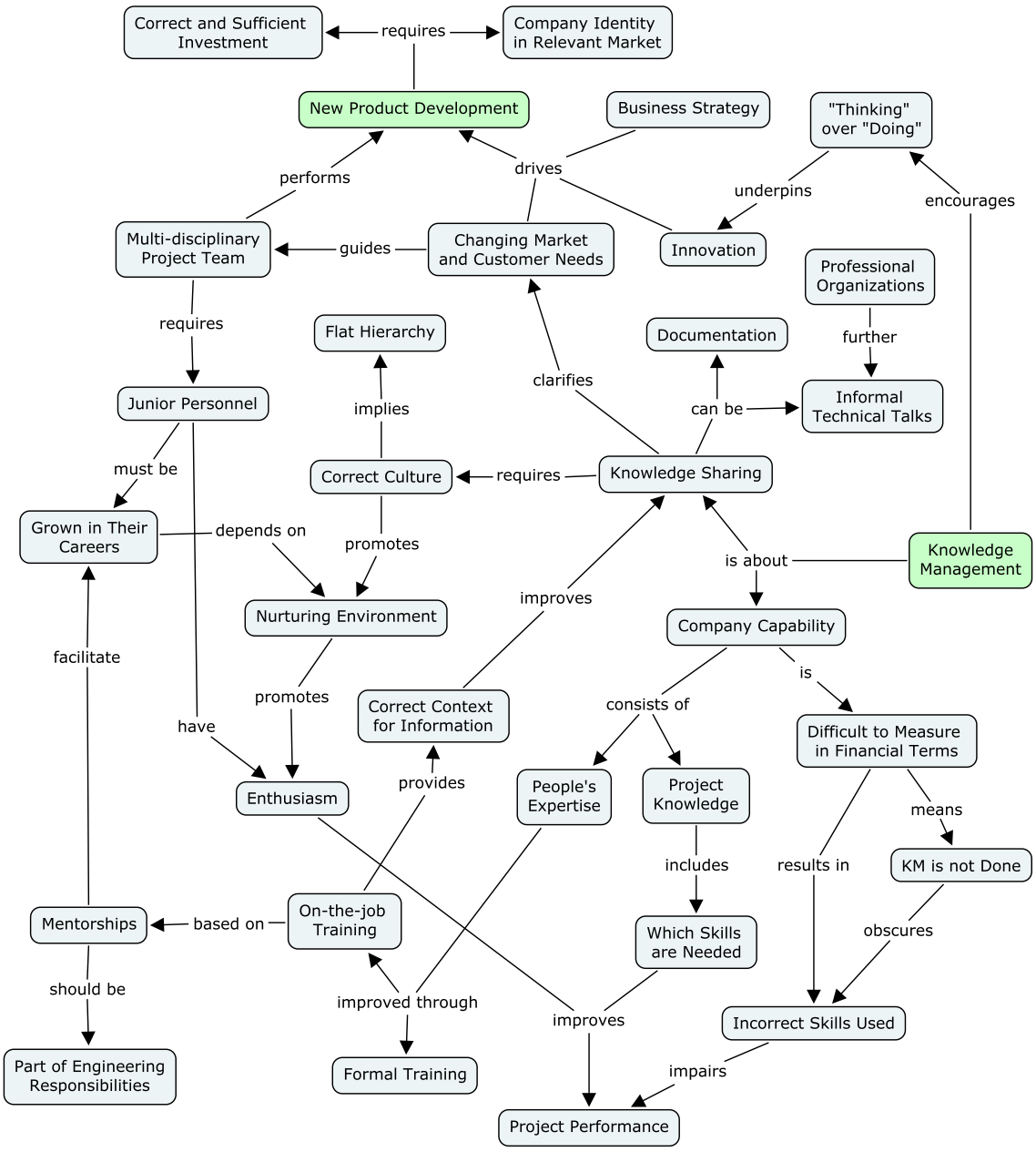


Figure 4.5.: Concept map for engineer number 1

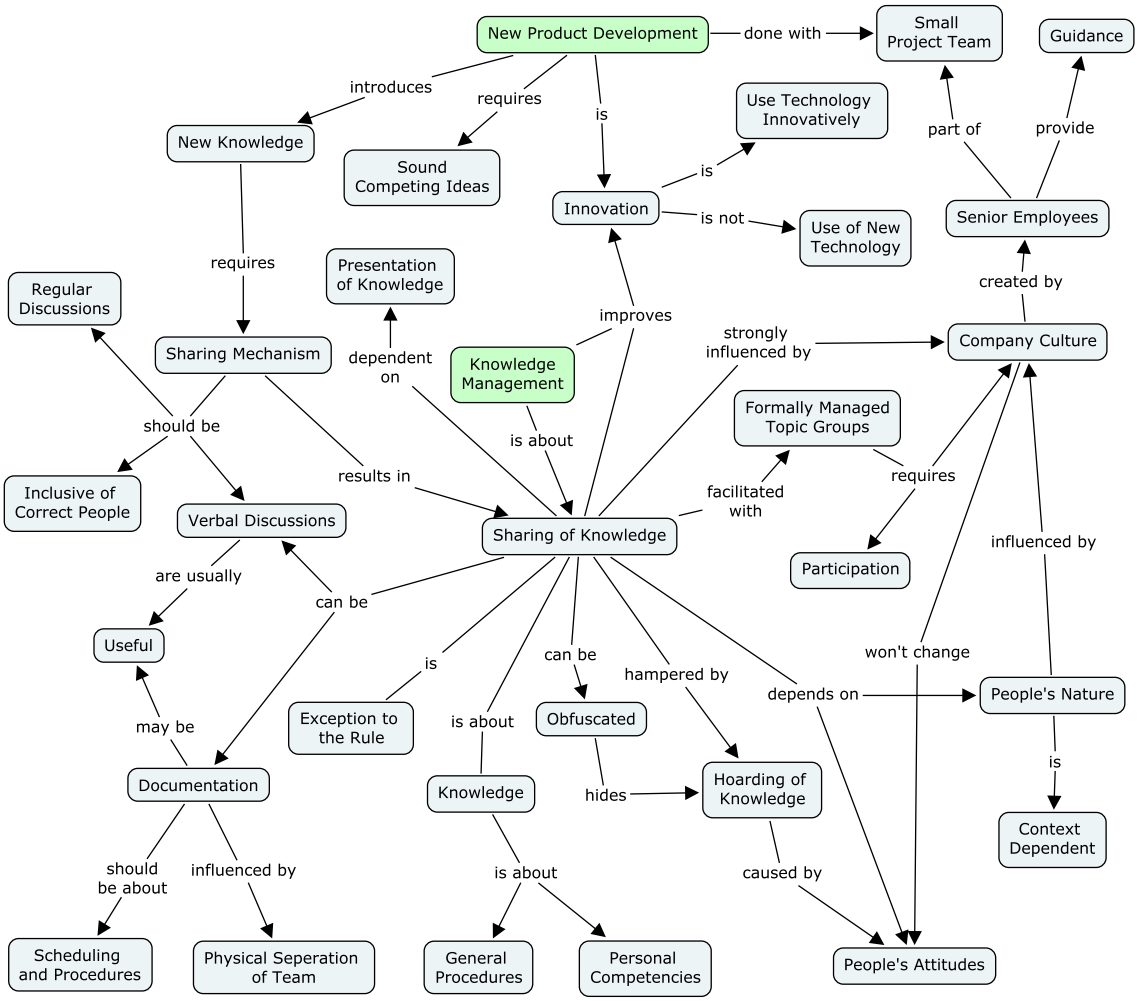


Figure 4.6.: Concept map for engineer number 2

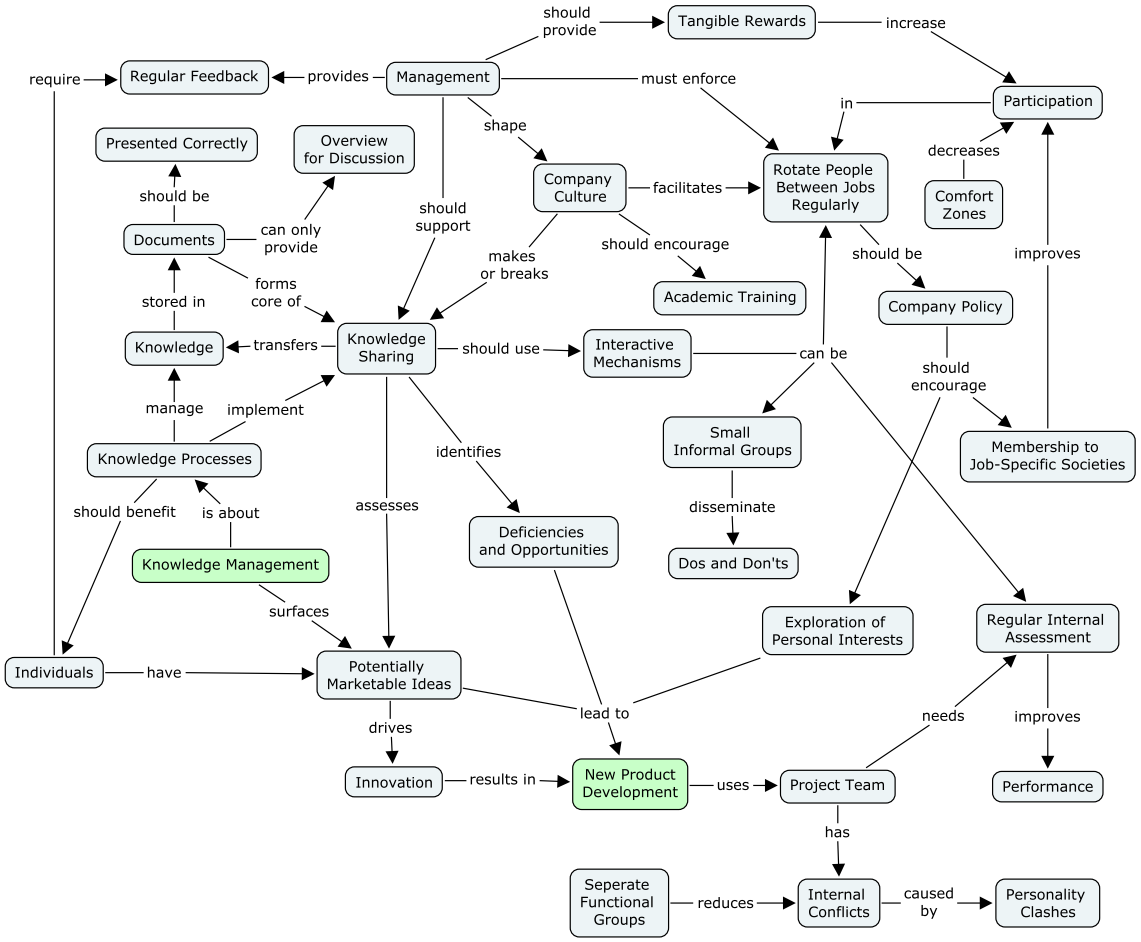


Figure 4.7.: Concept map for engineer number 3

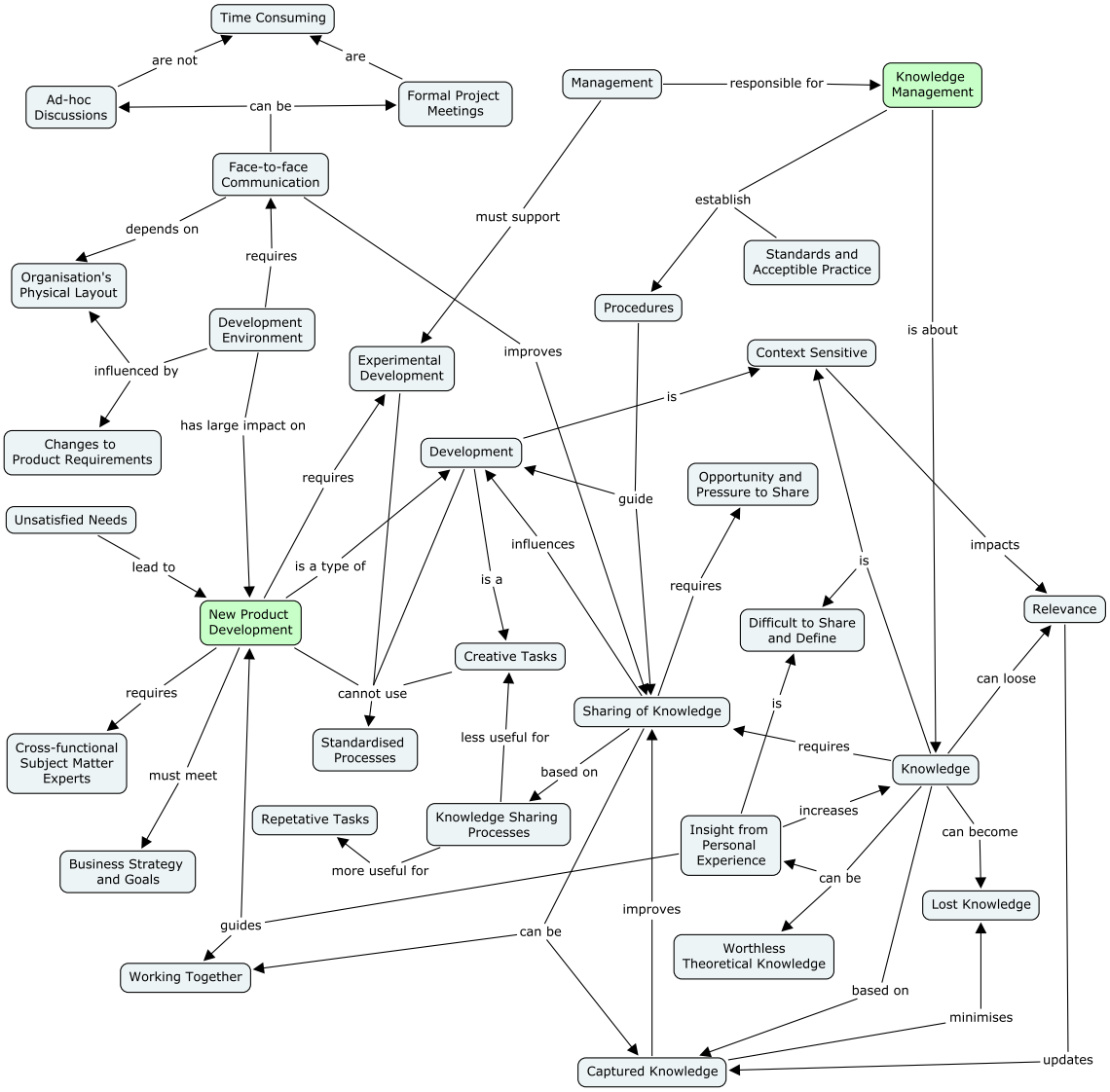


Figure 4.8.: Concept map for engineer number 4

4.3.3. Concept maps — manager view

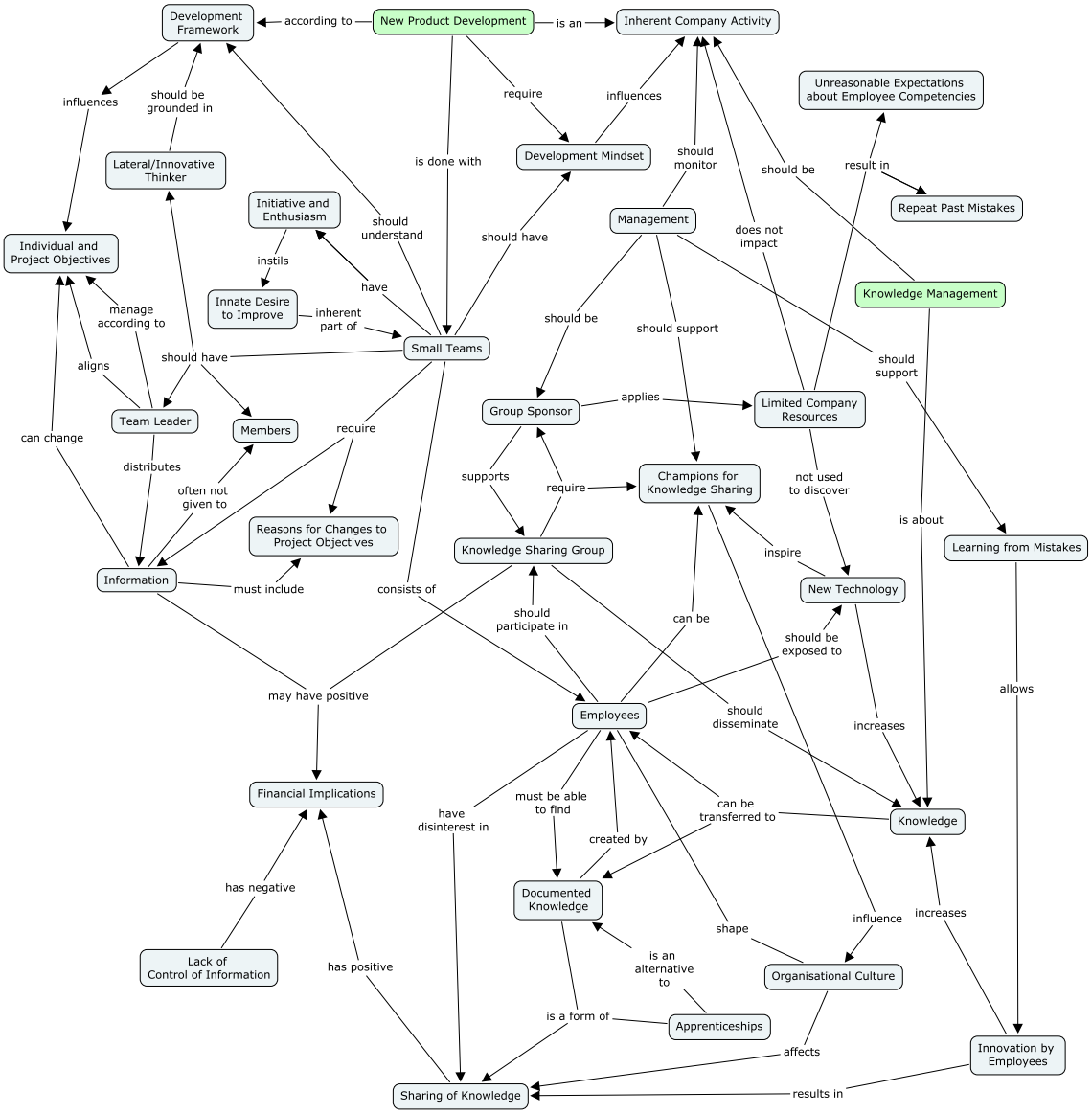


Figure 4.9.: Concept map for manager number 1

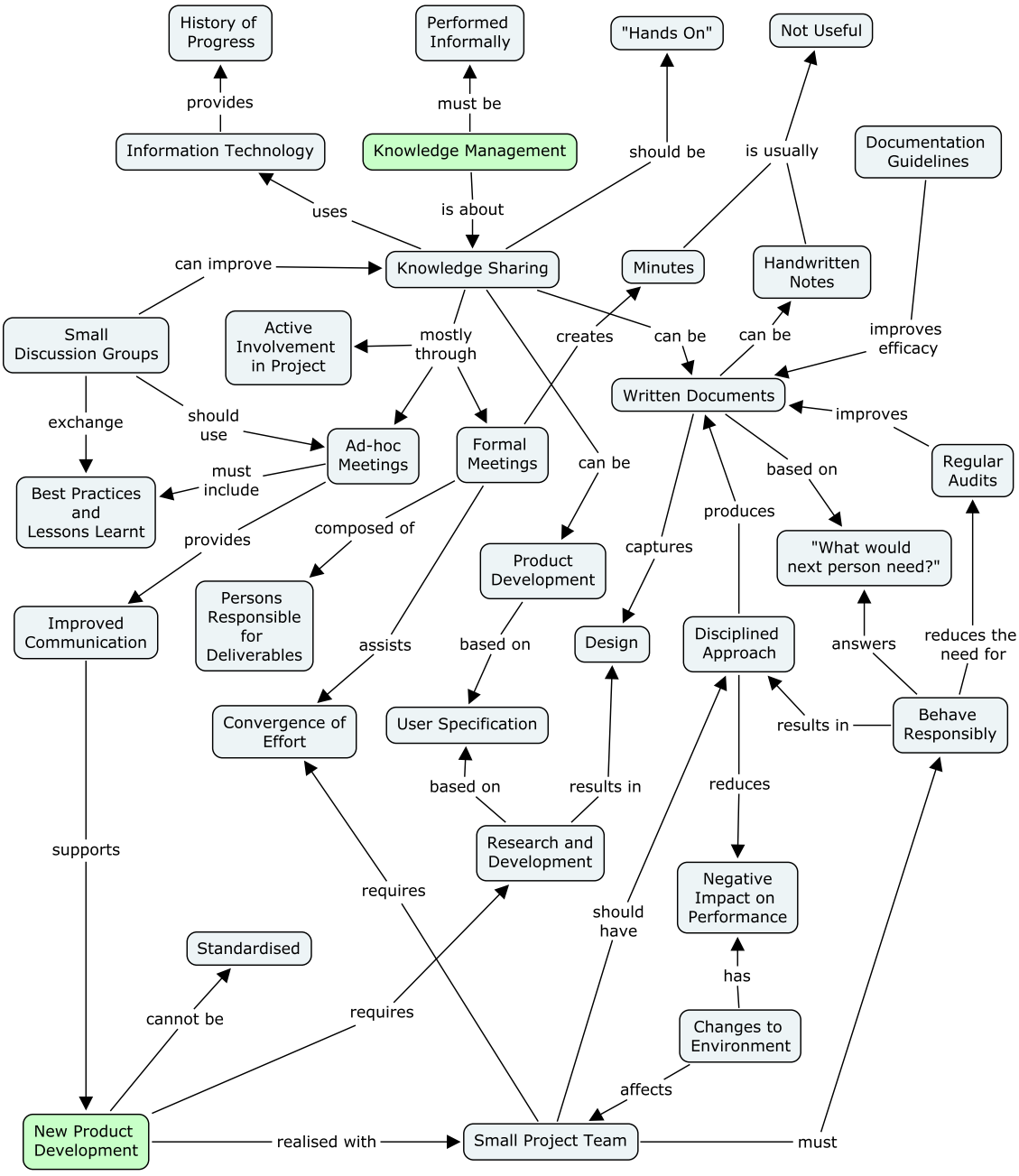


Figure 4.10.: Concept map for manager number 2

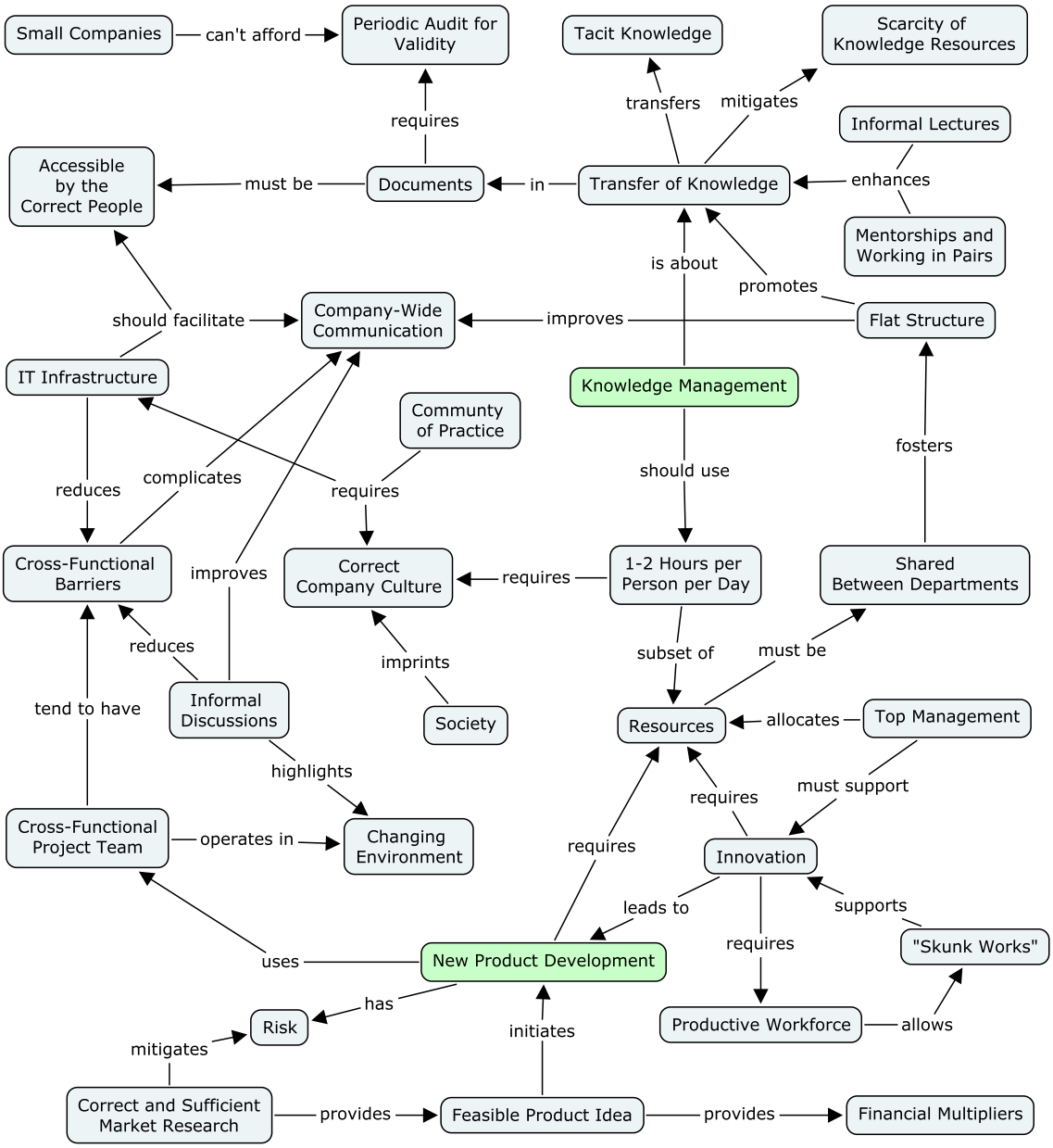


Figure 4.11.: Concept map for manager number 3

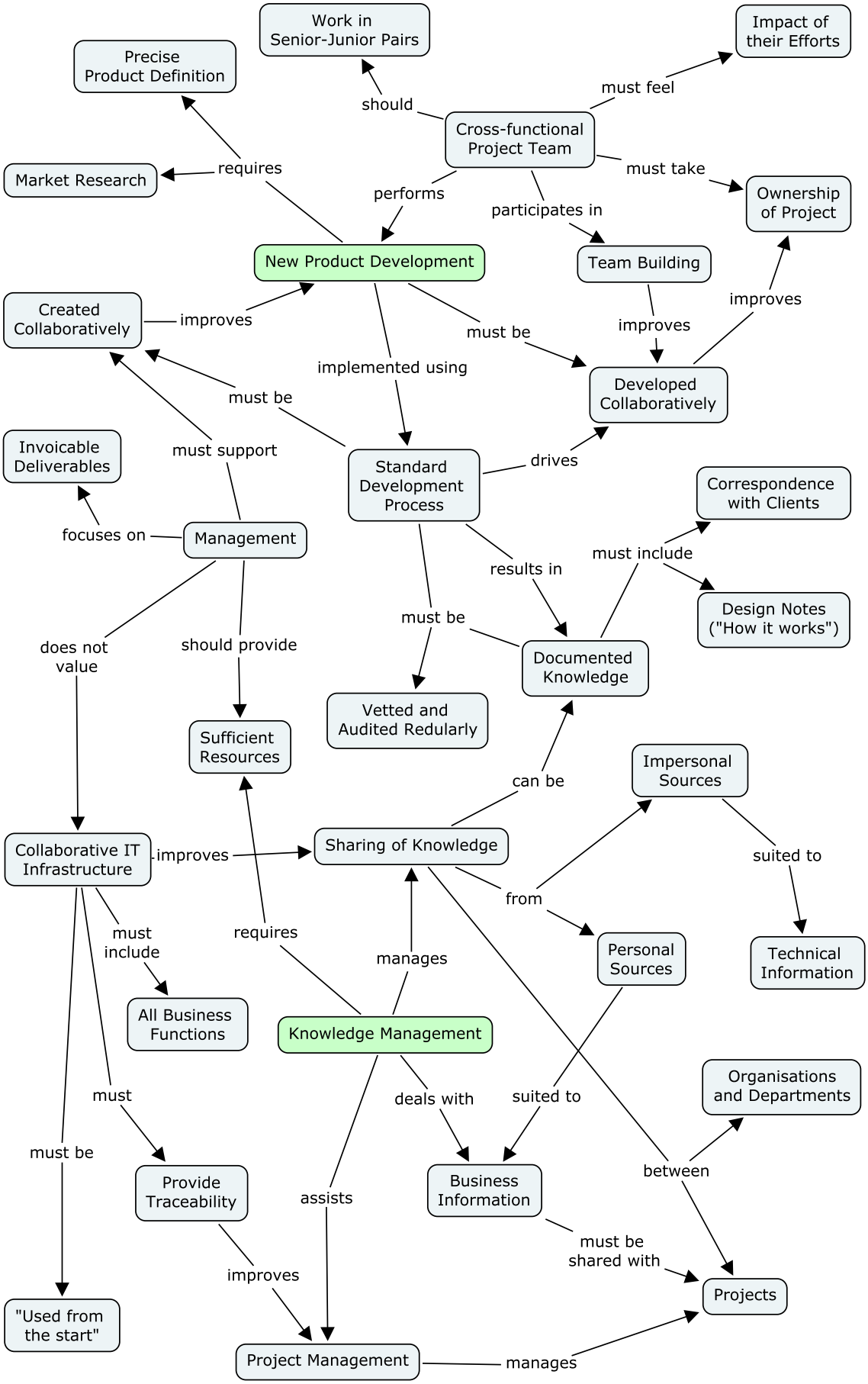


Figure 4.12.: Concept map for manager number 4

4.3.4. Concept maps — marketer view

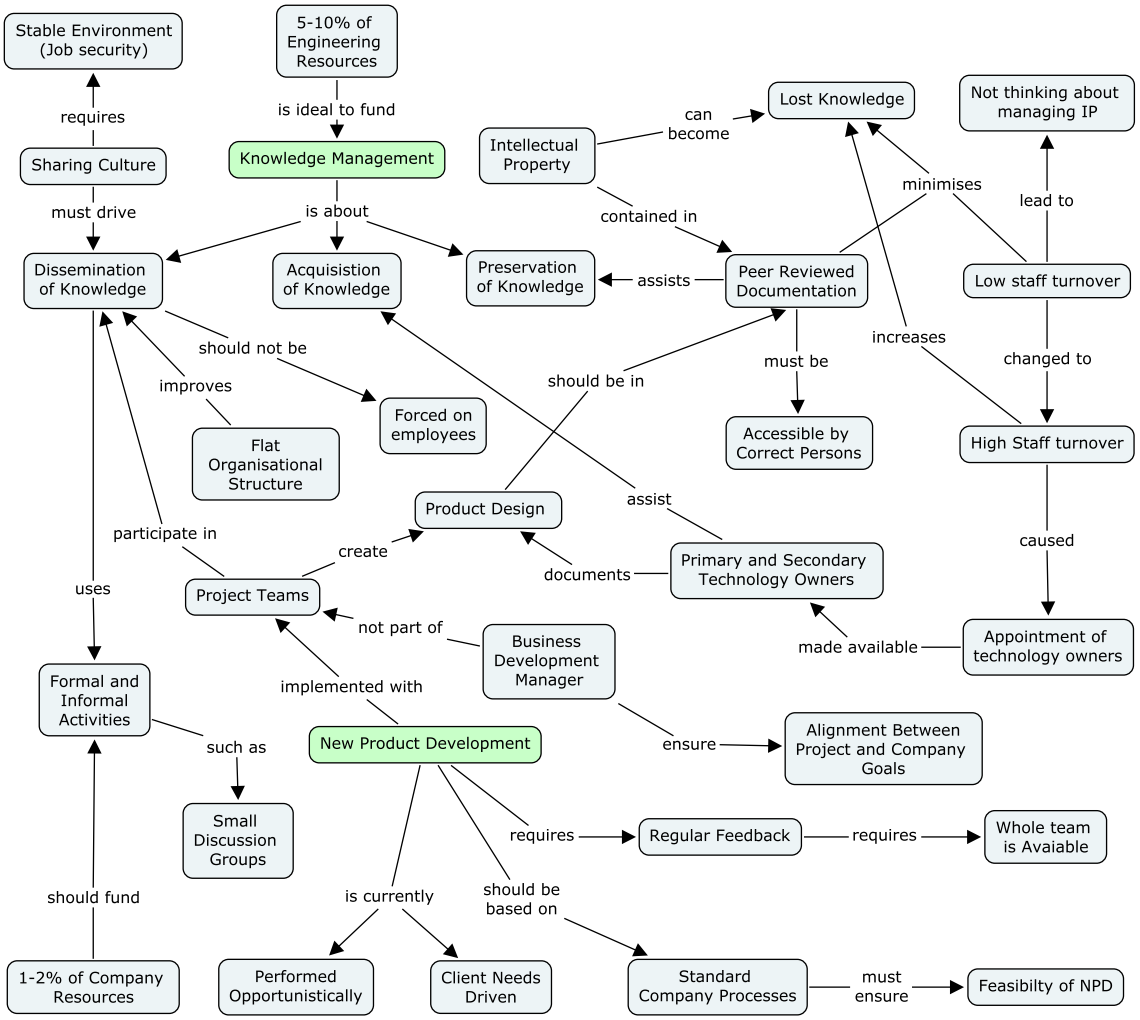


Figure 4.13.: Concept map for marketer number 1

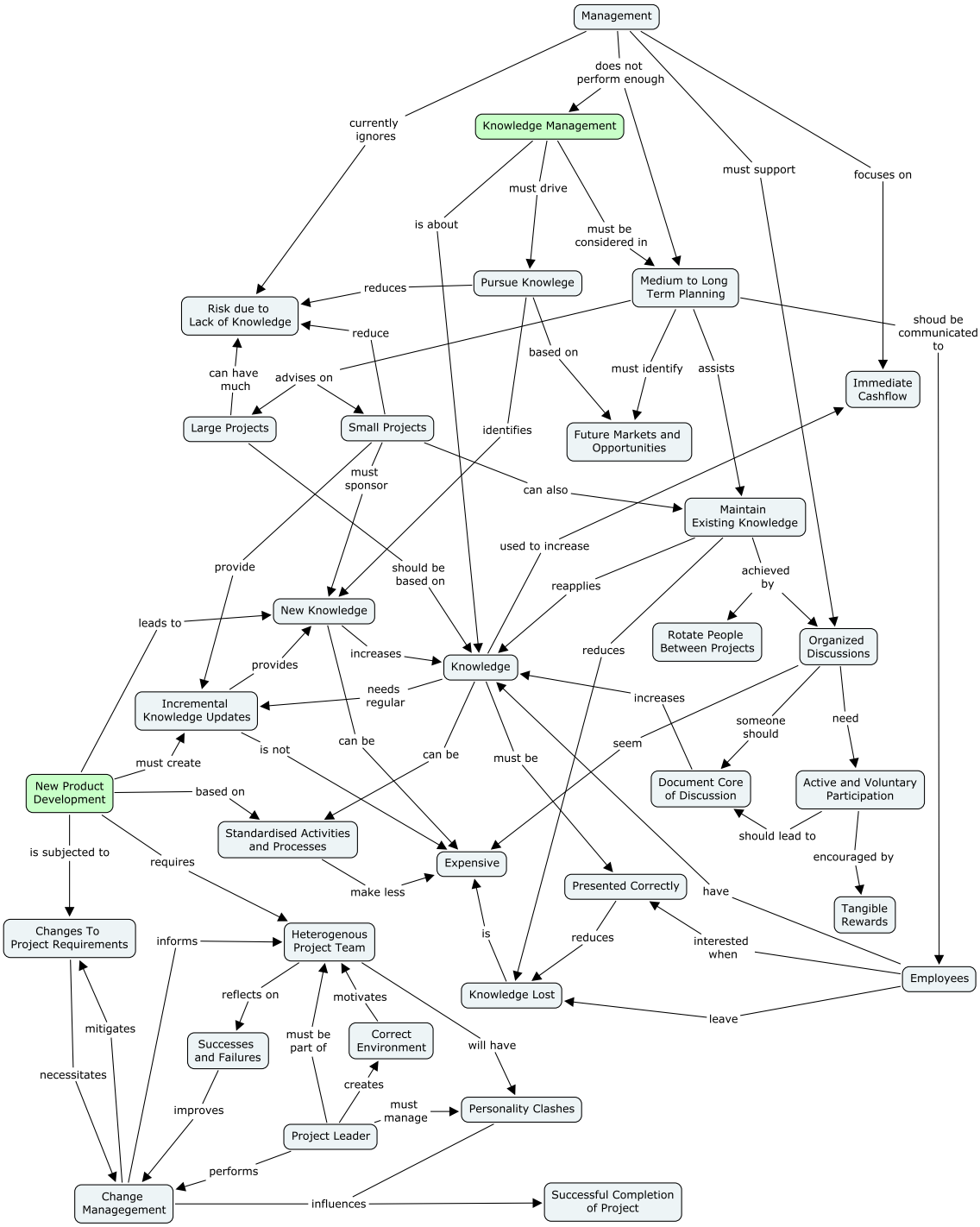


Figure 4.14.: Concept map for marketer number 2

5. DISCUSSION OF THE RESULTS

5.1. Introduction

The individual maps shown in chapter 4 were combined through an iterative process where common concepts were normalised, combined and grouped hierarchically into recurring themes. The result is shown using the treemap in figure 5.1. The relative size of each



Figure 5.1.: The relative importance of the identified themes

block represents the amount of influence it has compared to the others. In this instance, influence is defined as the number of links between a theme and all other themes as shown in table 5.1.

The data in table 5.1 was visualised using Circos-like diagrams in section 5.1.2.

The next section provides guidelines on how to interpret these visualizations for readers unfamiliar with the technique.

5.1.1. Guidelines for interpreting Circos visualizations

The following guidelines were extracted from the papers by Kosti et al. (2011) and Krzywinski et al. (2009). The reader is encouraged to refer to them should more detail be required.

Circos uses a circular ideogram to display the relationship between pairs of data using ribbons or chords. The tabular data is encoded by arranging the headings in segments

Table 5.1.: Number of interactions between themes

(from) \ (to)	Cross-functional team	Company-wide communication	Effective knowledge sharing	Resource management	Organisation environment	Knowledge lifecycle management	Mgt. and bus. strategy	Projects for skill improvement	Operations management	Innovation and R&D	Cooperating employees
Cross-functional team	—	2	0	0	1	2	0	2	5	2	4
Company-wide communication	0	—	4	3	1	0	0	0	3	1	5
Effective knowledge sharing	1	1	—	2	1	3	0	0	1	1	2
Resource management	0	0	0	—	1	2	0	1	2	0	1
Organisation environment	2	0	1	0	—	0	0	0	0	1	4
Knowledge lifecycle management	0	1	6	4	0	—	2	4	2	0	0
Mgt. and bus. strategy	0	3	0	3	1	2	—	2	0	0	4
Projects for skill improvement	3	1	6	1	1	2	0	—	1	0	0
Operations management	1	0	0	1	0	1	0	1	—	3	1
Innovation and R&D	0	0	3	3	1	1	1	1	2	—	0
Cooperating employees	2	1	3	0	0	4	1	1	0	2	—

in a circular fashion on the outside of a disc. The value of the corresponding cells are shown by ribbons that connect corresponding segments such that either end of the ribbon corresponds to the equivalent values in the table. The width of a chord at a segment indicates its relative value compared to the segment as a whole.

For example, the data in table 5.1 is represented in figure 5.2. In this figure it can be seen that about half of the links from *organisation environment* go to *cooperating employees,* whereas no links go in the opposite direction.

5.1.2. The influence of themes visualized

The data of table 5.1 is visualized in figure 5.2 using a simplified circular ideogram based on that provided by the Circos tool.

It is clear from the figure that complex relationships exist between the identified themes. None of the themes operate in isolation, which would suggest that the different functions in the organisation must all be in alignment to achieve congruency. The next sections will discuss each in depth. In each instance figure 5.2 was repeated but with the sections under discussion highlighted to provide the context for the discussion.

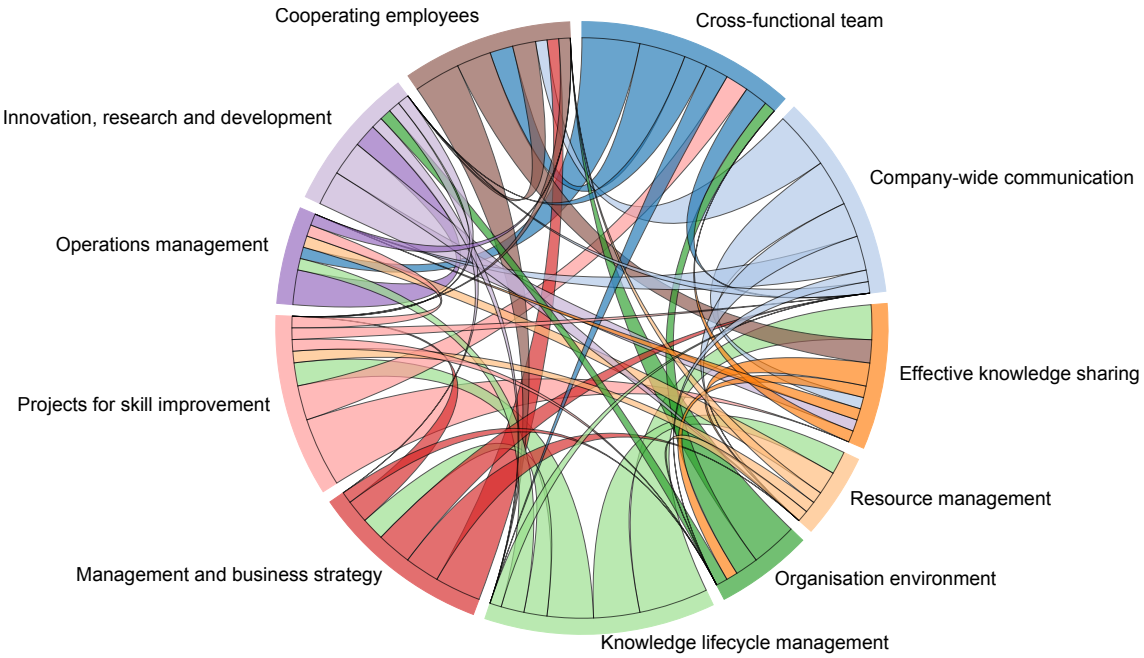


Figure 5.2.: The influence of themes on each other

5.2. Identified themes

The themes identified in the previous chapter and shown in figure 5.2 are discussed in detail in the following sections. Each theme is discussed according to its influence on other themes. In return, the influence of the related themes on the theme under discussion, if any, are discussed in their respective sections. For example, knowledge lifecycle management is discussed in section 5.2.1 and influences operations management, projects for skill improvement, management and business strategy, resource management, effective knowledge sharing and company-wide communication as shown in figure 5.3. These themes are discussed in turn in sections 5.2.3, 5.2.9, 5.2.10, 5.2.2, 5.2.6 and 5.2.11 respectively, where their impact on knowledge lifecycle management, if any, is discussed as part of their overall influence.

5.2.1. Knowledge lifecycle management

KM concerns itself with the acquisition and preservation of knowledge with the goal of minimising the loss of knowledge. It requires a mandate from management to give it the correct priority because it consumes scarce company resources. It is about improving the company's capability and its store of tacit knowledge, which are both based on the competencies of its employees. This tacit knowledge can therefore be lost when, for example, employees leave the company. It is therefore important to ensure KM is performed as part of the company's culture.

Furthermore, its nebulous nature makes it difficult to measure in financial terms, which has the knock-on effect of impairing the company's performance as a whole. Therefore,

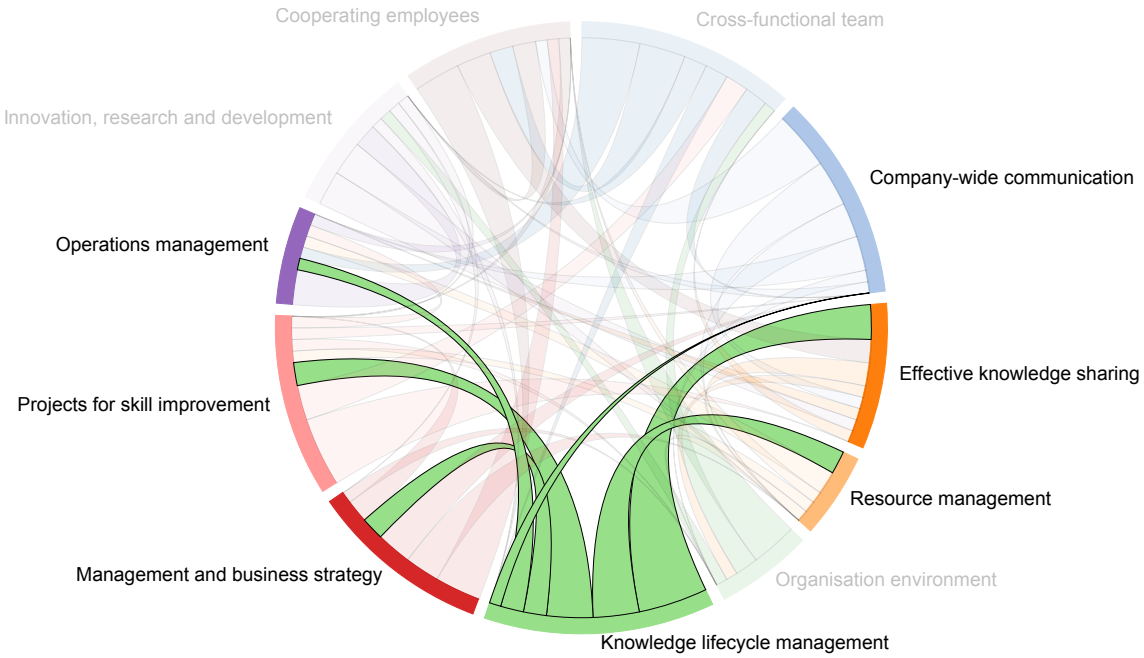


Figure 5.3.: The influence of knowledge lifecycle management on other themes

business information should be shared with active projects to allow them to make informed decisions.

Moreover, care should be taken with the acquisition of knowledge as it can be expensive. This is a necessary activity that identifies new and unknown knowledge, which reduces the business and technical risks associated with a lack of knowledge. What is more, it leads to the increase of the current knowledge base and should therefore be based on business opportunities whenever possible.

On the other hand, the introduction of new and unrelated technology is often the source of new knowledge. The pursuit of new technology should therefore be encouraged as it will inspire champions for that technology to share what they know.

The acquisition of knowledge, because it is usually an expensive pursuit due to limited resources, should be accompanied by an active drive to minimise the loss of knowledge. One such method is to document knowledge. Documented knowledge assists with the preservation of knowledge and may therefore have a positive financial impact. It should also be used to capture the knowledge management processes themselves. However, documents are not always the best way to share knowledge as it usually does not provide sufficient context for the information contained therein. Regular audits on the document base should therefore be conducted to ensure relevancy and completeness.

Furthermore, documents should be accessible by the relevant persons in order to be useful. It should also contain pertinent information, such as product designs and outputs from formal social interactions, e.g. project meetings. In this regard, documentation

guidelines go a long way to increase their utility as they can be used by, for example, technology owners when documenting product designs.

The impact of limited resources and the concerns around its management is discussed in depth in the next section.

5.2.2. Resource management

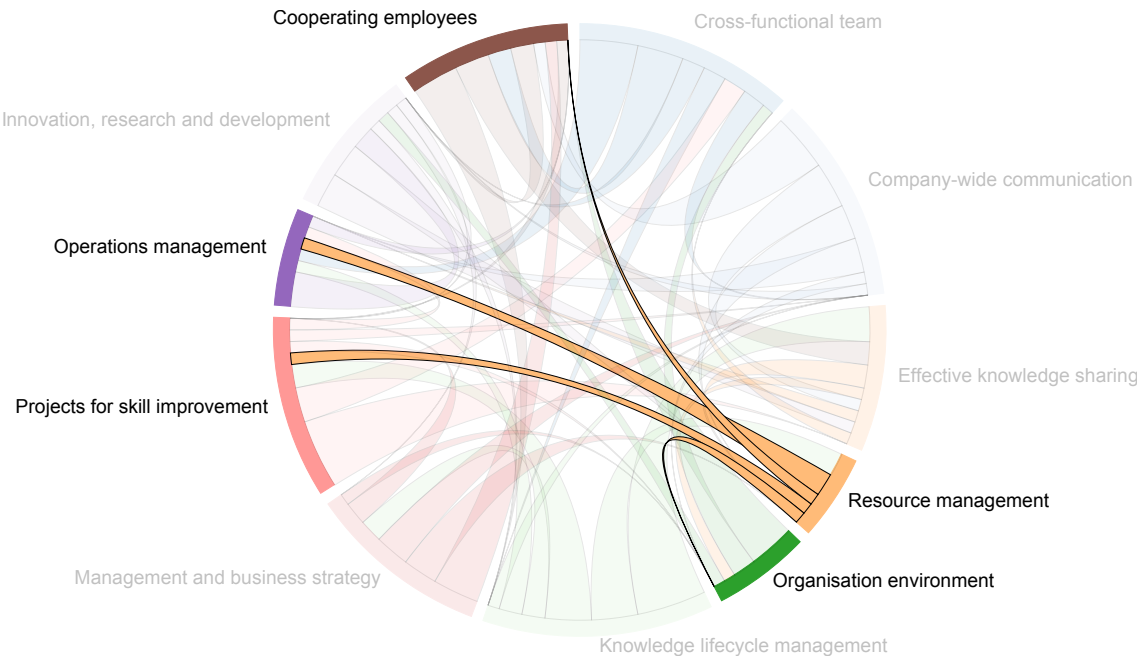


Figure 5.4.: The influence of resource management on other themes

Resource management is especially important in small organisations where resources are remarkably scarce. This places much focus on the immediate cashflow concerns of the company and leads to increased financial risk due to lack of knowledge because resources are grudgingly spent on KM.

This has a number of negative repercussions. For example, a lack of resources limit knowledge sharing in general and carrying out regular audits in particular. This leads to reduced feedback about the current state of the company, which invariably leads to crisis management caused by unforeseen events. Moreover, a lack of visibility creates unreasonable expectations about employee competencies that often leads to the application of incorrect or insufficient skills to critical tasks. Furthermore, a lack of communication obscures past mistakes, which causes them to be repeated.

All these factors contribute to place an even higher burden on available resources. This not only hampers the discovery of new technology that lead to new knowledge, but also increase employees' disinterest in knowledge sharing activities. For example, this

may happen when suggestions or requests from employees are repeatedly refused on the grounds that resources are unavailable. This invariably leads to reduced participation on their part, which in turn, hampers the discovery of new knowledge in the long term.

The management of scarce resources is closely knit with effective operations management as this determines how resources are allocated from day to day. The next section provides more insight on operations management.

5.2.3. Operations management

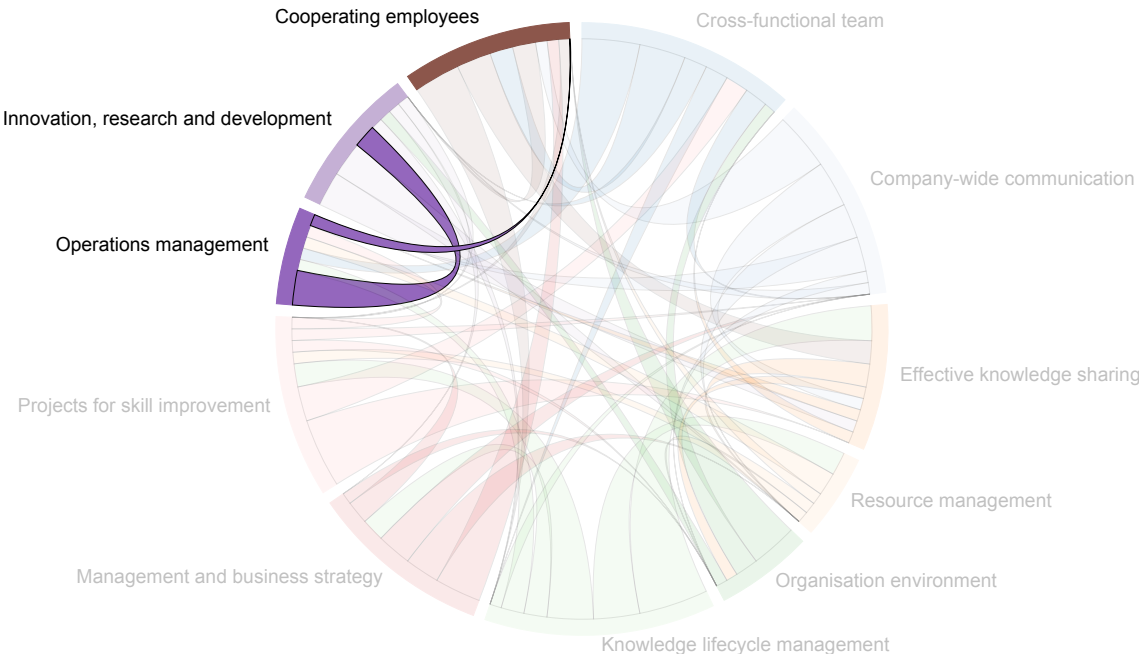


Figure 5.5.: The influence of operations management on other themes

Operations management is about using standardised activities to increase a company's performance and deal with changes in its operating environment. Standardised processes are an effective means to reduce operational expenses and risk as they provide a consistent way to deal with common situations. They remove much of the uncertainty in daily activities and often increase the personal motivation of employees as it provides a reliable and consistent means to address challenges.

Furthermore, standardised activities are only useful when they are used by everyone. It is therefore important to develop these through collaboration with all stakeholders. The activities also require regular audits to make sure they remain relevant in the operating context of the company. Moreover, standardised activities must contribute to the knowledge base of the company. One such mechanism is to ensure that the correct documents or artefacts are produced as part of the activities.

On the other hand, standardised activities must not only direct the daily operations of the company, but must also guide new product development activities. Specifically, they should ground innovation by ensuring the feasibility of any new development initiative before it is undertaken. Furthermore, standardised activities should then be used to guide the development programme from inception to completion.

However, companies do not operate in a static environment and change management, which forms part of operations management, endeavours to minimize the impact of unforeseen circumstances. Many events are caused by changes to the environment in which the company operates. This may be localised to a single project, for example newly discovered product requirements, or may affect the whole company, for example growth of its operating markets. In either case, the CFTs responsible successful development of the affected projects will be impacted, which will decrease their performance.

Consequently, poor change management will cause the company to operate in crisis management mode, which will be compounded by each additional unexpected event. On the other hand, robust operations management will increase the company's performance and back research activities thereby improving the company's innovation capability, which is discussed in depth in the next section.

5.2.4. Innovation, research and development

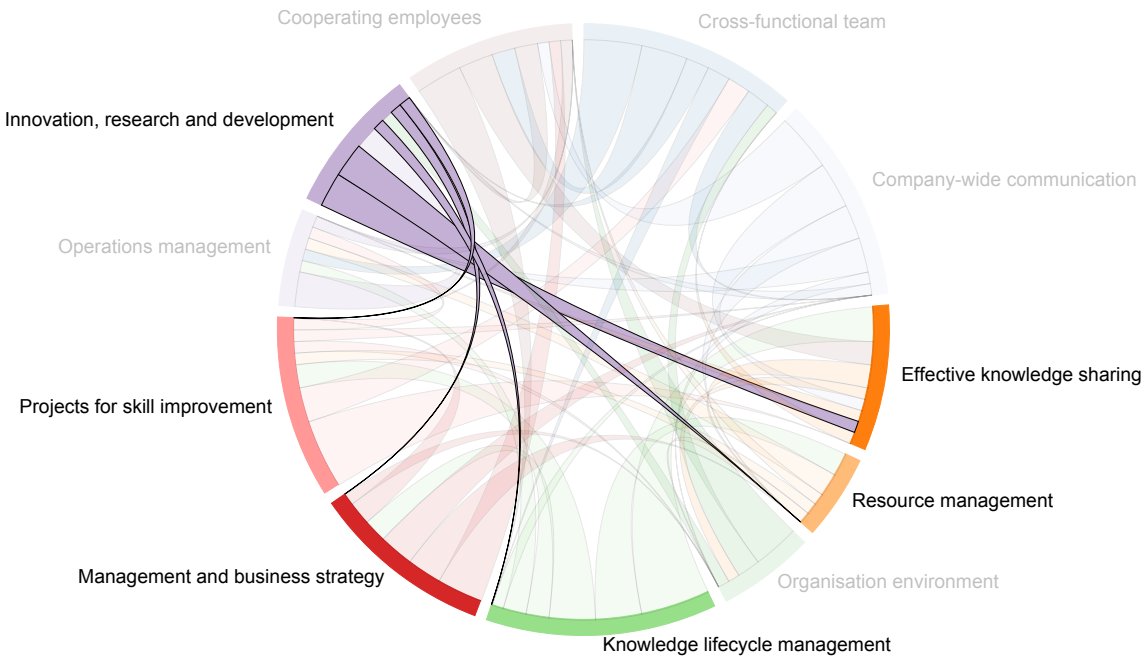


Figure 5.6.: The influence of innovation, research and development on other themes

Innovation is based on the sharing of knowledge and leads to new knowledge. However, innovation only thrives when the company's culture accepts failure as part of the learning process. New knowledge and insights unearthed by these activities forms the base on which NPD, the practical realisation of innovation, occurs.

NPD relies on effective research and development processes. It is inherently an expensive pursuit as it combines research and development, two fundamentally different processes. For example, research is a creative process that cannot use standardised processes whereas development relies on standardised processes to increase productivity. On the other hand, both processes should be guided by a single specification as this will result in synergies.

Furthermore, NPD must be a customer-centric activity that is aligned with business strategy and goals. Sufficient market research is therefore a prerequisite as this will mitigate some risk associated with a lack of knowledge. Moreover, risks are further reduced by founding new product development on the existing knowledge base in the company, which is exposed by the prolific sharing of knowledge, which in turn is largely determined by the company's culture.

Practically, NPD is performed as a project that relies on resources and is frequently subjected to changing requirements. Care should therefore be taken to ensure the development effort culminates in positive financial implications or other tangible benefit, such as the acquisition of new knowledge.

The impact of the organisation environment on NPD and knowledge sharing activities is detailed in the next section.

5.2.5. Organisation environment

The organisation environment is loosely defined as the physical and emotional setting in which employees function. It depends not only on the structure of the organisation, but also on the culture and policies in effect.

The structure affects both the physical environment, for example office layout, distribution of personnel among projects, geographical distribution of teams and so on, as well as the emotional environment, for example the levels of enthusiasm and motivation prevalent in the company. The physical environment has large impact on development activities by CFTs, especially their proximity to one another. For example, teams that are in close proximity experience improved communication compared to distributed ones. Whereas, a nurturing emotional environment will promote enthusiasm and increase motivation thereby improving productivity.

The structure of the organisation therefore directly impacts the efficacy of communication throughout the whole organisation. For example, it has large impact on the willingness of employees to share knowledge, the practical transfer of knowledge and the

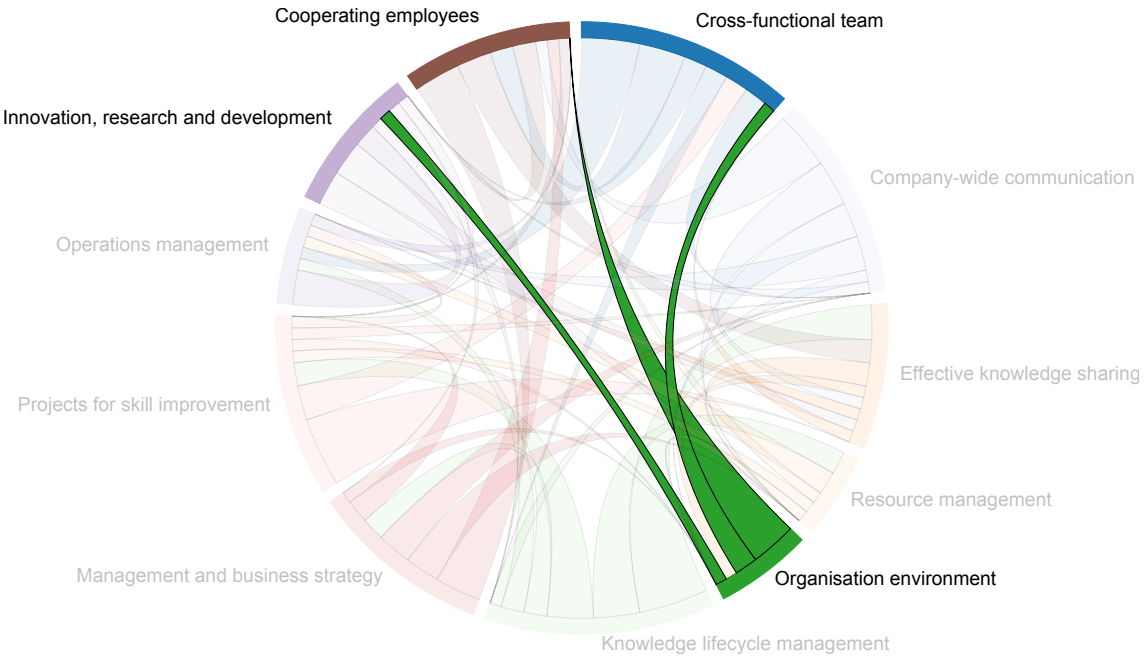


Figure 5.7.: The influence of organisation environment on other themes

productivity of cross-functional teams. The impact on the company's culture is quite clear.

However, the internals of the organisation is not the only thing that influences the company's culture. Society at large provides the framework of which the company's culture is part and therefore imprints the behaviour of employees. The company's culture should therefore work within acceptable norms to drive employee participation. For example, the company should create an emotional environment where training by rotating employees between tasks is not only acceptable but encouraged. It is by cultivating the sharing of knowledge that employees can be shaped and guided in their growth paths.

Then again, the desired culture requires the backing of company policy. For example, a culture of knowledge sharing can be encouraged by various policies that will motivate employees to share. Policies may for example, encourage employees to participate in external CoP, or compel employees to be rotated between tasks. In the end, culture and policy should work together to motivate employees to share their knowledge. The factors that affect effective knowledge sharing are discussed in depth in the next section.

5.2.6. Effective knowledge sharing

There is general agreement that knowledge sharing is an essential activity that improves cohesion in the company. However, this does not mean everything must be shared with everyone. Effective controls are essential not only to ensure the right knowledge gets

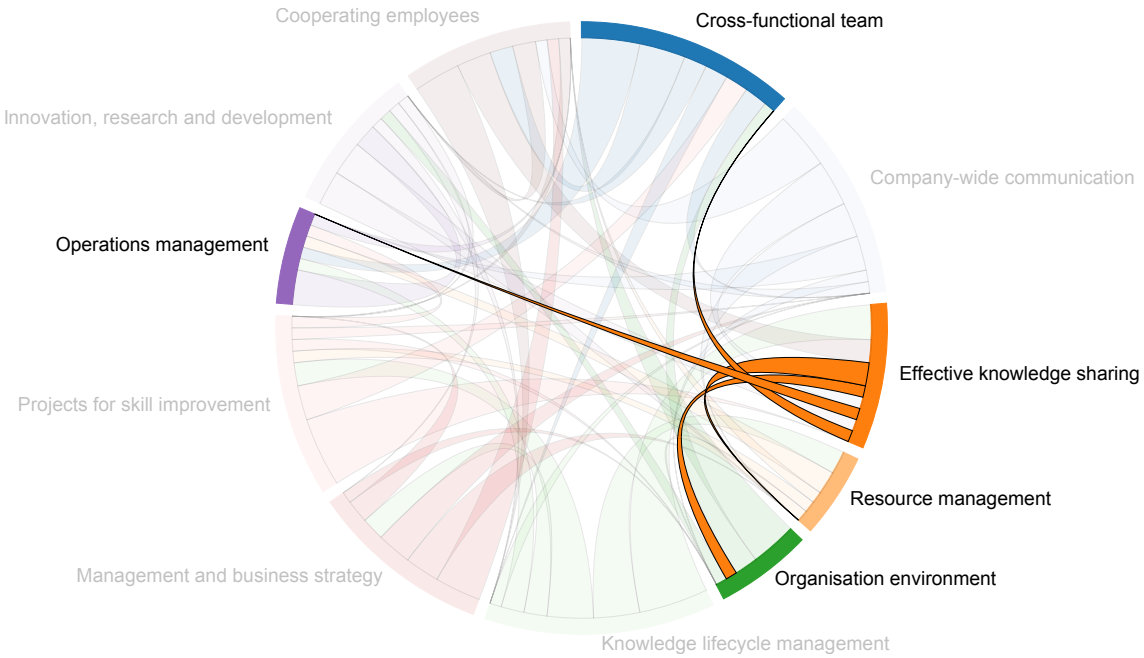


Figure 5.8.: The influence of effective knowledge sharing on other themes

disseminated to the right people, but also that sensitive information does not get shared with the wrong people, for example competitors. Sharing may therefore improve the efficacy of the company's operations, but may also have an adverse financial impact when controls are ineffective or absent.

Moreover, knowledge must be accessible in order to have utility. In this case, accessibility does not only imply finding the right knowledge at the right time, but also having said knowledge presented correctly to the consuming party, for example the context in which knowledge is presented provides the framework for its understanding and has great impact on its utility. Therefore, presentation is important as it improves the comprehension of knowledge consumers, i.e. the sharing mechanism is more effective, which in turn reduces the loss of knowledge over time.

Generally, knowledge can either be transferred between people, or from persons to knowledge stores, which leads to the preservation of knowledge. Knowledge sharing activities should therefore use interactive mechanisms as much as possible, for example sharing knowledge in person through discussions, mentorships, etc. and often leads to the discovery of new knowledge. It is therefore crucial for NPD as it is always based on new knowledge of some form.

Furthermore, these activities usually revolve around champions for knowledge sharing who are passionate about their various interests. These persons invariably influence the company's culture and should be used to drive knowledge sharing initiatives. It is by

making knowledge accessible through various means that the synergy in the company improves.

On the other hand, knowledge that gets shared does not always have to be new. Often, that what should be shared is "the way the company operates", i.e. the standardised processes that distinguish the company from its competitors as this is its competitive advantage.

However, in practice knowledge can only be shared effectively when employees cooperate with each other to meet the goals of the firm. The next section contains a depth discussion on how employees should cooperate.

5.2.7. Cooperating employees

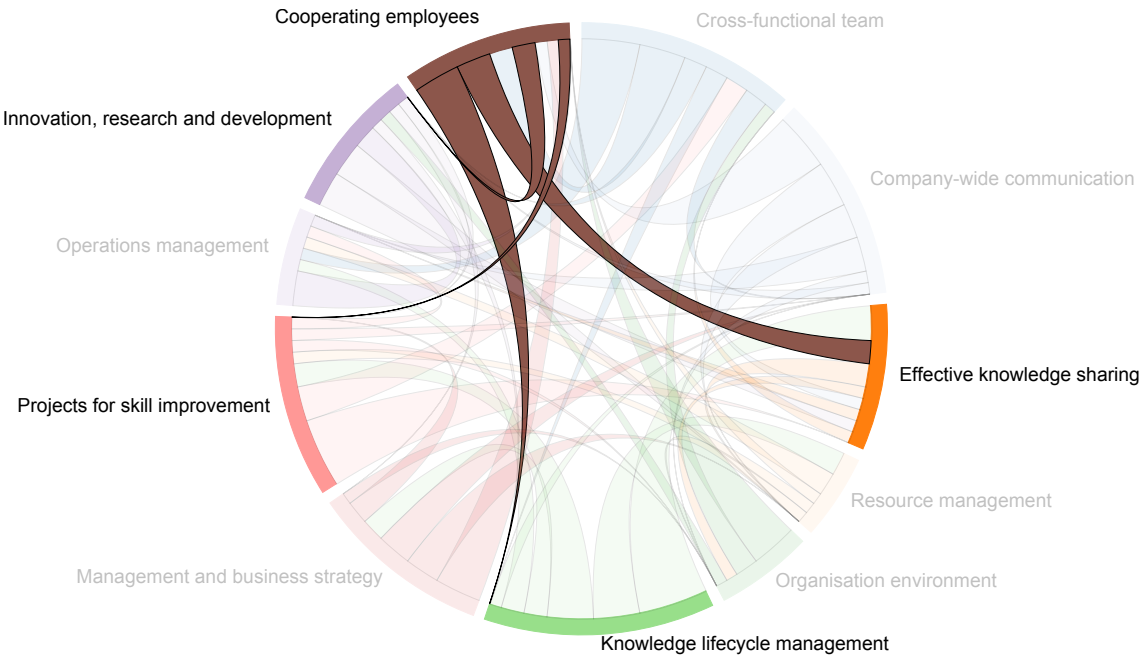


Figure 5.9.: The influence of cooperating employees on other themes

Employees are a valuable asset because they have existing knowledge and capabilities that gets exploited by business to meet its goals. However, this is only possible when employees are actively participating in company activities as this results in effective knowledge sharing. This participation leads to collaboration between different functions and teams, which in turn improves the synergy in the company. Furthermore, documentation created through collaboration has much greater utility than that produced in isolation.

But then, for all its benefits, the reality is that employees are often disinterested in sharing their knowledge or participating in knowledge sharing activities. Some of which, can be attributed to power play based on knowledge, for example for job protection or

political reasons; and some can be attributed to insufficient visibility on the personal and organisational benefits obtained from sharing. It is therefore very important for employees so see the benefits of their sharing endeavours as this will provide the motivation for continued sharing.

Moreover, one of the most prevalent complaints is that employees can't find relevant documentation easily, this leads to duplication of effort and reduces the efficacy of the company's knowledge sharing activities in general. It also has the side effect that employees' willingness to participate in further documentation activities decreases. To this end, the use of collaborative IT infrastructure as standard tool in the organisation is encouraged because it enhances cooperation in general and the utility of documentation in particular.

Another benefit provided by the correct IT infrastructure is that it provides history and traceability of many of the company's activities. This improves many operational processes, for example project management, product development and general collaboration. The improvement in cohesion directly leads to improved knowledge sharing.

However, a collaborative IT infrastructure does not provide the whole answer. A climate of knowledge sharing is required to encourage the behaviours that will correctly motivate employees. This culture will be prevalent when the correct activities occur in the organisation, for example employees should be encouraged to participate in internal CoP. This will increase the level of knowledge sharing and mitigate the impact when employees leave the firm somewhat.

Furthermore, properly informed and motivated employees will not only influence business strategy and goals sensibly, but may also lead the company in NPD. This is possible because the increased level of knowledge sharing will effectively drive cross-functional teams to be more dynamic.

The next section discusses the use of CFTs in a small company involved with development.

5.2.8. Cross-functional team

CFTs are central to new product development and should have a number of characteristics to ensure their optimal performance. Firstly, they need to have regular informal and formal social interactions as this will result in enhanced communication between team members, as well as between different teams. Informal social interactions consist of those actions not driven by the company, for example ad-hoc meetings or watercooler talk; whereas formal social interactions are coordinated by the company, for example project meetings and training sessions.

Secondly, they must contain junior personnel from the different functional areas as this will form part of their training. This presents the opportunity to work in pairs and

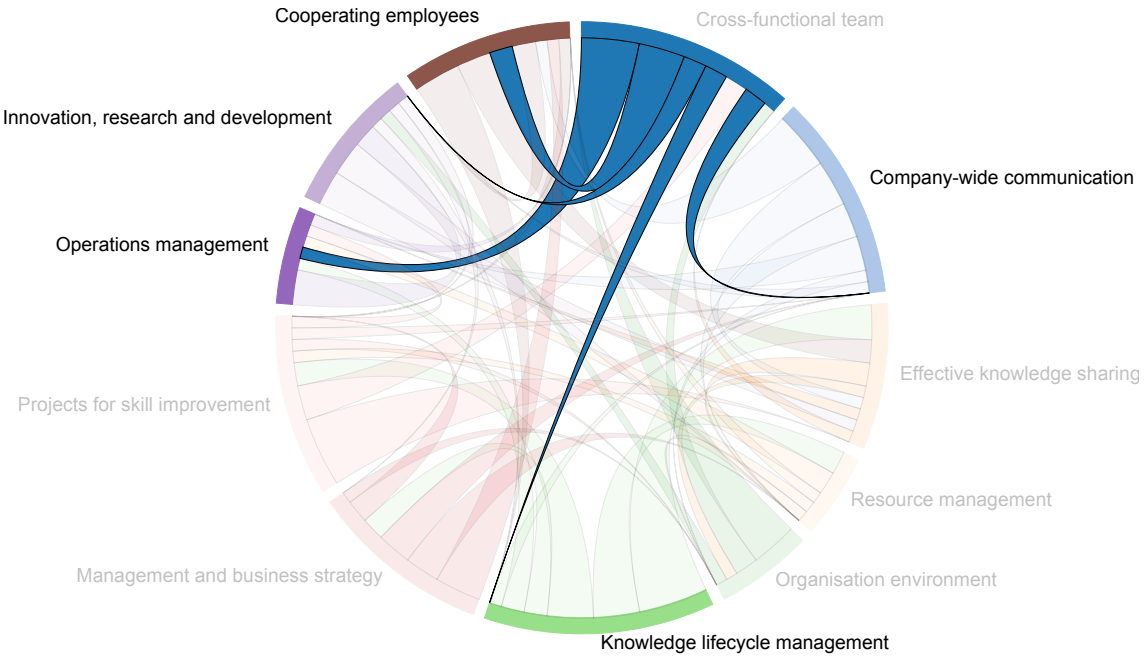


Figure 5.10.: The influence of cooperating employees on other themes

will allow fresh ideas to be introduced into the team as a whole. Unfortunately, conflicts in such a diverse group is unavoidable and the project leader should manage those to ensure the negative impact on the project is minimised.

Thirdly, the team should be encouraged to overtly reflect on their activities as this will allow them to address weaknesses and build on strengths. The result is improved change management and more effective informal social interaction, which underpins the innovation capability of the team.

Lastly, the team must be enthusiastic as this will create a dynamic culture with increased performance. This will encourage team members to participate in various activities that will result in a cohesive team. However, care should be taken to ensure this enthusiasm is grounded in responsible behaviour. For example, a mature team that owns the project will document pertinent information without the threat of regular audits. However, their performance should be assessed regularly to ensure their activities remains aligned with the project's goals. This feedback will allow them to create and implement a product design that meets the company's goals.

Therefore, a company that uses CFTs with the correct characteristic will benefit from a culture that promotes knowledge sharing, while enjoying increased performance as a result.

The use of CFTs to deliver projects are discussed in depth in the next section.

5.2.9. Projects for skill improvement

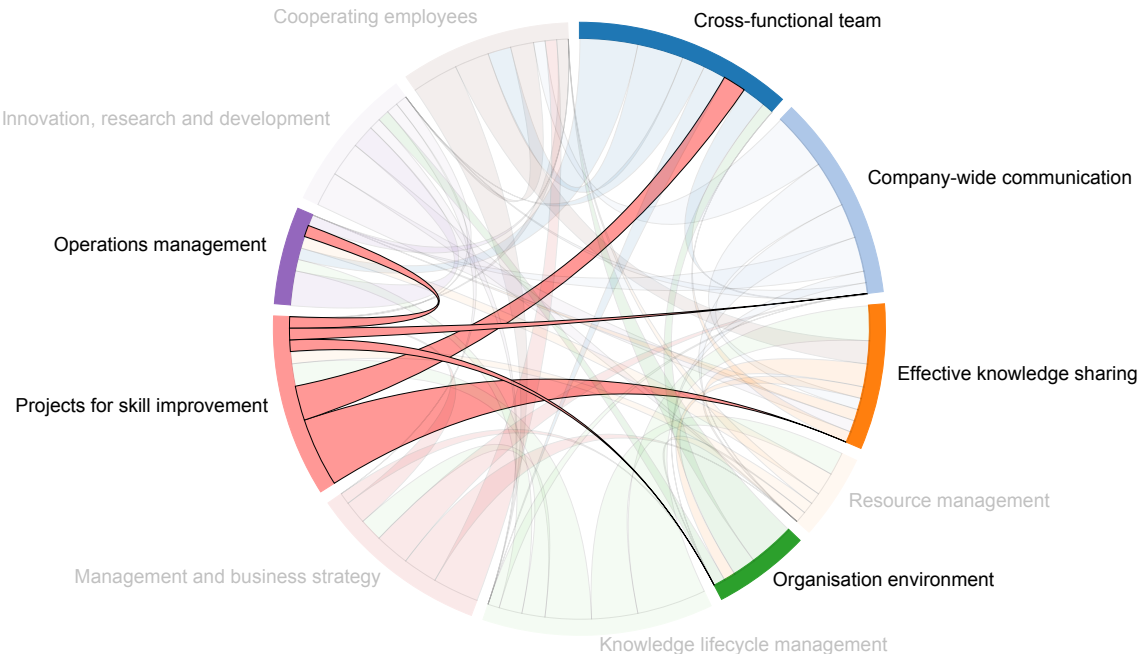


Figure 5.11.: The influence of projects for skill improvement on other themes

A company's capability is defined by the capabilities of its employees. It is therefore in its best interest to improve employees' skills, thereby improving their competencies. The preferred mechanism is practical training, which is especially useful for junior personnel. Moreover, the relevant context for the information imparted through practical training is much clearer compared to more theoretical forms.

Several knowledge sharing mechanisms can be employed, for example mentorships, working in pairs and regularly rotating employees between tasks are all useful. Mentorships are a practical alternative to documentation and has the added benefit that it guides the training journey. Whereas working in pairs allows immediate transfer of knowledge. On the other hand, rotating employees between tasks is ideally suited to maintain the company's existing knowledge base.

In addition, projects by virtue of being carried out, helps to maintain the company's existing knowledge base as it provides a pragmatic vehicle to implement the above mentioned mechanisms. However, projects can have much risk due to a lack of knowledge, which gets mitigated by skilling up their CFTs. These risks are therefore mitigated by the project leader who not only creates an emotional environment that encourages sharing of knowledge, but also performs the change management necessary to address unforeseen events.

However, this management is only possible if the progress of the project is tracked correctly as this allows an informed project leader to guide the project team through stressful situations. This implies that regular feedback should not only provided by the team to the leader, but also by the project leader to management. Projects are therefore ideally suited to sponsor the pursuit of new knowledge as it skills up employees.

Then again, projects must assist the business to achieve its goals while conforming to the business strategy. In this regard, management performs a critical task to ensure alignment between various projects and business functions. The next section discusses management's roll in depth.

5.2.10. Management and business strategy

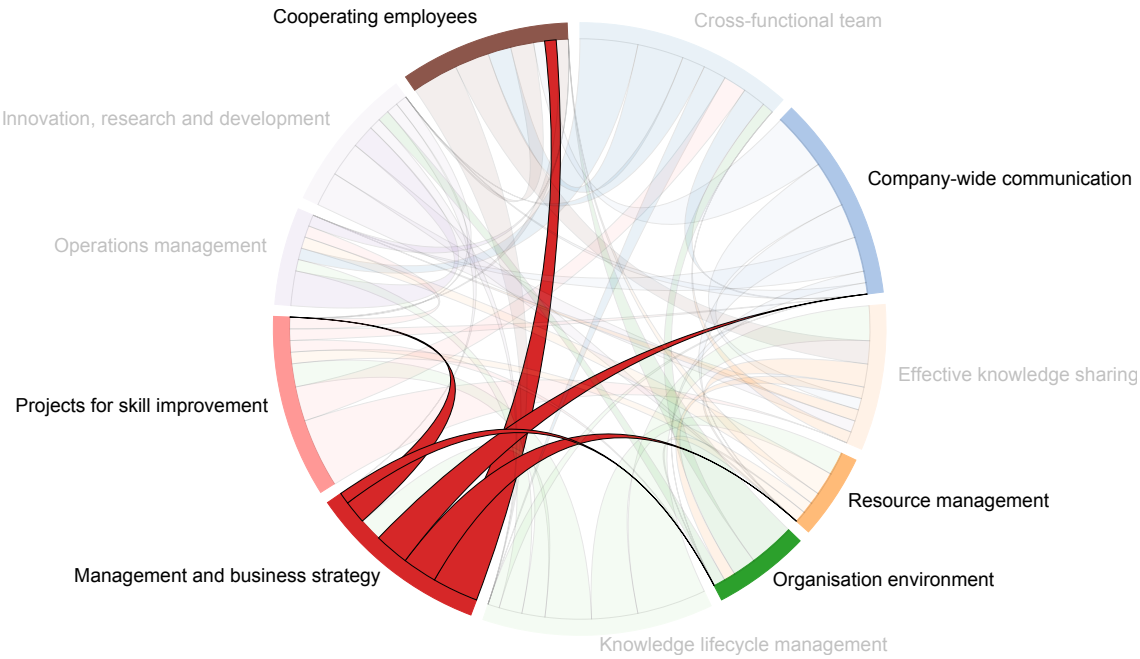


Figure 5.12.: The influence of management and business strategy on other themes

The support provided by management for KM and NPD determines to which extent these activities are successful. Furthermore, management has to deal with conflicting requirements while steering the company in a changing environment. This implies that company processes should be congruent with business strategy and goals.

The company's strategy must therefore identify business opportunities aligned with business goals. These opportunities should then be communicated to employees as this will allow them to perform their tasks with certainty in the correct context. Furthermore,

the business strategy and goals should be used to advise projects as needed to determine a course of action between alternatives.

On the other hand, management is also responsible for the daily operations of the firm. They provide the mandate for any sanctioned activity and allocate resources accordingly. Therefore, KM requires not only a mandate from management to be successful, but also sufficient resources. For example, management should not only motivate employees, but also give them tangible rewards as this will encourage their participation in KM activities. Furthermore, management should also create a sharing company culture that fosters the aptitude of its personnel. This includes sponsoring activities that will promote the sharing of knowledge, for example by establishing internal CoP. It will therefore come as no surprise that all this is only possible if management receives regular feedback from all areas in the company, and in turn provide regular feedback to the whole company.

There is therefore clear argument to have the business strategy include KM as one of its goals. This will enable management to support the required knowledge sharing activities and initiatives, for example they could support informal and formal social interactions, champions for knowledge sharing, learning from mistakes and research.

However, management often places too much focus on immediate cashflow without planning the business strategy and goals sufficiently. The result of this is that financial risk associated with a lack of knowledge is not evident and therefore ignored. This translates into practical deficiencies where not enough KM is performed, for example management usually does not value the benefits provided by IT infrastructure and therefore does not allocate sufficient resources to it.

Moreover, as mentioned above, management requires and provides feedback regularly. This process requires effective company-wide communication and is discussed in detail in the next section.

5.2.11. Company-wide communication

Effective company-wide communication is obtained when regular feedback and exchange of information occurs through interactive mechanisms as this improves the transfer of knowledge. This is especially true for NPD because it depends on effective sharing of knowledge between dissimilar disciplines. These mechanisms take many forms such as formal and informal social interactions, participation in internal or external CoP, development in teams, etc. and improves cohesion in the company. Each of these mechanisms address a niche and combine to enhance communication throughout the company.

Informal social interactions, for example ad-hoc meetings, watercooler talk, social gatherings, etc. are excellent ways to highlight and disseminate changes to the operating environment. Whereas formal social interactions, for example project meetings, training

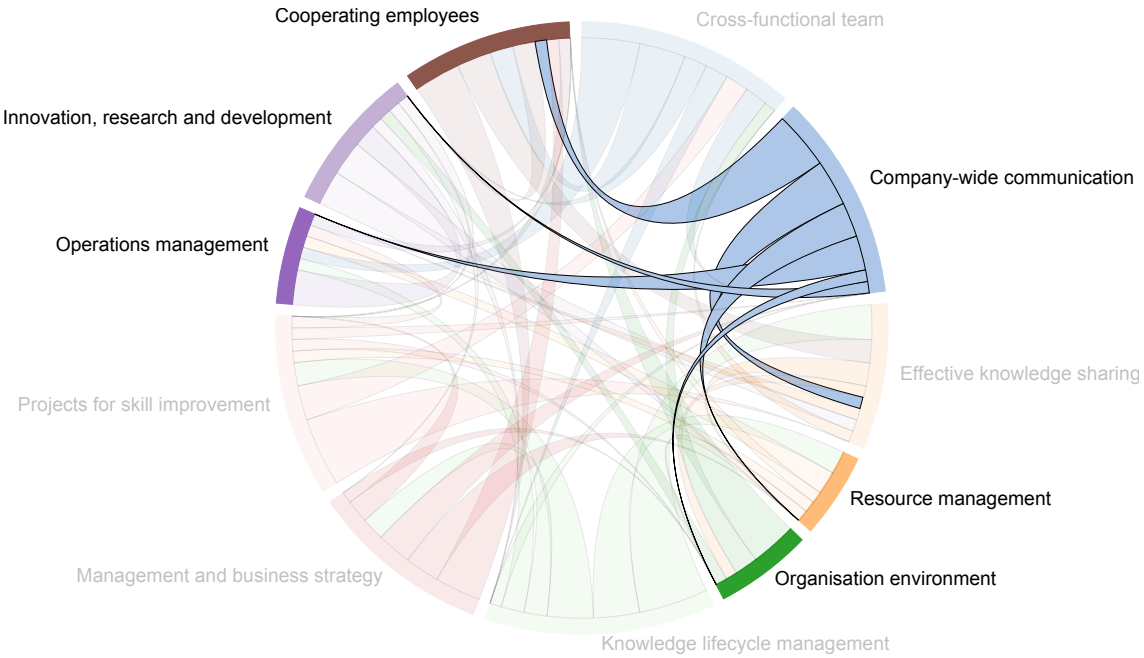


Figure 5.13.: The influence of company-wide communication on other themes

classes, sanctioned CoP, etc. are suited to maintain the existing knowledge base. In either case, these interactions require participation from employees to be effective and may seem expensive as there is no direct measurement of their efficacy.

Furthermore, development is ideally suited to convey the context of knowledge in a practical manner and assists with the distribution of knowledge. For example, working in pairs allows less experienced personnel to benefit from the experience of their counterparts, while employees acquire new skills at accelerated rate when they are rotated between tasks.

Moreover CoP can be both internal to the company, for example when functional groups gather to further their interests, or external to the company, for example professional associations that promote the field as a whole. External CoP will further informal social interactions because they provide the impetus for sharing newly obtained knowledge inside the organisation, which will increase participation in knowledge sharing activities.

On the other hand, internal CoP are suited to disseminate best practice, which must be incorporated into standardised processes. These communities rely onIT infrastructure to facilitate the exchange of knowledge and require champions of knowledge sharing to spearhead the initiatives. They should by and large make use of informal social interactions, i.e. their interactions should be sanctioned but not governed by the company, because voluntary participation will increase their efficacy. Increased level of knowledge sharing may lead to financial benefits for the firm because a lot of formal training will be unnecessary.

The above mentioned mechanisms all benefit from face-to-face interactions as this provides the best interactive experience. However, this may not be possible if the physical environment makes it impractical or impossible. Furthermore, these mechanisms will only increase performance when regular assessments that provide the necessary feedback are performed.

5.3. Results relative to propositions

This section discusses the research results relative to the propositions made in chapter 2.

5.3.1. Results relative to proposition 1

Proposition 1. *A knowledge sharing initiative in SMEs should be based on the personalisation or sociological strategy that emphasises the qualitative aspects thereof.*

KMas concept is something all respondents were familiar with to more or lesser degree, albeit in non-academic terms and language. Often knowledge sharing concepts were confused with KM concepts, but once the subtle differences were explained, the interviews proceeded productively. Most respondents understood the importance of sharing knowledge intuitively, even though some showed clear disinterest in doing so.

However, all respondents were in agreement that a codification strategy is of limited use when transferring knowledge, especially in SMEs where resources are limited. Some respondents even maintained that documentation not only had limited use, but were in fact useless. However, other respondents grudgingly admitted the need for detailed documentation to preserve knowledge and mitigate the loss of capability due to staff turnover.

Moreover, the different types of respondents' focuses corresponded to their functional areas, which was expected. It was however, interesting to note that most were in general agreement about the fundamentals as stated by proposition 1.

Furthermore, there was generally agreement that the knowledge work being performed was due to one's delight and interest in the work performed, rather than monetary compensation. However, their desire for recognition or the acknowledgement of their efforts was clearly a motivating factor. There was even mention of workers acting like primadonnas when their efforts were not recognised. This clearly highlights the importance of qualitative aspects for any knowledge sharing initiative.

5.3.2. Results relative to proposition 2

Proposition 2. *Effective KM will improve the efficacy of NPD activities in SMEs.*

The respondents generally agreed on what NPD entails. Definitions ranged from a strict interpretation where said product had to be developed completely from scratch,

to others that was more pragmatic where incremental updates to existing products or services were also included. All the respondents had an intimate understanding of the NPD process and the peculiarities it has compared to more traditional development efforts. As expected, their understanding was coloured by their respective functions, but they had a working understanding of related ones.

They provided several examples where effective KM helped their development efforts. For example, one respondent mentioned how earlier work in an unrelated field formed the basis for the technical understanding in a later project. This allowed him to come to grips with the peculiarities of the new technology much quicker, which resulted in much faster progress during prototyping. On the other hand, various examples were also provided where ineffective or absent KM were detrimental to their development efforts. For example, a number of respondents complained about time lost project after project by designing solutions, only to find out later that similar solutions already exist.

All in all, the general agreement was that NPD is or will be more effective when KM initiatives improved the flow of knowledge. This was especially true for SMEs where resources are limited and one needs to avoid the duplication of effort and the ineffective use of knowledge workers' time.

5.4. Conclusion

KMrequires the support of management to be effective. It should concern itself with the full lifecycle of knowledge and focus on a personalisation rather than codification strategy.

Management should allocate sufficient resources to promote knowledge sharing and avoid a cycle of crisis management. Resources will be used optimally when standardised processes are used not only to guide daily activity, but also to ground innovation in reality.

Furthermore, operations management should ensure unexpected events are dealt with as a matter of course, rather than exceptions. This will increase productivity, which will fund the necessary research required for superior innovation.

Then again, failure is part of any learning process. Companies should therefore embrace and learn from mistakes. This will facilitate effective NPD programmes that are customer centric. The CFTs used for these developments should have the correct composition and be encouraged to reflect on their activities as this will lead to improved performance.

These projects are ideally suited to drive skill improvement initiatives in the company without adding significant training overhead. It does however, rely on abundant feedback to leaders so they can make informed management decisions.

However, an organisation environment that fosters and promotes knowledge sharing depends on an inclusive culture and deliberate structure. This will ensure effective knowledge sharing by providing knowledge in accessible form to persons requiring it.

Furthermore, it is only with the cooperation of employees that knowledge can be shared effectively. Disinterested employees should therefore be encouraged to participate and participating employees should receive tangible rewards for their efforts. This behaviour can be encouraged by providing the necessary organisation structure and IT infrastructure.

It is therefore clear that knowledge sharing initiatives in SMEs should be based on the personalisation strategy. Furthermore, it should emphasise the qualitative aspects to address the emotional needs of knowledge workers. This will increase the efficacy of KM thereby improving the efficacy of NPD activities.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

This chapter brings the research to a close by discussing the conclusions of the study and presenting a number of inferred recommendations. Finally, further areas for future research are suggested.

6.2. Conclusions of the study

There is general agreement that effective KM is vital for NPD. And although effective KM as means to maintain competitive advantage was never expressed directly, the need for customer-centric development was. There is therefore an inherent understanding that KM should lead to business advantage.

Furthermore, the use of KMSs to facilitate knowledge management as proposed by the literature was not confirmed by the respondents. However, the need for a company culture that nurtures knowledge sharing activities was emphasised. This includes sufficient support from senior management as it is their prerogative to assign required resources and institute desired processes and behaviours. However, it was acknowledged that the difficulty of implementing a successful KM initiative in SMEs is partly due to the scarcity of resources. Senior management should therefore prioritise KM correctly to ensure a healthy balance between all business variables.

Moreover, the literature proposes a number of interactive technologies to aid knowledge sharing, for example by facilitating improved collaboration. This agrees with the prevailing opinion that such technologies should be used, even though no definitive preference for a specific technology was indicated.

Furthermore, it was felt that improved collaboration would lead to more effective NPD. A concept that is generally well understood to be a means to exploit tacit knowledge to create something new. This view is in full agreement with current literature. Furthermore, face-to-face collaboration is the preferred means to share knowledge and is deemed essential for NPD. In this context, informal processes are viewed as an ideal mechanism to exchange tacit knowledge whereas formal processes are more suited to codify knowledge. The personalisation strategy is clearly preferred over the codification strategy.

In summary, SMEs should pursue a personalisation strategy when implementing KM initiatives as this will result in improved sharing of knowledge. In turn, it will result in

more successful NPD activities whereby the innovative capability of the company will increase.

In conclusion, this study contributes by providing insight into employees' preferences of knowledge sharing in small business, which should help management decide on applicable parameters for their future KM initiatives.

6.3. Recommendations for management

The following recommendations are inferred from the research for managers caring to implement a successful knowledge management initiative in SMEs involved with NPD. They are discussed in no particular order and managers should prioritise these recommendations according to their needs.

Prioritise knowledge management correctly. This implies that KM activities should probably be given higher priority. They are usually, like insurance, seen as a "grudge purchase". This entails allocating sufficient resources, for example time, money, skill, etc., to KM activities and infrastructure. Employees easily become discouraged and disinterested when there is a perpetual lack of resources for their knowledge sharing activities or suggestions. On the other hand, much of the resources required for knowledge acquisition can be funded by projects if they are the preferred mechanism used to skill employees up.

Establish a culture that encourages knowledge sharing. This includes those activities that allow employees to *feel* the benefits of their participation as well as providing tangible rewards for desired behaviour on their part. Making mistakes should also be encouraged. In other words, mistakes should be embraced as a learning experience and not be used to punish employees. This will promote innovation.

Create healthy emotional and physical work environments for employees. This will facilitate improved collaboration and allow team members to reflect on their activities. Both are needed to improve the level of knowledge sharing. This includes the physical and logical structure of the organisation as they should ensure company activities are congruent with business strategy and goals.

Pursue new knowledge. This will mitigate the loss of knowledge due to for example, staff turnover, and open up avenues for new business pursuits.

Improve access to stored documentation. This implies making it easier for employees to access relevant knowledge and having said knowledge presented in a usable format. It requires that adequate controls are in place to deny access to sensitive information. For example, financial information should probably not be accessible by clients or service providers.

Ensure effective company-wide communication is the norm. Some examples of this are: share pertinent business information with employees; encourage the formation of

internal CoP; urge employees to join external CoP; promote informal interactions; use formal interactions minimally and mainly for outcomes that require artefacts.

Use standardised processes to mitigate the effects of a changing environment. Companies often operate in crisis-management mode because of poor change management. Standardised processes should be established collaboratively with employees and will provide a certain and consistent way to deal with adversity.

Communicate the business strategy to employees. This will empower employees to make informed decisions with regard to their product design choices. This will assist the company to be customer-centric because the desired business goals are known at design time.

Use knowledge management to improve resource utilisation. For example, the progress of activities should be tracked thereby allowing regular feedback for informed decision making throughout the whole organisation. Furthermore, the sharing of knowledge encouraged by KM will establish the feasibility of new projects when they are initiated.

6.4. Suggestions for further research

The impact of KM on NPD in SMEs has not been explored extensively, especially in the South African context, and suggests a number of areas that require further scrutiny. The following are some suggestions inspired by this research: —

- A detailed investigation into the structure and operation of internal CoP to determine the success factors required for this environment.
- A detailed investigation into currently available collaboration software for new product development to gauge their usefulness in SMEs.
- A longitudinal study of the effects of KM initiatives on NPD activities in SMEs.
- A comparative study of the resources spent directly on NPD as it relates to SMEs' innovation capability.

REFERENCES

Alavi, M. and Leidner, D. (2001) *Review*: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues, *MIS quarterly*, pp. 107–136.

Ardichvili, A., Page, V. and Wentling, T. (2003) Motivation and barriers to participation in virtual knowledge-sharing communities of practice, *Journal of Knowledge Management*, 7(1), pp. 64–77.

Argyris, C. and Schön, D. (1978) Organizational learning: A theory of action perspective.

Bontis, N., Hulland, J. and Crossan, M. M. (2002) Managing an organizational learning system by aligning stocks and flows, *Journal of Management Studies*, 39(4), pp. 437–469.

Boyle, T., Kumar, U. and Kumar, V. (2005) Organizational contextual determinants of cross-functional NPD team support, *Team Performance Management*, 11(1), pp. 27–39.

Burnes, B. (2004) Kurt Lewin and complexity theories: back to the future?, *Journal of Change Management*, 4(4), pp. 309–325.

Carrillo, P. and Chinowsky, P. (2006) Exploiting knowledge management: the engineering and construction perspective, *Journal of Management in Engineering*, 22, p. 2.

Carvalho, D., Fuks, H. and Lucena, C. (2012) 'Community Association Map: Processing inter-community relationships', *Proceedings of the 8th International Conference on Web Information Systems and Technologies (WEBIST)*, pp. 665–670.

Case, D. D. (1990) *The community's toolbox: The idea, methods and tools for participatory assessment, monitoring and evaluation in community forestry*, Community Forestry Field Manuals, Food and Agriculture Organization of the United Nations, Rome, last accessed 19/04/2011, from `http://www.fao.org/docrep/x5307e/x5307e00.htm`.

Cegarra-Navarro, J. G. and Sabater-Sánchez, R. (2005) E-learning: organizational requirements for successful feedback learning, *Journal of Workplace Learning*, 17(5/6), pp. 276–290.

Chong, S. and Choi, Y. (8th June 2005) *Critical Factors In The Successful Implementation Of Knowledge Management*, last accessed 09/03/2010, from `http://www.tlainc.com/articl90.htm`.

Choy, C., Yew, W. and Lin, B. (2006) Criteria for measuring KM performance outcomes in organisations, *Industrial Management and Data Systems*, 106(7), pp. 917–936.

CmapTools Developers (10th June 2009) *CmapTools - Home Page*, last accessed 01/07/2013, from `http://cmap.ihmc.us/`.

Compton, M. (2009) *Visualization of Software Metrics*.

Corum, J. and Hossain, F. (15th Dec. 2007) Naming names, *New York Times*, 41.

Cothrel, J. and Williams, R. L. (1999) On-line communities: helping them form and grow, *Journal of Knowledge Management*, 3(1), pp. 54–60.

Crossan, M. M., Lane, H. W. and White, R. E. (1999) An Organizational Learning Framework: From Intuition to Institution, *The Academy of Management Review*, 24(3), pp. 522–537.

Culkin, N. and Smith, D. (2000) An emotional business: A guide to understanding the motivations of small business takers, *Qualitative Market Research: An International Journal*, 3(3), pp. 145–157.

Dalkir, K. (2005) *Knowledge management in theory and practice*, Elsevier Butterworth-Heinemann.

Dayan, M. and Basarir, A. (2010) Antecedents and consequences of team reflexivity in new product development projects, *Journal of Business & Industrial Marketing*, 25(1), pp. 18–29.

Disterer, G. (2003) 'Fostering knowledge sharing: Why and how', *Proceedings of the IADIS International Conference e-Society*, pp. 219–226.

Fahey, L. and Prusak, L. (1998) The Eleven Deadliest Sins of Knowledge Management, *California management review*, 40(3), pp. 265–276.

Feldman, S. (Mar. 2004) The high cost of not finding information, *KMWorld*, 13(3), last accessed 11/03/2010, from `http://www.kmworld.com/Articles/Editorial/Feature/The-high-cost-of-not-finding-information-9534.aspx`.

Firestone, J. and McElroy, M. (2004) Organizational learning and knowledge management: the relationship, *The Learning Organization*, 11(2), pp. 177–184.

Frey, R. (2001) Knowledge management, proposal development, and small businesses, *Journal of Management Development*, 20(1), pp. 38–54.

Golafshani, N. (2003) Understanding Reliability and Validity in Qualitative Research, *The Qualitative Report*, 8(4), pp. 597–606.

Grinyer, A. (2002) The anonymity of research participants: assumptions, ethics and practicalities, *Social Research Update*, 36(3).

Guba, E. and Lincoln, Y. (1994) 'Competing Paradigms in Qualitative Research', Denzin, N. and Lincoln, Y., *Handbook of qualitative research*, chap. 6, pp. 105–117.

Hansen, M. T., Nohria, N. and Tierney, T. (2005) What's Your Strategy for Managing Knowledge?, *Knowledge Management: Critical Perspectives on Business and Management*, 77(2), p. 322.

Ho, L.-A. (2008) What affects organizational performance?: The linking of learning and knowledge management, *Industrial Management & Data Systems*, 108(9), pp. 1234–1254.

Johnson, R. (1997) Examining the Validity Structure of Qualitative Research. *Education*, 118(2), pp. 282–292.

Kessels, J. (2001) Learning in organisations: a corporate curriculum for the knowledge economy, *Futures*, 33(6), pp. 497–506.

Kinchin, I. M., Hay, D. B. and Adams, A. (2000) How a qualitative approach to concept map analysis can be used to aid learning by illustrating patterns of conceptual development, *Educational Research*, 42(1), pp. 43–57.

Kippenberger, T. (1998) Defining a new world of knowledge, *The Antidote*, 3, pp. 6–9.

Kosti, M. V., Lazaridou, S., Bourazani, N. and Angelis, L. (2011) Discovering patterns of correlation and similarities in software project data with the Circos visualization tool, *arXiv preprint arXiv:1110.1303*.

Krzywinski, M., Schein, J., Birol, İ., Connors, J., Gascoyne, R., Horsman, D., Jones, S. J. and Marra, M. A. (2009) Circos: An information aesthetic for comparative genomics, *Genome research*, 19(9), pp. 1639–1645.

Lin, H. and Lee, G. (2004) Perceptions of senior managers toward knowledge-sharing behaviour, *Management Decision*, 42(1), pp. 108–125.

March, J. and Olsen, J. (1975) The uncertainty of the past; organizational ambiguous learning, *European Journal of Political Research*, 3(2), pp. 147–171.

McDermott, R. and O'dell, C. (2001) Overcoming cultural barriers to sharing knowledge, *Journal of knowledge management*, 5(1), pp. 76–85.

McDermott, R. (1999) Why Information Technology Inspired But Cannot Deliver Knowledge Management, *CALIFORNIA MANAGEMENT REVIEW*, 41(4), pp. 103–117.

McElroy, M. W. (Apr. 1999) 'The Knowledge Life Cycle: An Executable Model For The Enterprise', *ICM Conference on Knowledge Management*, Miami, FL.

Morse, J., Barrett, M., Mayan, M., Olson, K. and Spiers, J. (2002) Verification Strategies for Establishing Reliability and Validity in Qualitative Research, *International Journal of Qualitative Methods*, 1, p. 19.

Mukherjea, S. and Foley, J. D. (1995) Visualizing the world-wide web with the navigational view builder, *Computer Networks and ISDN Systems*, 27(6), pp. 1075–1087.

Nonaka, I. (1991) The Knowledge-Creating Company, *Harvard Business Review*, 69(November–December), pp. 96–104.

Novak, J. D. and Cañas, A. J. (2008) The theory underlying concept maps and how to construct and use them, *Florida Institute for Human and Machine Cognition Pensacola Fl, www. ihmc. us.[http://cmap. ihmc. us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps. htm]*, 284.

Nunes, M., Annansingh, F., Eaglestone, B. and Wakefield, R. (2006) Knowledge management issues in knowledge-intensive SMEs, *Journal of Documentation*, 62(1), pp. 101–119.

Patrick, K. and Dotsika, F. (2007) Knowledge sharing: developing from within, *The Learning Organization*, 14(5), pp. 395–406.

Pitt, M. and MacVaugh, J. (2008) Knowledge management for new product development, *Journal of Knowledge Management*, 12(12), pp. 101–116.

Powell, T. (2001) 'The Knowledge Value Chain (KVC): How to Fix It When It Breaks', *National Online Meeting*, vol. 22, Information Today, Inc; 1999, pp. 301–314.

Qiu, T., Qualls, W., Bohlmann, J. and Rupp, D. (2009) The Effect of Interactional Fairness on the Performance of Cross-Functional Product Development Teams: A Multilevel Mediated Model, *Journal of Product Innovation Management*, 26(2), pp. 173–187.

Ramnarayan, S. and Reddy, N. M. (1989) Institutional Learning: The Essence of Strategic Sanagement, *Vikalpa*, 14(1), pp. 21–33.

Rech, J., Feldmann, R., Ras, E., Jedlitschka, A. and Decker, B. (2007) Knowledge Patterns and Knowledge Refactorings for Increasing the Quality of Knowledge, *Knowledge Management, Organizational Memory and Transfer Behavior: Global Approaches and Advancements*, p. 30.

Riege, A. (2005) Three-dozen knowledge-sharing barriers managers must consider, *Journal of Knowledge Management*, 9(3), pp. 18–35.

Rubin, H. and Rubin, I. (2005) 'Qualitative interviewing: The art of hearing data', SAGE Publications, Inc.

Senge, P. (2006) Give me a lever long enough... and single-handed I can move the world, *The Jossey-Bass Reader on Educational Leadership*, pp. 3–15.

Serenko, A., Bontis, N. and Hardie, T. (2007) Organizational size and knowledge flow: a proposed theoretical link, *Journal of Intellectual Capital*, 8(4), pp. 610–627.

Shani, A., Sena, J. and Olin, T. (2003) Knowledge management and new product development: a study of two companies, *European Journal of Innovation Management*, 6(3), pp. 137–149.

Shneiderman, B. and Plaisant, C. (25th June 2009) *Treemaps for space-constrained visualization of hierarchies*, last accessed 25/06/2009, from `http://www.cs.umd.edu/hcil/treemap-history/`.

Shneiderman, B. and Wattenberg, M. (2001) 'Ordered treemap layouts', *Proceedings of the IEEE Symposium on Information Visualization 2001*, vol. 73078.

Stats SA (2002) *The post and telecommunication industry*, Statistical release, Statistics South Africa.

Stewart, D. (2001) Reinterpreting The Learning Organisation, *The Learning Organization*, 8(4), pp. 141–152.

Subramani, M. and Venkatraman, N. (2003) Safeguarding investments in asymmetric interorganizational relationships: Theory and evidence, *The Academy of Management Journal*, 29(1), pp. 46–62.

The LyX Team (9th May 2013) *LyX 2.0.6 - The Document Processor*, last accessed 01/07/2013, from `http://www.lyx.org`.

Thomas, J., Kellogg, W. and Erickson, T. (2001) The knowledge management puzzle: Human and social factors in knowledge management, *IBM SYSTEMS JOURNAL*, 40(4), pp. 863–884.

Thomas, J. (23rd Aug. 2010) *The German Teacher*, last accessed 23/08/2010, from `http://www.research.ibm.com/knowsoc/stories_german.html`.

Tjosvold, D., Yu, Z. and Hui, C. (2004) Team Learning from Mistakes: The Contribution of Cooperative Goals and Problem-Solving, *Journal of Management Studies*, 41(7), pp. 1223–1245.

Trochim, W. M. (20th Oct. 2006) *The Research Methods Knowledge Base — Qualitative Validity*, 2nd Edition, version current as of 20 October, 2006, last accessed 21/04/2011, from `http://www.socialresearchmethods.net/kb/qualval.php`.

University of Melbourne (Oct. 2006) *IT & ITIL based Glossary of Terms : Knowledgebase : The University of Melbourne*, last accessed 11/10/2009, from `http://www.infodiv.unimelb.edu.au/knowledgebase/itservices/a-z/k.html`.

Usoro, A., Sharratt, M., Tsui, E. and Shekhar, S. (2007) Trust as an antecedent to knowledge sharing in virtual communities of practice, *Knowledge Management Research & Practice*, 5(3), pp. 199–212.

Ward, T. (6th Jan. 2010) *Technology, the intranet, and employee productivity*, last accessed 11/03/2010, from `http://intranetblog.blogware.com/blog/_archives/2010/1/6/4421930.html`.

Wattenberg, M. (1999) 'Visualizing the stock market', *CHI'99 extended abstracts on Human factors in computing systems*, ACM, pp. 188–189.

Wenger, E., McDermott, R. and Snyder, W. (2002) *Cultivating communities of practice: A guide to managing knowledge*, Harvard Business School Press.

West, M. A. (1996) 'Handbook of Work Group Psychology', ed. by M. A. West, John Wiley & Sons, chap. Reflexivity and work group effectiveness: a conceptual integration, pp. 555–579.

Wiles, R., Crow, G., Heath, S. and Charles, V. (2008) The management of confidentiality and anonymity in social research, *International Journal of Social Research Methodology*, 11(5), pp. 417–428.

Wong, K. Y. and Aspinwall, E. (2005) An empirical study of the important factors for knowledge-management adoption in the SME sector, *Journal of Knowledge Management*, 9(3), pp. 64–82.

Wong, K. (2005) Critical success factors for implementing knowledge management in small and medium enterprises, *Industrial Management & Data Systems*, 105(3), pp. 261–279.

Yang, J. and Yu, L. (2002) Electronic new product development — a conceptual framework, *Industrial Management and Data Systems*, 102(4), pp. 218–225.

Zapato, L. (8th Aug. 2010) *Lord Kelvin Quotations*, last accessed 09/03/2010, from `http://zapatopi.net/kelvin/quotes/#meas`.

Zhang, W. and Watts, S. (2008) Online communities as communities of practice: a case study, *Journal of Knowledge Management*, 12(4), pp. 55–71.

A. Interview guide

The interview guide was adapted from an example given by Case (1990) and is shown on the following page. No questions were designed or phrased beforehand to allow maximum flexibility during the interview. This allowed the interviewer and interviewee to probe for relevant details on issues as they arose. The interviewer made use of the interview outline shown on page 79 to ensure that relevant topics were discussed.

Name: _____ Date: _____ Capacity: _____

Topic	Awareness	Problems	Suggestions
Knowledge management			
Communities of Practice			
New product development			
KM in NPD			

Interview outline

Knowledge Management

- General
  - Expertise is more valuable than physical assets.
  - Assists with decision making.
  - Disseminates best practice.
  - Group interaction is needed for individuals to learn.
  - Capture knowledge — codification vs. personalisation
  - Mistakes provide an opportunity to learn.
  - KM models are useful to ground practical KM initiatives in sound theoretical frameworks
- Knowledge sharing
  - Within the organisation & with external parties
  - Personal vs. impersonal sources
  - All knowledge can be captured and lead to understanding
  - Support from senior management
  - Organisational structure
  - Integrated technology
  - Social aspects
- Communities of practice
  - Loosely connected network
  - Getting exposed to others' ideas
  - Active participation
  - Ideally suited to capture its own tacit knowledge
- In practice
  - Influence of group size
  - Practitioners need to *feel* the effects of their efforts
  - Correct performance measures
  - Correct presentation of knowledge

New Product Development

- Role of KM
  - Type of KM procedures influences its usability for NPD
  - Informal knowledge sharing processes should complement formal ones for optimal NPD performance.
- Perspectives:
  - What is NPD?
  - OL is vital to effective NPD
  - Standardisation of NPD activities
- Team dynamics
  - Loyalty division in cross-functional-teams.
- Environment
  - Team's performance relies on its ability to cope with change.
  - Senior project manager ensures congruent decisions.
  - Team reflexivity needed for improved performance.
- Managers
  - Should provide a clear project target.
  - Should guide the team.
  - Should align NPD and business strategy.
- Using Knowledge Management
  - Effective KM leads to improved NPD performance.
  - Project manager's ability to communicate across functions improved transfer of knowledge.
  - Increased reflexivity improves the sharing of knowledge between team members.
  - NPD must be managed as an integral business process NPD: Using KM: Company's ability to innovate depends on the amount of resources assigned to KM