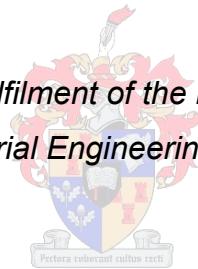


A KNOWLEDGE MANAGEMENT FRAMEWORK TO GROW  
INNOVATION CAPABILITY MATURITY

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*Thesis presented in partial fulfilment of the requirements of the degree of  
Master of Science of Industrial Engineering at Stellenbosch University*



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## **Declaration**

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## **Abstract**

Innovation is widely considered a key prerequisite for achieving organisational competitiveness and sustained long-term wealth in our increasingly volatile business environment. It is therefore imperative that organisations enable themselves to relentlessly pursue constant innovation; to grow and mature their innovation capability. A study aimed at organisational support by means of business tools toward maturity growth in these innovation capability areas is therefore warranted.

Knowledge management plays a fundamental role in the enterprise's ability to innovate successfully, and the question arises whether knowledge management tools and organisational facilitating conditions can be used to grow innovation capability maturity. The existing literature on the subject is sparse, which led to the following research problem statement: No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.

Knowledge conversion is a prominent theme within the knowledge management field. Knowledge creation processes form the core of this knowledge creation model and therefore, one solution to the above-stated problem is to investigate the use of knowledge creation processes to grow innovation capability maturity. This notion provides the platform for aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next as the cornerstone for developing a knowledge management framework that enables innovation capability maturity growth.

In order to align these knowledge processes with the requirements for growth in innovation capability maturity, the author identified a knowledge creation path as a key enabler for maturity growth in each innovation capability area. Knowledge management tools and organisational facilitating conditions that support the specific knowledge processes highlighted in the identified path were identified through a literature study and subsequently synthesised to form a framework.

The impact of this framework lies in providing guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth.

## Opsomming

Innovasie word allerweë beskou as 'n kernvereiste vir die verkryging van organisatoriese mededingendheid en volhoubare langtermynsukses in ons toenemend wisselvallige sake-omgewing. Dit is dus noodsaaklik dat organisasies hulself in staat stel om meedoënloos konstante innovasie na te streef; om hul innovasievermoë uit te brei en volwassenheid daarin te bereik. 'n Studie gemik op organisatoriese ondersteuning deur middel van sake-hulpmiddels ten einde groei in volwassenheid in hierdie innovasievermoë-areas te bereik, is dus nodig.

Kennisbestuur speel 'n fundamentele rol in die onderneming se vermoë om suksesvol te innoveer, wat die volgende vraag ontlok: Kan kennisbestuurhulpmiddels en organisatoriese fasiliteringsomstandighede gebruik word om innovasievermoëvolwassenheid te bereik? Die bestaande literatuur oor die onderwerp is gebrekkig, wat aanleiding tot die volgende probleemstelling gegee het: Daar is geen formele riglyne vir die gebruik van kennisbestuur om innovasievermoëvolwassenheid te verbeter nie.

Kennisomskakeling is 'n prominente tema in die gebied van kennisbestuur. Kennisskeppingsprosesse vorm die kern van hierdie kennisskeppingsmodel en daarom is een oplossing tot bogenoemde probleem om die gebruik van kennisskeppingsprosesse om innovasievermoëvolwassenheid te verbeter, te ondersoek. Hierdie idee skep 'n platform om kennisskeppingsprosesse met die vereistes vir innovasievermoëverbetering van een volwassenheidsvlak tot die volgende te belyn, as hoeksteen vir die ontwikkeling van 'n kennisbestuurraamwerk om innovasievermoëvolwassenheid te verbeter.

Ten einde hierdie kennisprosesse met die vereiste vir groei in innovasievermoëvolwassenheid te belyn, het die outeur 'n kennisskeppingspad as kernelement geïdentifiseer om volwassenheidsgroei in elke innovasievermoë-area in die hand te werk. Kennisbestuurhulpmiddels en organisatoriese fasiliteringsomstandighede wat die spesifieke kennisprosesse wat in die geïdentifiseerde pad uitgelig word, ondersteun, is deur middel van 'n literatuurstudie geïdentifiseer en daarna gesintetiseer om 'n raamwerk te vorm.

Die impak van hierdie raamwerk lê daarin om riglyne vir die gebruik van kennisbestuur as 'n middel tot innovasievermoëvolwassenheidsgroei te bied.

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## Glossary

Capability maturity model	A model that describes evolutionary plateaus for the improvement of a specific domain of practice. It may be used to determine the capability of executing the requirements of that domain of practice and to facilitate in developing a plan for the improvement thereof.
Domain of practice	An area of business activity that may be an organisational core competence, or a business unit. Domains include project management, knowledge management, etc.
Enterprise	A complex system of human, process and technological components that interact to accomplish strategic goals, under the ownership or control of a directing body, and which ultimately strives to create wealth for its stakeholders. <i>(Used synonymously with organisation.)</i>
Explicit knowledge	Explicit knowledge is knowledge that the individual holds clearly and consciously in mental focus and that is structured and retrievable.
Innovation capability	The organisational means by which innovative outputs may be facilitated.
Knowledge creation	Knowledge is created through conversion between tacit and explicit knowledge through knowledge creation processes.
Knowledge creation processes	Socialisation (tacit to tacit knowledge transfer), externalisation (tacit to explicit knowledge transfer), combination (explicit to explicit knowledge transfer) and internalisation (explicit to tacit knowledge transfer).
Knowledge management	A planned, structured approach to manage the creation, sharing, harvesting and leveraging of knowledge as an organisational asset.
Knowledge management tools	Tools (information and communication technology [ICT] or organisational) that provide the basis for a knowledge management infrastructure that supports the knowledge creation processes.
Maturity level	A well-defined evolutionary plateau of domain of practice capability maturity.
Organisational facilitating conditions	The environment in which the knowledge creation processes take place.
Tacit knowledge	Knowledge that is unarticulated and tied to the senses, movement skills, physical experiences, intuition or implicit rules of thumb.



## Chapter 1

## Introduction



This chapter familiarises the reader with the research presented in this thesis. The objective of this study, the specific research methodology followed and the scope of the research are discussed. The document outline and illustrative chapter key will also be introduced, providing a condensed reference for the content of this document.

## 1.1 Research objective

Innovation is widely considered a key prerequisite for achieving organisational competitiveness and sustained long-term wealth in our increasingly volatile business environment. It is therefore imperative that organisations enable themselves to relentlessly pursue constant innovation; to grow and mature their innovation capability.

Therefore, this research was aimed at investigating organisational support by means of business tools toward maturity growth in these innovation capability areas.

## 1.2 Research methodology

A literature review of the innovation landscape led the author to identify the need for organisations to grow and mature their innovation capability. Further reading highlighted the direct connection between innovation and knowledge management; knowledge creation processes act as critical enablers for the innovation process.

From this the research the following research problem statement was developed: *No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.* Consequently, this study investigated how knowledge management tools can be applied to advance innovation capability maturity growth.

Within this context, the research hypothesis reads as follows: *A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for growth from one maturity level to the next.*

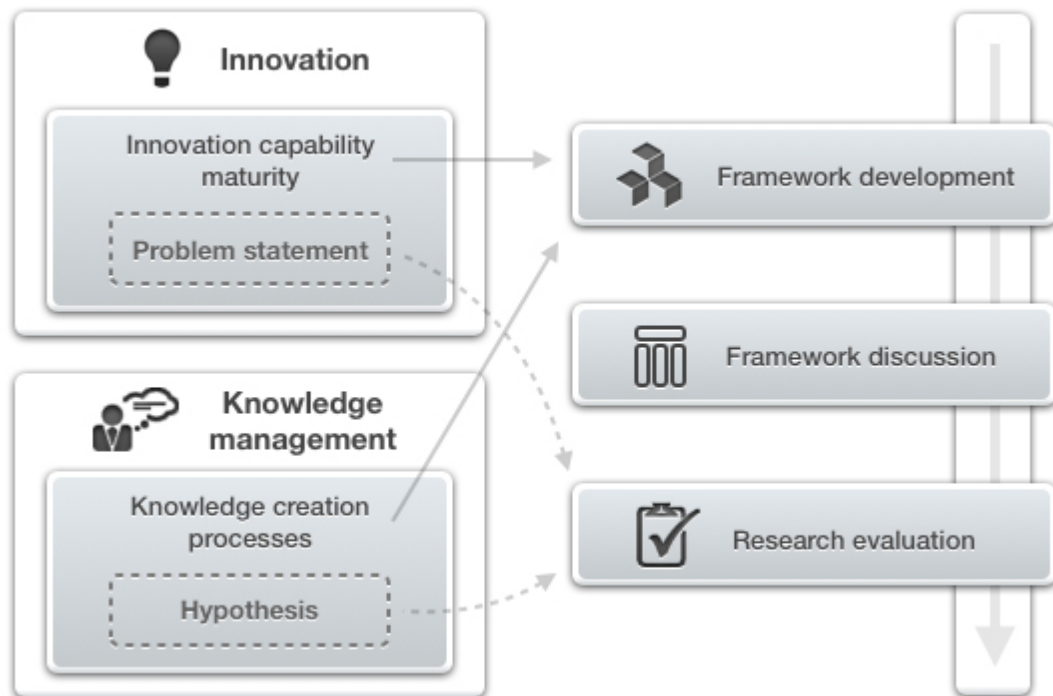
In order to align these knowledge processes with the requirements for growth in innovation capability maturity, a literature review led the author to identify a knowledge creation path as a key enabler for growth from one maturity level to the next. Knowledge management tool requirements and organisational facilitating conditions



that support the specific knowledge processes highlighted in the identified path were also reviewed and subsequently synthesised to form a framework.

The impact of this framework lies in providing guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth. The ability of the framework to enable innovation capability maturity growth was evaluated through a questionnaire and an interview-based evaluation procedure.

The following diagram (Figure 1) is a schematic outline of the previous research methodology discussion, and will be used throughout this text to highlight the specific research component discussed and to illustrate its context within the research methodology.



**Figure 1: Research outline diagram**

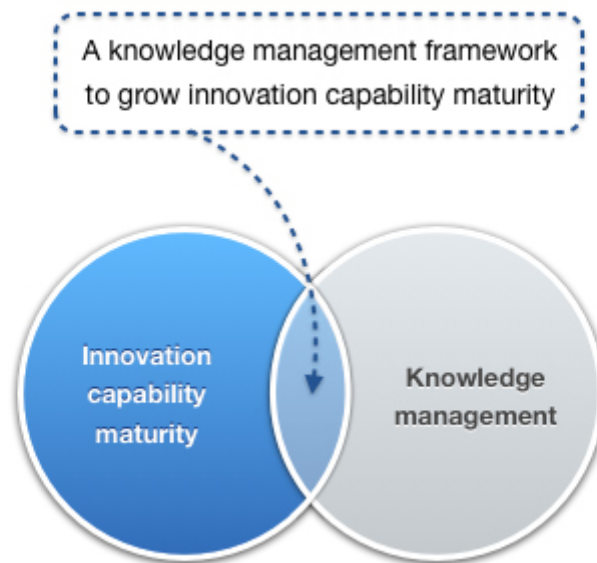
### 1.3 Research boundaries/scope

The framework presented in this document is neither intended as the be-all and end-all solution to enable innovation capability maturity growth, nor is the intention to provide a step-by-step enterprise-wide knowledge management integration plan. The author's



aim was to investigate organisational support by means of business tools toward innovation capability maturity growth. The result of this investigation was a conceptual framework, serving as guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth.

The unique research contribution lies in providing a tangible link between the fields of knowledge management and innovation capability maturity (refer to Figure 2).



**Figure 2: Research domain**

## 1.4 Document layout

Section 1.2 and Figure 1 presented the research methodology, and accordingly the document layout and chapter sequence are structured in a way that will enable the reader to best comprehend the flow of the research (refer to Figure 3).



**Figure 3: Document chapter outline**



### 1.4.1 Chapter 1: Introduction

Chapter 1 contains the introductory sections describing the objective of this research, the research methodology, the specific scope of this study and the document layout.



### 1.4.2 Chapter 2: Innovation

Chapter 2 introduces the innovation landscape, paving the way for a literary discussion of why growing innovation capability maturity is critical for the long-term sustainability of an organisation. This chapter concludes by asking the following question:

*If knowledge creation processes act as critical enablers for innovation, can we use knowledge management to grow innovation capability maturity?*

This question elicited the research problem statement: *No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*



### 1.4.3 Chapter 3: Knowledge management

Chapter 3 presents the field of knowledge management, examining why it is important, discussing the notion of knowledge and describing the different types of knowledge. The chapter then presents the concept of knowledge creation processes that form the backbone of the research hypothesis:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for growth from one maturity level to the next.*



### 1.4.4 Chapter 4: The framework

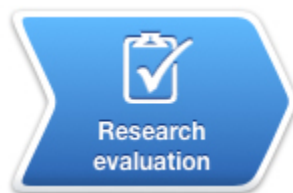
This chapter presents a step-by-step discussion of the development of the knowledge management framework to grow innovation capability maturity. It presents the





reasoning behind deriving the knowledge creation path as a key enabler of innovation capability maturity growth: the alignment of the knowledge creation processes with the requirements for growth in innovation capability from one maturity level to the next.

The chapter then describes the allocation of knowledge management tool requirements and organisational facilitating conditions that support the specific knowledge processes highlighted in the identified path. These requirements are subsequently combined to form a framework. The impact of the knowledge management framework on the growth of innovation capability maturity is illustrated by describing the framework guidelines in the context of a practical organisational scenario.



### **1.4.5 Chapter 5: Research evaluation**

This is the final chapter of the body of the research, and focuses on the process of evaluating the research done during this study. It presents the evaluation method (evaluating the framework via expert interviews) and discusses how this method can be used to either prove or refute the research hypothesis. The evaluation process is discussed, followed by a comprehensive account of the evaluation findings.

The result of these findings is consequently discussed, addressing whether or not the research hypothesis could be proven. The chapter concludes with positive feedback, shortcomings and a suggested scope for further research by industry, organisational and academic experts.



### **1.4.6 Chapter 6: Conclusion**

This is the final chapter, presenting a concise summary of the research done through a description of the research methodology followed, the results obtained from the research evaluation, as well as a reflection on aspects learnt and the scope for future research.



**Chapter 2**

**Innovation**



This chapter presents concepts that are the result of a literature review in an attempt to comprehend the different dynamics of innovation. Specifically, it aims to introduce the reader, in a logically structured manner, to the concept of innovation capability maturity. This review was instrumental in the development of the research problem statement for this thesis (found in Section 2.3) and in understanding the landscape necessary to instigate further research.

## 2.1 Innovation landscape

Innovation is a key prerequisite for achieving organisational competitiveness and long-term wealth in the volatile business environment. Being able to innovate, and do so on a constant and sustainable basis, is widely considered vital for organisations functioning within the competitive realm [1] – [6].

The primary role of this section (refer to Figure 4) is to sketch a picture of innovation (essentially, the innovation dilemma) that will assist in describing what it means for, and what is required from, an organisation to be innovative.

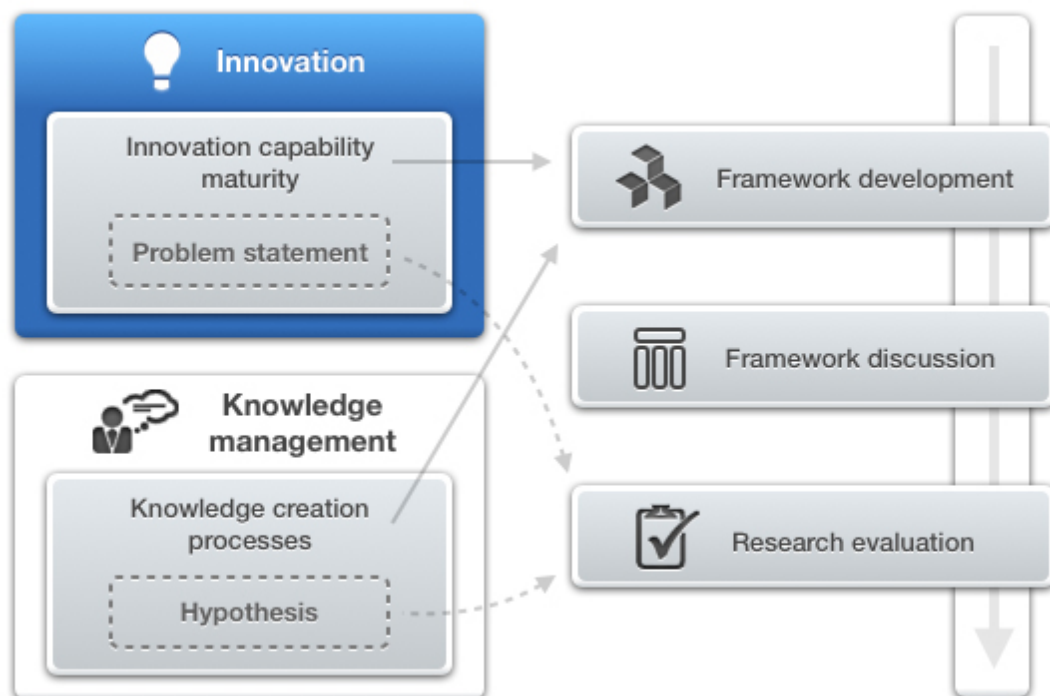


Figure 4: Research outline: Innovation



### 2.1.1 Innovation defined

The notion of innovation goes as far back as 1934 in the works of Joseph Schumpeter, with the publication of his *Theory of economic development*. In 1939, Schumpeter [6] directly addressed the vague concept of innovation, defining it as encompassing the entire process, starting from a kernel of an idea, continuing through all the steps to reach a marketable product that changes the economy. He also singled out five types of innovation: those that result in new products, new methods of production, new sources of supply, the exploration of new markets, and new ways to organise business.

Bigoness and Perreault [7] argue that the adoption of a single process, product or business concept by an enterprise does not necessarily represent a tendency toward innovativeness. They suggest that it is the enterprise that consistently adopts innovative ideas that appropriately demonstrates innovative characteristics.

More recently, Katz [8] defined innovation as follows:

*The successful generation, development and implementation of new and novel ideas, which introduce new products, processes and/or strategies to a company or enhance current products, processes and/or strategies leading to commercial success and possible market leadership and creating value for stakeholders, driving economic growth and improving standards of living.*

### 2.1.2 Categorising innovation

The literature indicates various seemingly different types of innovation; notably innovation regarding products, services, processes, strategy, marketing, finance and value. Still, these regularly overlap in definition.

The most common categorisation for innovation is into two high-level categories, namely product and process innovation [8]. Neely et al. [9] explain that product innovation involves the development and commercialisation of new tangible products or services, while process innovation involves the introduction of new, or the improvement of current manufacturing, distribution and service processes; any procedure or action that is implemented to execute the transformation of resources associated with the organisation. Du Preez et al. [10] further emphasise that, with product innovation, both parties involved (the organisation and the customer) should

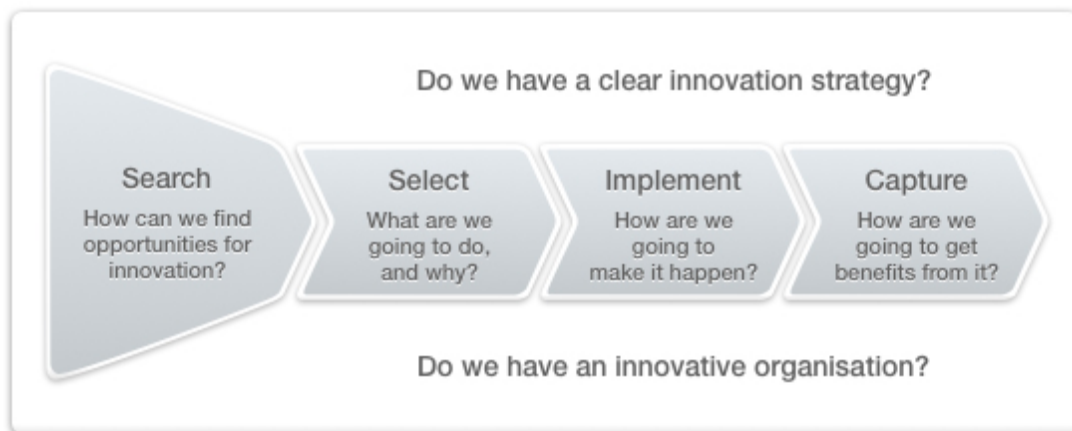


gain value from the transaction. They also argue that process innovation can relate to a high-level managerial process, or to a detailed set of tasks to execute an operational process.

In addition to product and process innovation categories, Baker [11] highlights the importance of a third type of innovation: strategy innovation. He argues that product and process innovation alone are no longer adequate, necessitating the introduction of strategy innovation to provide further support. This type of innovation emphasises the importance of a long-term view of the contribution of innovation toward the competitiveness and success as an organisation. Hamel [2] confirms this, referring to strategy innovation as business concept innovation (BCI). BCI involves innovations to a variety of business design variables, including pricing structures, distribution channels and value webs or relationships.

With innovation being categorised into product, process and strategic innovation, it is necessary to add that a successful innovation is often a combination of the three types of innovation, as a new strategy can result in a new product, which in turn requires a new process [10].

However, organisations often confuse invention for innovation. Tidd and Bessant [12] agree, stating that “innovation is more than simply coming up with good ideas: it is the process of growing them into practical use”. They argue that the innovation process primarily consists of four core actions: search, select, implement and capture (refer to Figure 5).



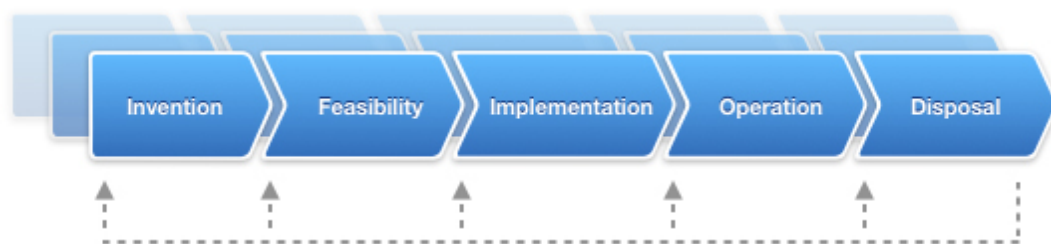
**Figure 5: A simple model of the innovation process [12]**



In short, the two fundamental aspects characterising any type of innovation are therefore a) a novelty or newness associated with innovation activities; and b) the presence of an inherent process.

### 2.1.3 Innovation lifecycle

As innovation necessitates the execution of a process, this process may be represented as a life cycle of phases. Du Preez et al. [10] describe a basic and generic representation of the innovation lifecycle that comprises the following phases (also refer to Figure 6):



**Figure 6: The basic innovation lifecycle**

- **Invention:** Opportunities are identified and ideas generated, with creativity playing an important role.
- **Feasibility:** The feasibility of these ideas are determined through rigorous testing and screening. The specification, functional analysis and initial design are also executed.
- **Implementation:** The feasible ideas and opportunities from the previous phase are now further designed and implemented in the organisation, or offered to the market.
- **Operation:** Once the process has delivered a commercially viable output, operation is undertaken. This encompasses the performance of activities such as production and quality control of products, monitoring and optimisation of processes, and deployment of strategy.
- **Disposal:** After maximum feasible utilisation has been attained, the innovation process enters into its final phase, that of disposal. Here, the focus is on reflecting and learning from the process and fulfilling final (legal, environmental,



etc.) obligations. Disposal does not refer to the conclusion of the innovation process, but rather to the closure of the particular initiative.

Essmann [13] points out that learning occurs in the activities through all innovation lifecycle phases. At the end of each phase, there is an opportunity to learn from the successes and failures of that phase. The innovation lifecycle phases may be revisited in order to re-execute certain activities or to refine certain aspects and improve upon the initiative.

Furthermore, it is vital that the innovation process continues in order to maintain and improve on any competitive advantage derived from previous initiatives through new and promising opportunities. This notion is affirmed by Moore [4] when he compares enterprises and markets to nature, which demands persistent evolution to maintain equilibrium and sporadic revolution to create advantage. As innovation is the source of this evolution and revolution, it is not only a current issue, but also a permanent one.

Moore [4] is widely quoted for stating: “To innovate forever, in other words, is not an aspiration; it is a design specification. It is not a strategy; it is a requirement”.

## **2.2 Innovation capability and capability maturity models: Connecting the dots**

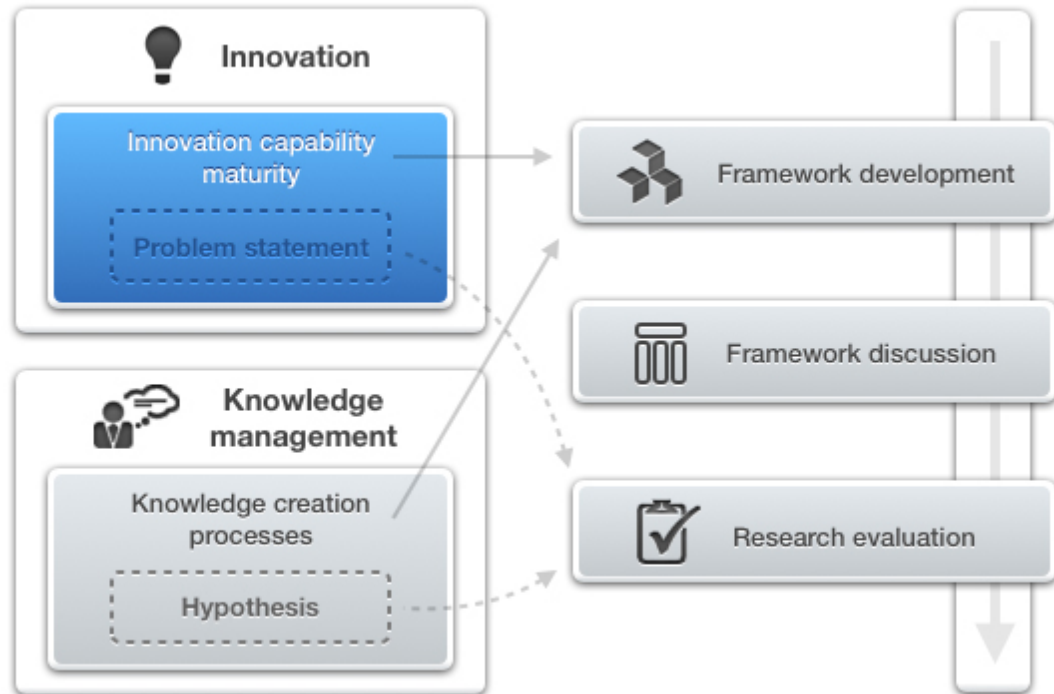
Throughout the literature, Hamel [2] is quoted in order to illustrate what is meant by the concept of innovation capability: “There is no sausage crank for innovation, but it’s possible to increase the odds of an ‘eureka!’ moment by assembling the right ingredients”. Essmann [13] emphasises that these ingredients can be seen as the requirements and practices of a capability to innovate, the essence of which is the same in any organisation.

The first part of this chapter identified that being able to innovate, and do so on a constant and sustainable basis, is considered vital for organisations functioning within the competitive realm.

This section (refer to Figure 7) presents literature relevant to understanding the requirements and practices that are necessary to create an innovation-capable organisation; an organisation enabled to relentlessly pursue constant innovation to



grow and mature its innovation capability, thereby delivering consistent innovative outputs.



**Figure 7: Research outline: Innovation capability maturity**

### 2.2.1 Innovation capability

It is a common misconception that innovation must be completely novel. Essmann [13] highlights that this is far from the truth. He argues that common processes and previously acquired knowledge and competencies, supported by the appropriate organisational structures, strategy, climate, culture and leaders, can collectively contribute to an environment that enables and/or is favourable for innovation.

This is what Essmann [13] refers to as the capability to innovate; innovation capability is the organisational means with which innovative outputs are generated.

While the introduction of Section 2.1 identified that organisations need to innovate on a constant and sustainable basis in order to remain competitive, it is widely deliberated





that the requirement to innovate subsequently necessitates innovation capability or innovation competence [1], [2], [11], [15] – [17].

## 2.2.2 Capability maturity models

With innovation capability being the organisational means with which innovative outputs may be generated, Essmann [13] points out that this innovation capability must be assessed and improved to sustain, repeat and accelerate innovative initiatives. This requirement for assessment and constant improvement directly translates to the concept of capability maturity models.

### 2.2.2.1 Maturity: A domain-specific concept

The definition of maturity is generally dependent on the domain it refers to. The Oxford English Dictionary defines maturity by including these concepts: fully developed or grown up; of plans or theories, fully considered or perfected; of insurance policies or bills, due or payable; and of fruit, wine or cheese, ripe or fully aged.

The following definition of maturity from an organisational or domain perspective will be used throughout this thesis: a system assessed to be optimally fit for its purpose, as described by its designer.

This definition of maturity was formulated by Essmann [13] after an intensive literature review, and is primarily based on the work of Terence Cooke-Davies, who has done extensive research predominantly directed at project management maturity models.

### 2.2.2.2 Goals and importance of capability maturity models

Generically, a capability maturity model can be seen as a method for judging whether processes used, as well as the way in which they are used, are characteristic of a mature organisation [18]. It is a set of structured levels that defines how well the activities, practices and processes of an organisation can reliably and sustainably produce the required outcomes.

The two essential goals of a capability maturity model are a) to determine the capability maturity of an organisation in terms of a specific domain of practice; and consequently b) to facilitate in establishing and guiding improvement that will best suit the enterprise and that complies with the prescribed best practices of the domain [13].



The abovementioned provides a platform for logical reasoning regarding the importance of capability maturity models. In order to understand the current positioning of an enterprise relevant to its competitors as well as enterprises in other industries, it is necessary to establish its capability maturity in terms of a specific domain of practice. Moreover, it is important for an enterprise to benchmark itself against the best or against those who are known to be successful, in order to determine how much and in what direction to improve. Although benchmarking is a recognised practice, it can present a problem, as most enterprises are reluctant to expose their competitive secrets. Here Essmann [13] points to a possible solution: Capability maturity models are available from creators who have used many resources to establish best practices for a specific domain, and it is against these best practices that an enterprise should benchmark itself.

### **2.2.2.3 Existing capability maturity models: An overview**

The original Capability Maturity Model® for software (SW-CMM®) is a widely accepted set of guidelines for developing high-performance software organisations [19]. The original concept behind SW-CMM® was developed in the early 1980s by Watt Humphrey and colleagues at IBM. He placed the emphasis for improving software development on the process, after establishing that the quality of software was directly related to the quality of the process used to develop it [19].

However, the Software Engineering Institute (SEI) of Carnegie Mellon University developed the original SW-CMM® and first published it under the sponsorship of the United States Department of Defence [20] – [22]. The majority of capability maturity models are based on the initial SW-CMM® of the SEI [13].

Most recently, SEI compiled the Capability Maturity Model Integration®, or CMMI®, which is a model consolidated from the following bodies of knowledge (or domains of practice): software development, systems engineering, integrated product and process development, and supplier sourcing. Degen-Hientz et al. [21] describe the CMMI® as a model and industry standard that contains best practices aimed at the development and maintenance of products and services throughout the product lifecycle.

The concept of the Capability Maturity Model, or simply the maturity model, has since spread to many organisational domains of practice. Champlin [23] affirms this, stating that the enterprise has a wide selection of capability maturity models from which to



choose, not only between applications, but also within each application, as capability maturity models have been developed for many applications, including software development, IT management, project management, data management, business management and knowledge management, with the total number of capability maturity models available by 2002 already exceeding 120.

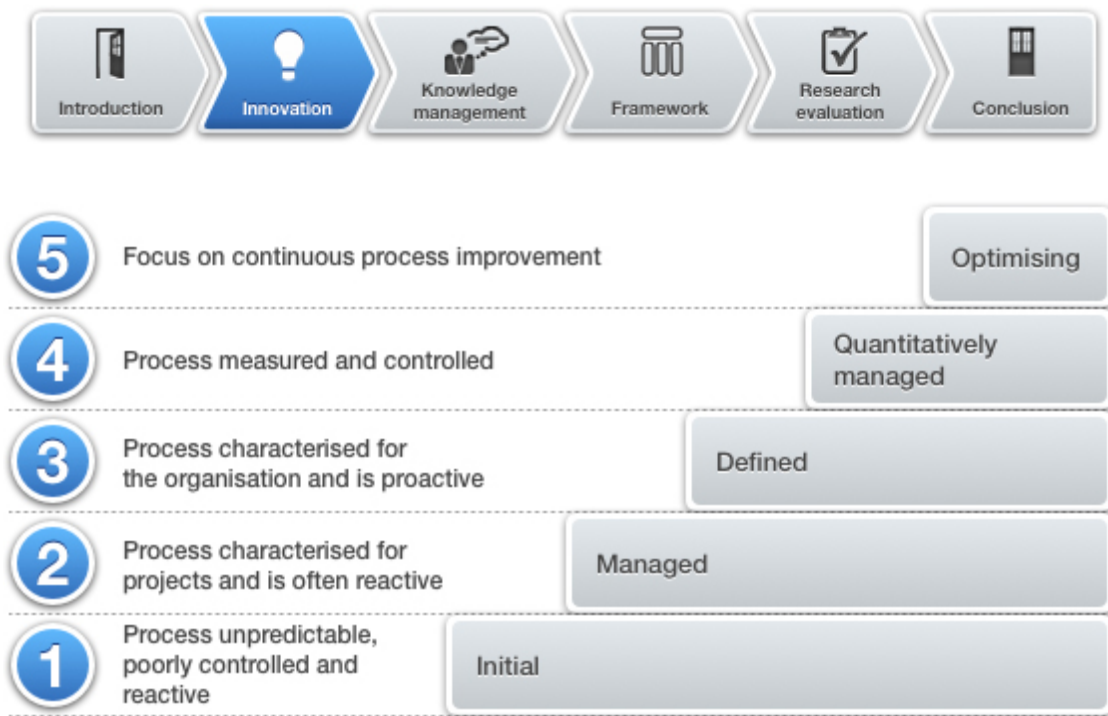
#### **2.2.2.4 Capability maturity models: Basic structure**

Most capability maturity models have the same basic five-level maturity scale structure, with maturity level descriptions often corresponding between the different models.<sup>1</sup> The CMMI® Product Team [24] defines a maturity level as a “well-defined evolutionary plateau of process improvement”. An often-observed representation of these maturity levels and their descriptions, as depicted by Degen-Hientz [21], is shown in Figure 8.

An enterprise does not necessarily start at maturity level 1; it is benchmarked against the capability maturity descriptions of each level and is then assigned the appropriate level on the condition that it continues to fulfil the requirements as stated in the description for that level. When assigning a specific level it is also assumed that all the requirements for the previous levels have been met. To have attained maturity level 4, for example, all the requirements of levels 2, 3 and 4 must have been continuously fulfilled and institutionalised. Level 1 serves as the launch pad for successive levels and does not imply that any maturity requirements have been met.

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<sup>1</sup> This is possibly due to the fact that the SW-CMM® formed the basis of the majority of other capability maturity models.



**Figure 8: Common maturity level structure**

### 2.2.2.5 Capability maturity models and innovation: Limitations

Innovation has been unmistakably linked to constant evolution and revolution [2], [4], [14]. The CMMI® aptly deals with this problem of constant change by stipulating innovation as a requirement. This requirement is however only addressed by organisations that have attained a level 4 maturity and are now working toward maturity level 5 [24], therefore indicating that innovation is reserved only for organisations with a high level of capability maturity.

Of the 567 organisations that have undergone a SCAMPI<sup>2</sup> appraisal conducted from its April 2002 release until December 2004, 69.7% fell into levels 1, 2 and 3 [21], and therefore were not addressing innovative ways of executing domain-specific activities. Even though this is representative of a single maturity model, it is the successor of the maturity model on which most other maturity models are based – the SW-CMM®.

Essmann [13] asks the following compelling questions: “What about organisations at lower levels of maturity? Is innovation not a fundamental requirement that needs to be addressed from the start of maturity development? Has competition not reached a degree of severity that necessitates this?”

<sup>2</sup> Standard CMMI® Appraisal Method for Process Improvement (SCAMPI), v. 1.1 Class A.



Innovation across all capability maturity levels is crucial for enterprise survival and therefore represents an essential omission in the original SW-CMM®, its successor CMMI®, and the many maturity models that are based thereon.

### **2.2.2.6 Capability maturity models and innovation: A solution**

The competitiveness and survival of the modern enterprise are reliant on its ability to innovate, providing a strong argument that innovation should not be apportioned to only the final levels of organisational maturity.

An initial reaction to this problem could be to suggest the following solution: Skip straight to the highest level of maturity in order to address the innovation imperative. This is, however, an invalid argument, as the CMMI® explicitly states that maturity levels should not be skipped [22]. The levels build upon the essential assumption that the requirements of previous levels have been met; disregarding this could lead to the omission of certain basic requirements and result in essential exclusions regarding domain practices.

However, the problem that innovation should not be apportioned to only the final levels of organisational maturity can be addressed by modifying existing capability maturity models so that they require innovation at earlier levels of maturity. Alternatively, a new maturity model specifically aimed at innovation capability is required.

The in-depth analysis required in order to modify existing maturity models so that they require innovation at earlier stages is beyond the interest of this research study. A discussion of current innovation capability maturity models or closely related initiatives is presented in Section 2.2.2.7.

### **2.2.2.7 Existing innovation capability maturity models**

As discussed in the previous section, this section presents current innovation capability maturity models or closely related initiatives currently being used to manage enterprise innovation capability.

Some recent and/or significant developments regarding innovation capability maturity models include the Innovation Capability Maturity Model from Indutech by Essmann [13], the Business Innovation Maturity Model from Accelper Consulting [25], the INPAQT Innovation Capability Maturity Model from INPAQT [26], the Innovation Maturity Model from Tata Consultancy Services Ltd [27], the Innovation Maturity Model



from OVO [28], the Innovation Maturity Model from PRTM [29], the Innovation Maturity Model from Think For A Change [30] and the Innovation Aptitude<sup>TM</sup> Audit from The Innovation Practice [31].

Even though they are applied in practice, insufficient information is available to distinguish between these models and the theoretical and/or empirical foundations of these innovation capability maturity models are unclear; all except for the Innovation Capability Maturity Model by Essmann [13].

Essmann developed a model that describes an innovation capability maturity improvement path for competitively orientated organisations. This was done by means of thorough academic research and practical case studies toward the generic and fundamental requirements for organisational innovation capability. These generic and fundamental requirements for organisational innovation capability were then consolidated into his Innovation Capability Maturity Model (hereafter referred to as ICMM).

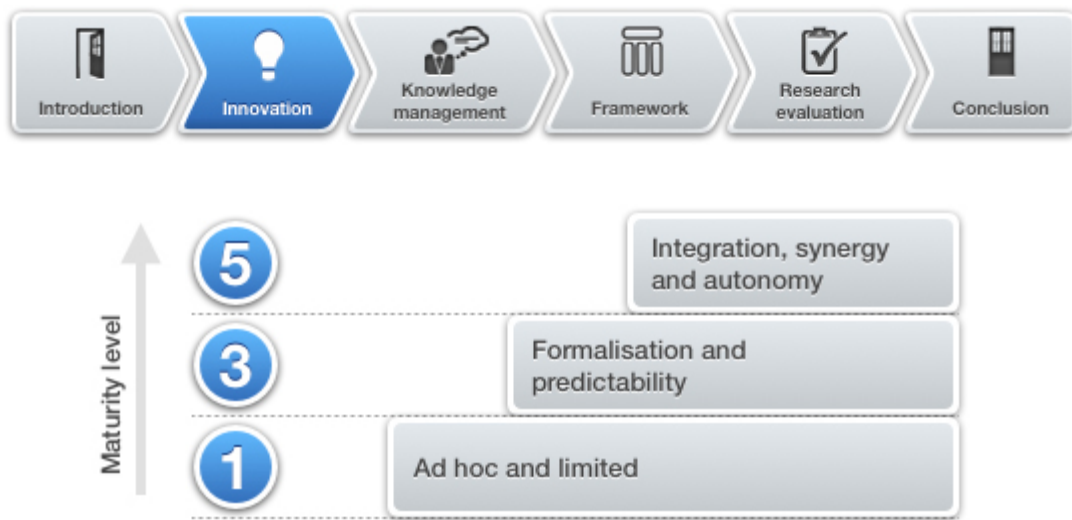
Due to the academic nature of the research study presented in this thesis, Essmann's ICMM forms the foundation of further innovation capability maturity-related discussion presented in this document, as the ICMM has sound academic merit as well as extensive practical implementation.

### **2.2.3 The Innovation Capability Maturity Model**

As stated above, the ICMM [13] is a capability maturity model that describes an innovation capability maturity improvement path for competitively orientated organisations, with the aim of capturing and improving an enterprise's capability to innovate. This section provides a brief discussion of the ICMM, with a more complete description of the ICMM in Appendix A (an article written by Essmann [13] that is included with his permission).

#### **2.2.3.1 ICMM maturity level descriptions and capability requirements**

The following is a description of the respective *generic* innovation capability maturity levels (with implicit intermediate levels between 1 and 3, and 3 and 5), as specified by the ICMM (also refer to Figure 9):



**Figure 9: Maturity levels: Innovation Capability Maturity Model [13]**

- **Maturity level 1: Ad hoc and limited**  
Innovation-related practices and procedures are impromptu and limited in their ability to fulfil the requirements for consistent innovation.
- **Maturity level 3: Formalisation and predictability**  
Innovation-related best practices and procedures have been identified and deployed, enabling the consistent fulfilment of the requirements for innovation. This does not imply the deployment of a rigid and stifling structure that must be conformed to, but rather a proactive and planned approach to innovating.
- **Maturity level 5: Integration, synergy and autonomy**  
Once formalisation has been attained, institutionalisation of practices emerges, in other words where activities become natural behaviour. This enables individual autonomy, and the freeing up of resources to concentrate on achieving alignment and synergy within and between innovation initiatives and with operational activities.

The primary content of the ICMM deals with the core requirements for innovation capability. These 42 innovation capability requirements are structured within the model, each with its own *specific* level 1, 3 and 5 maturity level scenario descriptions modelled on the *generic* maturity level descriptions as presented in Figure 9. Although the scope of this document, as well as the framework presented in it, does not necessitate a detailed account of the ICMM, listing a few of the requirements might provide context as to the application of the ICMM:

- Developing and conveying innovation strategy and objectives
- Championing and encouraging innovation
- Involving customers and suppliers in the innovation process



- Planning and coordinating the innovation portfolio
- Reducing uncertainty and mitigating risk
- Establishing intellectual property management and sharing policy
- Capturing, storing and retrieving data and information

### 2.2.3.2 ICMM innovation capability questionnaire and improvement methodology

Supplementing the core of the ICMM is an innovation capability questionnaire that is used to assess the organisation's innovation capability against the *specific* innovation capability requirements of the ICMM.

Individuals from the organisation (or business unit) being assessed are asked to complete a questionnaire wherein the enterprise is benchmarked against the requirements of each level. The individuals assign the appropriate level per innovation capability requirement, within the context of their daily exposure to the relevant innovation-related activity described by the maturity level scenario descriptions.

The results of the innovation capability questionnaire are intended to reveal the potential innovation capability improvement areas.

An example of such an innovation capability questionnaire question is: How is data and information captured, stored and retrieved?

- *Maturity level 1 description:* Information is 'dumped' into unstructured storage. Search and retrieval is predominantly manual.
- *Maturity level 3 description:* Procedures and frameworks for contextualising, categorising and capturing, and tools for storing and retrieving data and information have been identified, defined and deployed.
- *Maturity level 5 description:* Individuals and teams have adopted and exploit the deployed procedures, frameworks and tools.

After evaluation, the enterprise is guided through a rigorous consultation procedure to prioritise and improve key innovation capability improvement areas based on the results of this in-depth assessment. This is the start of a cyclical 'evaluate, plan,





improve' improvement process. This innovation capability maturity improvement process is currently facilitated through case-specific consultation.

Consequently, there is a requirement and an opportunity to develop innovation capability improvement guidelines to support the management of innovation capabilities toward innovation capability maturity growth. The author's research interest lies in investigating organisational support by means of business tools toward guidelines that enable maturity growth in these innovation capability areas.

Within this context, an initial research problem was identified:

*There is a gap in literature regarding formalised guidelines for the use of business tools to enable innovation capability maturity growth.*

## **2.2.4 Innovation and knowledge management**

Drucker [32] writes that “knowledge has become the key economic resource and the dominant – and perhaps even the only – source of comparative advantage”. Ruggles [33] affirms this, adding that leveraging knowledge is crucial, and in today's highly competitive environment and rapidly changing markets it might be the most important job management has.

In fact, throughout the literature it is agreed that there is a strong link between knowledge management and innovation [34] – [47].

According to Ruggles and Little [48], knowledge management activities are adding value to organisations by enhancing innovation and innovativeness. They propose that management's role should be “to carefully combine activities which enable and encourage ideas to be generated and grow, support their diffusion, and harvest the value for the organization”. They argue that knowledge management is one way of achieving this with some success.

Darroch [36] emphasises the importance of knowledge management to enhance innovation and performance within organisations. Her study provides empirical evidence that an enterprise that is knowledge management proficient will be more innovative and will perform better.

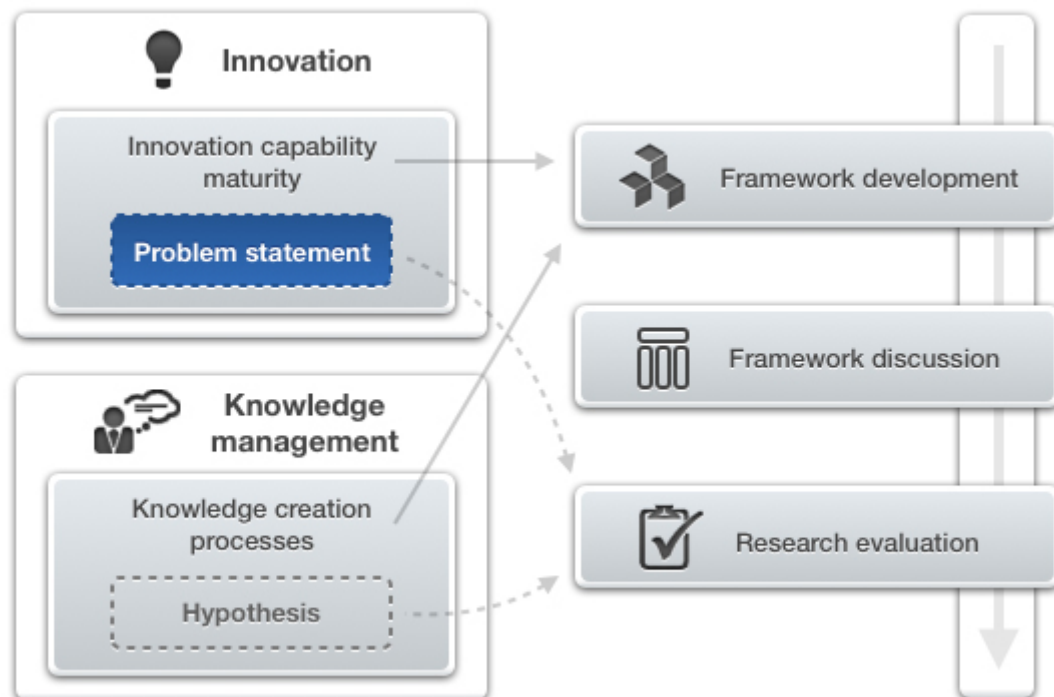


The initial research problem identified at the end of the previous section highlights that there is a gap in the literature regarding formalised guidelines for the use of business tools to enable innovation capability maturity growth.

From the discussion above it is clear that knowledge management plays a pivotal role in the enterprise's ability to innovate successfully. The pertinent question is, however, whether knowledge management tools and organisational facilitating conditions can be used to enable innovation capability maturity growth.

## 2.3 Research problem statement

This section provides a brief account of the research outline as it progressed to this section, and consequently presents a discussion leading to the research problem statement (refer to Figure 10).



**Figure 10: Research outline: Problem statement**

Innovation is widely considered a key prerequisite for achieving organisational competitiveness and sustained long term wealth in our increasingly volatile business



environment (Section 2.1). It is therefore imperative that organisations enable themselves to grow and mature their innovation capability (Section 2.2).

This innovation capability maturity improvement process is currently facilitated through case-specific consultation only (Section 2.2.3.2). Consequently, there is a requirement and an opportunity to develop innovation capability improvement guidelines to support the management of innovation capabilities toward innovation capability maturity growth. The author's research interest lies in investigating organisational support by means of business tools toward guidelines that enable maturity growth in these innovation capability areas. Within this context, an initial research problem was identified:

*There is a gap in literature regarding formalised guidelines for the use of business tools to enable innovation capability maturity growth.*

Section 2.2.4 argues that knowledge management plays a pivotal role in an enterprise's ability to innovate successfully, which leads to the pertinent question of whether knowledge management tools and organisational facilitating conditions can be used to enable innovation capability maturity growth.

The existing literature on the subject is sparse, at most implying a relation between knowledge management and an enterprise's innovation capability maturity. Cavusgil et al. [1] investigated how firms acquire tacit knowledge from partner firms and how the extent of inter-firm tacit knowledge transfer affects firm innovation capability. Calantone et al. [15] examined the concept of learning orientation and its effect on firm innovation capability. Lin [49] examined the influence of individual factors (enjoyment in helping others and knowledge self-efficacy), organisational factors (top management support and organisational rewards) and technology factors (ICT use) on knowledge-sharing processes and whether a presence of more of these factors leads to superior organisational innovation capability. This gap in the literature provides the platform for the work presented in the rest of this thesis, with the following research problem statement driving further research:

*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*



## 2.4 Summary

This chapter described the innovation landscape, stating that an organisation has to innovate on a constant and sustained basis to remain competitive in today's volatile business environment. Consequently, the concepts of innovation capability maturity and maturity models were introduced and the state of the art in capability maturity was discussed.

Significantly, reasons were given for why the ICMM forms the foundation for further innovation capability maturity-related discussions presented in this document. A concise discussion of the ICMM was presented, specifically highlighting that the innovation capability maturity improvement process is currently facilitated through case-specific consultation. Hence, there is a requirement and an opportunity to develop innovation capability improvement guidelines to support the management of innovation capabilities toward innovation capability maturity growth to maintain the organisation's competitive advantage.

Knowledge management plays a fundamental role in the enterprise's ability to innovate successfully, and the question arises whether knowledge management tools and organisational facilitating conditions can be used to enable innovation capability maturity growth.

The existing literature on the subject is sparse, and accordingly, the research problem statement reads as follows:

*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*

Chapter 3 explores the knowledge management landscape, systematically leading up to the hypothesis correlating to the above research problem statement.



## Chapter 3

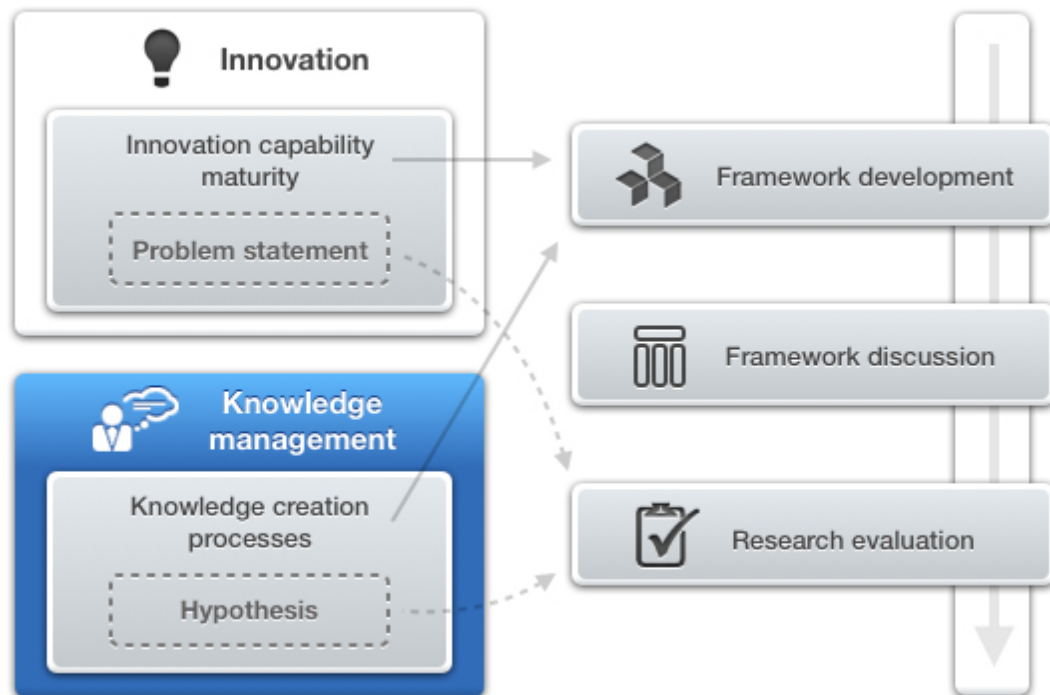
## Knowledge management



Knowledge management plays a fundamental role in the enterprise’s ability to innovate successfully. From this premise emerges the question that drives the rest of the research presented in this thesis: Can knowledge management tools and organisational facilitating conditions be used to enable innovation capability maturity growth? A gap in existing literature on the subject leads to the following research problem statement:

*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*

Chapter 3 (refer to Figure 11) discusses the concept of knowledge, different types of knowledge and the importance of knowledge work processes before highlighting related knowledge management concepts. The aim of Chapter 3 is to explore the knowledge management landscape in order to systematically uncover the hypothesis correlating to the above research problem statement.



**Figure 11: Research outline: Knowledge management**



### 3.1 What is knowledge?

*The basic economic resource – ‘the means of production’ to use the economist’s term – is no longer capital, nor natural resources (the economist’s ‘land’), nor ‘labor’. It is and will be knowledge [50]*

This well-known quote is used throughout the literature to highlight the importance of knowledge for the modern enterprise. With this in mind, Davenport and Prusak [51] emphasise the need to provide a clear, understandable ‘working definition’ for knowledge: “Confusion about what data, information, and knowledge are – how they differ, what those words mean – has resulted in enormous expenditures on technology initiatives that rarely deliver what the organisations spending the money needed or thought they were getting”.

While Davenport and Prusak [51] acknowledge that some researchers identify more than the three entities (data, information and knowledge) when referring to knowledge, elaborating to include concepts such as wisdom, insight, resolve and action, they advise against making the definition of knowledge too complex, as enterprises often have enough difficulty distinguishing among the three entities alone. This notion of complexity regarding the definition of knowledge is supported by a study by Zins [52], wherein definitions for data, information and knowledge were collected from a panel of 45 scholars. He obtained more than 130 definitions, of which the results noticeably indicate the diverse theoretical backgrounds of the panel, suggesting that the academic community also speaks in different languages when referring to these three entities.

The simplified and practical viewpoint exhibited in the work of Davenport and Prusak [51] is in line with this research study’s approach, and consequently, Section 3.1.1 provides a discourse aimed at discerning between data, information and knowledge in an effort to provide the reader with a clear mental picture of the context of ‘knowledge’ without venturing into the complexity of the information science domain. Section 3.1.2 describes the two dimensions of knowledge.

Both sections aim toward a clear, objective understanding of these knowledge-related topics without deferring from the research scope by entangling the reader in a reiteration of previous and current philosophical scholarly arguments.



### 3.1.1 Knowledge: A working definition

Most people find it difficult to articulate the difference between data and information, and between information and knowledge, and even though few people will reduce the concept of knowledge to merely being data, the term *information* often acts as an informal intermediary [53]. Davenport and Prusak [51] affirm this and emphasise that knowledge, information and data are not interchangeable concepts.

#### 3.1.1.1 Data

Data is frequently described as facts that are objective or context-free [51], [52], [54], [55]. It is also useful to observe that even though organisations tend to hoard data in an attempt to create the illusion of scientific accuracy, Davenport and Prusak [51] argue that more data is not necessarily better. Their reasons are twofold: “First, too much data can make it harder to identify and make sense of the data that matters. Second, and most fundamentally, there is no inherent meaning in data”.

Although decision making can include data, data on its own provides no reason or analysis or viable basis for action; its importance to organisations lies purely in that it is a vital raw material for the creation of information [51], [52], [54], [55].

#### 3.1.1.2 Information

“Information is data endowed with relevance and purpose” [39]. Hence, data is turned into information when its creator organises it for a particular use to add meaning [51], [52], [54], [55].

When defining information, Davenport and Prusak [51] use the analogy of a message (typically a document or an audible or visual communication), sender and receiver. They argue that information (the message), is meant to alter the perception of the receiver and to have an impact on his reasoning and behaviour; consequently, the receiver and not the sender determines the value or impact of the message. “Not only does it potentially shape the receiver, it *has* a shape: it is organized to some purpose.”

#### 3.1.1.3 Knowledge

Nonaka et al. [56] approach knowledge by adopting the traditional definition of knowledge as “justified true belief”. Here they emphasise the “justified” rather than the “true” aspect of belief toward the following definition for knowledge as a dynamic,





context-specific and relational concept: “[W]e consider knowledge to be a dynamic human process of justifying personal belief toward the ‘truth’”.

However, in a more pragmatic description, Davenport and Prusak [51] convey what is meant by knowledge within the context of the organisation and highlight the characteristics that make knowledge valuable, as well as those that make it hard to manage:

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

Alavi and Leidner [57] affirm this, stating that “knowledge is information possessed in the mind of individuals: it is personalized information (which may or may not be new, unique, useful, or accurate) related to facts, procedures, concepts, interpretations, ideas, observations, and judgments”.

The differences between knowledge and information can be seen as follows: “knowledge entails a knower; knowledge is much harder to detach, transfer, and share than information; and knowledge is much harder to assimilate and understand than information” [58].

Blair [54] describes the distinction between data, information and knowledge as follows: We lose something tangible when we lose data or information, but when we lose knowledge, we lose the ability to do something or exercise a specific expertise. Although we often need data or information to exercise this expertise, the data in itself would not be enough to enable someone else to exercise that same expertise.

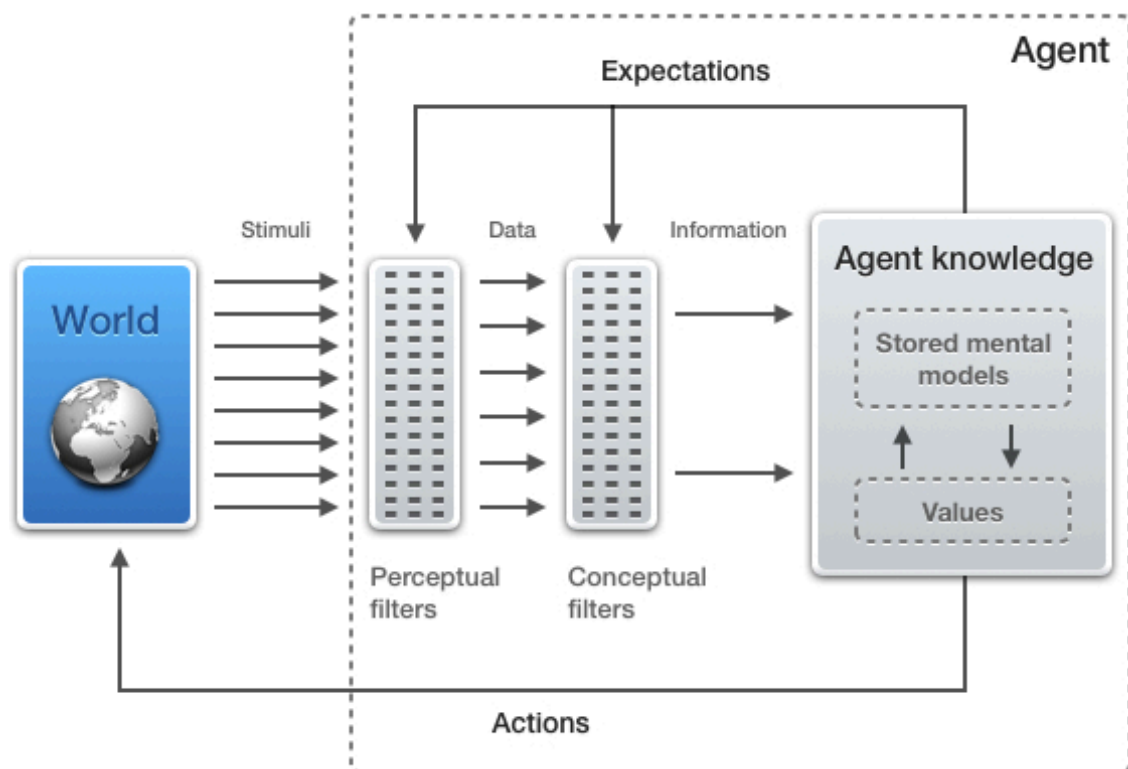
#### **3.1.1.4 Data, information and knowledge: A mental picture**

Davenport and Prusak [51] emphasise the importance of understanding the difference between data, information and knowledge, but more importantly, the relationship between the three entities; knowledge is derived from information just as information is derived from data.



Boisot and Canals [53] offer a useful conceptual model when considering the relationship between data, information and knowledge. This model is depicted in Figure 12.

People (referred to as agents in the model) are constantly flooded by stimuli from the physical world, but as it is impossible for us to notice it all, we do not register everything as data. From Figure 12 it can be seen that agents then use two kinds of filters when translating this incoming stimuli into information. Only stimuli that pass through the initial filter (perceptual filter) get registered as data. Conceptual filters then obtain information-bearing data from the data that has been registered as such. Information therefore establishes a relation between incoming data and a particular agent. Knowledge is then defined as the agent's expectations (cognitive and affective) that embody the prior interactions between the agent and the world (i.e. the agent's learning). These expectations are modified by the arrival of information, and in turn adjust the perceptual and conceptual filters to act selectively on both stimuli and data.



**Figure 12: Essential relationships between data, information and knowledge [53]**



Boisot and Canals [53] point out that this diagram not only indicates the dynamic relationship between data, information and knowledge, but also allows us to understand data, information and knowledge as different types of economic goods, each with its own value. The value of data lies in the fact that it can convey information about the physical world. This information can then in turn alter our expectation or a state of knowledge, while this knowledge allows us to act upon and adjust in the physical world. They give the examples of telephone books being data goods, specialised newsletters being information goods and brain surgery being a knowledge good.

### 3.1.2 Knowledge dimensions: Tacit versus explicit

We find data in archives or transactions and information in messages, but knowledge “is delivered through structured media such as books and documents, and person-to-person contacts ranging from conversations to apprenticeships” [51].

Although Knowledge Management experts generally refer to the above illustrated dimensions as explicit knowledge and tacit knowledge,<sup>4</sup> there are different approaches as to the exact definition of the tacit dimension.

This section draws on a few perspectives from the literature to describe the definitions that will be used throughout the remainder of the research discussion in this document. Care was taken not to defer from the research scope with a reiteration of previous and current philosophical scholarly arguments regarding tacit knowledge.<sup>5</sup>

#### 3.1.2.1 Explicit knowledge

Explicit knowledge is knowledge that the individual holds clearly and consciously in mental focus [10] and that is structured and retrievable [55].

Ichijo and Nonaka [60] emphasise that explicit knowledge can be codified and is sometimes referred to as ‘know-what’. Explicit knowledge can be expressed in formal and systematic language and can be processed, transmitted and stored relatively easily [46], [56], [61]. Examples of explicit knowledge include scientific formulae, design specifications and manuals.

<sup>4</sup> Gourlay [59] highlights that there are different names used by other disciplines.

<sup>5</sup> The author recommends a recent article by Nonaka and Von Krogh [61], wherein they discuss the main philosophical arguments on tacit knowledge as well as the concept of knowledge conversion, which is addressed in Section 3.3.



### 3.1.2.2 Tacit knowledge

Tacit knowledge includes the rich, complex, gathered expertise that exists in people's heads that is mostly very difficult or impossible to express [55].

Initially, Nonaka [46] defined tacit knowledge as involving both cognitive and technical elements. The cognitive element involves the mental generation and manipulation of analogies that human beings use to build working models (schemata, paradigms, beliefs and viewpoints) in their minds to perceive and define their world. The technical element covers context-specific concrete know-how, crafts and skills.

More recently, however, Nonaka et al. [56] simply refer to tacit knowledge as highly personal, hard to formalise and deeply rooted in action, procedures, routines, commitment, ideals, values and emotions [46], [56].

The following quotations provide concise definitions of explicit and tacit knowledge by Nonaka and Von Krogh [61], clearly illustrating the dynamics of the two dimensions without sacrificing complexity:

*Tacit knowledge covers knowledge that is unarticulated and tied to the senses, movement skills, physical experiences, intuition, or implicit rules of thumb. Knowledge of wine tasting, crafting a violin, or interpreting a complex seismic printout of an oil reservoir are well-known examples of tacit knowledge.*

*Tacit knowledge differs from "explicit knowledge" that is uttered and captured in drawings and writing. For example, knowledge of a solution to a differential equation is explicit knowledge.*

### 3.1.2.3 Explicit and tacit knowledge: A dynamic relationship

The importance of the relationship between explicit and tacit knowledge becomes clear when considering the fact that tacit knowledge forms the required context for allocating the structure to develop and understand explicit knowledge [57] and that explicit knowledge quickly loses its meaning if there is an absence of tacit insight [56].



It is vital to recognise that tacit and explicit knowledge are complementary rather than exclusive and that knowledge can be converted from one form to the other [46], [56], [57].

“It is tacit knowledge or ‘know how’ that puts explicit knowledge to work” [60].

#### **3.1.2.4 Nonaka and his knowledge view**

Onwards from Section 3.1.2, there is a frequent referral to Nonaka’s work as well as to his work in collaboration with colleagues. This is due to the fact that Nonaka’s theory of knowledge creation has “achieved paradigmatic status since the mid-1990s ... and is highly respected” [59], with Choo and Bontis [62] describing it as “one of the best known and most influential models in the knowledge strategy literature”, elaborating that Nonaka’s knowledge creation model “provides the intellectual scaffolding for a growing number of empirical and theoretical studies in strategic knowledge management”.

More than 15 years ago, Nonaka [46] presented ground-breaking premises that shaped the development of organisational knowledge creation theory as it exists today. Gourlay [59] points out that the yearly increase in the number of citations, as well as the range of categories of journals in which this publication has been cited, is indicative of a level of interest that deems his research outputs very important work.

However, issues have since then been raised regarding these premises, and in 2009 Nonaka and Von Krogh [61] presented an extensively researched article on the concepts of tacit knowledge and knowledge conversion, discussing controversies and advancements that have since developed in the organisational knowledge creation theory domain.

This article provides a useful and objective reference for discussing the knowledge conversion topic, which is presented in Section 3.3. However, before this notion of knowledge conversion is discussed, the next section (Section 3.2) provides background and context toward understanding knowledge conversion through a discussion of the basic Knowledge management principles.



## 3.2 Knowledge management

Section 3.1.1 explored the concept of knowledge by making a distinction between data, information and knowledge. Blair [54] agrees that it is important to make this distinction, elaborating that even though we often need data or information to exercise an expertise, the data in itself would not be enough to enable someone else to exercise that same expertise. This is affirmed by Alavi and Leidner [57] and Gray [55], adding that information is only of value when it is actively processed in the mind of an individual, and that this subsequent highly personalised knowledge of an individual or group is only as useful as the extent to which it effectively communicated in a form that is interpretable by the receivers.

Managing this supporting data and information, and most importantly, managing individuals with specific abilities, are core requirements associated with knowledge management [54].

Even though knowledge management is promoted as important for an organisation's competitive advantage [63], and academics and practitioners are slowly beginning to comprehend the nature and role of knowledge, "there is still a lack of clear, unified foundations in knowledge management" [64]. This could be due to the multidisciplinary origin and evolution of this discipline [64], [65]. Darroch [36] suggests that the "dearth of empirical studies in this discipline" could possibly be due to the "tacitness of knowledge" that hinders the identification and measurement of knowledge and knowledge management, or simply because knowledge management is a fairly new discipline. She states that there is insufficient guidance in existing literature toward providing an understanding of the meaning of effective knowledge management as well as its quantifiable outcomes.

Booker et al. [66] highlight that practitioners in general view literature on knowledge management and related subjects as "current, relevant and useful". However, they experience that there is a problem in communicating this scholarly body of knowledge to practice.

Viewing knowledge management within the abovementioned context of a young and emergent field, the principal aim of this section is to discuss principle notions in knowledge management necessary to understand the background and context of the



environment in which knowledge conversion<sup>6</sup> takes place. Section 3.2.1 aims to provide a discourse for defining knowledge management, with Section 3.2.2 presenting pragmatic Knowledge Management principles.

Similar to the aim of Section 3.1, the focus of these two sections are to provide an understanding of the knowledge management-related topics without deferring from the research scope by entangling the reader in a reiteration of previous and current philosophical scholarly arguments.

### **3.2.1 Knowledge management: A working definition**

Gray [55] states that knowledge management is best understood as the managerial practices associated with knowledge.

Even though this may seem as an oversimplified definition of knowledge management, the diverse literary discourse on the concepts of knowledge and the management thereof makes it difficult to provide a clear-cut and neutral definition for knowledge management.

#### **3.2.1.1 Different views of knowledge management**

Small and Sage [58] distinguish between two views of knowledge management. One approach focuses on knowledge resources to facilitate access and the reuse of existing explicit knowledge using almost only information technology tools. The other approach is of knowledge management as a multidisciplinary subject that focuses on “the context and environment for knowledge acquisition, representation, transformation, sharing, and use” through behavioural as well as technology management.

Alavi and Leidner [57] suggest that diverse interpretations of knowledge results in diverse approaches to knowledge management, with each view advocating a different strategy for managing the knowledge. If knowledge is viewed as an object, knowledge management should concentrate efforts on developing and managing knowledge as a physical asset, as ‘knowledge stocks’. Knowledge viewed as a process necessitates that knowledge management emphasises knowledge flow and the processes of creation, sharing and distribution of knowledge. The view of knowledge as a capability

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<sup>6</sup> The concept of knowledge conversion was introduced in Section 3.1.2.3 in the discussion of the dynamic relationship between tacit and explicit knowledge and forms the topic of discussion in Section 3.3.



suggests a knowledge management outlook aimed at fostering core competencies, recognising the strategic value of know-how and generating intellectual capital.

### 3.2.1.2 Defining knowledge management

Du Plessis [40] argues that knowledge management must be aligned with business strategy to consequently enhance an organisation's capability, tempo and effectiveness to deliver products or services through the planned and structured management of the "creation, sharing, harvesting and leveraging of knowledge as an organizational asset".

Swan et al. [47] agree, defining knowledge management as including any processes and practices oriented at the "creation, acquisition, capture, sharing and use of knowledge, skills and expertise". Similarly, knowledge management can be defined through four important activities: "creating knowledge, sharing knowledge, protecting knowledge, and discarding (obsolete) knowledge" [60].

Gray [55] writes that knowledge management is the process for "acquiring, organizing, and communicating" the explicit as well as tacit knowledge in an organisation in order to improve the productivity of the users of the knowledge. Numprasertchai and Igel [67] affirm the idea of improved productivity and efficiency, proposing that this is done through "steering of strategy, identifying and communicating explicit knowledge to tacit knowledge and transferring tacit knowledge that resides in processes, people, products and services".

It is often viewed as the responsibility of knowledge management to provide access to the "right knowledge in the right place at the right time" and to identify "who has knowledge" and, equally important, "who needs knowledge" [38].

### 3.2.2 Knowledge Management principles

Even though knowledge resides within people, knowledge management should reach beyond the individual level to incorporate management on a team as well as an organisational level by means of a "holistic solution" that includes diverse and equally important "people, process, culture and technology" approaches [40].

The introduction of Section 3.2 as well as the discussion of a working definition for knowledge management (Section 3.2.1) highlighted the lack of a sound theoretical





foundation within the knowledge management field. Within this context, this section aims to explore pragmatic knowledge management principles.

The reader is reminded that the purpose of Section 3.2 is to establish a background and context for a discussion of knowledge conversion in Section 3.3, as pre-empted at the end of Section 3.1.2.3 in the discussion of the dynamic relationship between explicit and tacit knowledge.

### **3.2.2.1 Successful knowledge management: Expected outcomes**

Davenport and Prusak [51] point to the benefits of establishing a knowledge culture. They include better corporate alignment and unity, improved innovation through sharing, higher staff morale, increased responsiveness, decreased cycle times, reduced costs and a rise in customer satisfaction.

Successful knowledge management stimulates the development of creative skills, increases individual commitment, supports employees to systematically outline task objectives in a network that enables them to share knowledge with others, assists employees in gaging their resource requirements and offers a platform for asking questions and providing innovative solutions [34].

The value of knowledge management lies in providing a candid perception of the organisation's potentials and shortcomings regarding knowledge, with employees better motivated as knowledge workers in an environment that is established as a learning organisation with the increased ability to compete with the guarantee of long-term survival [44].

### **3.2.2.2 Successful knowledge management: Key enablers**

Davenport and Prusak [51] discuss the need for management to recognise that knowledge is creative and originates and exists within people, and state that employees should therefore be encouraged to develop and share knowledge and should be rewarded for doing so. A culture of trust as well as a structured knowledge repository is needed and new knowledge behaviours can be initiated through an effective technical and organisational infrastructure. Another important issue is the relationship between knowledge management and a human resource department, which policies and practices must assist in developing a successful knowledge management culture.



Knowledge initiatives should be executed through a pilot programme that requires management's support and resources, and measures are needed to evaluate these initiatives [51]. Extensive research was done to understand the different types of knowledge initiatives, notably by De Long et al. [68] as well as by Ruggles [33], the result of which is consolidated here and indicates that organisations should conduct specific projects aimed at improving performance in one or more of the following areas:

- Generating, capturing and reusing accessible knowledge
- Capturing and sharing lessons learned from practice
- Identifying sources and networks of expertise
- Structuring and mapping knowledge needed to enhance performance
- Measuring and managing the economic value and/or impact of knowledge
- Accessing, synthesising and sharing knowledge from external sources
- Embedding knowledge in processes, products and/or services
- Facilitating knowledge growth through culture and incentives

Closely related to these initiatives are the six key knowledge management issues confronting the modern enterprise: “developing a working definition of knowledge, dealing with tacit knowledge and utilization of information technology, adaptation to cultural complexity, attention to human resources, developing new organizational structures, and coping with increased competition”, as identified by Kalkan [69] through a recent comprehensive literature review.

These six issues correspond to the “eleven deadliest sins” of knowledge management as identified by Fahey and Prusak [70], who argue that organisations have to constantly take part in critical and honest self-reflection about the following (additional) factors: that knowledge should not be emphasised as a stock to the detriment of knowledge flow, that knowledge cannot be separated from its uses and context, and that technology can seldom be a complete substitute for the human interface.

### **3.2.2.3 Knowledge management and knowledge conversion**

Knowledge management has been described throughout Section 3.2 as the “acquisition”, “representation”, “transformation”, “sharing”, “use” and “re-use”, “creation”, “harvesting”, “leveraging”, “capturing”, “organising”, “communicating”,



“transferring”, “generating”, “identifying”, “structuring”, “accessing”, “synthesising” and “growth” of knowledge.

As illustrated here, a unifying theme of knowledge conversion can be identified throughout the literature on knowledge management which, in combination with the discussion of the dynamic relationship between explicit and tacit knowledge in Section 3.1.2.3, form the background and context for the discussion in Section 3.3.

### 3.3 Knowledge conversion

Knowledge creation has been defined from several perspectives that can broadly be categorised into two views: a “stock” and a “process” view<sup>7</sup> [55], [71]. The stock view suggests that knowledge creation contributes to a “corporate knowledge stock” and assumes that a tangible measurable performance function is available [71], and like physical assets, the current knowledge stock depreciates as some knowledge becomes redundant or declines in importance [55]. The process view defines knowledge creation as “dynamic, interactive and process-oriented, as well as being focused on the relationships that are involved in creating new knowledge” [71].

Based on Samaddar and Kadiyala’s [71] argument that the process view “compliments and extends” the stock view of knowledge, Section 3.3 and subsequent sections focus on the process view, rather than the stock view, of knowledge creation.

Before delving any further into the literature on the topic of knowledge creation, Section 3.3.1 addresses the literary discourse on Nonaka’s knowledge creation theory. His knowledge creation processes are then discussed in Section 3.3.2 in an attempt to provide the reader with a clear picture of what is meant by the concept of knowledge creation.

As with the discussion in Section 3.1.2 of the explicit and tacit knowledge dimensions, the reader is reminded that the aim is to provide an objective exploration without deferring from the research scope by reiterating the philosophical scholarly arguments of the organisational knowledge creation theory domain.

<sup>7</sup> This notion is also supported by the discussion of a working definition for knowledge management, specifically in Section 3.2.1.1.



### 3.3.1 Knowledge conversion and Nonaka: Addressing the discourse

*[...] the success of organizations depends largely on how effectively and efficiently they can perform processes, such as the identification, acquisition, development, utilization, transfer, and validation of knowledge [67]*

Martensson [63] points out that most literature that view knowledge as a process corresponds to a model or theory of knowledge management that comprises individual yet related stages or phases. Knowledge is firstly acquired before it is entered, organised and stored in a system. Stored knowledge is then made accessible and distributed timeously into the hands of the right users, with the goal of utilising and sharing it through socialisation or exchange in digital or analogue form.

One of the best-known and most influential models that view knowledge as a process is Nonaka's knowledge creation theory (as previously discussed in Section 3.1.2.4). As with most prevalent scholars and academics, his work has attracted some criticism, the basis of which is discussed in Section 3.3.1.1, before Section 3.3.1.2 argues the inclusion of this knowledge view in this research study.

#### 3.3.1.1 Nonaka and organisational knowledge creation: Necessary background information

Nonaka and Von Krogh [61] define organisational knowledge creation as "the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it to an organization's knowledge system", while emphasising that knowledge creation is a significant result of knowledge management in organisations.

In 1994, Nonaka [46] presented the following two premises that shaped the development of organisational knowledge creation theory:

1. "[T]acit and explicit knowledge can be conceptually distinguished along a continuum"
2. "[K]nowledge conversion explains, theoretically and empirically, the interaction between tacit and explicit knowledge"

However, issues have since been raised regarding these premises, and notable critique against Nonaka's theory of knowledge creation has recently been summarised



in an article by Gourlay [59]. Nonaka and Von Krogh [61] address these and other issues in their recent article on the concepts of tacit knowledge and knowledge conversion as well as the controversies and advancements that have developed in the organisational knowledge creation theory domain.

The article is marked by extensive literature reference, providing a platform for thorough examination of the following issues:

1. Questioning whether explicit and tacit knowledge fall along a continuum and whether this explicit/tacit distinction along the continuum is valuable to organisation science.
2. Questioning the conceptual basis for knowledge conversion and the applicability of the concept of knowledge conversion given the relationship between tacit knowledge and social practices, as well as the outcome of knowledge conversion.

Although the scope of this study does not allow for a reiteration of all critique presented in the past 15 years since the publication of Nonaka's knowledge creation theory, it is reassuring to note that after intense scrutiny, Nonaka and Von Krogh [61] conclude by proposing to maintain the two premises in organisational knowledge creation theory, as "they serve theory building and empirical research on creativity, change, innovation, and learning in organization science".

They however recognise a significant scope to investigate the relationships between social practices and organisational knowledge creation, the contribution of social practises to the conservation of existing tacit knowledge as well as the role of organisational leadership.

### **3.3.1.2 Nonaka: Addressing the applicability to this study**

The author of this thesis acknowledges the literary discourse on Nonaka's knowledge creation theory and has weighed the significance of this critique against this research study's scope.

As discussed in Section 3.1.2.4 and the beginning of Section 3.3.1.1, Nonaka's work as well as his collaborations with colleagues is widely known and highly respected in academic circles. Furthermore, the criticism against his work is on a level of detail that does not impact the relevance of his theory for this study.



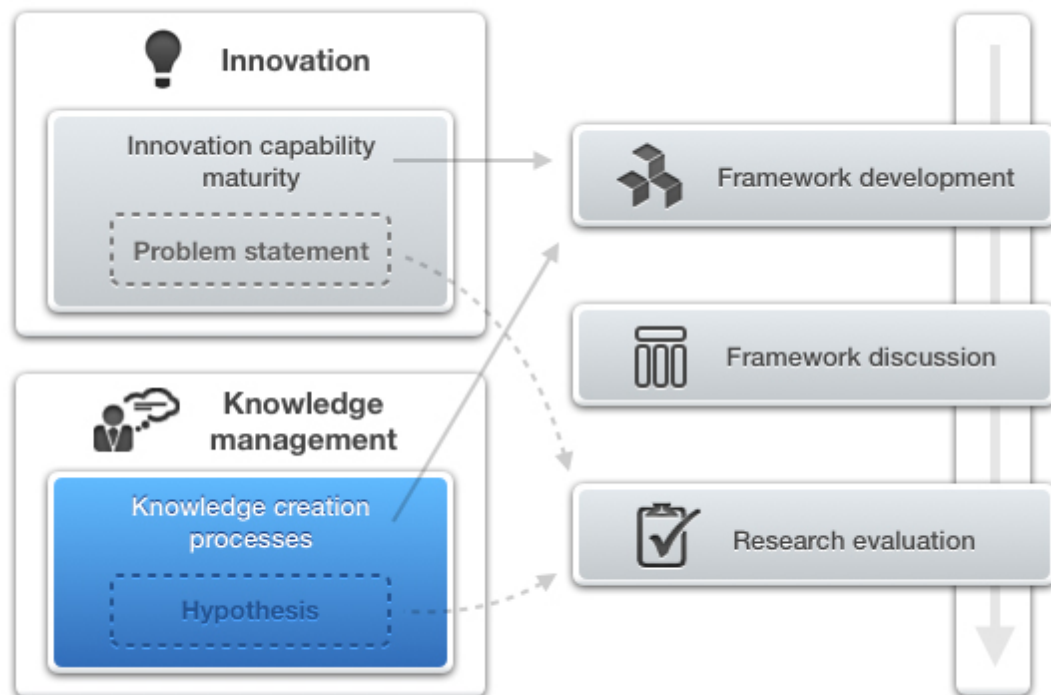
For the above-stated reasons, Nonaka’s knowledge creation theory, more specifically his definition of the knowledge creation processes, forms the basis of the discussion of knowledge creation for the remainder of this document. However, consistent reference is made to any specific critique that might influence the accuracy and applicability of this study.

### 3.3.2 Nonaka: A knowledge creation model

*Knowledge is created through interactions between tacit and explicit knowledge, rather than from tacit or explicit knowledge alone [56]*

As previously stated (in Section 3.1.2.3), it is vital to recognise that tacit and explicit knowledge are complementary rather than exclusive and that knowledge can be converted from one form to the other with both dimensions essential to knowledge creation.

This section (refer to Figure 13) discusses the knowledge creation processes within the context of the definitions of knowledge (Section 3.1.1), the explicit/tacit knowledge dimensions (Section 3.1.2) and knowledge management (Section 3.2).



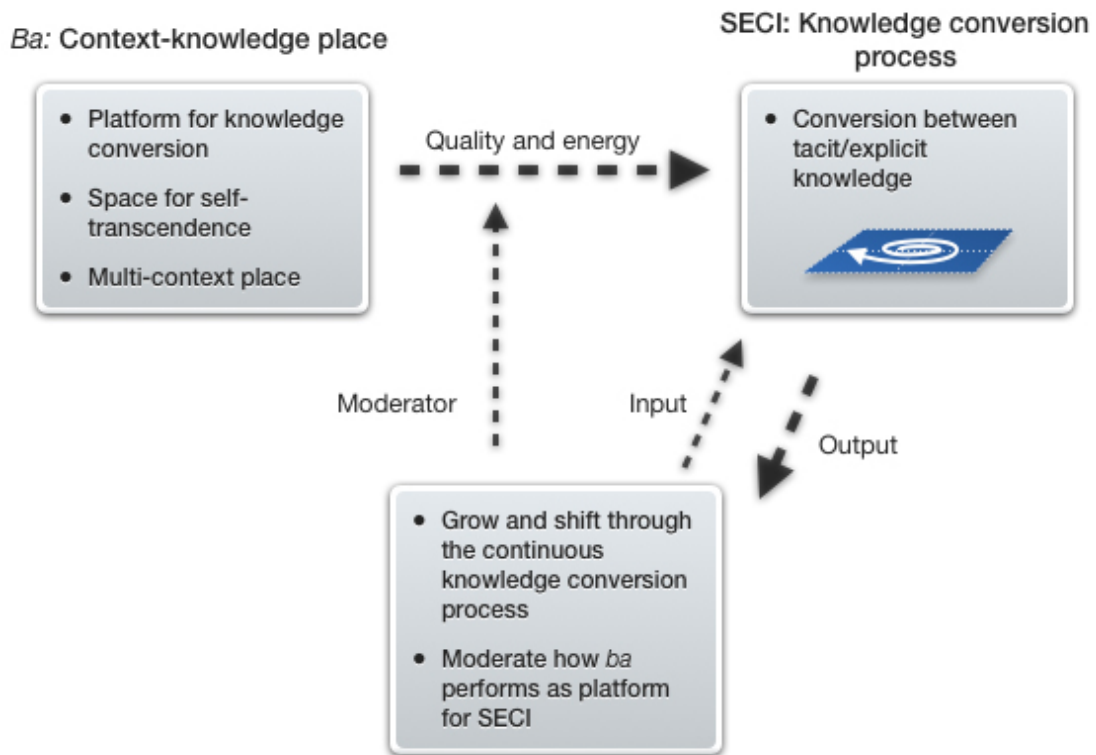
**Figure 13: Research outline: Knowledge creation processes**



Nonaka’s knowledge creation model, as it is presented in the article “SECI, Ba and leadership: A unified model of dynamic knowledge creation” by Nonaka et al. [56] forms the basis for this discussion. Consistent reference is made to any perspectives that are not represented in this specific article.

**3.3.2.1 The knowledge creation model: An overview**

Nonaka’s knowledge creation model relates how organisations, rather than individuals, create knowledge. The model comprises of three elements that have to interact dynamically to form the knowledge spiral that creates knowledge. A concise summary of these three elements as well as their interaction is presented below (also refer to Figure 14). The aim is to provide a pragmatic mental picture without losing the importance and context of interaction between the elements through oversimplification.



**Figure 14: The three elements of the knowledge creation process [56]**



**i. The SECI model**

The SECI model uses socialisation, externalisation, combination and internalisation processes of creating knowledge through conversion between tacit and explicit knowledge (described in Section 3.3.2.2).

**ii. “Ba”: The shared context needed to create knowledge**

*Ba* represents a place where information is interpreted to become knowledge, but it does not necessarily mean a physical space; it can be an office space, a virtual space such as e-mail or a mental space such as shared ideals. *Ba* is the context shared by those who interact with each other, so that those who interact and participate in *ba*, as well as the context itself, evolve through self-transcendence to create knowledge. *Ba* provides the energy, quality and place to perform the individual conversions and to move along the knowledge spiral.

**iii. Knowledge assets: The input, output, and moderating factors**

The role of knowledge assets in the knowledge creation process is best illustrated as follows: While trust among organisational members is created as an output of the knowledge creation process, it also moderates how *ba* functions as a platform for the knowledge creation process. There are four types of knowledge assets: experiential knowledge assets (shared tacit knowledge built through interaction, e.g. skills, know-how), conceptual knowledge assets (explicit knowledge articulated through images, symbols and language), systemic knowledge assets (systematised explicit knowledge, e.g. technologies, product specifications, manuals) and routine knowledge assets (tacit knowledge that is routinised and embedded in actions and practices of the organisation, e.g. know-how, organisational culture and organisational routines).

Choo and Bontis [62] point out that the most widely cited aspect of the model is the continuously expanding cycle of four processes that create knowledge by converting tacit knowledge into explicit knowledge (the socialisation-externalisation-combination-internalisation or SECI model). These processes are discussed in more detail in the following section (Section 3.3.2.2).





### 3.3.2.2 Knowledge creation processes

As mentioned previously, an organisation creates knowledge through the interactions between explicit knowledge and tacit knowledge. Explicit and tacit knowledge grow in both quality and quantity during this process of knowledge conversion. As discussed below, the four modes of knowledge conversion are socialisation, externalisation, combination and internalisation (refer to Figure 15):

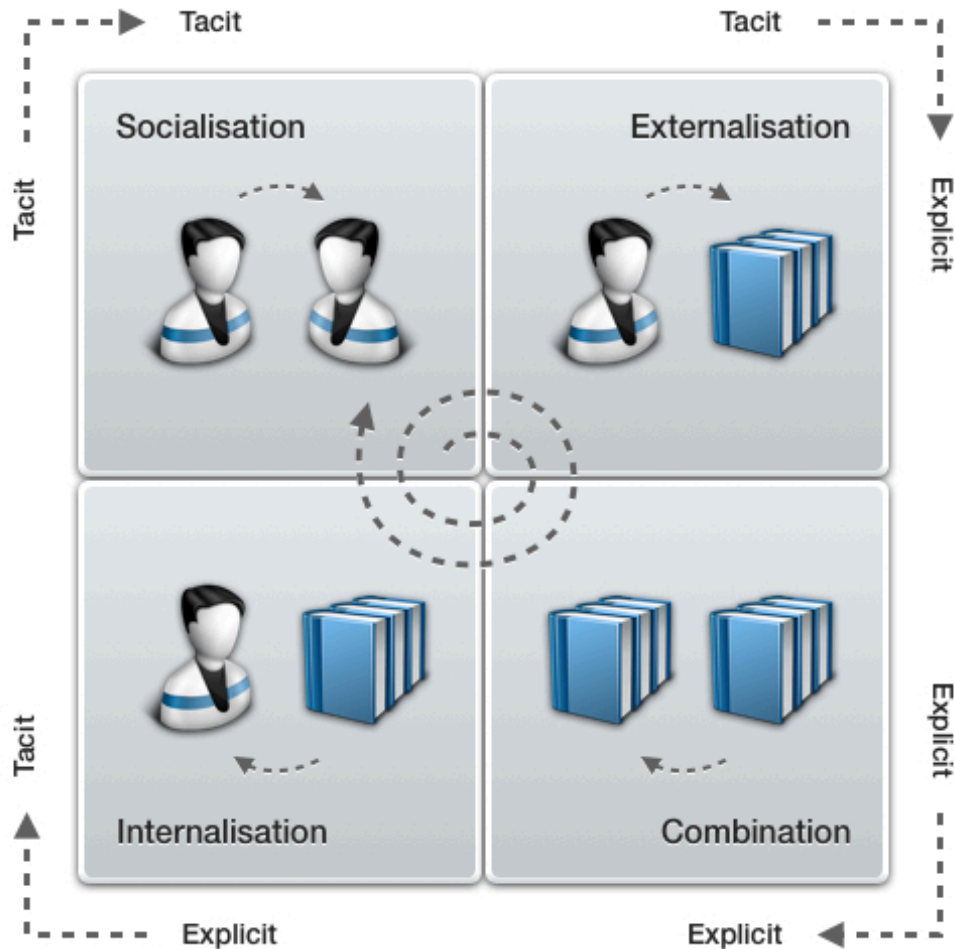


Figure 15: The SECI process [56]

i. **Socialisation**

Tacit to tacit knowledge transfer is referred to as socialisation. Since tacit knowledge is difficult to formalise and often time- and space-specific, tacit knowledge is acquired and converted only through shared experience. Socialisation typically occurs when sharing the same environment. Examples include a traditional apprenticeship (apprentices learning the tacit knowledge needed in their craft through hands-on experience, rather than



from written manuals or textbooks) and informal social meetings outside of the workplace (creating and sharing world views, mental models and mutual trust). It also occurs beyond organisational boundaries (acquiring and taking advantage of the tacit knowledge embedded in customers or suppliers).

**ii. Externalisation**

Explicit to tacit knowledge transfer is referred to as externalisation. Knowledge is formed when tacit knowledge is articulated into explicit knowledge. This allows it to be shared by others, and it then becomes the basis of new knowledge. Tacit knowledge becomes explicit through metaphors, analogies, concepts, hypotheses or models. An example of externalisation is a quality-control circle that allows employees to make improvements on the manufacturing process by articulating the tacit knowledge of the enterprise accumulated over years on the job.

**iii. Combination**

Transferring explicit knowledge to more complex and systematic sets of explicit knowledge is referred to as combination. Explicit knowledge is gathered internally in or external to the organisation and then combined, edited or processed to form new knowledge, which is then disseminated among the members of the organisation. This process can be supported through the creative use of computerised communication networks and large-scale databases. Examples of the combination process are collecting and contextualising organisation-wide information to form a financial report, or breaking down a corporate vision into operationalised business or product concepts, where the financial report and operationalised business or product concepts represent new explicit knowledge.

**iv. Internalisation**

Explicit to tacit knowledge transfer is referred to as internalisation, which is closely related to 'learning by doing'. Created explicit knowledge is shared throughout an organisation and converted into tacit knowledge by individuals as they embody it. Explicit knowledge has to be actualised through action and practice; for example, by reading documents or manuals about their jobs and the organisation and by reacting upon them, trainees can internalise the explicit knowledge written in such documents to enrich



their tacit knowledge base. Explicit knowledge can be also embodied through simulations or experiments that trigger learning by doing.

Knowledge becomes a valuable asset when it is internalised and becomes part of an individual's tacit knowledge base in the form of shared mental models or technical know-how. This tacit knowledge can then set off a new spiral of knowledge creation when the individual shares it with others through socialisation.

Nonaka and Toyama [72] emphasise that the interaction between tacit and explicit knowledge is amplified through the four knowledge creation processes and forms a spiral, not a circle. This spiral becomes larger in scale as it moves up the ontological levels (from individual to group to organisation to inter-organisation). Knowledge created through the SECI process can also trigger a new spiral of knowledge creation. The spiral therefore expands horizontally and vertically through communities of interaction that span across all boundaries, as “knowledge created by the organization can trigger the mobilization of knowledge held by outside constituents such as consumers, affiliated companies, universities, or distributors” [72].

### 3.4 Research hypothesis

This section provides a brief account of the research theme outline as it progressed to this section, and consequently presents a discussion leading to the research hypothesis (refer to Figure 16).

As summarised in the conclusion of Chapter 2, an organisation has to innovate on a constant and sustained basis to remain competitive in today's volatile business environment; it has to mature and grow its innovation capability. In order to do so, innovation capability improvement plan guidelines are needed to support the management of innovation capabilities toward innovation capability maturity growth.

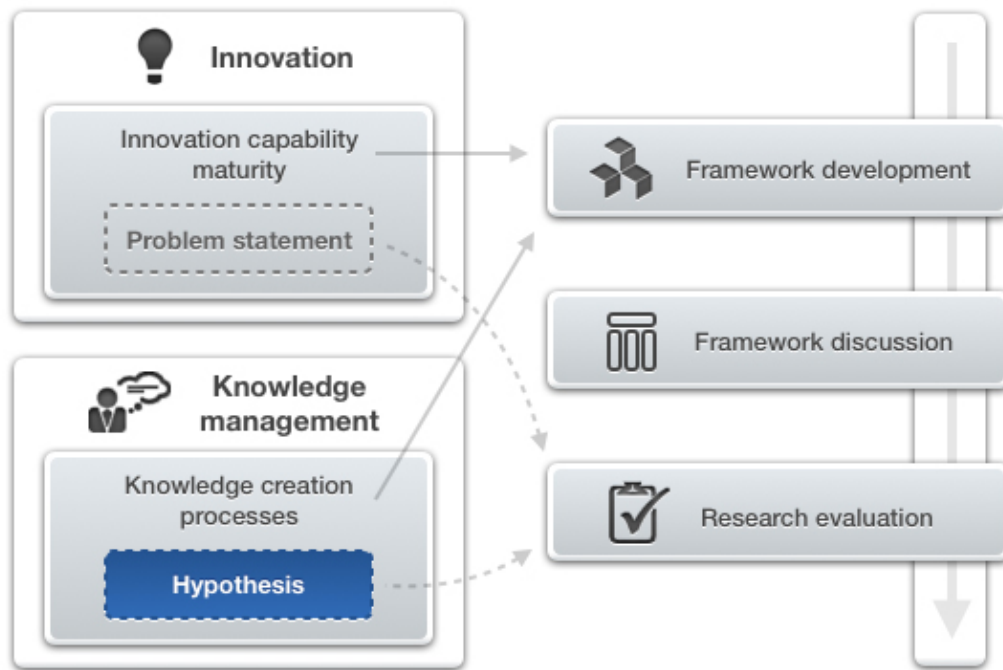
The author's research interest lies in investigating organisational support by means of business tools toward guidelines that enable maturity growth in these innovation capability areas. There is a gap in the literature regarding formalised guidelines for the use of business tools to enable innovation capability maturity growth. As knowledge management plays such a fundamental role in the enterprise's ability to innovate successfully, the following question arises: Can knowledge management tools and



organisational facilitating conditions be used to enable innovation capability maturity growth?

As existing literature on the subject is sparse, the research problem statement reads as follows:

*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*



**Figure 16: Research outline: Hypothesis**

Knowledge management plays a fundamental role in innovation (as discussed in Section 2.2.4). Knowledge conversion and knowledge creation emerge as central themes in knowledge management (as highlighted in Section 3.2.2.3), with knowledge creation processes lying at the core of knowledge creation theory (as discussed in Section 3.3.2.2).

The literature therefore provides a strong basis from which to argue that the concept of knowledge creation processes could be utilised when investigating knowledge management guidelines to improve innovation capability maturity. What does this imply from a practical point of view?



When the innovation capability maturity of an enterprise is evaluated, the enterprise is benchmarked against the requirements of the maturity level description of each innovation capability and is assigned the appropriate level (refer to Section 2.2.3.1). Consequently, this enterprise has then grown in its innovation capability maturity when it is again benchmarked against the requirements of each maturity level, and it is determined that the innovation-related activities of the enterprise has improved to such an extent that it is now benchmarked against a higher maturity level description.

To grow innovation capability maturity is then, in practice, synonymous with an enterprise improving its innovation-related activities to such an extent that it is now benchmarked against a higher maturity level description. How can knowledge creation processes be used to enable the enterprise to improve its innovation-related activities in such a way as to move from one maturity level description to a higher maturity level description?

An answer to this question depends on an understanding of the key knowledge-related needs when moving upwards between maturity levels or, approaching it from a different angle: What are the key knowledge actions (and therefore the key knowledge creation processes) that enable innovation capability growth from one maturity level to the next?

This notion provides the platform for the work presented in the rest of this thesis, with the following hypothesis driving further research:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

### 3.5 Summary

Chapter 2 studied the innovation landscape, identifying the need to mature and grow an organisation's innovation capability maturity. Knowledge management plays such a fundamental role in the enterprise's ability to innovate successfully, and the question arises whether knowledge management tools and organisational facilitating conditions can be used to enable innovation capability maturity growth. There is a gap in existing literature on the subject, and accordingly, the research problem statement reads as follows:



*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*

Within this context, Chapter 3 explored the knowledge management landscape with the aim of systematically leading up to the hypothesis that correlates to the above research problem statement.

The concept of knowledge was discussed by distinguishing it from data and information, as well as describing its explicit/tacit dimensions, where specific reference was made to Nonaka's knowledge view. Consequently, the concept of knowledge management was described by exploring its definition and reviewing pragmatic knowledge management principles. Knowledge conversion emerged as a central theme in this discussion of knowledge management, and this topic was presented by firstly addressing the literary discourse on Nonaka's knowledge creation theory and thereafter providing a concise summary of his knowledge creation model.

Specifically, the knowledge creation processes of socialisation, externalisation, combination and internalisation were described, as they form a prolific element of this knowledge creation model. These knowledge creation processes form the core of the knowledge conversion model and the concept of knowledge conversion as a central theme in knowledge management. A possible answer to the above-stated problem statement could be to investigate the use of knowledge creation processes to grow innovation capability maturity. This idea forms the basis of the work presented in this research study, with the following hypothesis driving further research:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

Chapter 4 presents the reasoning and development process behind the knowledge management framework to grow innovation capability maturity, followed by an illustration of the impact of the knowledge management framework on the growth of innovation capability maturity by describing the framework in the context of a practical organisational scenario.

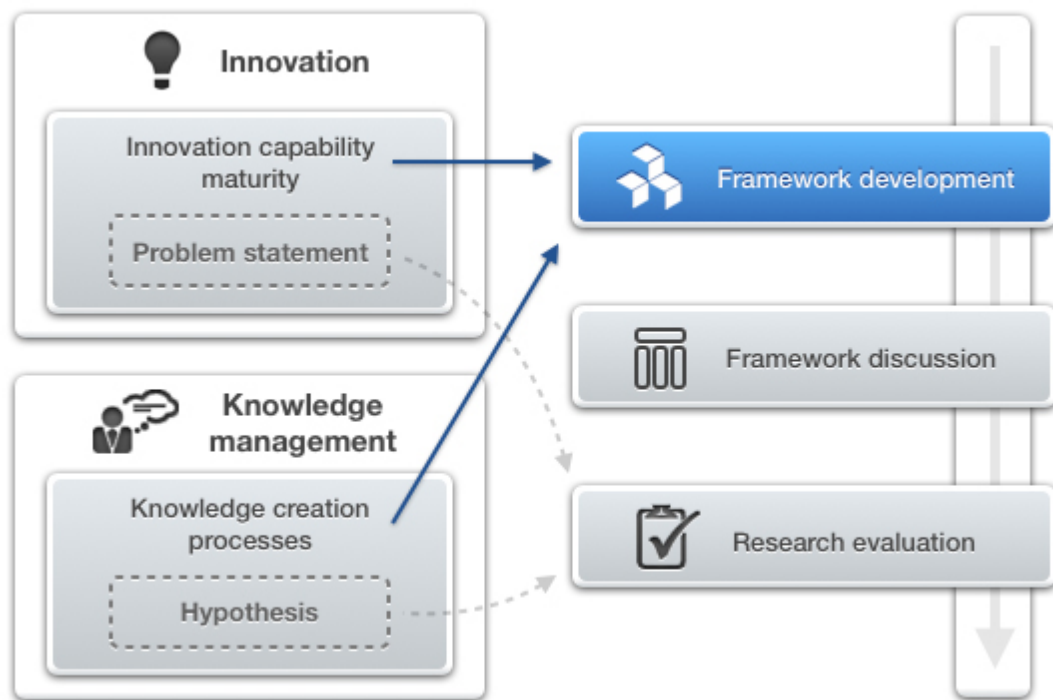


## Chapter 4

## Framework



With chapters 2 and 3 providing the necessary research background and context (refer to Section 3.5 for a concise summary), this chapter discusses the logic and development process behind building a knowledge management framework to grow innovation capability maturity (refer to Figure 17).



**Figure 17: Research outline: Framework development**

Section 4.1 derives the fundamentals of the framework through independent reasoning by the author, while Section 4.2 discusses a detailed expansion of these fundamentals through a literature study. The chapter concludes with an illustration of the impact of the knowledge management framework on the growth of innovation capability maturity by describing the framework guidelines in the context of a practical organisational scenario (Section 4.3).

## 4.1 Framework development: Deriving the fundamentals

Knowledge management plays a fundamental role in innovation (Chapter 2), leading to the question of whether knowledge management can also be used to grow innovation





capability maturity. The literary exploration done in Chapter 3 concluded that knowledge conversion emerges as a central theme in knowledge management, with knowledge creation processes in turn lying at the core of knowledge creation theory.

The literature therefore provides a strong basis for the argument that knowledge management and more specifically knowledge creation processes could be used to improve an enterprise's innovation capability maturity. Consequently, the following hypothesis (derived in Section 3.4) suggests a platform for investigating the use of knowledge creation processes to grow innovation capability maturity:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

#### **4.1.1 Knowledge creation processes: Alignment**

Growing innovation capability maturity is, in practice, synonymous with an enterprise improving its innovation-related activities to such an extent that it is now benchmarked against a higher maturity level description (as discussed in Section 3.4). How can knowledge creation processes be used to enable the enterprise to improve its innovation-related activities in such a way as to move from one maturity level description to a higher maturity level description?

An answer to this question depends on an understanding of the key knowledge-related needs when moving upwards between maturity levels. Approaching the question from a different angle: What are the key knowledge actions (and therefore the key knowledge creation processes) that enable innovation capability maturity growth from one level to the next? (Refer to Figure 18.)



**Figure 18: Key knowledge creation processes to enable growth?**

#### 4.1.1.1 Growing from maturity level 1 to 3: Key knowledge creation processes

Considering the ICMM innovation capability maturity descriptions in Figure 18 (first presented in Section 2.2.3.1), the knowledge creation process that acts as a key enabler for innovation capability maturity growth between maturity level 1 and maturity level 3 was identified through the following reasoning:

In order to grow from maturity level 1 to maturity level 3, the enterprise needs to improve its innovation-related activities from a state where these activities are mostly ad hoc and informal to a state where they have been formalised into best practices and procedures.



What are the key knowledge actions (and therefore the key knowledge creation processes) that are needed to move from a state where activities are ad hoc to a state where activities are formalised?

The key knowledge action that will facilitate this growth is that the enterprise is able to 'define' its innovation-related activities. Here the key knowledge creation process is externalisation; making tacit knowledge regarding innovation-related activities that reside in the heads of workers tangible (explicit).

#### **4.1.1.2 Growing from maturity level 3 to 5: Key knowledge creation processes**

Similarly, considering the ICMM innovation capability maturity descriptions in Figure 18 (as presented in Section 2.2.3.1), the knowledge creation process(es) that acts as a key enabler for innovation capability maturity growth between maturity level 3 and maturity level 5 was identified through the following reasoning:

In order to grow from maturity level 3 to maturity level 5, the enterprise needs to improve its innovation-related activities from a state where the ad hoc innovation-related activities have been formalised into best practices and procedures (the tacit knowledge that resides in the heads of workers have been made tangible) to a state where these formalised activities have been institutionalised.

What are the key knowledge actions (and therefore the key knowledge creation processes) that are needed to move from a state where activities are formalised to a state where activities are institutionalised?

The key knowledge actions without which growth to the next maturity level is impossible are to encourage workers to 'learn' in order to institutionalise those best practices and procedures that have been formalised. Here the key knowledge creation process is internalisation; encouraging workers to embody the formalised explicit knowledge in their daily (innovation-related) activities.

Simultaneously, it is of equal importance to continuously 'rework' the current formalised innovation-related best practices and procedures in order to keep them aligned with the enterprises strategy and current operational requirements. Here the key knowledge creation process is combination; revising formalised explicit knowledge toward new explicit knowledge.



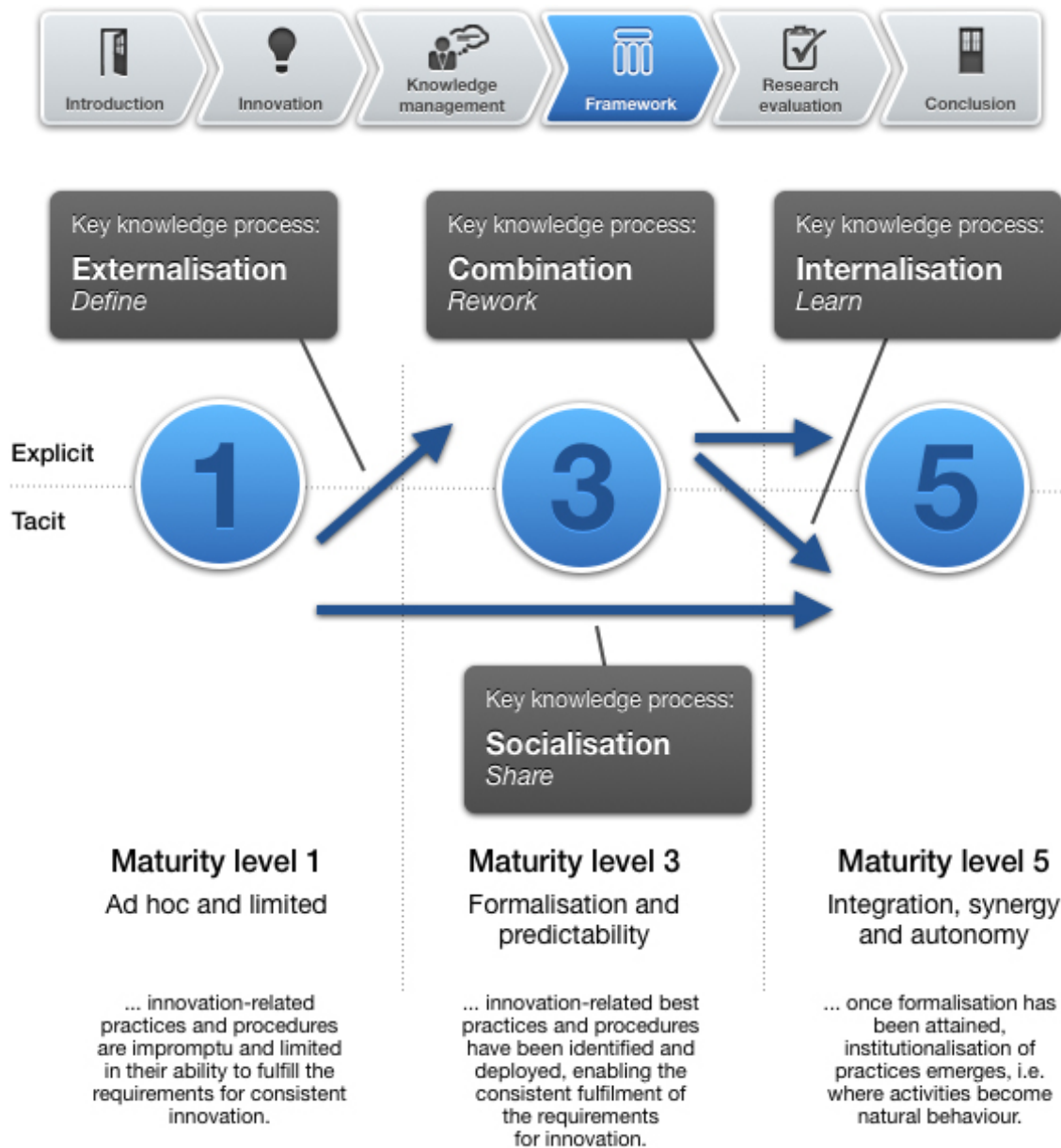
#### **4.1.1.3 Growing from maturity level 1 through to 5: The people component**

As identified in Section 4.1.1.1, growing from innovation capability maturity level 1 to maturity level 3 necessitates the knowledge creation process of externalisation, and growing from innovation capability maturity level 3 to maturity level 5 necessitates the processes of internalisation and combination (Section 4.1.1.2).

A central theme emerges when considering the practical implications of these above-identified knowledge actions: the importance of the people component. Externalisation requires employees to convey their tacit knowledge to make it explicit, combination requires the reworking of explicit knowledge into new explicit knowledge (although mostly through the use of technology, never independent of human intervention), and internalisation requires that employees embody knowledge in their daily activities.

As the people component is a crucial element without which externalisation, combination and internalisation would be impossible, the underlying process supporting innovation capability maturity growth from maturity level 1 through to 5 is the need to facilitate 'sharing' through enabling tacit to tacit knowledge transfer through socialisation.

Identifying this knowledge creation path (as depicted in Figure 19) that acts as a key enabler for maturity growth from maturity level 1 through to maturity level 5 forms the cornerstone of the research done toward a knowledge management framework to grow innovation capability maturity (hereafter simply referred to as "the framework").



**Figure 19: Key knowledge creation path enabling innovation capability maturity growth**

With this knowledge creation path as a foundation, Section 4.2 presents a discussion of the development of the rest of the framework.

## 4.2 Framework development: Filling in the blanks

In Section 4.1 the author, through independent reasoning, made a tangible link between the fields of knowledge management and innovation capability maturity by identifying a knowledge creation path that acts as a key enabler for maturity growth (as depicted in Figure 19). Subsequently, this section presents a discussion of the development of the rest of the framework, guided by a literature study.



Firstly, Section 4.2.1 provides background information on how the supporting literature study was conducted. The section also presents the overall structure of the framework. Thereafter, Section 4.2.2 discusses the knowledge management tool requirements and organisational facilitating conditions that support the specific knowledge creation processes highlighted in the identified knowledge creation path. Section 4.3 presents the framework as well as an illustration of its intended impact by describing the framework guidelines in the context of a practical organisational scenario.

Throughout this document, knowledge management tools refer to ICT tools or organisational tools that provide the basis for a knowledge management infrastructure that supports the knowledge creation processes, while organisational facilitating conditions refer to the environment in which the knowledge creation processes take place.

## **4.2.1 Background discussion: Literature study method and framework structure**

The author's emphasis was on researching generic knowledge management tool requirements and facilitating conditions, rather than specific tools, as this would ensure that the research remains applicable and relevant for a period of time surpassing the ever-changing technology-development landscape and would enable utilisation across a wider range of organisational domains.

### **4.2.1.1 Literature study method**

The aim of this literature study was to determine generic knowledge management requirements, independent of organisational domain, knowledge management school of thought or time of publication.

It is important to note, as discussed in Section 3.2, that there is lack of clear, unified foundations in knowledge management, with insufficient guidance in the existing literature toward providing an understanding of the meaning of effective knowledge management as well as its quantifiable outcomes [36], [64].

Within this context, the literature study was conducted with a focus on supporting a discussion of the underlying logic and practical implications of knowledge creation processes, by thoroughly referencing from studied academic works.



These academic works were obtained through an internet search engine and electronic database search using the following keywords: “knowledge management”, “organisational knowledge creation”, “tacit”, “implicit”,<sup>8</sup> “explicit”, “knowledge creation”, “knowledge transfer”, “knowledge conversion”, “knowledge creation processes”, “knowledge transfer processes” and “knowledge conversion processes”.

When sifting through the myriad of knowledge management-related documents available to date, the use of automatic ‘text-mining tools’ such as topic modelling were ruled out in favour of a manual study by the author, as an inherent level of subjective understanding is needed to judge the applicability of the specific document to this study, with the aim of achieving the goal of broad applicability stated above.

Documents were chosen on the basis of their ability to directly or indirectly provide requirements for, or fundamental factors to consider when, managing knowledge. Here the specific focus was on managing or facilitating the knowledge creation that takes place in the processes of socialisation, externalisation, combination and internalisation. Document selection was also guided by (although not restricted by) author prominence in the field. This was done by referring to knowledge management review articles, such as those done by Alavi and Leidner [57], Small and Sage [58], Nonaka and Peltokorpi [64] and Prusak [65], as well as distinction on the basis of the number of citations.

#### **4.2.1.2 Framework structure**

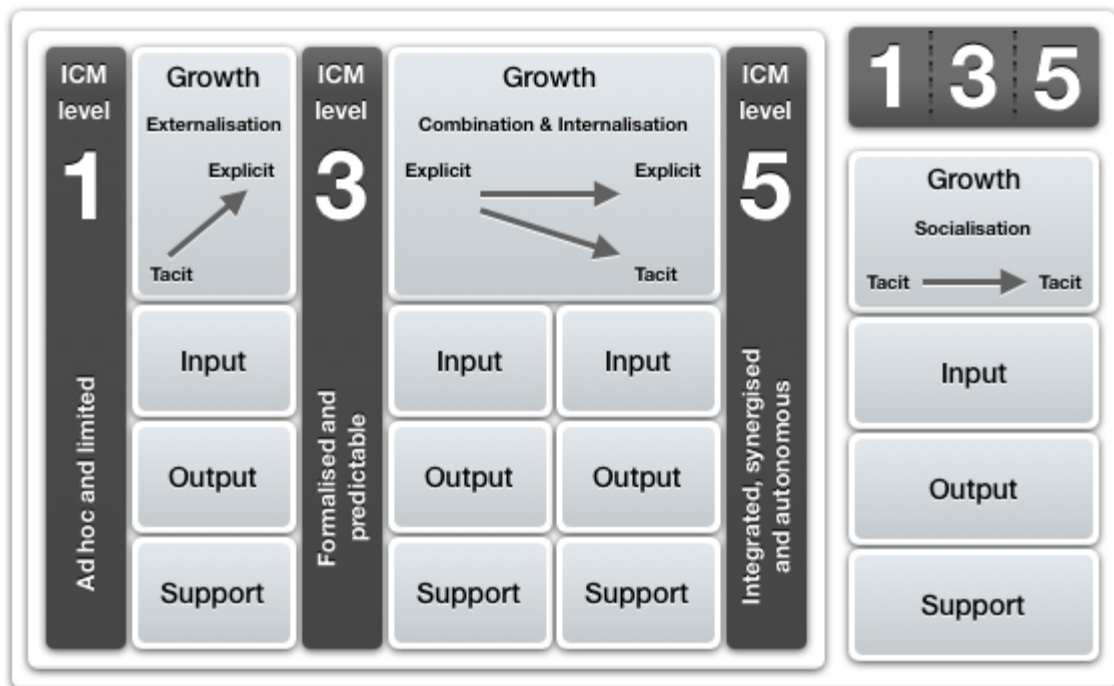
A descriptive and practical approach to the concept of knowledge creation processes, especially with the aim of understanding the underlying logic and practical implications thereof, is to envision it as having an input and output perspective, as well as an operational task associated with it [73], [74]. The process of internalisation would, for example, have as an input explicit knowledge that has to be located, with tacit knowledge that has to be learned as an output.

Following this notion, the generic knowledge management tool requirements and organisational facilitating conditions that support the specific knowledge creation processes highlighted in the identified knowledge creation path (Figure 19) were structured into an input, output and supporting perspective for each knowledge creation process.

<sup>8</sup> Depending on the knowledge management school of thought, the terms *implicit* and *tacit* are sometimes used interchangeably, although they both refer to the same dimension of knowledge.



The structure of the framework therefore comprises four improvement columns (refer to Figure 20) that indicate the key knowledge creation path identified: one between innovation capability maturity (ICM) levels 1 and 3 (externalisation), one between maturity levels 3 and 5 (combination and internalisation), as well as the supporting improvement column (socialisation).



**Figure 20: Framework outline diagram**

Each improvement column comprises the following four main components:

- An innovation capability maturity growth perspective depicting the key knowledge creation processes needed to enable innovation capability maturity growth
- A knowledge creation input perspective depicting the main knowledge action as well as enabling knowledge management tool requirements to support the input perspective of the specific knowledge creation process
- A knowledge creation output perspective depicting the main knowledge action as well as enabling knowledge management tool requirements to support the output perspective of the specific knowledge creation process
- A knowledge creation supporting perspective depicting elements that are crucial to the success of the specific knowledge creation process(es), but is related more to





organisational facilitating conditions than exclusively to the input or output aspect of the knowledge creation process

Figure 20 is used to guide the reader through the remainder of the discussion on the development of the framework details.

## **4.2.2 Innovation capability maturity growth: Generic requirements**

As previously stated, this section details generic knowledge management tool requirements and facilitating conditions that support the key knowledge creation path to enable innovation capability maturity growth (as identified in Section 4.1 and summarised in Figure 19).

Each improvement column (Section 4.2.1.2, Figure 20) in the framework is discussed by reasoning the underlying logic and practical implications of each knowledge creation process by referring to the following components: the main knowledge actions and the generic knowledge management tool requirements associated with the column's knowledge creation process input perspective; the main knowledge actions and generic knowledge management tool requirements associated with its knowledge creation output perspective, and the organisational facilitating conditions associated with its supporting perspective.

Caution was taken not to provide an unnecessarily laborious discussion of the literature study findings, as more real-world application value is created by rather discussing the underlying logic and practical implications of each knowledge creation process, thoroughly referenced from academic works obtained through the literature study (refer to Section 4.2.1.1).

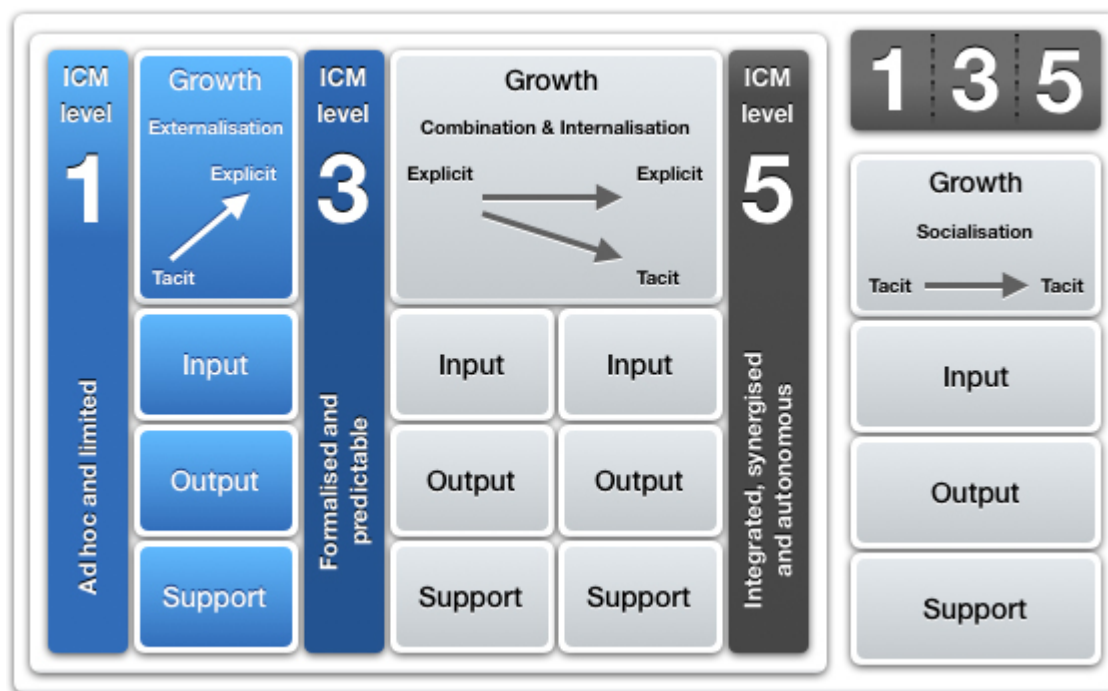
### **4.2.2.1 Growing from maturity level 1 to 3: Externalisation**

This section details generic knowledge management tool requirements and facilitating conditions that support innovation capability maturity growth from maturity level 1 to 3 (refer to Figure 21).

Growing from innovation capability maturity level 1 to maturity level 3 entails the organisation's improvement of its innovation-related activities from a state where these activities are mostly ad hoc and informal to a state where they have been formalised



into best practices and procedures. The knowledge creation process that acts as a key enabler for growth between maturity level 1 and maturity level 3 was identified as externalisation (Section 4.1.1.1, Figure 19); making the tacit knowledge of employees explicit in order to ‘define’ innovation-related activities.



**Figure 21: Framework outline: Growing from maturity level 1 to 3**

As growing from maturity level 1 to 3 relies on the process of externalisation, the main operative goal should be to capture tacit knowledge and make it explicit. This requires the conversion of implicit knowledge as an input into new explicit knowledge as an output.

The input perspective is dependent on the individual and organisation’s ability to know where to acquire the tacit knowledge that has to be externalised in order to grow. A key knowledge action is therefore to obtain tacit knowledge, which would be an impossible task if the organisation is not able to identify people with tacit knowledge [56], [75], [76]. These people are not necessarily only employees (internal to the organisation), but can also be sources external to the organisation, such as clients, suppliers or competitors.

Identifying people with the appropriate knowledge is crucial [74], [77], as an attempt at capturing all tacit knowledge is not only infeasible, but unnecessarily time- and capital-



intensive. These people cannot be identified if they hold back their tacit knowledge, which highlights the importance of trust, primarily because tacit knowledge is often the employee, client or competitor's only strategic leverage in modern industry [78] – [85].

Once people with the appropriate knowledge have been identified, they must be able to convey that knowledge, as tacit knowledge cannot be captured if it remains in the head of the knower. This is achieved through interaction, and here the ability to achieve a culture of shared values and trust plays a crucial role [86] – [88]. Interaction is primarily facilitated through the creation of dialogue and discussion opportunities [1], [56], [57], [88], where the success of these opportunities is dependent on the efficiency and degree of communication [87], [89].

Trust, as well as open lines of communication, is closely related to fostering strong personal relationships [1], [75], [84], [90], [91] – [93]. While this in turn is dependent on face-to-face contact and geographical and/or social closeness, Lee and Cole [93] point out that the use of electronic communication is becoming more established and researchers need to study the issue of building trust in a virtual environment, so that “organisationally and geographically dispersed near strangers can collaborate”.

The output perspective is dependent on the organisation's ability to convert the conveyed tacit knowledge into explicit knowledge. The key knowledge action is therefore to transform tacit into explicit knowledge. Aside from the obvious need for ICT and organisational tools that can perform this action, it is also important to clearly define roles and responsibilities for the people involved in transforming the tacit knowledge in order to maximise their efficiency and minimise uncertainty regarding the task at hand [74].

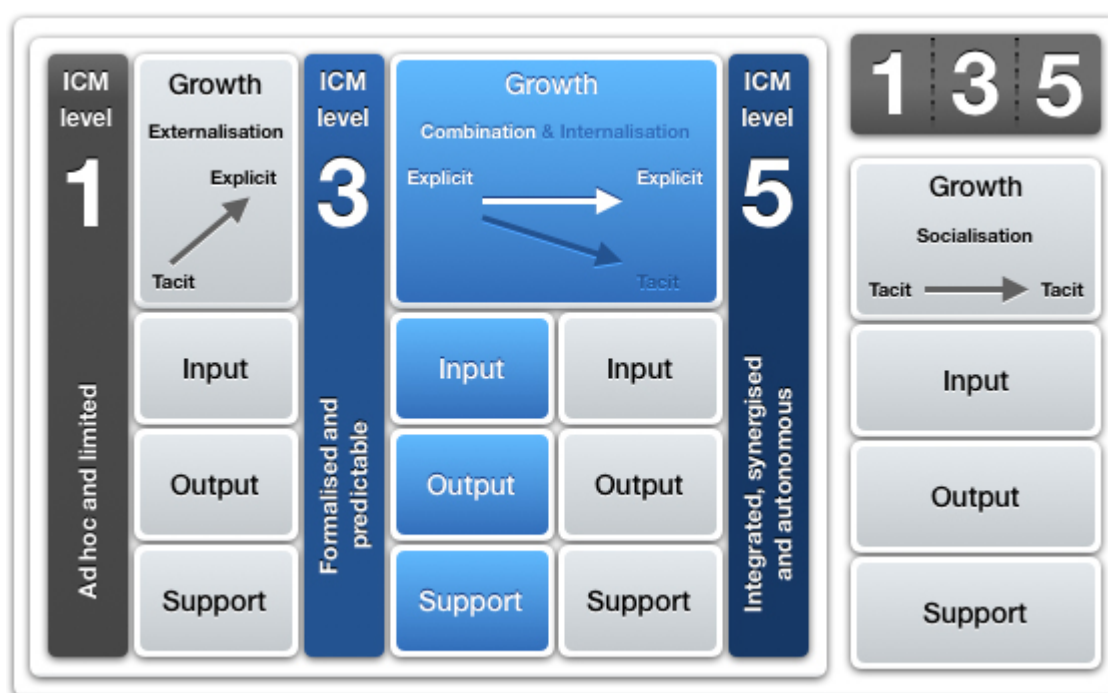
Being able to transform tacit knowledge into explicit knowledge is only as useful as the organisation's ability to record it in a format that is comprehensible and usable by the intended audience [45], [57], [75]. Here structuring of a knowledge base is important, as well as allocating enough time to do so [74], [80], [94].

#### **4.2.2.2 Growing from maturity level 3 to 5: Combination**

This section details generic knowledge management tool requirements and facilitating conditions that support innovation capability maturity growth from maturity level 3 to 5 (refer to Figure 22).



Growing from innovation capability maturity level 3 to maturity level 5 entails the organisation’s improvement of its innovation-related activities from a state where the ad hoc innovation-related activities have been formalised into best practices and procedures to a state where these formalised activities have been institutionalised. One of the knowledge creation processes that acts as a key enabler for growth between maturity level 3 and maturity level 5 was identified as combination (Section 4.1.1.2, Figure 19); continuously ‘reworking’ the current formalised innovation-related best practices and procedures in order to keep them aligned with the enterprise’s strategy and current operational requirements.



**Figure 22: Framework outline: Growing from maturity level 3 to 5**

As growing from maturity level 3 to 5 relies on the process of combination, the main operative goal should be to rework explicit knowledge. This requires the conversion of explicit knowledge as an input into new explicit knowledge as an output.

The input perspective is dependent on the organisation’s ability to know where to acquire the explicit knowledge that has to be combined into new explicit knowledge in order to grow. A key knowledge action is therefore to firstly identify what explicit knowledge has to be reworked and then to locate and obtain it [95]. This would be an impossible task if the organisation is not able to foster a culture that prohibits or at



least minimises knowledge hiding, which goes hand in hand with providing unrestricted access to explicit knowledge [79], [96]. The success of assuring access to explicit knowledge also relies on high degrees of structure within the knowledge base.

As explicit knowledge is not only obtained from within the organisation, but also from external sources such as clients, suppliers or competitors, clear-cut roles and responsibilities are needed to help formalise and manage this process, for example establishing roles such as the 'knowledge gatherer', who scouts external knowledge [74]. Due to the possibility of a large geographical dispersion from which to source this existing explicit knowledge, the knowledge base should be highly formalised and structured [56], [79].

The output perspective is dependent on the organisation's ability to convert the acquired existing explicit knowledge into new explicit knowledge. The key knowledge action is therefore to disseminate this explicit knowledge to the appropriate entities in order to organise and improve it. Aside from the obvious need for ICT and organisational tools that can perform this action, it is also important to cultivate a positive attitude toward yet realistic perception of the potential and limitations of ICT tools [97], [80], [86].

A positive attitude toward ICT is needed, as one of the main reasons for the failure of technology is resistance to change by those who have to implement it to ensure its success. A realistic perception of the potential and limitations of ICT is important if the organisation wants a reasonable chance of predicting, with fair confidence, the expected scope and outcome of its activities related to systematising existing explicit knowledge. The ability to make such predictions is closely related to planning the expenditure and the return on capital invested associated with such a project.

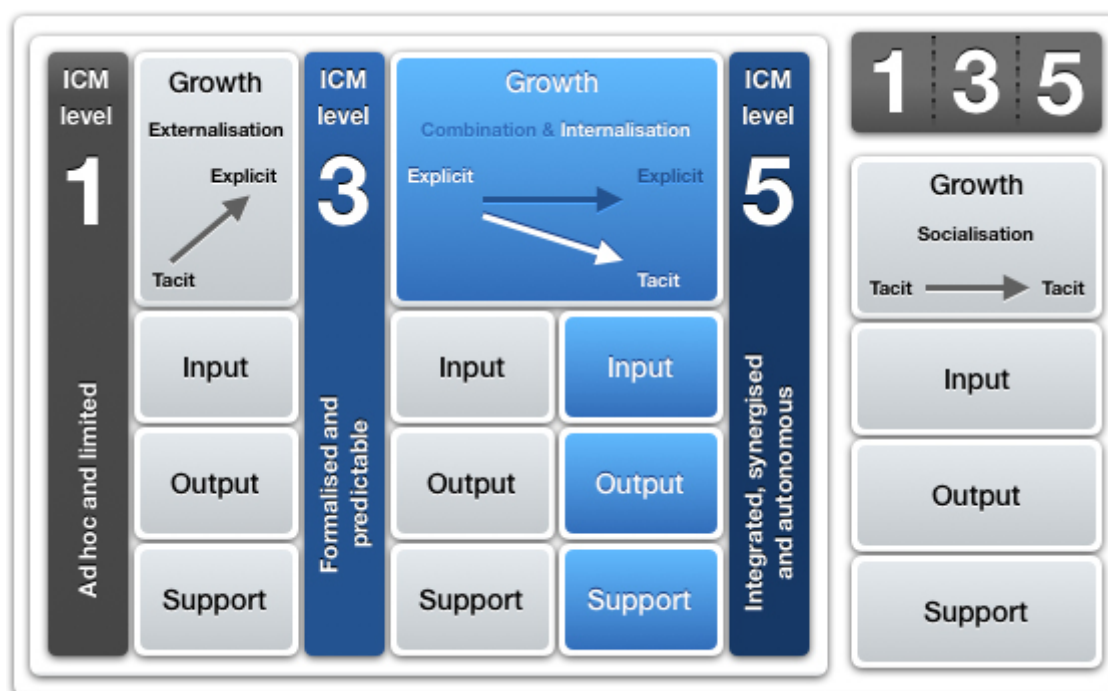
Clear-cut roles and responsibilities help formalise and manage this process of organising and improving existing explicit knowledge, for example establishing roles such as the 'knowledge analyst', who interprets client needs [74]. People fulfilling these roles should also sensitise the organisation to identify the current void where the new explicit knowledge can be reapplied more effectively.



### 4.2.2.3 Growing from maturity level 3 to 5: Internalisation

This section details generic knowledge management tool requirements and facilitating conditions that support innovation capability maturity growth from maturity level 3 to 5 (refer to Figure 23).

Growing from innovation capability maturity level 3 to maturity level 5 entails the organisation’s improvement of its innovation-related activities from a state where the ad hoc innovation-related activities have been formalised into best practices and procedures to a state where these formalised activities have been institutionalised. Together with the knowledge creation process of combination, as described above, the other knowledge creation process that acts as a key enabler for growth between maturity level 3 and maturity level 5 was identified as internalisation (Section 4.1.1.2, Figure 19); encouraging workers to embody the formalised explicit practices and procedures in their daily (innovation-related) activities.



**Figure 23: Framework outline: Growing from maturity level 3 to 5**

As growing from maturity level 3 to 5 also relies on the process of internalisation, the main operative goal should be to learn from existing explicit knowledge. This requires the conversion of explicit knowledge as an input into new tacit knowledge as an output.



The input perspective is dependent on the individual and organisation's ability to know where to acquire the explicit knowledge that has to be internalised into new tacit knowledge in order to grow. A key knowledge action is therefore to identify what explicit knowledge has to be learned. Organisations can stipulate explicit knowledge that has to be learned, but it also entails that the individual has to be able to recognise relevant knowledge within the organisation, which strongly depends on a well-structured knowledge base [58], [97] and a local, decentralised, self-directed learning approach [74], [98].

Once the explicit knowledge to be learned has been identified, the organisation has to provide access to it [99]. It has to be available in the right format, with the knowledge itself provided in a well-structured manner to maximise effective utilisation thereof in the time allocated for learning. This time allocation should be sufficient to support the organisation's goals for learning [51], [85], which, in turn, should also serve as organisation-wide motivation for creating an environment that is supportive of learning [97].

The output perspective is dependent on an employee's ability to understand the explicit knowledge that has to be learned. Frequently, the comprehension of explicit knowledge is reliant on efficient communication, and it is therefore necessary that the organisation provides support for this [56]. This communication can be supported by balancing phases of ICT-supported learning with face-to-face contact and social/geographical closeness [90].

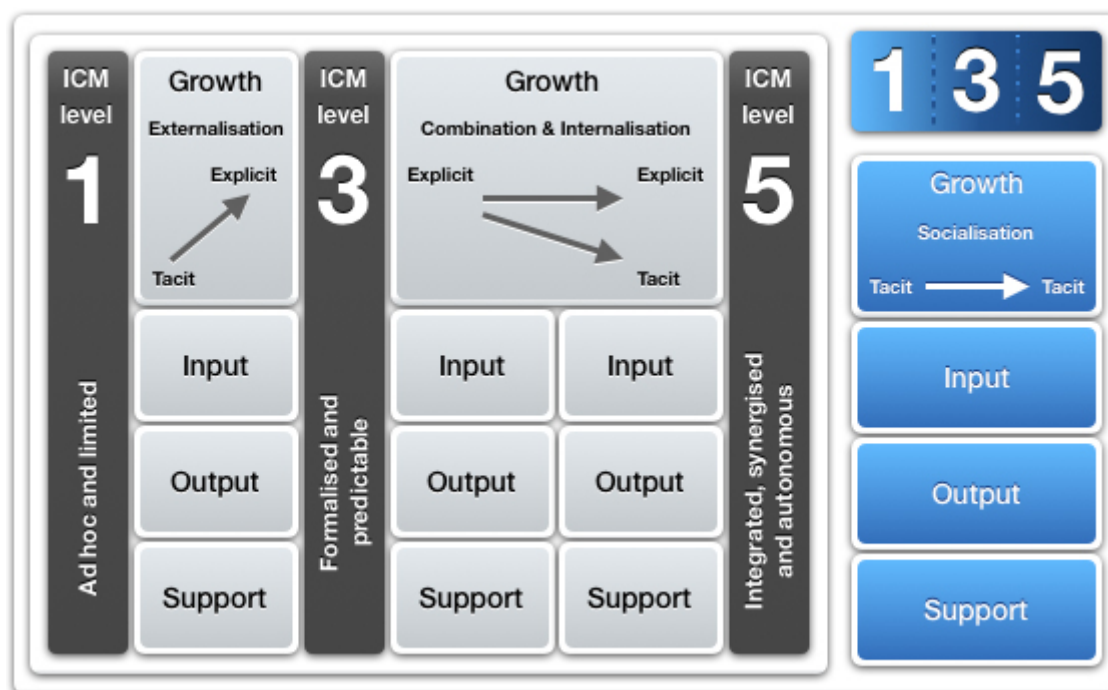
Understanding the identified explicit knowledge is also closely linked to an organisational culture that encourages experimenting and experiencing with new knowledge and tolerates failures by employees during the learning process [51], [79], [83], [85], [97], [99], [100]. This in turn facilitates the process of embodying the explicit knowledge in an employee's tacit knowledge base and promotes the notion that employees should be able to actively and continuously apply this existing knowledge in their daily activities [56] – [58], [74], [101].

#### **4.2.2.4 Growing from maturity level 1 through to 5: Socialisation**

This section details generic knowledge management tool requirements and facilitating conditions that support innovation capability maturity growth from maturity level 1 through to 5 (refer to Figure 24).



The people component is a crucial element without which externalisation, combination and internalisation would be impossible. Therefore, the underlying knowledge creation process supporting innovation capability maturity growth from maturity level 1 through to 5 is the need to facilitate ‘sharing’ through enabling tacit to tacit knowledge transfer through socialisation (refer to Section 4.1.1.3, Figure 19).



**Figure 24: Framework outline: Growing from maturity level 1 through to 5**

As growing from maturity level 1 through to 5 relies on the supporting process of socialisation, the main operative goal should be to share tacit knowledge. This requires the conversion of tacit knowledge as an input into new tacit knowledge as an output.

The input perspective is dependent on the individual and organisation’s ability to know where to acquire the tacit knowledge that has to be shared through socialisation in order to grow, as well as the organisation’s ability to support this. A key knowledge action is therefore to obtain tacit knowledge from people who are not necessarily only employees (internal to the organisation), but can also be sources external to the organisation, such as clients, suppliers or competitors.

As with the input perspective of the externalisation process (Section 4.2.2.1), identifying people with the appropriate knowledge is crucial [74], as an attempt at





sharing all tacit knowledge is not only infeasible, but unnecessarily time- and capital-intensive. Direct collaboration between individuals helps identify people with the appropriate knowledge [74], [93], [102] – [104]), but is highly dependent on the degree of trust between parties. Trust acts, and will forever act, as an important mediator between interacting parties, primarily because tacit knowledge is often the employee, client or competitor's only strategic leverage in modern industry [79], [81] – [85].

Mutual experiences and activities also help foster a culture of trust, empathy and openness within close personal relationships [57], [75], [84], [93], [97], [105], [106]. This is needed to convey knowledge once people with the appropriate knowledge have been identified, as tacit knowledge cannot be shared if it remains in the head of the knower.

The output perspective is dependent on the individual's ability to convert the conveyed tacit knowledge into his or her own tacit knowledge. The key knowledge action is therefore to transform tacit into new tacit knowledge through sharing. This is only possible through frequent occurrences of face-to-face contact between parties [1], [56], [57], [92], [106], which is dependent on geographical and social closeness [57], [97], [105], [107].

There is also a need for intensive communication in the short term, but also in the long term [86], [88], [93], [100]. This in turn requires low levels of lingual and cultural differences [51], [87], [91], [95], [107].

These requirements for knowledge management tools and organisational facilitating conditions as discussed in sections 4.2.2.1 to 4.2.2.4 were subsequently synthesised to form the framework presented in the next section.

### **4.3 A knowledge management framework to grow innovation capability maturity**

This section presents the knowledge management framework to grow innovation capability maturity (refer to Figure 25), by discussing the scope of its intended use (Section 4.3.1), as well as an illustration of the impact of the framework through a description of the framework guidelines in the context of a practical organisational scenario (Section 4.3.2).

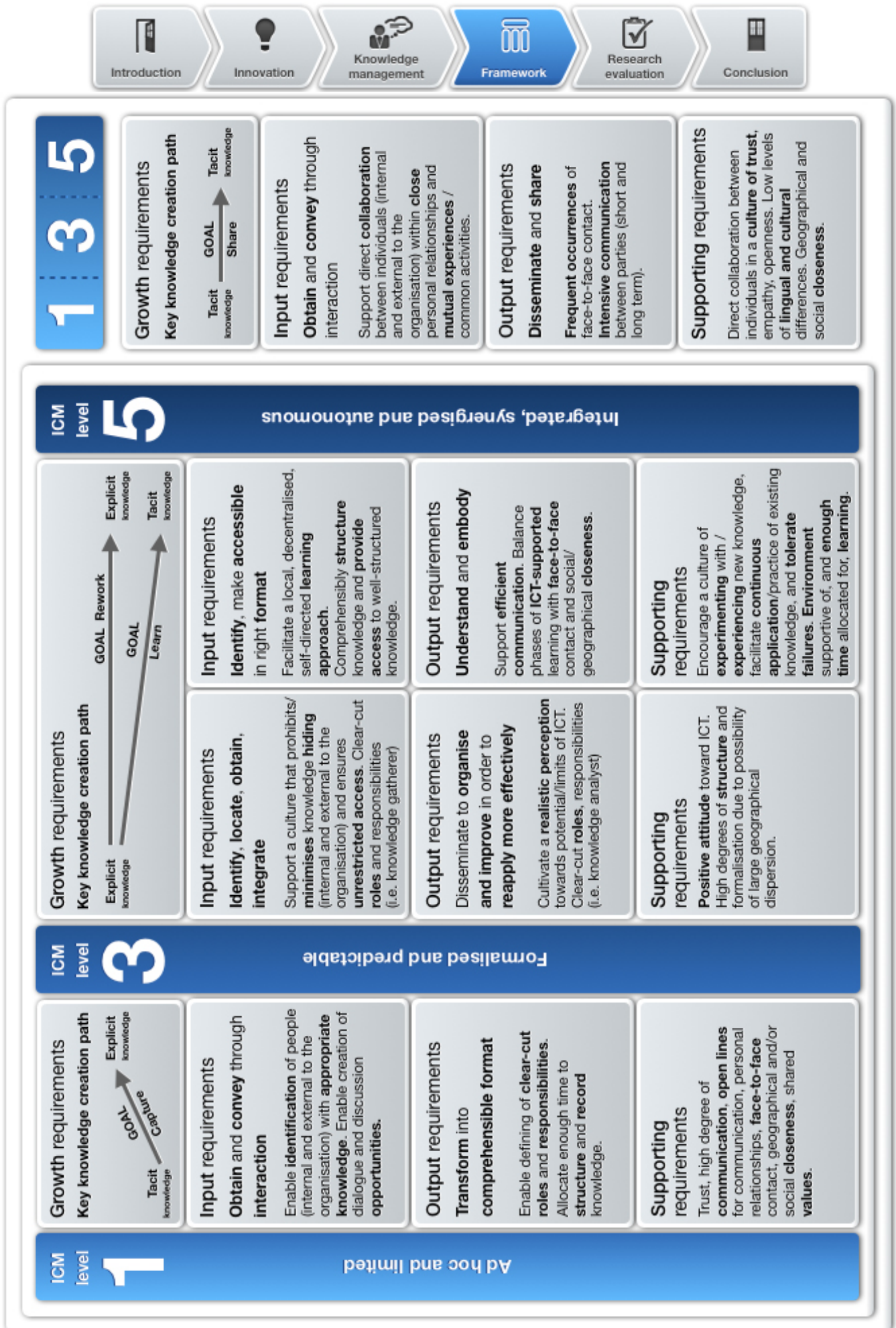


Figure 25: A knowledge management framework to grow innovation capability maturity



### 4.3.1 Framework scope and intended use

At this point it is meaningful to revisit the intended scope of this study (Section 1.3). The framework presented in this document is neither intended as the be-all and end-all solution to enable innovation capability maturity growth, nor is the intention to provide a step-by-step enterprise-wide knowledge management integration plan.

The aim was to investigate organisational support by means of business tools toward innovation capability maturity growth. The result of this investigation was a conceptual framework, serving as guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth. The unique research contribution lies in providing a tangible link between the fields of knowledge management and innovation capability maturity.

#### 4.3.1.1 Framework application and impact

The impact of this framework lies in providing guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth. In practical terms, the framework aims to provide an ‘as is’ and ‘to be’ reference point for determining whether an enterprise’s organisational conditions and business tools are sufficient in order to sustain or grow its innovation capability maturity.

It is important to note that the framework is simply a tool, and as with all tools, its success is dependent on the knowledge, experience and dedication of the individual, project team, department or organisation applying it.

The framework provides a reference point for *evaluating* an enterprise’s organisational conditions and business tools in order to *sustain* innovation capability maturity. Using the framework, an organisation should be able to answer the following question:

- ✓ Given our innovation capability maturity level, do our knowledge management-related tools and organisational conditions meet the requirements that will enable us to *continuously fulfil* our innovation-related activity requirements for this maturity level?

The framework provides a reference point for *benchmarking* an enterprise’s organisational conditions and business tools in order to *grow* innovation capability maturity. Using the framework, an organisation should be able to answer the following question:



- ✓ Given our innovation capability maturity level, do our knowledge management-related tools and organisational conditions meet the requirements that will enable us to *improve* our innovation-related activity requirements for this maturity level and hence grow from our current maturity level to the next?

This innovation capability maturity level indication mentioned in the two questions above could be obtained formally or informally. A formal indication would entail an innovation capability maturity assessment – enterprise-wide, per innovation capability area, per innovation capability requirement or per combinations thereof (refer to Section 2.2.3 and Appendix A for details of this assessment as part of the ICMM). A less formal indication would entail that an enterprise simply benchmarks its known innovation-related activities against the generic ICMM maturity level descriptions without going through an official assessment.

### 4.3.2 Framework guidelines: An illustrative example

This section illustrates the impact of the framework through a description of the framework guidelines in the context of a practical organisational scenario. Section 4.3.2.1 describes the use of the framework as a tool to enable growth from innovation capability maturity level 1 to 3, and Section 4.3.2.2 describes its use as a tool to enable growth from maturity level 3 to 5.

Although the organisation described below is entirely hypothetical, the maturity level descriptions of the innovation-related activity presented here are based on the innovation capability requirement “Allocating resources properly”, as researched by Essmann [13]. The level of detail described in the scenario is a product of the author’s degree of industry exposure.

#### 4.3.2.1 Using the framework as a tool to enable innovation capability maturity grow from maturity level 1 to 3

XYZ Retailers would like to improve their resource-allocation approach. Employees at XYZ Retailers are currently randomly allocating as much resources, as needed, when needed, on an impromptu first-come-first-serve basis, where ideally they should be using a structured approach with resources being allocated to the portfolio according to project prioritisation. XYZ Retailers must therefore establish a resource-allocation procedure.



When improving an innovation-related activity such as resource allocation from an ad hoc to a formalised approach, the main operative task is to capture knowledge. First the tacit knowledge of employees related to the current resource-allocation activities must be obtained and conveyed through interaction.

Tools that enable the identification of employees with the appropriate knowledge and that create dialogue/discussion opportunities can support the process of finding out how decisions are currently being made regarding resource allocation, as well as who is making them. Simultaneously, these discussions should provide a platform for employees to also share ideas on improvement within the current ad hoc process. Forming trust and establishing open lines for communication within XYZ Retailers can play a pivotal role in this collaboration effort, as employees frequently regard any survey of their work-related tasks and decisions as a performance evaluation that could likely lead to a deliberate misrepresentation of their involvement in and contribution to the current innovation-related activity.

Once the identified employees are involved in the interactive process of conveying their tacit knowledge regarding resource allocation, this knowledge must systematically be transformed into a comprehensible format in order to establish an explicit resource-allocation procedure. This is facilitated through the definition of clear-cut roles so that everyone has a clear picture of how they contribute to the formalisation of XYZ Retailer's resource-allocation process. Here shared values can go a long way in convincing employees of the need for establishing such an explicit procedure. Allocating enough time to actually record and most importantly structure the tacit knowledge gathered is also a significant requirement when establishing an explicit allocation procedure toward a method where resources are allocated to the portfolio according to project prioritisation.

#### **4.3.2.2 Using the framework as a tool to enable innovation capability maturity grow from maturity level 3 to 5**

Some time has passed and XYZ Retailers are now in a position where they have established a resource-allocation procedure and are no longer randomly allocating as much resources as needed when needed on a first-come-first-serve basis. They have matured their innovation-related activities to a formalised state where employees are using a structured approach, with resources being allocated to the portfolio according to project prioritisation.



This implies that procedures have been identified and deployed toward a proactive and planned approach to the innovation-related activity of resource allocation. Formalisation has been attained, but in order to grow their capability maturity regarding this innovation-related activity even further, they need to institutionalise this practice. This would entail the pooling of resources through alignment and integration within and between operational activities in projects.

When improving innovation-related activities such as resource allocation from a formalised to an institutionalised approach, one of the main operative tasks is to rework. Procedures have been formalised according to which employees are now using a structured approach by allocating resources to the portfolio according to project prioritisation. These procedures now have to be continuously reworked in order to keep them aligned with the enterprise's strategy and current operational requirements.

Firstly, the type of resource-allocation-related procedure that has to be reworked as well as all the relevant explicit knowledge regarding resource allocation must be identified. Following this, the identified knowledge has to be located and obtained in order to commence the integration within and between operational activities in projects. The success of this relies heavily on a culture of trust and the minimising of knowledge hiding, enabling unrestricted access to the different types of explicit knowledge regarding resource-allocation methods as well as integration requirements across project teams.

Due to the volume of knowledge and the possibility of a large geographical dispersion across departments and branches, the knowledge base has to be well structured. It should also be supported by clearly defined roles, such as an employee who is tasked with finding out exactly what the requirements for integration between project teams are, specifically regarding resource allocation. This is reliant on effective collaboration between individuals, which is facilitated by intensive communication.

The fulfilment of these requirements provides a basis from which to organise and improve the obtained procedures into a resource-pooling approach that is agile in adapting to the resource needs of different projects. Here a positive yet realistic attitude toward ICT is needed. The positive attitude is required to ensure success of implementation as far as employee involvement is concerned, while the realistic



perception supports an accurate estimate of the expected outcome of, and expenditure required by, these reworking activities.

The other main operative task when improving innovation-related activities such as resource allocation from a formalised to an institutionalised approach is to learn. Employees have to embody the procedures regarding resource allocation that has been formalised. This has to become natural behaviour and part of their daily activities in order to enable individual autonomy so that they can concentrate on pooling resources through alignment and integration within and between operational activities in projects.

First the procedures that have to be embodied must be identified, which is closely related to the individual's ability to recognise relevant and required explicit knowledge within his or her work environment. This is facilitated through cultivating a local, decentralised learning approach, supported by access to a well-structured knowledge base from which to obtain the explicit knowledge regarding resource allocation.

Understanding these procedures and their impact on daily activities is reliant on efficient communication and collaboration with other individuals. Continuous application and practice of these procedures should be encouraged in order to fully embody them. Experimenting with the application of this knowledge also helps form a mental picture regarding the requirements for integration between project teams, specifically regarding resource allocation. The importance of these activities necessitates that enough time be allocated for learning.

## 4.4 Summary

The literature provides a strong basis for the argument that knowledge management and more specifically knowledge creation processes could be used to improve an enterprise's innovation capability maturity. Consequently, the following hypothesis suggests a platform for investigating the use of knowledge creation processes to grow innovation capability maturity:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*



With chapters 2 and 3 proving the necessary research background and context, Chapter 4 discussed the logic and development process behind building this knowledge management framework to grow innovation capability maturity.

The fundamentals of the framework were derived through independent reasoning by the author, by identifying a knowledge creation path (as depicted in Figure 19) that acts as a key enabler for maturity growth from maturity level 1 through to maturity level 5. This forms the cornerstone of the research done toward a knowledge management framework to grow innovation capability maturity

A detailed expansion of these fundamentals was discussed to determine the knowledge management tool requirements and organisational facilitating conditions that support the specific knowledge creation processes highlighted in the identified knowledge creation path.

The framework (Figure 25) and its intended scope were presented, concluding with an illustration of the impact of the knowledge management framework on the growth of innovation capability maturity by describing the framework guidelines in the context of a practical organisational scenario. Consequently, evaluation of this research is addressed in Chapter 5.





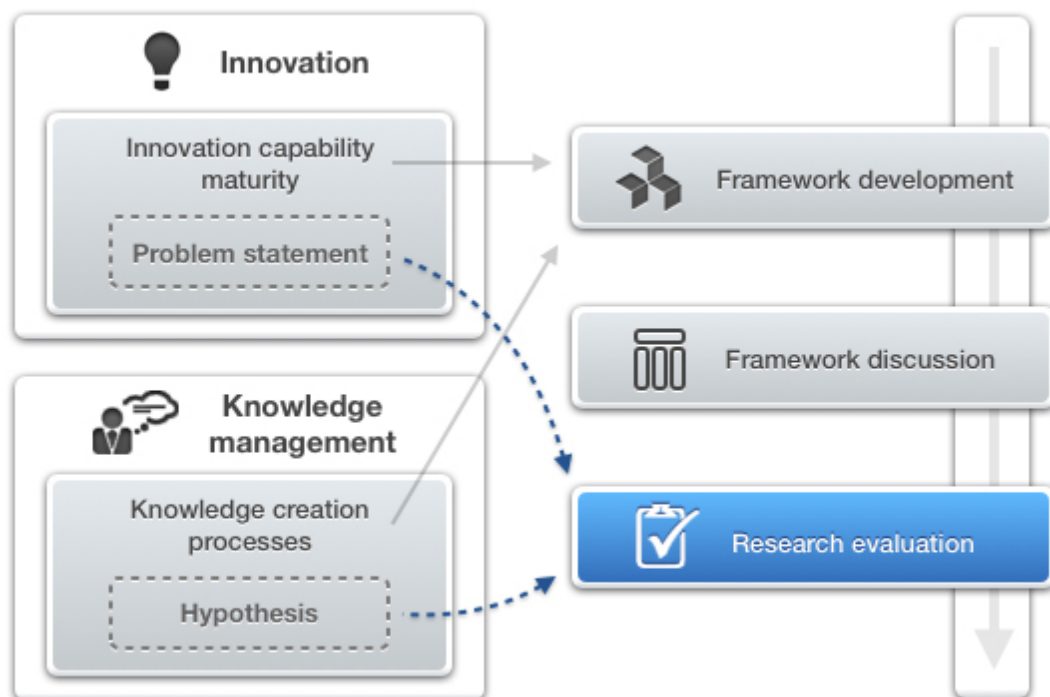
## Chapter 5

## Research evaluation



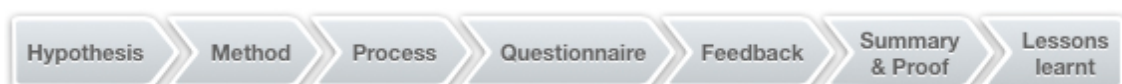
This chapter focuses on the evaluation of the research done during this study (refer to Figure 26).

It presents the evaluation method and discusses how this method can be used to either prove or reject the research hypothesis. Thereafter, the evaluation process is discussed, followed by a comprehensive account of the evaluation findings. The result of these findings is discussed in the last section, which addresses whether or not the research hypothesis could be proven and highlights positive feedback, shortcomings and the suggested scope for further research by industry, organisational, and academic experts.



**Figure 26: Research outline: Evaluation**

The following diagram is used throughout Chapter 5 to illustrate the content of the specific section within the research evaluation discussion:





## 5.1 Hypothesis



At this point, it is meaningful to revisit the research problem statement of Chapter 1, and the research hypothesis at the end of Chapter 3, as derived through an extensive literature study on innovation and knowledge management, as detailed in chapters 2 and 3.

Problem statement:

*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*

Hypothesis:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

## 5.2 Evaluation method



A practical application of the framework in a real organisation would prove or negate the hypothesis, and provides the obvious advantage of seeing measurable results as well as testing the adoption by users. Unfortunately, this is not a suitable evaluation method given the length of study, as permitted by the degree Master of Science in Industrial Engineering. The amount of time needed to practically test the framework could take anything up to five years or more, as innovation capability maturity growth takes time, especially when testing growth enablement through all five maturity phases.

As the scope of this research study does not allow for practical implementation with real-life results, the hypothesis can be proven if it can be determined with fair



confidence that the framework could enable innovation capability maturity growth, should the framework be used in a real organisation.

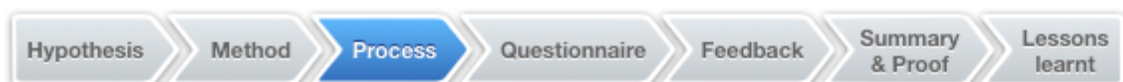
Therefore, the hypothesis can be proved if the following is determined:

1. That the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next as the cornerstone of research toward a knowledge management framework to grow innovation capability maturity is valid
2. That the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels is logical and sound
3. That the identified knowledge creation path accurately addresses the key requirements for growth from one maturity level to the next
4. That the knowledge management tool requirements and organisational facilitating conditions for each identified knowledge creation process in the path, as detailed in the framework, are accurate

Subsequently, five industry and subject theory experts from various fields each focused on the evaluation of the research methodology and framework. The framework was evaluated through responses to an evaluation questionnaire and/or through interview-based discussions, with the intention of establishing whether the framework meets the above-stated four requirements to prove the hypothesis.

The downside of this method is that the interviewees could only respond from within their own experience and frame of reference as well as through consideration of what was presented to them.

### 5.3 Evaluation process



As mentioned before, the framework was evaluated through responses to an evaluation questionnaire and/or interview-based discussions. Five industry and subject theory experts from various fields each focused on evaluating the research methodology and framework. These interviewees were chosen to provide a broad



perspective of the research. A description of the five interviewees, their relevant background as well as the focus of each evaluation can be found in Figure 27.

A research-evaluation questionnaire and accompanying research summary (refer to appendices B and C) were chosen as means to facilitate a semi-structured interviewing process, discussing the accuracy of the author's research methodology as well as the accuracy, applicability and usability of the framework. The questionnaire contained three background contextualisation, four research methodology and five framework-specific questions as well as a section for further comments. These questions were chosen to systematically cover all aspects of the research methodology as well as the framework, and the intention was to hereby create a platform for a comprehensive discussion of the author's research. (Refer to Section 5.4 for a discussion of the research evaluation questionnaire.)

The evaluation process began by electronically sending each expert a 14-page research summary document accompanying the framework, as well as the research-evaluation questionnaire. Upon receiving the document, the experts could work through the research summary and consider the framework in their own time.

The schedule of and time available to each expert dictated his or her method of response to the research-evaluation questionnaire. Three experts preferred to provide detailed written answers, limiting their time dedicated to an interview, while two experts preferred to use the evaluation questions as a means to prepare for a one-on-one discussion of the research with the author. The evaluation questions provided a backbone to these discussions, assuring that all experts had an equal platform from which to evaluate the research.

The goal of each evaluation differed in the sense that each evaluation aimed to assess a different focus of the research. Even though each expert was sent the same set of evaluation questions, the three written responses provided unique angles to the questions, highlighting the diverse backgrounds of the experts. Similarly, the two interviews were also marked by an emphasis on the discussion of research aspects relevant to the background of the specific expert.



Interviewee and industry	Occupation	Exposure to maturity models	Exposure to knowledge management	Included in evaluation process to:
<b>Dr HE Essman</b>  Innovation Management Consulting	Programme Manager at Indutech, Stellenbosch	Extensive research for PhD. Multiple ICM assessments deployed in practice	Basic research for PhD. Application of principles during consulting.	Evaluate research methodology; framework validity from ICM perspective & for overall applicability and usability.
<b>Mr DF Botha</b>  Academic / Strategic consulting	Lecturer at Department of Information Science at Stellenbosch University. Contracted consultant to SA Government, DST and HSRC on TTS.	Limited formal exposure.	Extensive management, research, consulting and training experience.	Evaluate research methodology; framework validity from KM perspective & for overall applicability and usability.
<b>Mr L Labuschagne</b>  Professional Services Industry	Enterprise Architect and Training Manager at Real IRM, Midrand.	Exposure to CMMI within software-development environment. Using maturity models within enterprise architecture (EA) domain to measure EA management within an organisation.	Exposure limited to: Experience with establishing Communities of Excellence. Mentorship and establishment of intern development programme within consulting services environment. Sharepoint Portal Server configuration as KM platform.	Evaluate research methodology; framework validity from holistic perspective & for overall applicability and usability.
<b>Mr PWJ van Zyl</b>  Information Technology and Services industry	Strategy Consultant at Nedbank. Business Consultant at Demix Business Development	Extensive management, research, consulting and training experience: Certified HMLA of SEI and CMMI instructor.	Management, research, consulting and training experience in KM aspects related to CMMI.	Evaluate research methodology; framework validity from ICM perspective & for overall applicability and usability.
<b>Ms H Smuts</b>  Mobile Telecommunication Industry	General Manager at MTN – Customer Experience Enablement	Managed Process and People project during CMMI audit. Exposure to CMMI project and training related to IS.	Extensive management, research and consulting experience.	Evaluate research methodology; framework validity from KM perspective & for overall applicability and usability.
ICM : Innovation capability maturity HMLA: High maturity lead appraiser CMMI: Capability maturity model integration HSRC: Human Sciences Research Council		KM : Knowledge management SEI: Software Engineering Institute of Carnegie-Mellon University DST: Department of Science and Technology TTS: Technology transfer strategy		

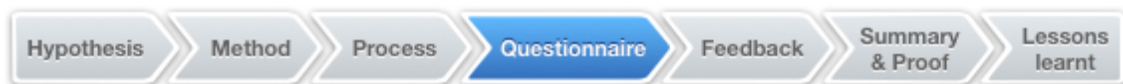
**Figure 27: Interviewee background summary and reason for inclusion in research evaluation**



Refer to Appendix D for a complete set of transcripts, portraying the relevant aspects from each interview. Discussion points that are not directly relevant to the research evaluation are concisely summarised and indicated in brackets, as they occurred in the interview. Highlights from each of the interviews are given in the following section.

A comprehensive summary of the evaluation findings, highlighting positive feedback as well as shortcomings and the suggested scope for further research by industry, organisational and academic experts, can be found in the next section.

## 5.4 Evaluation questionnaire



As stated previously, the questions were chosen to systematically cover all aspects of the research methodology as well as the framework, and the intention was to hereby create a platform for a comprehensive discussion of the author's research.

### 5.4.1 Three background contextualisation questions

These questions aimed to provide context to the answers, comments and suggestions received in response to the research methodology and framework evaluation. Here the experts were asked to state their occupation and industry and to explain to what extent they have been exposed to the fields relevant to the author's research, namely knowledge management and capability maturity models (and/or innovation capability maturity).

### 5.4.2 Four research methodology questions

These questions aimed to provide a basis for systematically evaluating the logic of the research methodology followed by the author.

Here the experts were asked whether or not they agree with the emphasis placed in the research on the importance of growing and maturing the innovation capability of an organisation to ensure sustained competitiveness. Following the innovation capability maturity question, experts were asked whether or not they agree with the notion that knowledge creation processes act as critical enablers for the innovation process. These two questions then led to the question of whether or not they agree with the aim



of this study, namely investigating how knowledge management tools can be applied to grow innovation capability maturity.

The final link in the research methodology reasoning chain was then evaluated by asking: “To what extent do you agree/disagree with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next as the cornerstone of research toward a knowledge management framework to grow innovation capability maturity?”

### **5.4.3 Five framework-specific questions**

These questions aimed to provide a basis for systematically evaluating the accuracy, applicability and usability of the framework.

The first two questions evaluated the accuracy of the identified knowledge creation path as a key enabler for growth between innovation capability maturity levels. Here the experts were asked whether or not they agree with reasoning applied by the author when identifying this knowledge-growth path. Consequently they were also asked whether or not this knowledge-growth path accurately addresses the key maturity level description requirements for growth from one maturity level to the next.

The next two questions evaluated the accuracy of the content of the framework and the logic of its structure. The experts were asked whether or not they agree with the specific knowledge management tool requirements detailed in the framework, as well as whether they agree with the structure of the framework, synthesised to provide an input, output and supporting perspective to each knowledge creation process in the growth path.

The final framework-related evaluation question was aimed at determining the overall research contribution made by the author: “Please comment on the applicability and usability of this framework, from your professional viewpoint, to provide guidelines for the use of knowledge management to advance innovation capability maturity growth”.

### **5.4.4 Further comments**

A further comments section was included in the questionnaire to create the opportunity for remarks from the experts that could otherwise not be facilitated through answering the previous step-by-step research-evaluation questions.





## 5.5 Evaluation feedback



The following five sections aim to each provide an accurate account of the five evaluation responses, whether it was a written reply, a one-on-one discussion or both. All evaluation response descriptions follow the same order – firstly describing the specific means of evaluation (written response or one-on-one discussion or both), and then the goal of the evaluation, followed by a summary of the feedback received regarding the specific focus of the evaluation.

### 5.5.1 Dr HE Essmann

Dr Essmann provided a detailed written response to the evaluation questionnaire and had no further comments for the purpose of an interview. His answers can be found in Appendix C.

The objective of this research evaluation was to firstly establish the soundness of the research methodology followed. Following the research methodology questions, the aim of the framework-related questions was to evaluate the framework from an innovation capability maturity perspective. Dr Essmann's opinion would be valuable here, as he is a keen researcher with extensive knowledge of and experience in the subject of innovation, especially innovation capability maturity, and has a solid background in the field of knowledge management.

#### 5.5.1.1 Dr Essmann's written research-evaluation response

From a research methodology perspective, Dr Essmann was in complete agreement. He also commented that this alignment of the knowledge creation processes with the requirements for innovation capability maturity growth *“has been performed at a high level to create a generic and broadly applicable framework for applying knowledge processes to grow ICM – at the ‘maturity level’ level”*. He suggested that *“future research could also be conducted to align knowledge process requirements and ICM requirements at a more detailed level (out of scope of this research)”*.

From a framework-evaluation perspective, Dr Essmann agreed with the reasoning applied when the knowledge creation path was identified as a key enabler of innovation capability maturity growth. He is also of the opinion that this path accurately



addresses the key maturity level description requirements for growth from one maturity level to the next. He could not find any gaps in the specific knowledge management tool requirements detailed in the framework, and found the structure of the framework clear and concise, while *“effectively depicting a landscape for the activities, tools, methods, etc. to enable the knowledge processes in a generic manner”*. He added that *“should these activities, tools, methods, etc. be categorised into the framework, it would provide an easy means for referencing the appropriate mechanisms for the task at hand”*.

From a framework applicability and usability perspective, Dr Essmann commented that the framework is generic and does not stipulate specific activities, tools or methods, but *“should a company go to the effort to select the appropriate tools using the framework and allocate them into the framework, it should be applicable and useful”*.

Dr Essmann concluded his response by commenting that he would like *“to show appreciation for the seemingly ‘simple’ framework represented as the research output – it often takes significantly more effort to represent something that is complex in a simple manner while ensuring its accuracy”*.

## 5.5.2 Mr DF Botha

Mr Botha did not provide a written response to the evaluation questionnaire and an interview guided by these evaluation questions was conducted. A transcript of his interview can be found in Appendix C.

The objective of this research evaluation was to firstly establish the soundness of the research methodology followed. Following the research methodology questions, the aim of the framework-related questions was to evaluate the framework from a knowledge management perspective. Mr Botha’s opinion would be valuable here, as he is a proficient researcher with extensive experience in the field of knowledge management, and although he has had limited formal exposure to the field of capability maturity models, he has a solid knowledge of the field of innovation.

### 5.5.2.1 Mr Botha’s interview: Research-evaluation response

From a research methodology perspective, Mr Botha was in complete agreement with the links made by the author, stating that *“it is so important that we do not even have to questions those ideas”*, and further commenting that *“innovation capability is the*



*single greatest factor that will influence the sustainability of your organisation*". He was initially opposed to the term *maturity growth*, stating that *"if you're mature, you're already grown"*, but after further discussion, a mutual understanding regarding its meaning was reached.

From a framework-evaluation perspective, Mr Botha agreed with the reasoning applied when the knowledge creation path was identified as a key enabler of innovation capability maturity growth. He confirmed that this identified knowledge creation path can be used to grow innovation capability maturity from one maturity level to the next, but remarked that *"I would recommend that you make sure to specify that the growth path that you have identified isn't for the whole organisation; just trying to manage it all"*. When asked whether he agrees with the tool requirements detailed in the framework, and whether he agrees with the structure of the framework, he replied "Yes" to both questions.

From a framework applicability and usability perspective, when asked whether he thought the framework was usable, Mr Botha replied: *"Absolutely"*.

Other research-related comments included Mr Botha's suggestion that the word *creation* be substituted with *discovery* in the concept of knowledge creation processes. He also cautioned the author to take care not to refer only to Nonaka, as he is part of the first wave of knowledge management: *"If you use only Nonaka, you could create the impression that you think there is nothing else"*. After further discussion, Mr Botha was satisfied that the author also views the knowledge creation processes as dynamic, and that this research is not based on Nonaka's linear approach.

The interview lasted well over two hours and was marked by extensive elaboration on the literature by Mr Botha, aptly summarised in his comments: *"Don't get me wrong, I think you've got an excellent thing going here; one of the better, more advanced attempts that I've seen. I'm just afraid that you'll make it too complex ... which is why I'm hesitant to give you too much extra information; this could lead to side-tracking, but it's such a neat piece of research"* and *"All I tried to show you today is that there are other writers in your field that think the same way as you do; that you are correct; whether you're calling it maturity or dominant design"*.



### 5.5.3 Mr L Labuschagne

Mr Labuschagne provided a detailed written response to the evaluation questionnaire, but a few of his comments warranted further discussion, and an interview guided by these evaluation questions was conducted. His answers and a transcript of his interview can be found in Appendix C.

The objective of this research evaluation was to firstly establish the soundness of the research methodology followed. Following the research methodology questions, the aim of the framework-related questions was to evaluate the framework from a holistic perspective. Mr Labuschagne's opinion would be valuable here, as he has considerable experience in information-management consulting, with solid knowledge of the subject of capability maturity models and experience in the field of knowledge management.

The rest of this section firstly presents his written answers, then the subsequent one-on-one discussion stimulated by them, and lastly his final response to his evaluation of the research from a holistic perspective.

#### 5.5.3.1 Mr Labuschagne's written research-evaluation response

From a research methodology perspective, Mr Labuschagne agreed that it is important for an organisation to grow and mature its innovation capability in order to innovate on a constant and sustainable basis, and that knowledge creation processes act as critical enablers for the innovation process. He was, however, not convinced that knowledge management tools will have a significant impact. His comment on the question of whether or not he agrees with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next as the cornerstone of research toward a knowledge management framework to grow innovation capability maturity was: *"Agree that it would assist organisations with formalising the process of innovation"*.

From a framework-evaluation perspective, Mr Labuschagne's answer to the question of whether or not he agrees with the reasoning applied when the specific knowledge creation process path was identified as a key enabler of growth between innovation capability maturity levels was: *"I don't agree with the alignment of processes to the maturity levels. I would suggest that all the processes are required on all the maturity levels to a certain extent"*. He thought that the identified knowledge creation processes



do not accurately address the key maturity level description requirements for innovation capability growth. He indicated that he agrees with the specific knowledge management tool requirements detailed in the framework, but that it is very high-level. Regarding the structure of the framework, he wrote: *“I think the structure is good, with the right perspectives, I just don’t agree with the mapping or detail”*.

From a framework applicability and usability perspective, his response was that he thought the framework was not very practical in the current format. As a further comment he added that the author should re-evaluate her use of the capability maturity model and the levels of maturity, indicating that he did not understand that there are implicitly defined maturity levels that lie between maturity levels 1, 3 and 5.

### **5.5.3.2 Mr Labuschagne’s interview: Final research-evaluation response**

From the written response, it became clear that in order for Mr Labuschagne to evaluate the framework from a holistic perspective, it was important to discuss and reach a mutual understanding regarding the following topics: the research methodology, the maturity levels as depicted in this research, the knowledge process alignment and the scope of the framework.

The interview started with the author explaining the research to Mr Labuschagne in the same order and level of detail as found in the document, upon which he remarked the following: *“Now I understand. The information in your document doesn’t highlight this very well. I understand where you’re headed with this. When I read your document it wasn’t very obvious that all knowledge processes are present from level 1. Your explanation and interpretation of the framework seems like you understand this very well, but I’m not sure whether you’ve written it down as clearly, or I didn’t read it that well”*.

When asked whether he agrees with the specific knowledge creation process path identified as a key enabler of growth from one maturity level to the next, Mr Labuschagne’s reply was: *“Yes, I completely agree; it makes sense”*.

The author and Mr Labuschagne subsequently discussed the scope of the framework, to provide an ‘as is’ and ‘to be’ guideline for knowledge management tool requirements, from an organisational and ICT perspective, that enables growth from one innovation capability maturity level to the next. To this he replied: *“Yes, I*



*understand. That wasn't very clear to me when I read the document. I now understand the output of your framework. It is valuable, and there is a great need for this".*

Mr Labuschagne gave a positive response from an applicability and usability perspective: *"I think it's very applicable, and on the right level of detail. I find it practical".*

From a holistic evaluation perspective, his comment was: *"After the conversation we just had, I understand your work, and I really think it is very good. I think you chose a very good topic and it is in today's environment an important topic to address and understand".*

His final comment was that the author should take care to present the research in a way that is understandable: *"I think the thing about your work is contextualisation; it can be difficult to explain to someone who doesn't have the same background and level of knowledge of the subject as you have; where it fits in and how it works".*

#### **5.5.4 Mr PWJ van Zyl**

Mr Van Zyl did not provide a written response to the evaluation questionnaire and an interview guided by these evaluation questions was conducted. A transcript of his interview can be found in Appendix C.

The objective of this research evaluation was to firstly establish the soundness of the research methodology followed. Following the research methodology questions, the aim of the framework-related questions was to evaluate the framework from an innovation capability perspective. Mr Van Zyl's opinion would be valuable here, as he has extensive experience in the field of capability maturity models, and although he has had limited formal exposure to the field of knowledge management, he has practical experience in the subject area in how it relates to the CMMI®.

##### **5.5.4.1 Mr Van Zyl's interview: Research-evaluation response**

From a research methodology perspective, Mr Van Zyl was in complete agreement. Mr Van Zyl then elaborated on the question of whether or not he agrees with the idea of aligning knowledge creation processes with the key requirements for innovation capability maturity growth as the cornerstone of research toward using knowledge management to grow innovation capability maturity. He was in agreement with the author's approach, and pointed out that there can be two approaches: *"One way is to*



*enhance and extend the maturity model with knowledge management best practices; the other is to use knowledge management to achieve the maturity model's practices. And this is what you're saying here [using the latter approach], and I think this is a good view of the 'how'; using knowledge management to improve from maturity level 1 to 2 to 3 to 4 to 5. So this is absolutely meaningful".*

From a framework-evaluation perspective, Mr Van Zyl was in complete agreement with the specific knowledge creation path identified by the author as a key enabler of innovation capability maturity growth between maturity levels. He was also satisfied that this identified path accurately addresses the key maturity level description requirement for growth from one maturity level to the next. The author went through the tool requirements detailed in the framework, and Mr Van Zyl responded positively, with comments ranging from *"Yes, that's right"* to *"Yes, it's very good and I agree"*. He also agreed with the structure of the framework, synthesised to provide an input, output and supporting perspective on each of the identified knowledge creation processes, commenting that *"this framework is very good, I'm 100% with you, and I think it's very valuable"*.

From a framework applicability and usability perspective, Mr Van Zyl's response to the question of whether or not he thinks this framework is usable was: *"Yes, I think so"*, From here the discussion focussed on the differences between the ICMM on which this framework is based and the widely used CMMI® on which Mr Van Zyl is an expert, highlighting that there are a few differences in terminology that make the author's framework not immediately applicable in the CMMI® context. Mr Van Zyl concluded that *"in the context of someone who understands the CMMI® very well, your framework will be very useful, so I suggest you keep it this way"*, adding: *"When you're done with this study, I would like to write an article with you; and refine this framework for the CMMI®"*.

The interview ended on the following note: *"It is definitely usable and valuable within the context of the ICMM, and I think with a little adaptation, it will be valuable to the CMMI® community as well"*.

### **5.5.5 Ms H Smuts**

Ms Smuts provided a detailed written response to the evaluation questionnaire, but a few of her comments warranted further discussion, and an interview guided by these



evaluation questions was conducted. Her answers and a transcript of her interview can be found in Appendix C.

The objective of this research evaluation was to firstly establish the soundness of the research methodology followed. Following the research methodology questions, the aim of the framework-related questions was to evaluate the framework from a knowledge management perspective. Ms Smuts's opinion would be valuable here, as she is a keen researcher with solid knowledge of the subject of knowledge management and experience in the field of capability maturity models.

#### **5.5.5.1 Ms Smuts's written research-evaluation response**

From a research methodology perspective, Ms Smuts was in complete agreement, adding that *"with the rapid change of technology in this industry [mobile telecommunication], your innovative capability is key to maintaining and growing market share"*.

From a framework-evaluation perspective, Ms Smuts agreed with the reasoning applied in the identification of the knowledge creation growth path, and added that she feels that even though innovation is enabled by more than just knowledge processes, *"if you have limited your scope to knowledge management and innovation only, then I feel your proposal is the best 'link' as key enabler between the two"*. Ms Smuts also agreed with the specific knowledge creation path identified as a key enabler for innovation capability maturity growth, but was unsure what the author meant with the socialisation process: *"Does it imply that it runs across all CMM levels?"* Regarding the detailed knowledge management tool requirements, Ms Smuts questioned whether the author also intended the use of system tools and technology. She agreed with the structure of the framework, but here the uncertainty regarding the implication of the socialisation process also surfaced: *"I like the framework – only the socialisation component, exactly where it fits in (across 1 to 5 or for 5 only) as described above is not clear to me"*.

From a framework applicability and usability perspective, Ms Smuts commented that she *"will definitely be able to apply the framework in practice"*. She commented that she found it easy to translate the guidelines into what it means for them as an organisation and for their innovation objectives, as she has prior knowledge of capability maturity models and knowledge management. She added that someone





less experienced would be able to understand the framework, even though he or she may find it difficult to translate it to his or her work environment. Ms Smuts added that *“for your thesis and scope thereof, I feel you have achieved your objective of applicability”*.

Ms Smuts’s concluded her written response with: *“I enjoyed reading your documentation. It is well written and presented and I can see applicability from an organisational perspective”*.

### **5.5.5.2 Ms Smuts’s interview: Final research-evaluation response**

From the written response, it became clear that in order for Ms Smuts to evaluate the framework from a knowledge management perspective, it was important to discuss and reach a mutual understanding regarding the following topics: scope of the research, how the socialisation process fits into the model as well as the intended focus of the knowledge management tool requirements as detailed in the framework.

From a research methodology perspective, Ms Smuts reaffirmed that she had no objections, adding that *“everything is fine; very good”*.

From there the interview turned to the framework-evaluation perspective. Firstly the scope of the research was discussed, with the author agreeing that there is a lot more to innovation than knowledge management alone. The author stated that the framework and the angle of this research should however be seen as one way of linking the two, specifically linking the fields of innovation capability and knowledge management, to which Ms Smuts replied: *“Okay, 100%. That’s correct”*.

The second point to address was the socialisation process, with the author stating that it should be managed from maturity level 1, as indicated by the heading of the right-hand column in the framework. To this Ms Smuts responded: *“That’s correct. That is exactly what I wanted to confirm with you”*. She suggested that the appearance of the framework could be altered to show the socialisation process in a line across all the maturity levels, adding that this will visually enhance the reader’s understanding.

The last point from the written response that needed to be addressed was the intended focus of the detailed knowledge management tool requirements of the framework. It was subsequently explained that the framework should serve as a guideline for organisational tools but also for ICT tool requirements by enabling us to



evaluate new software products, and so forth, to which Ms Smuts replied: “Yes, *that’s correct, now I understand*”. She also reaffirmed that she liked the structure of the framework.

From a framework applicability and usability perspective, Ms Smuts responded very positively: “Yes. *It [the framework] is definitely something that I can personally very easily use in my work environment. I would easily be able to translate it to how I can apply it in our organisation. I went through every block in the framework, asking what the input and output was, and how we can support that, and it was very easy for me to make those links; it works very nicely. What was also very interesting was that it enables you to identify gaps; if you for example say ‘Identify, locate, obtain and integrate’, I can for example go and check that, yes, we can identify, locate and obtain, but integration is a bit of an issue; so to use it as a bit of a rough analysis*”.

## 5.6 Summary of evaluation feedback



Five industry and subject theory experts from various fields each evaluated the research by means of a written response to and/or an interview-based discussion facilitated by an evaluation questionnaire. These interviewees were chosen to provide a broad perspective of the research, while the evaluation questions were chosen to systematically cover all aspects of the research methodology as well as the framework. The intention was to hereby create a platform for a comprehensive discussion of the author’s research.

The results show an overwhelmingly positive response, with all five experts agreeing with the research methodology-related questions and the framework-evaluation-related questions presented in the evaluation questionnaire.

### 5.6.1 Research hypothesis: Proven or rejected?

All five experts responded positively to, and were in agreement with, the following statements:

1. That the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next as



the cornerstone of research toward a knowledge management framework to grow innovation capability maturity is valid

2. That the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels is logical and sound
3. That this path accurately addresses the key requirements for growth from one maturity level to the next
4. That the knowledge management tool requirements and organisational facilitating conditions detailed in the framework for each identified knowledge creation process in the path are accurate

It can therefore be stated with fair confidence that the following research hypothesis was proven:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

### 5.6.2 Research applicability and usability

From a framework applicability and usability perspective, the responses were encouraging:

*“... should a company go to the effort to select the appropriate tools using the framework and allocate them into the framework, it should be applicable and useful.”* (Dr HE Essmann)

*“Absolutely.”* (Mr DF Botha) [When asked whether he finds the framework applicable and usable.]

*“I think it’s very applicable, and on the right level of detail. I find it practical.”* (Mr L Labuschagne)

*“It is definitely usable and valuable within the context of the ICMM, and I think with a little adaptation, it will be valuable to the CMMI® community as well.”* (Mr PWJ van Zyl)



*“It [the framework] is definitely something that I can personally very easily use in my work environment. ... I would easily be able to translate it to how I can apply it in our organisation. ... What was also very interesting was that it enables you to identify gaps ... to use it as a bit of a rough analysis.” (Ms H Smuts)*

### 5.6.3 Research evaluation: Lessons learnt



This section highlights the constructive criticism received during the evaluation process; reassuringly, however, none of which was aimed at the ability of the framework to enable innovation capability maturity growth. Suggestions were made for further research, a possible literary bias was discussed, a comment was made on the readability of the research summary document and the visual impact of the framework was addressed.

#### 5.6.3.1 Scope for further research: Level of detail of framework

From a future work perspective, Dr Essmann suggested that *“research could also be conducted to align knowledge-process requirements and ICM requirements at a more detailed level (out of scope of this research)”*.

#### 5.6.3.2 Scope for further research: Applicability wider than ICMM

Mr Van Zyl highlighted that there are a few differences in terminology that make the framework presented in this document not immediately applicable in the CMMI® context. Mr Van Zyl concluded that *“in the context of someone who understands the CMMI® very well, your framework will be very useful, so I suggest you keep it this way”*, adding: *“When you’re done with this study, I would like to write an article with you; and refine this framework for the CMMI®.”*

#### 5.6.3.3 Research summary document: Possible literary bias

Dr Botha cautioned against referring only to Nonaka in the literature study, as he is part of the first wave of knowledge management: *“If you use only Nonaka, you could create the impression that you think there is nothing else”*.

This comment was based on the research summary sent to the interviewees, and was consequently valuable input for the writing of this thesis. Hence, Nonaka’s knowledge



view (Sections 3.1.2.4), critique against his work (Section 3.3.1) and the applicability of his work for this study (Section 3.3.1.2) were included in this document.

#### **5.6.3.4 Research summary document: Readability**

Mr Labuschagne found the description of the research in the interviewee summary document insufficient for understanding the scope of the framework: *“I think the thing about your work is contextualisation; it can be difficult to explain to someone who doesn’t have the same background and level of knowledge of the subject as you have; where it fits in and how it works”*. After a verbal explanation of the research during the interview, he commented: *“That wasn’t very clear to me when I read the document. I now understand the output of your framework. It is valuable, and there is a great need for this”*.

In contrast, Ms Smuts’s written comment was: *“I enjoyed reading your documentation. It is well written and presented”*.

Mr Labuschagne’s comment was important for the writing of this thesis, as it acted as a motivational factor for constantly measuring the level of detail and providing a clear and understandable storyline against the research scope.

#### **5.6.3.5 Visual impact of framework**

Ms Smuts commented about the visual impact of the framework and its ability to convey the context of the elements of the framework. She mentioned that at first glance, she was unsure whether the socialisation process runs across all the innovation capability maturity levels, or whether it is only a supporting process at level 5. Since this was her only concern, and no other interviewees had a problem with the visual interpretation of the framework, the decision was made to keep the current framework presentation.

## **5.7 Summary**

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

(Research hypothesis, Section 3.4)



The scope of this research study does not allow for practical implementation with real-life results; consequently, four research questions were designed to test whether it can be determined with fair confidence that the framework could enable innovation capability maturity growth, should the framework be used in a real organisation. Therefore, the research hypothesis can be proved if the following is determined:

1. That the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next as the cornerstone of research toward a knowledge management framework to grow innovation capability maturity is valid
2. That the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels is logical and sound
3. That the identified knowledge creation path accurately addresses the key requirements for growth from one maturity level to the next
4. That the knowledge management tool requirements and organisational facilitating conditions for each identified knowledge creation process in the path, as detailed in the framework, are accurate

Five industry and subject theory experts from various fields each focused on evaluating the research methodology and framework through responses to an evaluation questionnaire and/or interview-based discussions, with the intention of establishing whether the framework meets the above-stated four requirements. The questionnaire outcome supports the hypothesis, as all five experts were in agreement with the four questions. The results also show a positive response toward the applicability and usability of the framework. The scope for additional research was identified as aligning knowledge creation processes at a more detailed innovation capability level, as well as refining the framework for use in the context of the CMMI®.



**Chapter 6**

**Conclusion**



This chapter provides an objective and concise overview of the research done toward a knowledge management framework to grow innovation capability maturity, concluding with a discussion of future work.

## 6.1 Research overview

This section outlines the research methodology and work done, draws conclusions on the research output and its evaluation and highlights the unique research contribution.

### 6.1.1 Research summary

The research done in this study is based on the premise that innovation is a key prerequisite for being organisationally competitive and attaining sustained long-term wealth within a business environment that is ever-more unpredictable. It is therefore seen as imperative that organisations grow and mature their innovation capability.

Knowledge management plays a fundamental role in the enterprise's ability to innovate successfully, but the literature on the use of knowledge management tools and organisational facilitating conditions to enable innovation capability maturity growth is sparse, which led to the following research problem statement:

*No formal guidelines exist for the use of knowledge management to grow innovation capability maturity.*

Within this context, the knowledge management landscape was explored. The literature strongly supports the reasoning that knowledge management and more specifically knowledge creation processes could be used to improve the innovation capability maturity of an organisation. This notion formed the basis for the following research hypothesis:

*A knowledge management framework that enables innovation capability maturity growth can be designed by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.*

Within this context, the logic and development process behind building this knowledge management framework to grow innovation capability maturity were discussed. This was done by identifying a knowledge creation path (Figure 19) that acts as a key





enabler for maturity growth from maturity level 1 through to maturity level 5. This forms the cornerstone of the research done toward a knowledge management framework to grow innovation capability maturity.

A detailed expansion of these fundamentals was done through a discussion of the underlying logic and practical implications of the knowledge creation processes. A literature study supported this reasoning, with the goal of determining generic knowledge management tool requirements and organisational facilitating conditions that support the specific processes highlighted in the identified knowledge creation path.

The technology-development landscape changes over time, and therefore emphasis was placed on researching generic requirements rather than specific tools in order to position the relevance and applicability of the research in the long term. This will also allow for use of the framework across a wider range of organisational domains. These requirements were subsequently synthesised to form the framework presented in this study (Figure 25). The impact of the framework was demonstrated by discussing a practical organisational scenario.

This study concluded with a research evaluation conducted through an evaluation questionnaire and subsequent expert interviews, all of which showed an overwhelmingly positive response to the research output.

### **6.1.2 Research-evaluation results**

The scope of this research study did not allow for practical implementation, and consequently four research questions were designed to test whether it can be determined with fair confidence that the framework could enable innovation capability maturity growth, should the framework be used in a real organisation. Five industry and subject theory experts from various fields each focused on evaluating the research methodology and framework. This was done through responses to an evaluation questionnaire and/or interview-based discussions, detailing the questions that were designed to systematically test the hypothesis.

The questionnaire outcome supports the hypothesis, as all five experts responded positively to, and were in agreement with, the abovementioned four questions. An encouraging response to the practical applicability and usability of the framework was



received from all five interviewees. Section 6.2 details the lessons learnt from this research-evaluation process and discusses the scope for future research.

### 6.1.3 Unique research contribution

The literature study presented in this thesis provided compelling evidence that knowledge management tools and organisational facilitating conditions could be used to enable innovation capability maturity growth.

However, there is a gap in existing literature on the use of knowledge management toward innovation capability maturity growth. The unique research contribution of the framework therefore lies in providing a tangible link between the fields of knowledge management and innovation capability maturity (Figure 28).



**Figure 28: Research domain**

Throughout this document it is emphasised that the framework is not a comprehensive solution to enable innovation capability maturity growth or an enterprise-wide knowledge management integration plan. Rather, the impact of this framework lies in providing guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth.

The framework serves as an 'as is' and 'to be' reference point for determining whether an enterprise's organisational conditions and knowledge management tools are



sufficient in order to sustain or grow its innovation capability maturity. Here the framework is a tool, which success relies on the knowledge, experience and dedication of the individual, project team, department or organisation applying it.

## 6.2 Recommendations for future work

Constructive criticism has been received throughout the evaluation process, and this section concludes the body of this document in a discussion of the lessons learnt as well as future work to enhance the practical and academic value of this study.

### 6.2.1 Lessons learnt

Concerning the readability of the research summary document, one interviewee felt that the description of the research in the document is insufficient to understand the scope of the framework. Although only one interviewee had a problem with the readability of the summary document, the comment was important for the writing of this thesis, as it acted as a motivational factor for constantly measuring the level of detail and providing a clear and understandable storyline against the research scope.

One interviewee cautioned against a possible literary bias when referring only to Nonaka in a literature study, as this could create the impression that the author is not aware of any other knowledge creation theories. This comment was only based on the research summary sent to the interviewees, and was consequently valuable input for the writing of this thesis. Hence Nonaka's knowledge view, critique against his work and the applicability of his work for this study were discussed in this document.

Another interviewee commented on the visual impact of the framework and its ability to convey the context of the elements of the framework. The interviewee was unsure, at first glance, whether the socialisation process runs across all the innovation capability maturity levels, or whether it is only a supporting process at level 5. Since no other interviewees had a problem with the visual interpretation of the framework, the decision was made to keep the current framework presentation.

### 6.2.2 Future work

In terms of future work, it was suggested during the evaluation process that research could be conducted to align knowledge creation processes and innovation capability maturity requirements at a more detailed level. This implies investigating knowledge



management tools and facilitating conditions for all 42 capabilities (refer to Appendix A and Essmann [13]), as this study was only aimed at improving innovation capability maturity as described in the generic maturity level descriptions.

It was also suggested that wider applicability could be achieved if the framework is refined for use in a CMMI® context, as the CMMI® is the successor of the SW-CMM®, which is the basis for most maturity models used today. There are a few differences between the ICMM and CMMI® that make the framework presented in this document not immediately applicable in the CMMI® community, notably that the CMMI® implies that innovation is only required at higher organisational maturity levels. It was, however, commented that someone who understands the CMMI® very well would still find the framework, as presented in this document, useful.

Furthermore, the conceptual nature of the research study leaves ample opportunity for further research into the practical application of the framework, as the ability of the framework to enable innovation capability maturity growth will only be determined via real-world implementation.

Practical implementation would also provide a platform for investigating whether there are essential gaps in the knowledge management tool requirements and facilitating conditions as presented in the framework and would point to the nature of these shortcomings. This could serve as a starting point to determine the need for future work toward an implementation manual and/or an implementation methodology to accompany the framework, as the framework is a tool, the success of which is dependent on the knowledge, experience and dedication of the individual, project team, department or organisation applying it.

Currently, this framework serves as a unique, first conceptual step toward providing knowledge management guidelines to enable innovation capability maturity growth.

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## Appendix A

# Innovation Capability Maturity Model

Dr HE Essmann



This appendix presents a concise summary of the ICMM by Dr HE Essmann [13].

Rather than providing an independent summary with the inherent risk of altering the essence and diminishing the academic value of his work, the author includes the following article with consent from, and full acknowledgement to, Dr Essmann:

H. Essmann and N. du Preez, "An Innovation Capability Maturity Model - Development and initial application", *World Academy of Science, Engineering and Technology*, vol. 53, pp. 435–446, 2009.

# An Innovation Capability Maturity Model – Development and initial application

H. Essmann, and N. du Preez

**Abstract**—The seemingly ambiguous title of this paper – use of the terms maturity and innovation in concord – signifies the imperative of every organisation within the competitive domain. Where organisational maturity and innovativeness were traditionally considered antonymous, the assimilation of these two seemingly contradictory notions is fundamental to the assurance of long-term organisational prosperity. Organisations are required, now more than ever, to grow and mature their innovation capability – rendering consistent innovative outputs. This paper describes research conducted to consolidate the principles of innovation and identify the fundamental components that constitute organisational innovation capability. The process of developing an Innovation Capability Maturity Model is presented. A brief description is provided of the basic components of the model, followed by a description of the case studies that were conducted to evaluate the model. The paper concludes with a summary of the findings and potential future research.

**Keywords**—Capability Maturity, Innovation, Innovation Capability

## I. INTRODUCTION

TECHNOLOGY has been and continues to be the primary driving force of growth [1]. Innovation, constituting the processes of invention through to commercialisation, is the source of technological advancement [2]. Moore [3] equates enterprises and markets to nature, requiring relentless evolution to maintain equilibrium, and sporadic revolution to create advantage. Innovation is the source of this evolution and revolution [4]. Thus, innovation is not only a current issue, it is a perpetual one. According to Moore [3], “To innovate forever, in other words, is not an aspiration; it is a design specification. It is not a strategy; it is a requirement.”

Many definitions for innovation permeate the literature. Countless journals and publications, theses and dissertations, books and internet sites are dedicated to the proliferation of innovation principles. One prominent actuality unifies this extensive literature – *innovation is crucial for creating and sustaining organisational competitive advantage*. From the multitude of definitions, certain fundamental principles may be identified. Katz [5] sees the literature as encapsulating of

“similar themes relating to innovation.” His consolidation of these themes rendered the following definition for innovation: “the successful generation, development and implementation of new and novel ideas, WHICH introduce new products, processes and/or strategies to a company OR enhances current products, processes and/or strategies LEADING TO commercial success and possible market leadership AND creating value for stakeholders, driving economic growth and improving standards of living.” [5]

According to Hamel [6], “There is no sausage crank for innovation, but it’s possible to increase the odds of a ‘eureka!’ moment by assembling the right ingredients”. These ingredients are the requirements and practices of organisational innovation capability and, according to Moore [3]; the essence of which is the same in any organisation. These generic and fundamental requirements for innovation are, therefore, the primary subject of interest for this research.

Dismukes [1] identified the following motivational factors for developing and improving innovation capability within organisations: the rising standard of innovation (essentially, meta-innovation), perpetually escalating diffusion rates, increased complexity requiring increased multidisciplinary involvement, heightened collaboration necessitating better cooperation and communication among scientists and engineers and between creators and consumers, higher levels of creativity demanded from both creators and consumers, and the broadening scope of innovation in response to demands from centres of excellence and consumers. These factors demonstrate the importance of organisations being capable of consistent innovation – as the primary source of competitive advantage, and the means by which advantage is maintained [1], [7] and [8].

Thus, with a clear understanding of the importance of developing and improving organisational innovation capability, research commenced with the objective of identifying the organisational ingredients of innovation capability and incorporating them into a so called Innovation Capability Maturity Model (based on the original Capability Maturity Models of the SEI, Carnegie Mellon University [9]).

## II. MODEL DEVELOPMENT

This research formed part of a PhD in Industrial Engineering that was divided into 3 phases. Phase I constituted the preliminary literature review, research proposal and scrutinising of the Maturity Modelling approach and its

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applicability to the innovation capability domain. Phase II began with a detailed literature review of innovation fundamentals. This led to the development of a first version of the ICMM. Thereafter, a case study was performed in which the ICMM v1 was evaluated, resulting in several refinement objectives. Phase III involved a rigorous refinement initiative in which multiple activities were undertaken to improve the representation of the model in an effort to simplify its utilisation, while maintaining (if not improving) the comprehensive thereof. The consolidation of these activities would lead to the second version of the model. Subsequently, a series of evaluation and validation case studies were executed using the ICMM v2, and in the process, describing the foundation for an Innovation Capability Improvement Methodology. This research paper focuses on the activities of Phase III, but presents the overall conclusions of the research.

The activities of Phases I and II of this research led to an initial version of the ICMM and, having utilised the model in a specific application, resulted in the following refinement objectives:

- 1) Present the model, its structure and contents in a more pragmatic manner – improve the applicability and practicality thereof.

model – continue to ensure that the fundamental constituents of innovation capability are addressed.

While the ICMM v1 could be used as an evaluation and improvement framework for organisational innovation capability, and was found to be relatively comprehensive in nature, it was tedious and laborious to deploy and therefore required refinement.

The high-level process and associated activities performed to refine the model are presented in Fig. 1. Each of the high-level activities individually depicted in the diagram is a meta-analysis that provided additional insight into the content and structure of the ICMM v1 and the evaluated literature. The consolidation of these analyses with the ICMM v1 served to improve the robustness of the second version and contributed to fulfilling the objectives discussed previously.

The model itself, although central to the process depicted in Fig. 1, was not the primary source of information in developing the second version of the model. The first version provided the framework with which several Innovativeness Constructs were mapped and the content with which the outputs of the other activities were compared during consolidation. This consolidation process, while not depicted as one of the major activities in Fig. 1, was a crucial process.

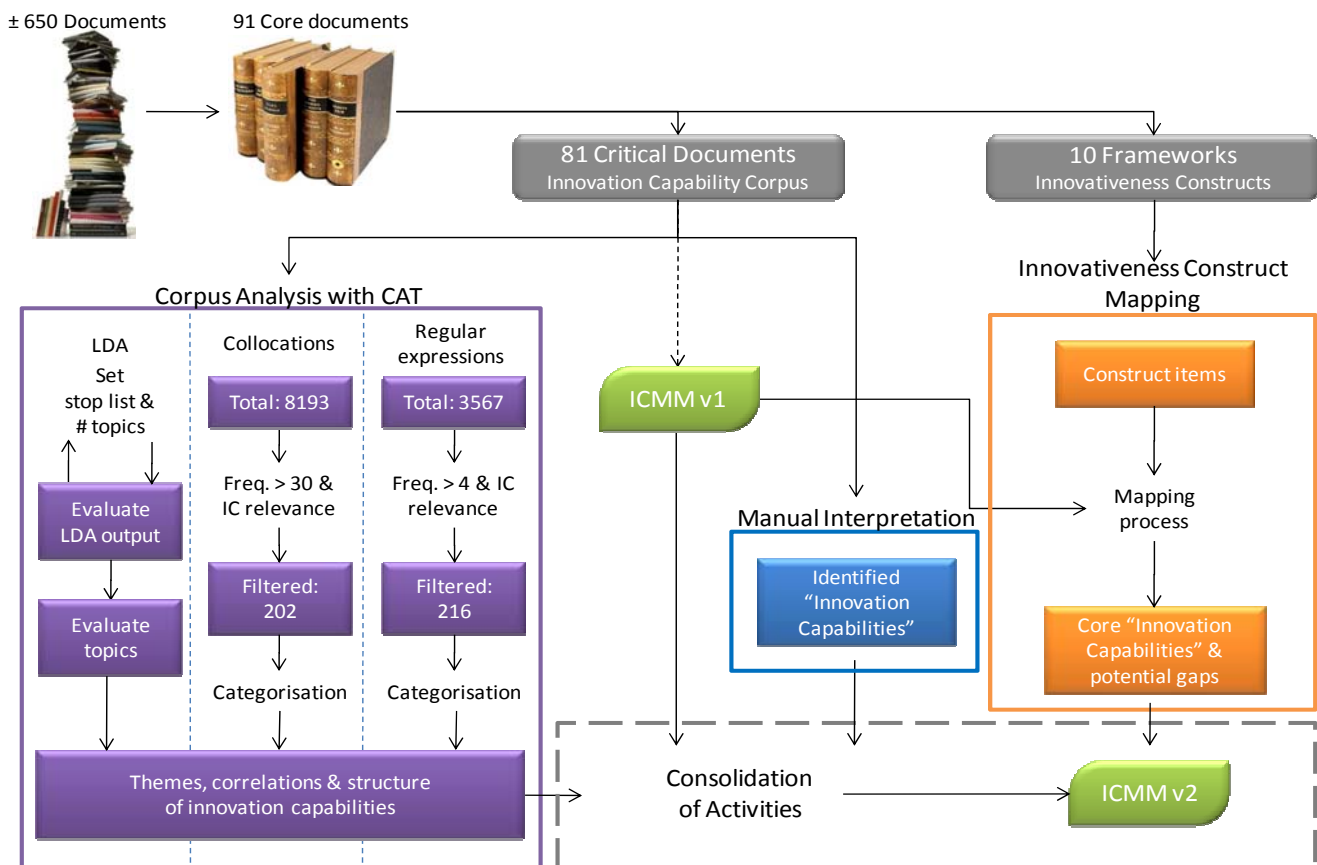


Fig. 1 Refinement process

- 2) Maintain and/or improve the comprehensiveness of the The outputs of the refinement activities had to be integrated in

a holistic manner, taking the results of each activity into consideration simultaneously.

The literature surveyed prior to the refinement process, and throughout the duration of this project, constituted approximately 650 documents. From this large literature set, 91 documents were identified as core, directly addressing the subject of organisational innovation capability. These documents were sourced from many locations, including peer reviewed journals, conference proceedings, white papers, electronic books, etc.

These 91 documents were further subdivided into two groups. The first, containing 81 of the 91 documents, is referred to as the Innovation Capability Corpus and was used to perform 2 analyses. The first was a detailed manual analysis and interpretation of the innovation capability landscape (supplementing the initial literature study) and the second a Latent Dirichlet Allocation (LDA) based topic modelling analysis. The remaining 10 documents, containing so called "Innovativeness Constructs", were used in a mapping and comparison exercise.

The "Manual Interpretation" involved reviewing, in detail, the contents of the Innovation Capability Corpus with the objective of identifying the core organisational innovation capabilities researched and presented therein. The results were presented in a table capturing all the metadata on the documents (such as author(s), keywords, etc.) and, most importantly, the various themes of innovation capability identified in each. This table was then used in the final consolidation process.

The LDA-based topic modelling analysis had the high-level objective of generating an alternate and objective perspective on the innovation capability landscape – one that was independent of any particular individual's perspective. LDA is a generative probabilistic model for collections of discrete data [10]. In the context of documentation and text, it represents documents as random mixtures over latent topics, where each topic is characterised by a distribution over words from the corpus [10]. LDA is therefore a useful model for identifying structure in text that is essentially unstructured [11]. Uys et al. [12] discusses how topic modelling, for which LDA is utilised, may be applied to assist knowledge workers in digesting large collections of textual documents. The basis of this process was used to analyse the Innovation Capability Corpus with the objective of:

- 1) Identifying the core concepts (or topics) pertaining to innovation capability according to the LDA-based topic modelling process.
- 2) Depicting the (text-based statistical) interrelations between the topics of innovation capability.
- 3) Identifying hierarchical structure within the topics of innovation capability.
- 4) Providing a framework by which to compare and evaluate the content and structure of the ICMM v1.

Software, known as CAT (Corpus Analysis Toolkit – see [13]), was used for this analysis as it utilises LDA-based topic modelling. The software also utilises various other techniques,

such as Collocation and Regular Expressions, to contextualise a corpus. These techniques supplemented the LDA analysis by providing additional insight into the content of the Innovation Capability Corpus.

The most significant benefits from having performed this analysis were: (1) being able to identify the different concepts of innovation capability from a perspective that was unique in terms of application – no literature on innovation was found to have used such a technique; and (2) the fact that the perspective was (more) objective in nature – themes being identified based on the statistical relevance of the words within the corpus text. The activities targeted at evaluating and refining the model's structure (topic interrelations and hierarchical structure) were regularly used to understand the nature of a specific topic, its appropriate level of detail and how it relates to the other topics. While their contribution to the overall refinement process was less than that of the identified topics, the omission of these activities would certainly have reduced the richness of the insight gained from the analysis as a whole.

The final activity, a mapping and comparison exercise, made use of 10 Innovativeness Constructs to evaluate the content of the ICMM v1. These constructs discussed various attributes and requirements supporting organisational innovativeness. The activity had the following objectives:

- 1) By mapping the content of the ICMM v1 onto the constructs, it would be possible to identify gaps in the model – certain construct requirements may not be addressed by any specific ICMM items.
- 2) By tracking the extent of the mapping, it would be possible to identify the core innovation capability requirements – certain aspects of the ICMM v1 would address specific requirements stipulated in the constructs on several occasions, thus highlighting their relevance.

This activity therefore served as a thorough evaluation of the content of the ICMM v1, identifying potential gaps, highlighting the core content and even content that was potentially redundant.

Once the individual refinement activities had been completed, the process of consolidating the outcomes began. The challenge faced during this task was in considering the outputs of the abovementioned activities in a simultaneous and lucid manner. A vast quantity of information had been generated through these activities, which had to be related, in an integrated manner, with the ICMM v1. This was achieved by separately comparing the outputs of the refinement activities with the ICMM v1, firstly from a content perspective, and then structurally. While this remained true for the first cycle, the iterative nature of the process thereafter implied that various aspects of the refinement activity's outputs and the model (in the form it was in at the time) were revisited. Once this process had been completed, so that all aspects had been considered sufficiently, the model had reached a second state of revision – ICMM v2.

### III. ICMM v2

There are 3 high-level parts to the ICMM v2. The first is a framework that provides the model with the required structure. The second addresses the core requirements for innovation capability – aptly named Innovation Capability Requirements. These requirements represent the primary content of the model and are categorised therein based on the framework. The third part of the model deals with the organisational roles that are required for innovation. Fig. 2 illustrates how the latter mentioned parts of the model become part of the framework.

#### A. Framework

The most significant change to the initial ICMM relates to structuring – the categorisation of content and the approach taken to depict innovation capability maturity. In version 2 this structure is provided by a three dimensional framework consisting of the following axes: an Innovation Capability Construct, an Organisational Construct and Capability Maturity (as depicted in Fig. 2).

The first dimension of the framework, the so called

Innovation Capability Construct, uses two levels of detail to describe organisational innovation capability. The highest level components are referred to as Innovation Capability Areas (such as “Innovation Process”) and the second level components are referred to as Innovation Capability Construct Items (such as “Portfolio Management”). Basically, the capability areas imply that there are 3 fundamental areas of innovation capability:

- 1) Innovation Process – the practices, procedures, activities etc. that take ideas and/or opportunities through to concepts, then through development and implementation and eventually to a stage of commercialisation and operation (which may include continuous refinement and optimisation). Basically, it refers to the complete innovation lifecycle.
- 2) Knowledge & Competency – the innovation process requires both specific and broad-based knowledge and competency, whether already within the organisation or still to be developed or acquired. Also included are the associated management requirements for knowledge, competencies as well as technology.

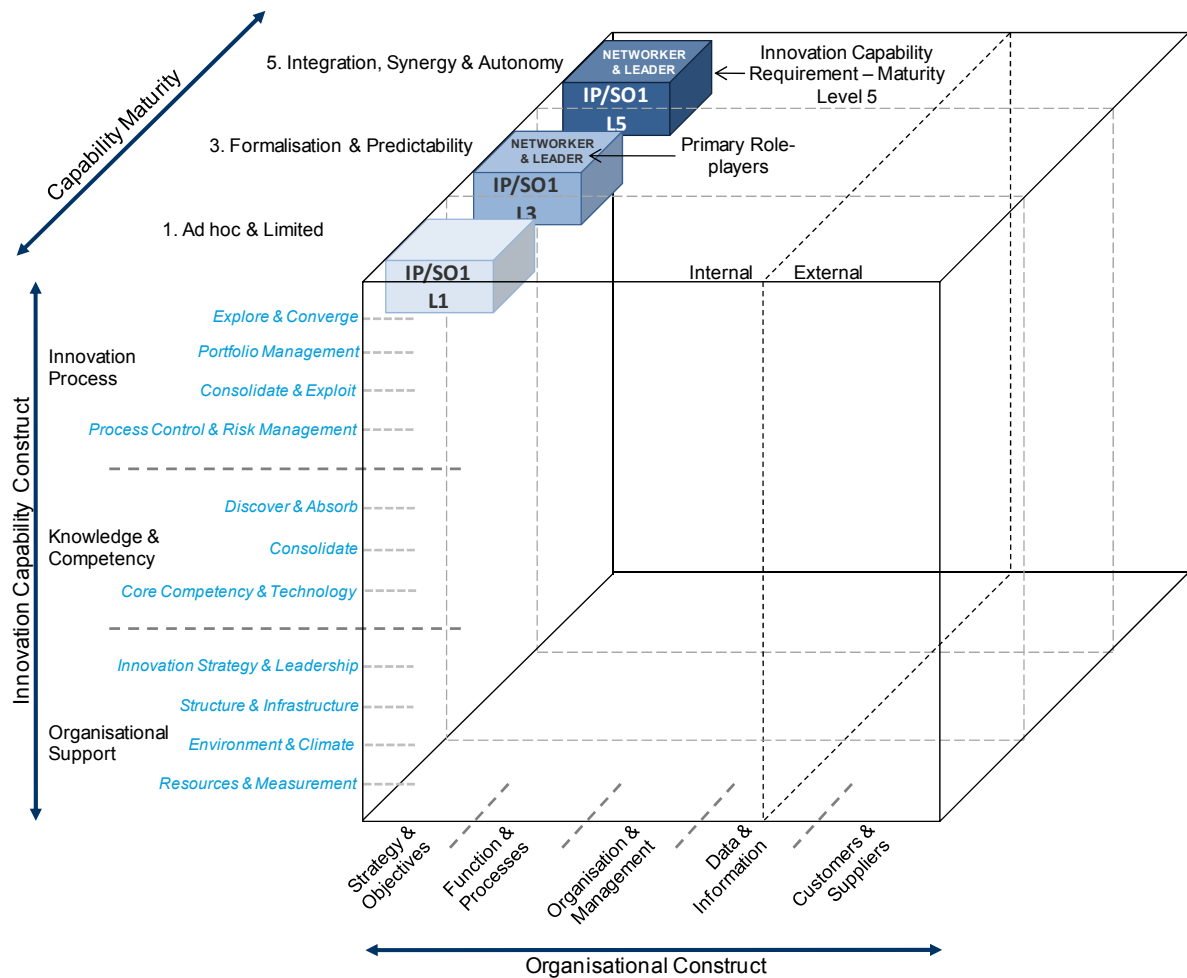


Fig. 2 ICMM v2 framework, example capability requirement and primary role-players

- 3) **Organisational Support** – the structures, resources, measures, infrastructure, strategy and policies, leadership, etc. necessary to support the process, and knowledge and competency requirements for innovation.

The purpose for introducing an Organisational Construct to the framework is to ensure that the fundamental aspects of an organisation are addressed by the content of the model. Furthermore, the formation of a matrix by the Innovation Capability and Organisational constructs provides an effective mechanism for depicting the interrelations between the capability requirements and the impact that the requirements may have of on these organisational attributes. The construct items, consolidated from the work of [4] and [14] – [18], are as follows:

- 1) **Strategy & Objectives** – the mission and vision, short- and long-term objectives, etc. are at the core of an organisation and steer it in a particular direction that will eventually determine the competitiveness of the organisation.
- 2) **Function & Processes** – the activities that are in place to drive the organisation closer to fulfilling its objectives, whether directly (such as valued-added processes) or indirectly (such as administrative and support processes).
- 3) **Organisation & Management** – the structures and entities that are tasked with governing and/or controlling the execution of activities in order to fulfil objectives.
- 4) **Data & Information** – relating to the internal and external environments, the basis for all decision making (from complex strategic decisions to process decisions) and the (communication) link between all internal and external entities (individuals, production units, departments, management, suppliers, the market, etc.).
- 5) **Customers & Suppliers** – customers are willing to pay for the organisation's value offering and suppliers provide crucial components for that value offering.

The last axis of the framework represents the different levels of (innovation) Capability Maturity. Based on the SEI's definition [9], maturity levels are well-defined evolutionary plateaus for capability improvement – in this case innovation

capability. Fig. 3 provides a brief description of each of the 5 levels of innovation capability maturity.

### B. Innovation Capability Requirements

The Innovation Capability Requirements are at the core of the ICMM v2. They are generic organisational attributes that are necessary for organisations to be capable of innovating consistently. Using the ICMM v1, and through the refinement activities mentioned previously, 42 requirements were identified as essential to organisational innovation capability.

The capability requirement depicted in Fig. 2 is IP/SO1 – Scanning & exploring for latent opportunities. Based on its representative code (IP/SO1), the requirement is categorised into the “Innovation Process” capability area and the “Explore & Converge” item of the Innovation Capability Construct and the “Strategy & Objectives” item of the Organisational Construct. The 3 maturity level descriptions (representative of 5 levels by having intermediate levels between 1 and 3, and between 3 and 5) for this requirement are as follows:

- 1) **Maturity Level 1: IP/SO1 L1** – "Opportunities" of the future are based on extrapolations of the past.
- 2) **Maturity Level 3: IP/SO1 L3** – Initiatives to find latent opportunities are undertaken. Procedures have been developed and implemented, and the required outputs defined.
- 3) **Maturity Level 5: IP/SO1 L5** – Future-orientated scanning and exploring activities provide consistent strategic input. Procedures to identify latent opportunities are institutional.

Each of the 42 capability requirements is similarly categorised into the model's framework. However, the mapping is not always on a one-to-one basis – Fig. 4 demonstrates how the 42 requirements map onto the front-facing two dimensional plane of the framework. This mapping provides essential information as to the interrelations between the capability requirements. These interrelations are presented from an innovation capability perspective (Innovation Capability Construct – horizontal relations) and an organisational perspective (Organisational Construct – vertical relations).

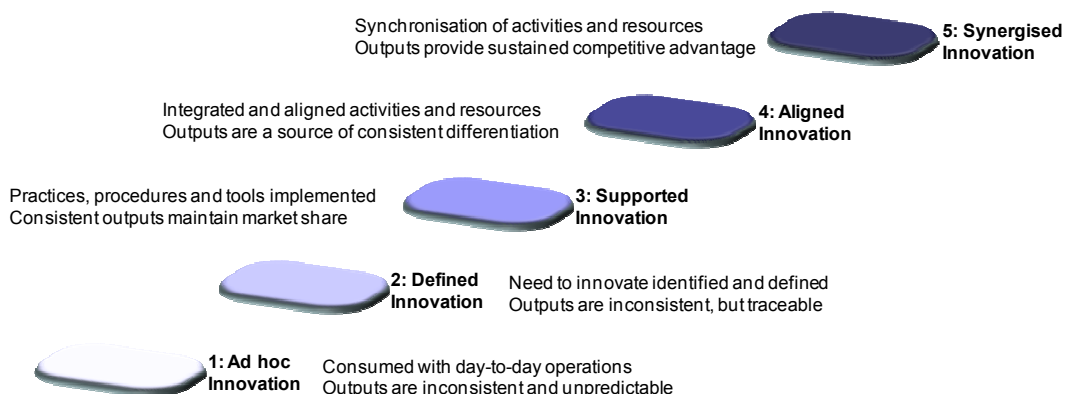


Fig. 3 ICMM v2 Maturity Levels

Organisational Construct		Internal				External	
		Strategy & Objectives	Function & Processes	Organisation & Management	Data & Information	Customers & Suppliers	
Innovation Capability Construct	Explore & Converge	IP/SO1 - Scanning & exploring for latent opportunities	IP/FP1 - Identifying opportunities IP/FP2 - Developing concepts	IP/OM1 - Contextualising opportunities & concepts		IP/CS1 - Understanding the market	
	Portfolio Management	IP/SO2 - Balancing the innovation portfolio	IP/FP3 - Testing, screening & prioritising opportunities & concepts	IP/OM2 - Planning & coordinating the innovation portfolio			
	Consolidate & Exploit	IP/SO3 - Using fundamental principles to guide process & make decisions	IP/FP4 - Substantiating, implementing & exploiting opportunities	IP/OM3 - Allocating resources appropriately IP/OM4 - Using appropriate project management techniques	IP.KC/DI1 - Capturing, storing & retrieving data & information IP.KC/DI2 - Formal & informal external networking & collaboration	IP/CS2 - Involving customers & suppliers in the innovation process	
	Process Control & Risk Management		IP/FP5 - Identifying and planning for key decision points	IP/OM5 - Reducing uncertainty & mitigating risk			
Knowledge & Competency	Discover	KC/SO1 - Establishing knowledge, competency & technology development & acquisition strategy	KC/FP1 - Continuous research	KC/OM1 - Managing tacit knowledge		KC/CS3 - Ensuring supplier competency & technology supports requirements	
	Absorb & Consolidate		KC/FP2 - Identifying & extracting relevant information	KC/OM2 - Managing intellectual property			
	Core Competency & Technology	KC/SO2 - Establishing intellectual property management & sharing policy	KC/FP3 - Developing & acquiring the required competencies & technologies	KC/OM3 - Managing core competency & technology			
Organisational Support	Innovation Strategy & Leadership	OS/SO1 - Developing & conveying innovation strategy & objectives	OS/FP1 - Championing & encouraging innovation	OS/OM1 - Meta-Innovation	OS/DI1 - Communication & the flow of information		
	Structure & Infrastructure	OS/SO2 - Organisational values & policies	OS/FP2 - Infrastructure, systems & tools to support process & management requirements	OS/OM2 - Creating cross-functional & multidisciplinary teams OS/OM3 - Developing flexible & adaptable organisational structure & infrastructure OS/OM4 - Motivating, rewarding & celebrating success			
	Environment & Climate		OS/FP3 - Organisational practices & procedures				
	Resources & Measurement	OS/SO3 - Investment in innovation & sourcing of capital	OS/FP4 - Providing the necessary resources (Resource slack, focussed resources) OS/FP5 - Measuring innovation	OS/OM5 - Hiring & aligning people's values & skills with organisation & task OS/OM6 - Benchmarking innovation			

Fig. 4 Innovation Capability Requirements categorised into construct

### C. Innovation Roles

The innovation roles provide an additional means of relating Innovation Capability Requirements to one another and understanding an individual's role in (responsibility for and/or exposure to) developing organisational innovation capability. Further, this roles-based view on the capability requirements provides an essential mechanism of interpreting completed questionnaires (discussed later) by adding context to the responses of individual respondents. The core innovation roles, based on a consolidation of [19]–[22], are:

- 1) **Networker** – Scan market, industry, technology, regulatory and societal trends to understand potential futures and identify latent opportunities. Create connections between internal and external individuals, teams and organisations that have common or complementary objectives.
- 2) **Coordinator** – Balance project objectives, resources and risk. Contextualise, position and promote opportunities and concepts. Prioritise, plan, coordinate, schedule, and assure completion of projects. Overcome or outsmart obstacles faced during projects.
- 3) **Builder** – Make tangible concepts of ideas, demonstrate concepts, obtain feedback from colleagues and customers, and refine concepts. Build, test and refine working "products" and ensure "production" readiness. Strive towards the initial vision of the concept with minimal compromise for design, production and delivery.
- 4) **Anthropologist** – Develop understanding of how people interact physically and emotionally with products, services, one another and their environment. Transform the physical environment into a tool to influence behaviour and attitude, enabling individuals to do their best work. Anticipate and service the needs of colleagues, customers, suppliers and other stakeholders.
- 5) **Leader** – Align activities with strategy and objectives. Build and involve teams of the "right" individuals at the "right" time. Evaluate and prioritise opportunities and ideas against a standard framework considering all business requirements. Guide progress, monitor metrics and instigate corrective action. Build synergy into projects and the organisation.

### IV. CASE STUDIES

A total of 5 case studies were conducted with the ICMM v2 with the primary objective of evaluating the content and structure of the model, as well as, the mechanisms used to translate these concepts into organisational innovation capability improvement. The case studies had, however, not been taken through the complete improvement cycle by the time of writing this paper – implementation of refinements had yet to be completed. Therefore, in order to validate the model, it was assumed that, should the model and the associated methodology appropriately identify the organisation's strengths and weakness in terms of innovation capability, to the extent that participants could relate to the results, conclusions and the recommended actions, then the model would have served its purpose. Thus, validation was based on executive and management buy-in. A summary of the case studies is presented in Table I.

#### A. Questionnaire

Various components and mechanisms were required to translate the model and its associated components into a practical tool that could be used to assess the innovation capability of an organisation. The most important of these was a questionnaire that was used to gauge the organisation (or business unit) against each of the 42 Innovation Capability Requirements – the level of maturity at which they fulfil the requirements. The process is, therefore, reliant on the organisation's employees relaying the internal situation via the questionnaire. It consists of the following sections:

- 1) **Respondent general information** – includes name, contact details, number of years in organisation, basic description of day-to-day activities, etc. This section may be adapted to capture specific information that may assist in the interpretation of results for a specific organisation.
- 2) **Role description** – the role profile of a respondent is determined using the Innovation Roles. Individuals are only exposed to and/or responsible for certain requirements. This influences their responses and needs to be accounted for during interpretation.
- 3) **Innovation status description** – the respondent is tasked with providing a once-off rating of the organisation's innovation capability maturity. Additionally, each

TABLE I  
SUMMARIZED CASE STUDY DATA

Case Study	Description	No. of respondents	Organisation/ business unit size (approx.)	Once-off overall rating (5 – highest)	Overall average rating	Overall normalised average rating	Average std. dev. between respondents	Std. dev. between requirements ratings (normalised ave.)
CS1	Innovation Management consultancy	21	25	3.1	2.93	2.68	1.03	0.55
CS2	Innovative insurance products	1	10	3.0	2.30	N/A	N/A	0.91
CS3	Underwriting consultants for financial services	3	3	2.0	2.68	N/A	0.57	1.03
CS4	Client Services of major insurance provider	30	160	1.6	2.27	2.22	0.96	0.40
CS5	Public Relations and communications provider	6	13	2.3	2.66	2.55	0.82	0.69

progressive description of innovation capability maturity links with a corresponding status of innovation-based outputs. This once-off rating is later related to the outcomes of the overall results of the case studies to determine if there is consistency between the results.

- 4) 42 Capability Requirement questions – there is a question for to each of the Innovation Capability Requirements. The procedure involves the respondent relating the situation within his/her organisation to the maturity level descriptions and marking the level that corresponds with the internal situation.

### B. Sample Results

An important aspect of innovation capability maturity evaluation (and any evaluation based on a questionnaire) is the interpretation of the questionnaires and the translation of answers into value-adding and descriptive results that improve the respondents' understanding of the situation. Little can be extracted from a single maturity rating (except for intra-organisational benchmarking). The results must be presented at various levels of aggregation and from multiple perspectives. This is necessary to identify the innovation capability strengths and weaknesses of the organisation. Fig. 5 and Fig. 6 present examples of the results that were shown to the organisational participants. Constraining the use of advanced statistics was the significance of the sample sizes. Even in these cases, however, participants found the use of

basic statistics valuable.

In Fig. 5, the so called Innovation Capability Portfolio is presented. This figure plots a point, based on the average rating from the respondents (no normalisation applied) and the standard deviation between the respondents, for each of the 42 Capability Requirements. It was used as the first representation of the results during the questionnaire interpretation and results presentation activities. Individuals are able to rapidly identify potential strengths, opportunities for improvement and areas of non-consensus in terms of the capability requirements.

Another view on the data was that of the different perspectives of the three organisational groups of individuals that completed the questionnaire. Those capability requirements showing the greatest differences (based on the standard deviation between the average, non-normalised rating for each group) between the 3 groups are shown in Fig. 6. This figure served as a major discussion point during the presentation of results and proved to be largely beneficial in terms of clarification of group perspectives.

### C. General Findings

The case studies provided support for the validity of the model's content, structure and the approach used to evaluate innovation capability. In each case, the participants were satisfied with the results and recommendations, and were optimistic that should the recommended actions be taken, the

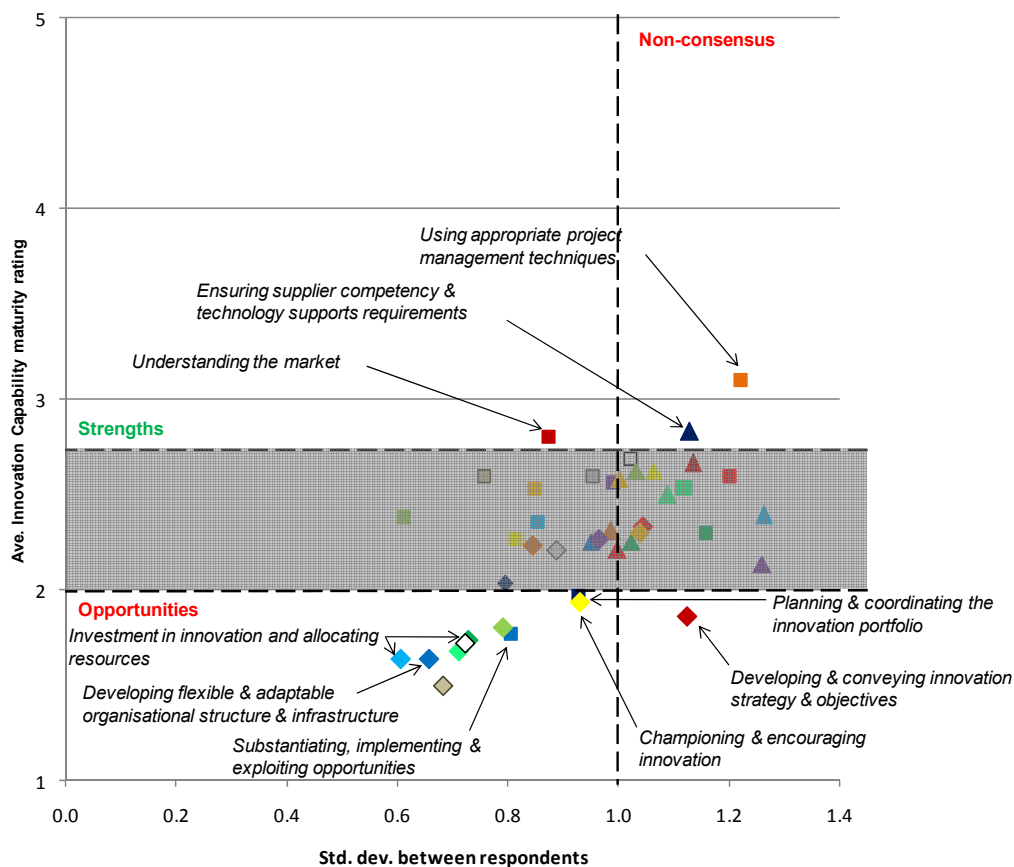


Fig. 5 Case Study 4 – Innovation Capability Portfolio

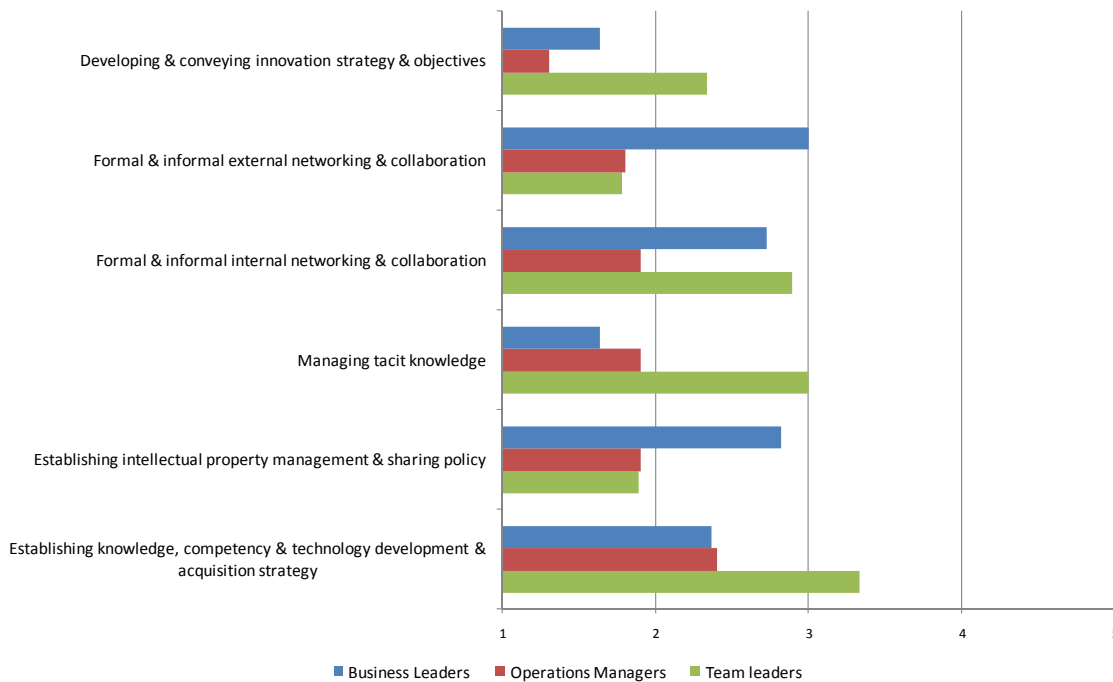


Fig. 6 Case Study 4 – differences between organisational groups

innovation capability and essentially, the manner in which they conduct business, would improve.

Having completed the process several times, certain essential insights were gained to demonstrate the benefit and value in using the model and the associated improvement methodology. These fundamental findings are:

- 1) Discussion between participants stimulated by the process is a major value-add. It ensures that the participants walk away with a common understanding of their organisation that will enable a coordinated and proactive effort to improve their innovation capability.
- 2) The identification of differences in perspective between individuals and groups signifies potential misalignment within the organisation and enables communication and clarification thereof. The process can be used to stimulate the communication that will ensure improved alignment between individuals and groups within the organisation.
- 3) An overall measure of the organisation's innovation capability maturity has little value for a specific organisation except to compare with other organisations, i.e., for benchmarking purposes. However, collectively considering the more detailed results of the evaluation provides an accurate representation of the organisation's situation.
- 4) The evaluation is based upon the individuals' perspective of innovation capability (normalised for their role within the organisation) and not an objective quantitative measure. This is appropriate because, essentially, people are the instigators and executors of innovation and their perspective carries more "hands-on" knowledge and understanding of the organisation's innovation capability

than any purely quantitative aspect could. The ICMM v2 and questionnaire, therefore, provide the guiding framework by which to extract this hands-on knowledge and understanding of the organisation.

These aspects are core to the value of the model, but also to better understanding innovation and the organisational capability to do so consistently. The latter mentioned finding highlighting the fact that innovation is "people" driven reiterates the often quoted statement that an organisation's biggest resource is its people.

On a final note regarding findings, certain trends appeared within the results of the case studies that may be of interest. It must be noted, however, that these trends are based on only 5 cases and should, therefore, be interpreted accordingly. Table 1 provides the data for the following discussion and diagrams.

One of the objectives of including a once-off maturity rating of an organisation in the questionnaire was to enable a comparison between the eventual results of the completed questionnaire and this once-off rating, testing for consistency between the outcomes. This once-off rating also refers to the status of the innovation-based outputs, thus linking the outputs of innovation to the innovation capability maturity of an organisation. To make the intended comparison, the 3rd and 4th columns of Table 1 are plotted against one another in Fig. 7.

The ideal situation would be to see the points plotted along the grey dotted line depicted in Fig. 7. The actual situation, while not severely inconsistent with the aforementioned, does not follow this trend outright – deviations from the line are evident. Again, note that this is based on only 5 cases studies. There are 2 potential reasons for these deviations:



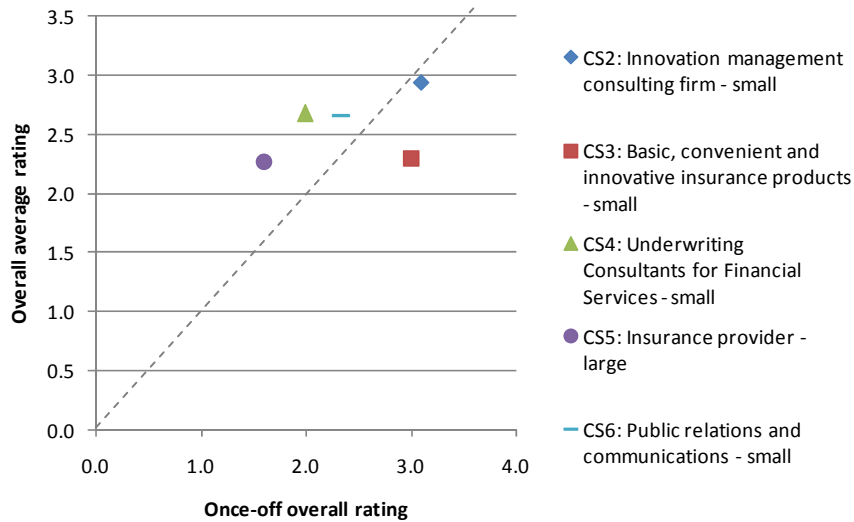


Fig. 7 Once-off overall rating vs. overall average rating

- 1) The once-off rating descriptions do not present an accurate and generic global picture of an organisation at each of the maturity levels.
- 2) Individuals completing the questionnaire find it difficult to provide a once-off rating of a complex system. Additionally, given the fact that this once-off rating is performed prior to having gone through the core Innovation Capability Requirements, the individuals are not fully aware of the situation.

While the findings of this analysis are not entirely inconsistent with the suggested trend, additional research should be done to refine these outcomes. This may simply mean moving the once-off rating to the end of the questionnaire (in line with the second potential reason for deviation) or refining the wording of the descriptions on which the ratings are based.

Another interesting trend that surfaced from the summarised results of the case studies is that of the relation between the organisation or business unit size and the dispersion between the normalised average ratings for each of the 42 Innovation Capability Requirements (measured as the standard deviation between the normalised average ratings of the requirements – column 8, Table 1). These 2 values were plotted against one another for each of the case studies – Fig. 8.

The findings indicate a hyperbolic trend between the dispersion of requirements ratings and the size of the organisation. Literally interpreted, this implies that a smaller organisation's strengths will be relatively stronger and the weaknesses, relatively weaker. Conversely, a larger organisation's fulfilment of the requirements is less dispersed. Note that it does not imply that smaller or larger organisations are stronger or weaker in general.

The hyperbolic nature is logical because it is seemingly unlikely that the dispersion will reach zero for extremely larger organisations. However, the reason for the general trend is unclear and should be researched further. It may be linked

to the presence or absence of certain formal structures within an organisation – the appropriate balancing of which to facilitate innovation being the objective of the ICMM v2. If this were the case, it would require correlation between an organisation's size and the implementation of structure.

## V. CONCLUSION

This paper concludes with a discussion on the relevance and applicability of the Innovation Capability Maturity Model and potential further research. The first point pertains to the generic nature of the model. Basically, the ICMM v2 describes the innovation capability landscape at 3 levels of detail and relates it to the organisation by means of an Organisational Construct. The lowest level of detail of the model is intended to remain generic, i.e., be applicable to various organisations in different industries and with different value offerings (and other aspects such as strategy, culture, size, etc.). The model does not, however, prescribe specific practices, but rather the requirements that need to be fulfilled by those practices – the so called Innovation Capability Requirements. The practices that fulfil those requirements will (generally) be specific to an organisation and not applicable to all. Certainly, the best practices of a benchmark organisation can be used to develop those of another organisation, but to replicate each and every instantiation thereof will not be effective. In short then, the ICMM v2 defines the “what” of innovation capability and not the “how”. This is intended to be the “essence of innovation” that, according to Moore [3], is the same in every organisation.

Finally, the following future research opportunities have been identified from the research described in this paper. The intention would be to improve the ICMM v2, with specific attention to the methodology, i.e., the application of the model. These aspects include:

- 1) Questionnaire and related aspects – focussing on the detailed design thereof and the inclusion of a response-

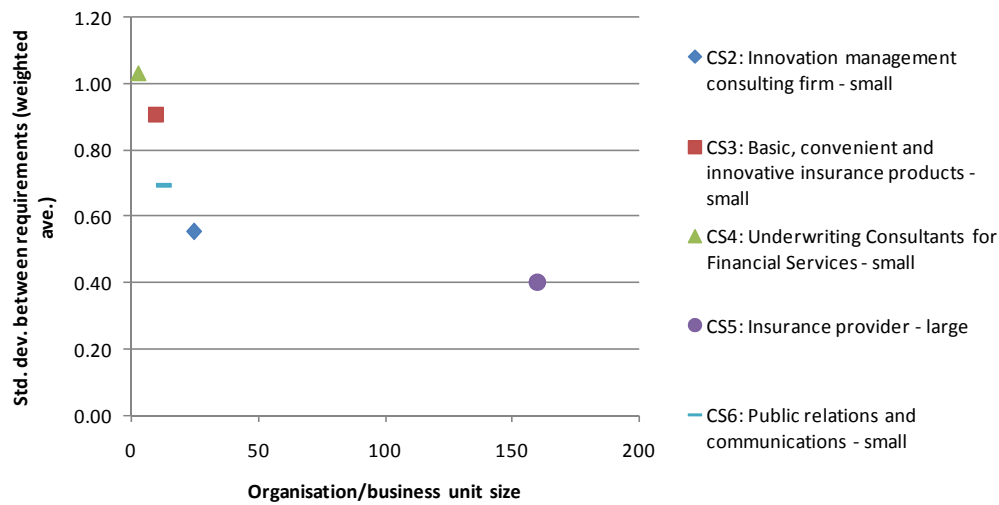


Fig. 8 Dispersion in requirements vs. organisation size

validity test (such as an infrequency test to determine inconsistencies in an individual's responses). Further, while the roles-based normalisation mechanism proved successful under the given circumstance, its effectiveness in other situations should be evaluated.

- 2) A framework describing the implicit interdependencies within the Innovation Capability Requirements, i.e., those that are not depicted in the framework (Fig. 4). Based on these interdependencies, a mechanism could be developed to understand the impact of prioritising certain requirements during an improvement initiative. The mechanism could be used to refine the prioritisation process.
- 3) The proposed improvement stage activities – with specific attention to the parallel execution of innovation projects and improvement initiatives, the appropriate points of interface between the two processes, and the information and lessons that should be shared at these interfaces.
- 4) The possibility of using the model and an appropriate mechanism to establish official innovation capability benchmarks, possible for various organisational-types (size, industry, value offering, etc.).

On a final note, this model is not offered as an easy route to attaining innovation capability maturity. Hard work and perseverance cannot be replaced with miracle methods or models. According to Thomas Edison, "Genius is one percent inspiration and ninety nine percent perspiration." There are, however, methods and models that may assist with what would otherwise be an extremely difficult task. Being consistently innovative requires a complex arrangement of the right ingredients. It is a phenomenon that will probably never be fully understood. Partial understanding thereof combined with a fraction of the right ingredients is, however, a massive improvement upon ignorance. The Innovation Capability Maturity Model is intended to *reduce* this ignorance.

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**Appendix B**

**Summary  
document**



# A KNOWLEDGE MANAGEMENT FRAMEWORK TO GROW INNOVATION CAPABILITY MATURITY

## EVALUATION DOCUMENT – PART 1

Background literature, methodology and framework

September 2010

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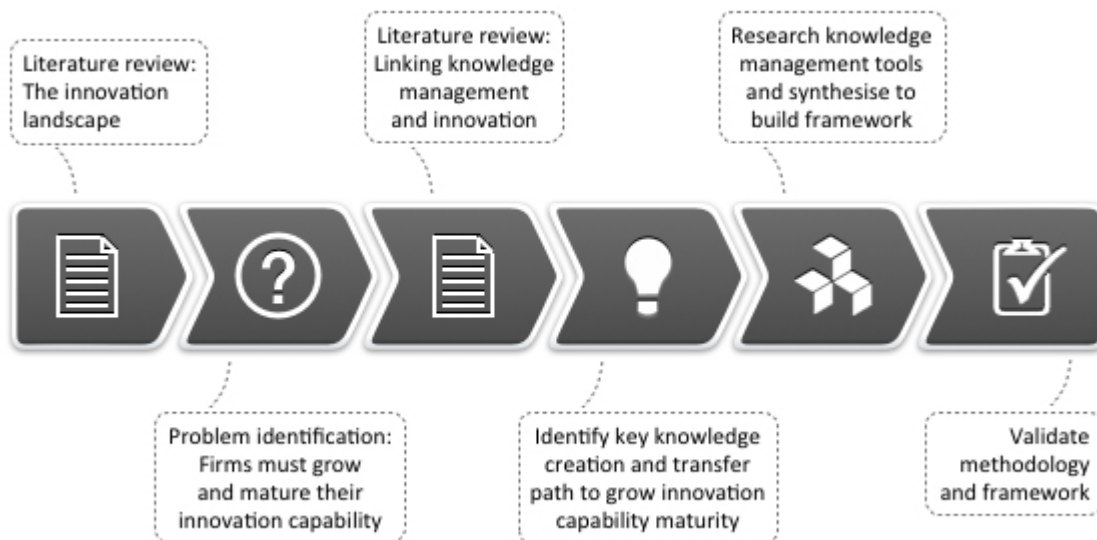
## Purpose of the research<sup>9</sup>

Innovation is widely considered a key prerequisite for achieving organisational competitiveness and sustained long-term wealth in our increasingly volatile business environment. It is therefore imperative that organisations enable themselves to relentlessly pursue constant innovation; *to grow and mature their innovation capability*.

Therefore, the aim of this research is to investigate organisational support by means of business tools toward maturity growth in these innovation capability areas.

## Research methodology

Figure 29 depicts the outline of the research methodology followed during this study. A literature review of the innovation landscape led the author to identify the need for organisations to grow and mature their innovation capability. Knowledge management plays a fundamental role in the enterprise's ability to innovate successfully, and consequently, this thesis investigates how knowledge management tools can be applied to advance innovation capability maturity growth.



**Figure 29: Research outline**

The literature strongly supports the reasoning that knowledge management and more specifically knowledge creation processes could be used to improve the innovation

<sup>9</sup> Terminology used in this and subsequent sections will be clarified in the Background literature: Innovation capability maturity and knowledge management section.



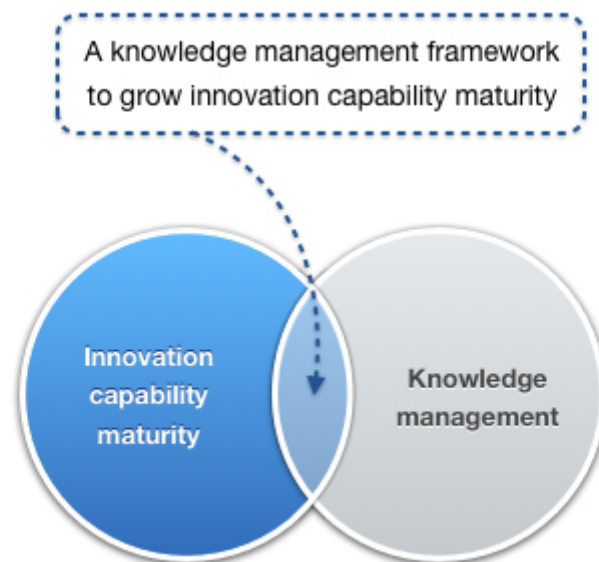
capability maturity of an organisation. This forms the basis for the research aimed at developing a knowledge management framework that enables innovation capability maturity growth by aligning knowledge creation processes to the requirements for innovation capability growth from one maturity level to the next.

In order to align these knowledge processes with the requirements for growth in innovation capability maturity, the author identified a knowledge creation path as a key enabler for growth from one maturity level to the next. Knowledge management tool requirements and organisational facilitating conditions that support the specific knowledge processes highlighted in the identified path were reviewed and subsequently combined to form a framework.

The impact of this framework lies in providing guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth.

## Research scope

The framework presented in this document is neither intended as the be-all and end-all solution to enable innovation capability maturity growth, nor is the intention to provide a step-by-step enterprise-wide knowledge management integration plan.



**Figure 30: Research domain**



The author's aim was to investigate organisational support by means of business tools toward innovation capability maturity growth. The result of this investigation was a conceptual framework, serving as guideline for the use of knowledge management as a vehicle for innovation capability growth. The unique research contribution lies in providing a tangible link between the fields of knowledge management and innovation capability maturity.

## Your role

An evaluation of the methodology used, the framework developed as well as its ability to provide guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth is required. Your input concerning the following will be much appreciated:

- a) The logic and accuracy of the research methodology
- b) The accuracy, applicability and usability of the framework

This will be achieved via completion of a written questionnaire, followed by a one-to-one feedback-orientated interview, during which your answers and comments on the framework will be discussed. To facilitate this evaluation procedure, a short literature summary as well as a brief explanation of how the framework was developed is presented to act as background information for understanding the context of the framework as well as its scope and impact.

## Background literature: Innovation capability maturity and knowledge management<sup>10</sup>

### Why innovation capability?

Innovation has been defined as “the successful generation, development and implementation of new and novel ideas, which introduce new products, processes and/or strategies to a company or enhance current products, processes and/or strategies leading to commercial success and possible market leadership and creating

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<sup>10</sup> This literature summary is far from a complete representation of all topics related to innovation capability maturity or knowledge management. The aim of this section is to ensure that the reader has enough background information to understand the terminology, methodology, context, scope and impact intended by the author.





value for stakeholders, driving economic growth and improving standards of living” [8]. It is therefore a dynamic process.

Consequently, innovation is a key prerequisite for achieving organisational competitiveness and long-term wealth in a volatile business environment. The ability to innovate and to do so on a constant and sustainable basis is considered vital for organisations functioning within the competitive realm.

There is a common misconception that innovation must be completely novel. This is far from the truth: Common processes and previously acquired knowledge and competencies, supported by the appropriate organisational structures, strategy, climate, culture and leaders, can collectively contribute to an environment that facilitates and/or is conducive to innovation [13]. This is what is referred to as the capability to innovate; *innovation capability is the organisational means with which innovative outputs are generated* [13].

This innovation capability must be assessed and improved in order to sustain, repeat and accelerate innovative initiatives. This requirement for assessment and constant improvement directly translates to the concept of innovation capability maturity and capability maturity models.

## Why capability maturity models?

The two essential goals of a capability maturity model are a) to determine the capability maturity of an organisation in terms of a specific domain of practice, and consequently b) to facilitate in establishing and guiding improvement that will best suit the enterprise and that complies with the prescribed best practices of the domain [13].

The importance of capability maturity models can be seen as follows: In order to understand the current positioning of an enterprise relevant to its competitors as well as enterprises in other industries, it is necessary to establish its capability maturity in terms of a specific domain of practice. Moreover, it is important to benchmark oneself against the best or against those who are known to be successful, in order to determine how much and in what direction to improve.

The enterprise has a wide selection of capability maturity models from which to choose, not only between applications, but also within each application, as capability maturity models have been developed for many applications, including software



development, IT management, project management, data management and business management [19].

## What is an innovation capability maturity model?

Recently, the Innovation Capability Maturity Model<sup>11</sup> (ICMM) has been developed – a capability maturity model specifically aimed at measuring the innovation capability maturity of an enterprise.

Most capability maturity models have the same basic five-level maturity scale structure,<sup>12</sup> with corresponding maturity level descriptions. A maturity level can be defined as a well-defined evolutionary plateau of process improvement. The following is a description of the respective *generic* innovation capability maturity levels (with implicit intermediate levels between 1 and 3, and 3 and 5), as specified by the ICMM:

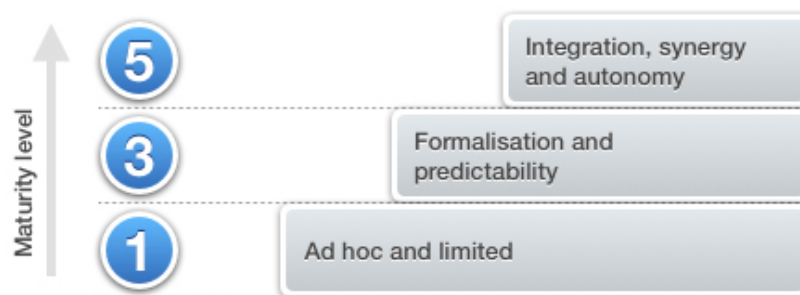


Figure 31: Innovation capability maturity levels [13]

- **Maturity level 1: *Ad hoc and limited*** – innovation-related practices and procedures are impromptu and limited in their ability to fulfil the requirements for consistent innovation.
- **Maturity level 3: *Formalisation and predictability*** – innovation-related best practices and procedures have been identified and deployed, enabling the consistent fulfilment of the requirements for innovation. This does not imply the deployment of a rigid and stifling structure that must be conformed to, but rather to a proactive and planned approach to innovating.

<sup>11</sup> The generic and fundamental requirements for organisational innovation capability researched and consolidated into an ICMM by Dr HE Essmann, “Toward innovation capability maturity,” PhD dissertation, Dept. of Ind. Eng., Stellenbosch Univ., South Africa, 2009.

<sup>12</sup> Most maturity models are based on SW-CMM®, the original Capability Maturity Model® for software. It is a widely accepted set of guidelines for developing high-performance software organisations.



- **Maturity level 5: *Integration, synergy and autonomy*** – once formalisation has been attained, the institutionalisation of practices emerges, in other words where activities become natural behaviour. This enables individual autonomy and the freeing up of resources to concentrate on achieving alignment and synergy within and between innovation initiatives and with operational activities.

An enterprise does not always begin at maturity level 1. The enterprise is benchmarked against the requirements of each level, and is assigned the appropriate level – subject to the continuous fulfilment of requirements. All the requirements at each level are assumed to have been fulfilled for each of the successive levels.

The primary content of the ICMM deals with the core requirements for innovation capability. These 42 innovation capability requirements are structured within the model, each with its own *specific* level 1, 3 and 5 maturity level scenario descriptions modelled on the *generic* maturity level descriptions as in Figure 31. Although the scope of this document, as well as the framework presented in it, does not necessitate a detailed account of the ICMM, listing a few of the requirements might provide context as to the application of the ICMM:

- Developing and conveying innovation strategy and objectives
- Championing and encouraging innovation
- Involving customers and suppliers in the innovation process
- Planning and coordinating the innovation portfolio
- Reducing uncertainty and mitigating risk
- Establishing intellectual property management and sharing policy
- Capturing, storing and retrieving data and information

Supplementing the core of the ICMM is an innovation capability questionnaire that is used to assess the organisation's innovation capability against the *specific* innovation capability requirements of the ICMM. Individuals from the organisation (or business unit) being assessed are asked to complete a questionnaire in which the enterprise is benchmarked against the requirements of each level. The individual then assigns the appropriate level per innovation capability requirement, within the context of his or her



daily exposure to the relevant innovation-related activity described by the maturity level scenario descriptions. The results of the innovation capability questionnaire are intended to reveal the potential innovation capability improvement areas.

An example of such an innovation capability questionnaire question is: How is data and information captured, stored and retrieved?

- *Maturity level 1 description:* Information is ‘dumped’ into unstructured storage. Search and retrieval are predominantly manual.
- *Maturity level 3 description:* Procedures and frameworks for contextualising, categorising and capturing, and tools for storing and retrieving data and information have been identified, defined and deployed
- *Maturity level 5 description:* Individuals and teams have adopted and exploit the deployed procedures, frameworks and tools

After evaluation, the enterprise is guided through a rigorous consultation procedure to prioritise and improve key innovation capability improvement areas based on the results of this in-depth assessment. This is the start of a cyclical ‘evaluate, plan, improve’ improvement process.

*This innovation capability maturity improvement process is currently facilitated through case-specific consultation, and it is exactly here that the author’s research interest lies; in providing formalised generic guidelines for knowledge management as a vehicle for innovation capability maturity growth.*

## Why knowledge management?

Knowledge plays an intrinsic role in the process of innovation – it forms the foundation on which innovation is based. In a world where markets, products, technologies, competitors, regulations and even societies change rapidly, continuous innovation and the knowledge that enables such innovation have become important sources of sustainable competitive advantage.

This knowledge resides within the heads of people in the form of tacit knowledge, but also as explicit knowledge that has been codified in documents, processes, tools, and so forth. It is used to make decisions throughout the innovation process – decisions that ultimately determine the success of innovation projects [10].



- *“**Tacit knowledge** covers knowledge that is unarticulated and tied to the senses, movement skills, physical experiences, intuition, or implicit rules of thumb. Knowledge of wine tasting, crafting a violin, or interpreting a complex seismic printout of an oil reservoir are well-known examples of tacit knowledge” [61].*
- *“Tacit knowledge differs from ‘**explicit knowledge**’ that is uttered and captured in drawings and writing. For example, knowledge of a solution to a differential equation is explicit knowledge” [61].*

However, the key to obtaining a long-term competitive advantage is not to be found in the administration of existing knowledge, but in the ability to constantly generate new knowledge. New knowledge can be created either through the expansion of already existing tacit or explicit knowledge, or through a new method of combining these forms of knowledge.

The process of generating knowledge can be categorised into four different knowledge creation processes: socialisation, externalisation, combination and internalisation [56] (refer to Figure 32):

i. **Socialisation**

Tacit to tacit knowledge transfer is referred to as socialisation. Since tacit knowledge is difficult to formalise and often time- and space-specific, tacit knowledge is acquired and converted only through shared experience. Socialisation typically occurs when sharing the same environment.

ii. **Externalisation**

Explicit to tacit knowledge transfer is referred to as externalisation. Knowledge is formed when tacit knowledge is articulated into explicit knowledge. This allows it to be shared by others, and it then becomes the basis of new knowledge. Tacit knowledge becomes explicit through metaphors, analogies, concepts, hypotheses or models.

iii. **Combination**

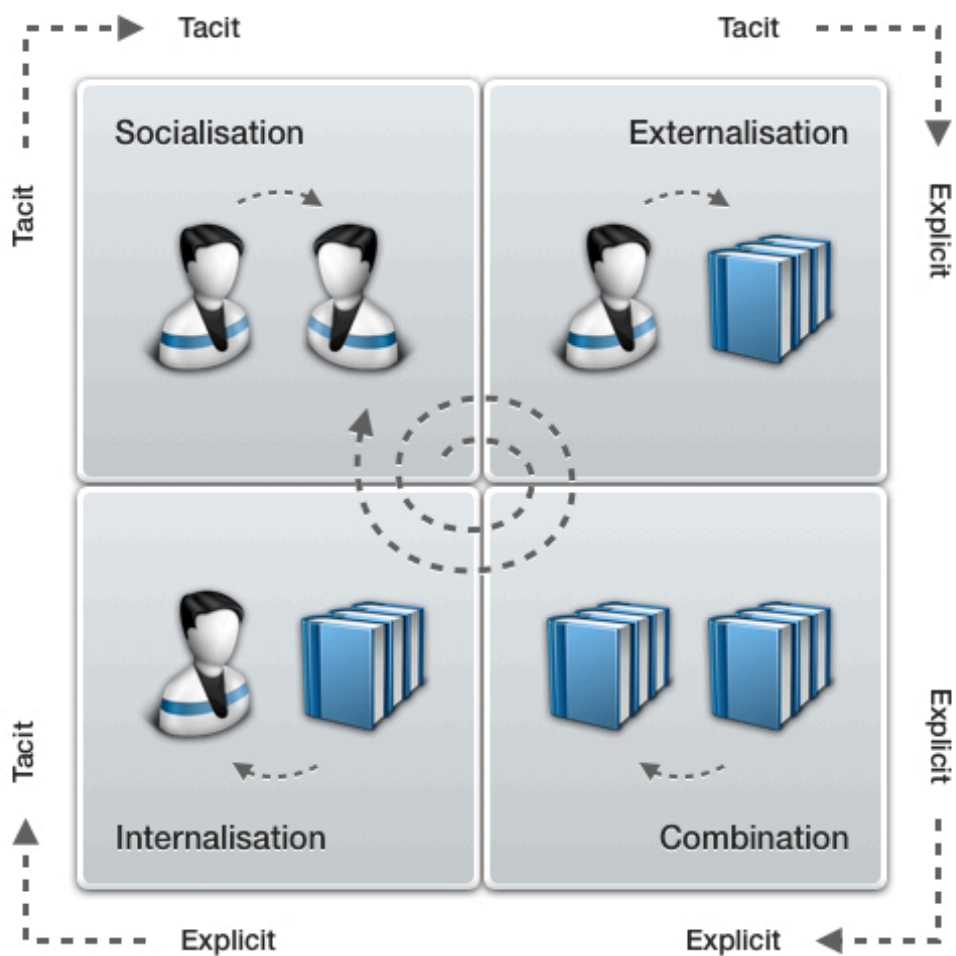
Transferring explicit knowledge to more complex and systematic sets of explicit knowledge is referred to as combination. Explicit knowledge is gathered internally in or external to the organisation and then combined, edited or processed to form new knowledge, which is then disseminated



among the members of the organisation. This process can be supported through the creative use of computerised communication networks and large-scale databases.

**iv. Internalisation**

Explicit to tacit knowledge transfer is referred to as internalisation, which is closely related to ‘learning by doing’. Created explicit knowledge is shared throughout an organisation and converted into tacit knowledge by individuals as they embody it.



**Figure 32: Knowledge creation processes [56]**

Knowledge creation can occur at various real (e.g. in the office, with the customer), virtual (e.g. distributed team rooms) or mental (e.g. common values, ideas, ideals) places, therefore tacit and explicit knowledge can be gathered from within or external to the enterprise.



*To maintain their competitive advantage, enterprises need to grow and mature their innovation capability in order to innovate on a constant and sustainable basis. As knowledge creation processes are a central theme in the knowledge management field, this study investigates how knowledge management tools can be applied to grow innovation capability maturity.*

## Developing the framework

As the literature review provides a sound basis for the argument that knowledge management could be used to improve an enterprise's innovation capability maturity, the question is now: *How?* A methodology and usable framework or reference guide were needed to logically link the two fields.

The breakthrough came with appreciating, in practical terms, what it means 'to grow innovation capability maturity'. When the innovation capability maturity of an enterprise is evaluated, the enterprise is benchmarked against the requirements of the maturity level description of each innovation capability and is assigned the appropriate level. Consequently, this enterprise has grown in its innovation capability maturity when it is again benchmarked against the requirements of each maturity level, and it is determined that the innovation-related activities of the enterprise have improved to such an extent that the enterprise is now benchmarked against a higher maturity level description.

*'To grow innovation capability maturity' is therefore, in practical terms, synonymous with an enterprise improving its innovation-related activities to such an extent that it is now benchmarked against a higher maturity level description.*

The question is therefore: How can we use knowledge management tools to enable the enterprise to improve its innovation-related activities in such a way as to move from one maturity level description to a higher maturity level description? What are the key knowledge-related needs when moving upwards between maturity levels? These questions initiated the following answer: *by aligning the knowledge creation processes as critical enablers of innovation with the requirements for growth in innovation capability maturity for each maturity level transition.* What are the key knowledge actions (and therefore the key knowledge creation processes) enabling innovation capability growth from one maturity level to the next? Reconsider the innovation capability maturity descriptions in Figure 33:

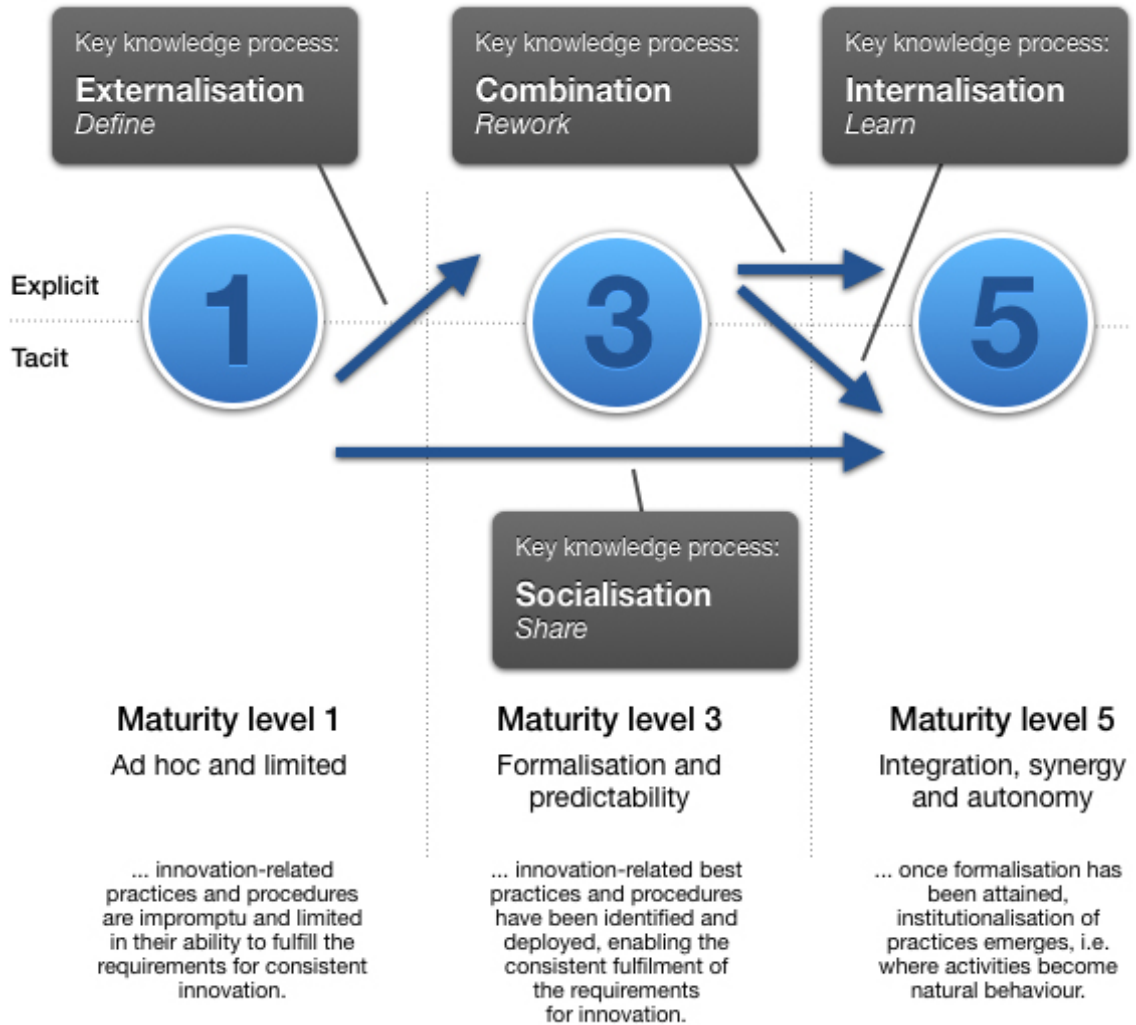


**Figure 33: Key knowledge creation processes to enable growth?**

The knowledge creation path that acts as a key enabler for innovation capability maturity growth was identified through the following reasoning (refer to Figure 34):

- In order to grow from *maturity level 1* to *maturity level 3*, the enterprise needs to improve its innovation-related activities from an ad hoc and informal to a formalised state. The key knowledge action that will facilitate this growth is that the enterprise is able to ‘define’ its innovation-related activities. Here the key knowledge creation process is externalisation; making tacit knowledge that resides in the heads of workers tangible (explicit).





**Figure 34: Key knowledge creation path enabling innovation capability maturity growth**



- Similarly, to improve from *maturity level 3* (a formalised state) to *maturity level 5* (one where practices are institutionalised), the key knowledge actions without which growth to the next maturity level is impossible are to encourage workers to ‘learn’ in order to institutionalise that which have been formalised and to continuously ‘rework’ the current formalised innovation-related activities. Here the key knowledge creation processes are internalisation and combination; encouraging workers to embody the formalised explicit knowledge and revising formalised explicit knowledge toward new explicit knowledge.
- A crucial element supporting these knowledge actions of defining and then learning while continuously reworking is the people component, without which externalisation, combination and internalisation would be impossible. Therefore, the underlying process supporting the key knowledge creation processes enabling innovation capability maturity growth is the need to ‘share’; enabling tacit to tacit knowledge transfer through socialisation.

Identifying the knowledge creation path<sup>13</sup> that acts as a key enabler for maturity growth from one maturity level to the next forms the cornerstone of the research done toward a knowledge management framework to grow innovation capability maturity.

A tangible link has now been made between the fields of knowledge management and innovation capability maturity. Subsequently, knowledge management tool requirements and organisational facilitating conditions that support the specific knowledge creation processes highlighted in the identified path were reviewed through a literature survey. *The author’s emphasis was on researching tool requirements rather than specific tools, as this would ensure that the research remains applicable and relevant for a period of time surpassing the ever-changing technology-development landscape and would enable utilisation across a wider range of organisational domains.*

<sup>13</sup> The identification of this path does not mean that the other knowledge processes are not present or needed when improving innovation-related activities. This path aims to capture the essence of what needs to be supported when growing innovation capability maturity by identifying the KEY knowledge processes without which growth to the next maturity level would be impossible.



These organisational facilitating conditions and knowledge management tool requirements were subsequently synthesised to form the framework presented in the next section.

## A knowledge management framework to grow innovation capability maturity

The framework comprises three improvement columns that indicate the key knowledge creation path identified: one between maturity levels 1 and 3 (externalisation), one between maturity levels 3 and 5 (internalisation and combination), as well as the supporting improvement column (socialisation) (Refer to Figure 35). Each column comprises the following four main components:

- 1) An innovation capability maturity **growth perspective**
  - Depicts the key knowledge creation processes needed to enable innovation capability maturity growth
- 2) A knowledge creation **input perspective**<sup>14</sup>
  - Depicts the main knowledge action as well as enabling knowledge management tool requirements to support the input aspect of the specific knowledge creation process
- 3) A knowledge creation **output perspective**
  - Depicts the main knowledge action as well as enabling knowledge management tool requirements to support the output aspect of the specific knowledge creation process
- 4) A knowledge creation **supportive perspective**
  - Depicts elements that are crucial to the success of the specific knowledge creation process(es), but is related more to organisational facilitating conditions than exclusively to the input or output aspect of the knowledge process

The impact of this framework lies in providing guidelines for the use of knowledge management as a vehicle for innovation capability maturity growth. In practical terms, the framework aims to provide an 'as is' and 'to be' reference point for

<sup>14</sup> For example: The externalisation knowledge creation and transfer process has implicit knowledge as an input and explicit knowledge as an output.



- **evaluating** an enterprise's organisational conditions and business tools in order to **sustain** innovation capability maturity ("Given our innovation capability maturity level,<sup>15</sup> do our knowledge management-related tools and organisational conditions meet the requirements that will enable us to *continuously fulfil* our innovation-related activity requirements for this maturity level?"); and
- **benchmarking** an enterprise's organisational conditions and business tools in order to **grow** innovation capability maturity ("Given our innovation capability maturity level, do our knowledge management related tools and organisational conditions meet the requirements that will enable us to *improve* our innovation-related activity requirements for this maturity level and hence grow from our current maturity level to the next?")

## EXAMPLE

XYZ Retailers would like to improve their resource-allocation approach. Employees at XYZ Retailers are currently randomly allocating as much resources, as needed, when needed, on a first-come-first-serve basis, where ideally they should be using a structured approach with resources being allocated to the portfolio according to project prioritisation. XYZ Retailers must therefore establish a resource-allocation procedure.

When improving an innovation-related activity such as resource allocation from an ad hoc to a formalised approach, the main operative task is to **capture**. First the tacit knowledge of employees related to the current resource-allocation activities must be obtained and conveyed through interaction.

Tools that enable the identification of employees with the appropriate knowledge and that create dialogue/discussion opportunities can support the process of finding out how decisions are currently being made regarding resource allocation, as well as who is making them. Simultaneously, these discussions should provide a platform for employees to also **share** ideas on improvement within the current ad hoc process.

<sup>15</sup> This could be a formal indication obtained through an innovation capability maturity assessment (enterprise-wide, per innovation capability area, per innovation capability requirement or per combinations hereof), or a less formal indication with an enterprise simply benchmarking its known innovation-related activities against the generic ICMM maturity level descriptions without going through an official assessment.



Forming trust and establishing open lines for communication within XYZ Retailers can play a pivotal role, as employees frequently regard any survey of their work-related tasks and decisions as a performance evaluation that could likely lead to a deliberate misrepresentation of their involvement in and contribution to the current innovation-related activity.

Once the identified employees are involved in the interactive process of conveying their tacit knowledge regarding resource allocation, this knowledge must systematically be transformed into a comprehensible format in order to establish an explicit resource-allocation procedure. This is facilitated through the definition of clear-cut roles so that everyone has a clear picture of how they contribute to the formalisation of XYZ Retailer's resource-allocation process. Here shared values can go a long way in convincing employees of the need for establishing such an explicit procedure. Allocating enough time to actually record and most importantly structure the tacit knowledge gathered is also a significant requirement when establishing an explicit allocation procedure where resources are allocated to the portfolio according to project prioritisation.

(The knowledge management framework to grow innovation capability maturity follows on the next page.)

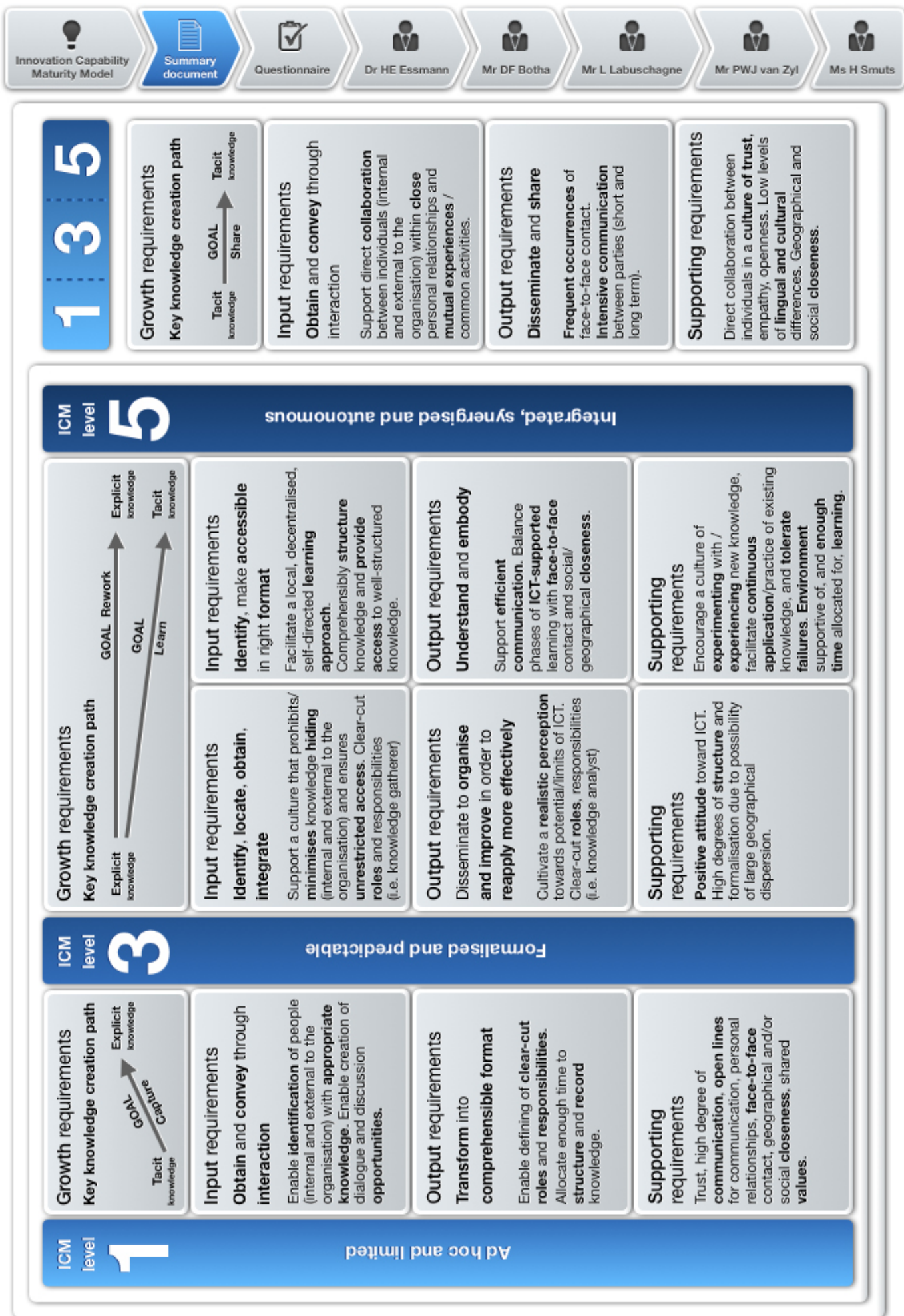


Figure 35: A knowledge management framework to grow innovation capability maturity



## Appendix C

## Questionnaire



### 1) Interviewee background contextualisation

- a) Occupation / Industry?
- b) Previous exposure to the field of knowledge management?
- c) Previous exposure to the fields of capability maturity models and/or innovation capability maturity?

### 2) Research methodology related questions

- a) To what extent do you agree/disagree that to maintain its competitive advantage an enterprise needs to grow and mature its innovation capability in order to innovate on a constant and sustainable basis?
- b) To what extent do you agree/disagree that knowledge creation processes act as critical enablers for the innovation process?
- c) Is it logical to therefore aim a study at investigating how knowledge mtools can be applied to grow innovation capability maturity?
- d) To what extent do you agree/disagree with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next, as the cornerstone of research toward a knowledge management framework to grow innovation capability maturity?

### 3) Framework related questions

- a) To what extent do you agree/disagree with the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels?

Do these identified knowledge creation processes accurately address the key maturity level description requirements for growth from one maturity level to the next?

- b) To what extent do you agree with the knowledge management tool requirements detailed in the framework?

To what extent do you agree with the structure of the framework? [Synthesised to provide an input, output and supporting perspective to the requirements for the specific knowledge creation process(es)].

Please comment on the applicability and usability of this framework, from your professional viewpoint, to provide guidelines for the use of knowledge management to advance innovation capability maturity growth.

### 4) Further comments





**Appendix D**  
**Part 1**

**Research  
evaluation**

**Dr HE Essmann**



## Dr HE Essmann<sup>16</sup>

Programme Manager – Indutech (Pty) Ltd

Evaluation questions: written answers received on 15 September 2010

### 1) Interviewee background contextualisation

a) Occupation / Industry?

- *Programme Manager, Innovation Management Consulting*

b) Previous exposure to the field of knowledge management?

- *Basic research for PhD, application of principles during consulting - Development and deployment of Roadmaps as guiding structures and knowledge management tool for collaborative teams executing complex projects.*

c) Previous exposure to the fields of Capability Maturity Models and/or innovation capability maturity?

- *Extensive research for PhD. Multiple ICM assessments deployed in practice.*

### 2) Research methodology related questions

a) To what extent do you agree/disagree that to maintain its competitive advantage an enterprise needs to grow and mature its innovation capability in order to innovate on a constant and sustainable basis?

- *Agreed 100%. This is the premise on which I based my research and consult to clients. Organisational viability requires innovation (in balance with the operational environment of course).*

b) To what extent do you agree/disagree that knowledge creation processes act as critical enablers for the innovation process?

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<sup>16</sup> Regarding interview transcripts: Discussion points that are not directly relevant to the research evaluation are concisely summarised and indicated in brackets, as they occurred in the interview.



- Agreed 100%. The innovation process is heavily based on many knowledge creation processes through all stages and between many role players.
- c) Is it logical to therefore aim a study at investigating how knowledge management tools can be applied to grow innovation capability maturity?
- Yes.
- d) To what extent do you agree/disagree with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next, as the cornerstone of research towards a knowledge management framework to grow innovation capability maturity?
- I would agree that alignment at the correct level is appropriate. This particular alignment has been performed at a high-level to create a **generic and broadly applicable framework for applying knowledge processes to grow ICM** – at the “maturity level” level. I would say that future research could also be conducted to align knowledge process requirements and ICM requirements at a more detailed level (out of scope of this research).

### 3) Framework related questions

- a) To what extent do you agree/disagree with the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels?
- Agreed.

Do these identified knowledge creation processes accurately address the key maturity level description requirements for growth from one maturity level to the next?

- With the focus being on “key enablers” I would agree. If I were to ID a possible gap, then possibly the Combination process could be included in the Level 1 → Level 3 growth in the identification for benchmarks and best



*practices and then translating/customising those to the specific needs of the company (from an ad hoc state to formalisation). This may however fall outside of the “key enablers” definition.*

b) To what extent do you agree with the knowledge management tool requirements detailed in the framework?

- *Cannot find any gaps.*

To what extent do you agree with the structure of the framework? [Synthesised to provide an input, output and supporting perspective to the requirements for the specific knowledge creation process(es)].

- *The structure is clear and concise, effectively depicting a landscape for the activities, tools, methods, etc. to enable the knowledge processes in a generic manner, and should these activities, tools, methods, etc. be categorised into the framework, it would provide an easy means for referencing the appropriate mechanisms for the task at hand.*

c) Please comment on the applicability and usability of this framework, from your professional viewpoint, to provide guidelines for the use of knowledge management to advance innovation capability maturity growth.

- *As stated in the previous comment, the framework is generic in nature, i.e. without specific activities, tools, methods, etc. attached. But should a company go to the effort to select the appropriate tools using the framework **and** allocate them into the framework, it should be applicable and useful.*

#### 4) Further comments

*The only comment I would like to add is to show appreciation for the seemingly “simple” framework represented as the research output – it often takes significantly more effort to represent something that is complex in a simple manner while ensuring its accuracy.*



## Dr HE Essmann

Programme Manager – Indutech (Pty) Ltd

Feedback-orientated interview

Interviewed at Indutech, Stellenbosch.

21 September 2010, 10h00.

*Dr. Essmann did not have any further comments on his detailed written answers to the evaluation questions.*



## **Appendix D**

### **Part 2**

## **Research evaluation**

**Mr DF Botha**



## Mr DF Botha

Knowledge management expert and lecturer at the Department of Information Science  
– Centre for Knowledge Dynamics and Decision Making, Stellenbosch University

*(No written answers received)*

Feedback-orientated interview

Interviewed at the Department of Information Science, Stellenbosch University<sup>17</sup>

20 September 2010, 11h00

*Mr Botha (B): Where does this framework come from?*

Author (A): This framework is the end result of my research.

*B: So you've developed it yourself?*

A: Yes.

*B: Using inputs from the doctoral dissertation?<sup>18</sup>*

A: Yes, what I've used from the doctoral dissertation is the specific descriptions of the innovation capability maturity levels. From that my research progresses to how I link the fields of knowledge management and innovation capability; my understanding of the key requirements, specifically regarding knowledge management, that needs to be met in order to grow innovation capability maturity. And this has been consolidated in a framework with generic requirements for tools to facilitate the key process that is needed in order to move from one level to the next. So that is the angle of my research.

*B: Good. Yes. I see the definition of innovation that you refer to is more or less correct.*

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<sup>17</sup> Translated from Afrikaans to English. Interview duration: 2 hours 30 min.

<sup>18</sup> The generic and fundamental requirements for organisational innovation capability researched and consolidated into an ICM by Dr HE Essmann, "Toward Innovation capability Maturity." PhD thesis, Dept. of Ind. Eng., Stellenbosch Univ., South Africa, 2009.



[Author and Mr Botha establish through discussion that they both view innovation within the same process context.]

*B: So with that I'm satisfied [the author's view on innovation]. I do not completely agree with this concept of maturity growth. This has been covered during doctoral studies, so I accept that his theoretical approach to define the constructs of innovation capability growth has been accepted.*

A: Yes. His innovation capability maturity level descriptions are based on a widely accepted maturity model, but adapted specifically for innovation. That's why one section of my document discusses "Why maturity models?"

*B: I have nothing against maturity models; I do however have a problem with the growth concept.*

A: Okay?

*B: If you're mature, you're already grown. But I see from the model that he places maturity on different levels.*

A: Yes.

*B: So you're actually starting at infancy and working his way up to maturity.*

[Author proceeds to discuss through example what is meant by maturity]

*B: Yes, I understand. But let's not spend any more time on this. Personally I do not like using the concepts of maturity and growth together. I do however agree that innovation capability is the single greatest factor that will influence the sustainability of your organisation, whether you're calling it maturity growth or not. If you have innovation capability and innovation capacity; then you'll be sustainable.*

A: What Dr Essmann addresses in a formal way, is exactly what you're saying. You have to have the capability to innovate, but simultaneously you have to know what your capability is, and how you can improve it.

*B: Yes, of course.*





A: So I think, even if you do not like the words maturity and growth, this is the essence that it boils down to: know what you have that enables you to innovate, and know how to improve it.

*B: Yes, with that I agree. You have to know what you have, and this needs to be identified.*

A: Yes, this is what I referred to with the innovation capability assessment in the document.

*B: Okay, good. So we've sorted that out. Now what I'd like to know is, what do you think is knowledge? How would you define it? You didn't define it in your document.*

[Author and Mr Botha establish through discussion that they both view knowledge within a dynamic context, distinguishing between data, information and knowledge.]

[Mr Botha proceeds by describing how he understands the relationship between technology, competency and capability. Technologies combine to form competencies, which in turn combine to form a capability.]

*B: I have never before come across the term innovation capability maturity growth; it is a new construct to me.*

A: Yes, that is exactly the gap that Dr Essmann addresses.

*B: Okay, now let's have a look at knowledge.*

[Mr Botha proceeds by describing knowledge as seen by Boisot in his book "Knowledge Assets: Securing Competitive Advantage in the Information Economy", using the terms: data/information, perception, conception, filters and knowledge agents.]

[The author adds that the term "agent" relates to Seufert's definition of a knowledge network, as well as that the term "conceptual filters" relates to Senge's learning organisation and the constant reworking of our own mental models.]

[Mr Botha relates the perception and conception ideas of Boisot to the ideas of Weick and Sensemaking.]



*B: Information is always the relationship between what we perceive and what we conceive and knowledge. So information is the thing that flows.*

A: Yes.

[Mr Botha illustrates through an example.]

*B: So this is an important concept when dealing with knowledge transfer, which is something you need to describe in your document... Boisot's model fits exceptionally well within the innovation environment.*

A: Yes, definitely.

*B: We have teams that drive innovation projects; each member of a team will perceive the same information differently, will be able to see something different.*

A: Exactly. The fact that they are in the same team means that they have common activities that enable them to also add some of the same context to the knowledge they obtained whilst in that team; a common baseline.

*B: Yes; they achieve consensus on what they see and experience.*

[Mr Botha elaborates on this further, through an example.]

*B: A lot of the things that we are unable to transfer because there are no words or codes, are tacit.*

A: Yes.

[Mr. Botha proceeds to describes how Nonaka is considered to be within the first wave of knowledge management, but as we're not at the third wave, Nonaka's work is now being questioned.]

*B: The problem with the SECI model is that he talks about linearity. The processes are linear. And we engineers tend to think linear, although the real world is not always linear. We make it linear because we want to create order.*

A: Yes, we want to have a simplified view and understanding of the world.

*B: Yes; you are quick to comprehend something. The world is not linear, but the SECI model provides us with a process.*



A: I think the usability of the SECI model depends on your understanding and how you want to use it. If you understand it within the right context, that this isn't a linear world, the SECI model can help to make sense of what we're dealing with in knowledge management, even if it isn't the complete picture.

*B: Yes. However, the linear idea obtained by students from the model, that it's one phase after the other, is wrong.*

A: I completely agree. Especially when we get back to my contribution... Looking at the description for a specific innovation capability maturity level, as well as the description for the next maturity level; then asking what is the key knowledge creation process without which growth to the next level would be impossible.

*B: Yes.*

A: Then it doesn't mean that we're only executing the process once, or that only one process can be present. If we as an organisation have innovation related activities that are very ad hoc, and we want to improve to a point where we have formalised certain aspects of this, the most important thing, and you can tell me if you agree with this; the most important thing without which we cannot move forward in our maturity, is that we have to make those ad hoc procedures and practices explicit.

*B: Yes, yes.*

A: It doesn't mean that, whilst we are making our innovation related activities explicit, that that is all we're doing. We are busy interacting, we are busy reworking existing explicit knowledge etc., but the key thing that needs to happen in order to grow our innovation capability maturity is that we need to be able to formalise our innovation related activities.

*B: Yes. Our natural inclination is to try and structure, and this is what you've done; and it's entirely correct.*

[Mr Botha again refers to Boisot, his article "Data, Information and Knowledge: have we got it right?" and his subsequent new book: "Explorations in Information Space: Knowledge, Agents and Organization"]

*B: If you have time, you can work through Boisot, but you'll have to study it. We [department of Information Science] present a whole series of lectures on just that*



*book. And there's a lot more in it than what I've just referred to. You'll have to reconsider whether you're going to use what I've told you; this research has the potential to evolve into a PhD study.*

A: I agree. That is exactly my question to you at this point; if my goal was to determine how to link the fields of knowledge management and innovation capability maturity: the questions that I sent you are aimed to eventually answer the question of whether this is a good starting point. Is this framework a usable conceptual framework? The idea was not to provide a lowest level detailed integration plan, but rather a check-list for determining, for where we are now and where we want to be, what we should focus on to move forward.

*B: Yes.*

A: Not necessarily in the finest of detail an integrated management plan describing exactly how everything works, but rather providing a comprehensive framework to refer to.

*B: Yes.*

A: So the main idea was to find a way to link the two fields, as I could not find any literature doing so.

*B: Yes; you wouldn't. But you'll find the link between knowledge management and innovation.*

A: Yes, that is exactly what the first part of my document is about.

*B: Yes, it isn't a question anymore whether the two go together, they are inseparable.*

A: Yes, that is what my first two evaluation questions are about.

[Author and Mr Botha proceeds to discuss the first two research methodology evaluation questions]

A: So I gather that you agree with the research methodology related questions, in the sense that they are actually non-questions as the ideas are so important.

*B: Yes, it is so important that we do not even have to questions those ideas.*



A: I think from my research background it was still necessary to ask this; am I making the right links?

*B: Yes, you are.*

[Mr Botha proceeds to elaborate that his role in this interview is to be hypercritical in order to prepare the author for any possible examination angle. He asks a few questions on how we write a thesis at our department (Industrial Engineering); whether we have a literary theory chapter on the different research methodologies, etc.]

[Mr Botha point out that the author should rather talk about a research study than a survey.]

[Author and Mr Botha discuss the purpose of the questionnaire; to evaluate the framework against the opinions of experts]

*B: It's necessary to be able to say that you've discussed your research with different people. A study is also about observation, and this is what you've done. So you have to state what you've learned from these interviews – this is what we call secondary sources of research. Primary sources still remain, in your case, literature.*

A: Yes. My goal was to say; here is the framework, and I've had a discussion with the following people with the following backgrounds and experience; this is their suggestions, this is what they agree with, this is where they feel I'm missing the point of what I intended with the framework, etc.

*B: Okay. Don't get me wrong, I think you've got an excellent thing going here; one of the better, more advanced attempts that I've seen<sup>19</sup>. I'm just afraid that you'll make it too complex for a M level thesis, that you're heading towards a PhD level, which is why I'm hesitant to give you too much extra information; this could lead to side-tracking, but it's such a neat piece of research.*

[Mr Botha proceeds to discuss that the problem with these interviews is that every expert would like to guide the study in his preferred direction, and that the author has to filter what she will use.]

<sup>19</sup> “Ek dink jy het 'n uitstekende ding hier beet, moenie 'n fout maak nie. Dit is een van die betere, van die hogeres wat ek al gesien het; jou poging.”



[Author and Mr Botha proceed to discuss the fact that the framework should not be made any more detailed/complex.]

*B: I'm just showing you today what the different ways of thinking are in the field of knowledge management so that you're prepared [for the examination process]. We've discussed that knowledge cannot flow. The other point I'd like to address is that knowledge can't be created. Tell me how one creates knowledge? You can't separate data, information and knowledge; it's a relationship. [Mr Botha refers to Boisot: his world events, information flow, perception filter, conception filter, knowledge agent process model.] We can separate them for the sake of a model; a cognitive simplification.*

A: My idea of how we create knowledge, if I have to relate it to Boisot's model, is that if I have knowledge, and I transfer it to you as information, then you create new knowledge by having different filters than I've got for receiving the same type of information. I send it to you with a certain intention, but your filters are different to mine, therefore you receive, or create, different or new knowledge by adding new context to my information.

*B: Yes.*

A: This is what I understand under knowledge generation or creation.

*B: Yes, there is a new school of thought that we cannot create new knowledge; it's always been there. We can only discover new knowledge, not create it.*

A: Okay, I see what you're getting at.

[Mr Botha proceeds to elaborate with an example.]

A: So you'd suggest that, especially in my literature study, I make a discussion point of what I understand the term transfer and the term creation to mean, when I write about knowledge creation processes<sup>20</sup>?

*B: Yes, you could also leave out the word creation and rather use the word discovery.*

A: Okay, that might not change my context, but might be clearer for the reader.

<sup>20</sup> Knowledge creation and transfer processes is a term coined by Seufert.



[Author and Mr Botha refer to the four SECI processes, and through discussion and examples agree with the academic argument that you cannot manage knowledge, but that you can manage knowledge assets.]

[Concerning knowledge management in practice:]

*B: The important thing that you touch on is what was missing [in an enterprise]. Where does it [knowledge] come from? Who has it in the organisation, and how do you reveal it? This is what is important and this is what organisations don't know.*

[Mr Botha elaborates with an example, and the author affirms with background information on her initial post-graduate studies being directed towards knowledge profiling.]

A: When we look at my framework, for example the first tool requirement to improve from a maturity level 1 to a maturity level 3, is “enable the identification of people, internal and external to the organisation, with the appropriate knowledge”. Ideally speaking, and this is definitely more in the scope of a PhD study, this requirement would warrant a study towards current best practices and literature aimed at identifying these people.

*B: Yes, and in that area, the question that you ask, that you are correctly asking; they've started to advocate the use of knowledge mapping. The question that we should now ask should be directed at: what knowledge should be mapped? As they have started to try and map all knowledge, all information in an enterprise; a lot of times this is unnecessary.*

[Mr Botha elaborates with a discussion and examples on information vs. knowledge audits, especially his experience in the South African landscape.]

A: When you mention CoPs [communities of practise]; in my framework I address this idea by including the socialisation process supportive of growth through all maturity levels. There a tool requirement is “frequent occurrences of collaboration”. This ties strongly to what you're saying: we need to approach a network dynamically to keep it going.

*B: Yes. And this can be managed, collaboration can be managed. You can create opportunities for people to collaborate, being it formal or informal depending on the*



*organisation. And this is knowledge asset management. The new approach for management is not to manage the people and their work, but to manage the interfaces between them.*

[Mr Botha elaborates with an example from his experience, also highlighting the need for face-to-face contact.]

*B: You talk about alignment somewhere? You say we have to align innovation capability growth and knowledge management.*

A: Yes. One of my evaluation questions is: “To what extent do you agree/disagree with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next”?

*B: Yes.*

A: So one of the questions I asked myself when developing the framework is: what are the key requirements for growth when moving from where we are ad hoc to somewhere where we are formalised? Is it logical to say that what we have to do is that we have to capture, we have to make something explicit?

*B: Yes.*

A: So, do you agree with the logic when identifying the key knowledge creation path, that it makes sense?

*B: Yes. Any path indicates linearity, although we have to follow a growth path; I agree with that. Look, I agree with your research, I'm just trying to be difficult and stimulate you to maybe broaden your horizons.*

[At this point it is 1 hour 15 min into the interview, and Mr Botha enquires to how much time the author has available for supplementary discussions.]

*B: I can see that you are very quick to comprehend a concept, that you can immediately see where it fits in.*

[Mr Botha proceeds by discussing more concepts and examples regarding Boisot's work. Boisot's take on the economical production function of capital vs. labour, towards an evolutionary function that fits into the knowledge economy: data vs.





physical assets (time, space, energy). His dominant design concept also links to the idea of maturity.]

[Mr Botha moves on by referring to personal experience at a radar facility; analysing and establishing the core value offering / core competency of the enterprise, and being adaptable to a changing environment and emerging opportunities.]

[Author comments on how these concepts relate to the different innovation capability maturity level descriptions.]

*B: Your description of maturity growth is starting to make sense to me now. Most companies are doing what you suggest, but reactively due to business circumstances and their current environment. What you're trying to do with your framework is to make it more proactive. Am I ready to do these things? Do I have the capability and the capacity to act on the opportunity, to grow? And you want to make that sustainable.*

A: Exactly.

[Mr Botha proceeds and refers to Boisot's discussion of Mintzberg; deliberate and emergent strategies.]

*B: I would recommend that you make sure to specify that the growth path that you have identified isn't for the whole organisation; just trying to manage it all. That it's for these deliberate strategies.*

A: Exactly. I discuss in my document that this is aimed at a prioritised capability, or capability area. The framework is definitely not aimed at an enterprise-wide attempt at, for example, capturing everything single thing that every employee knows. That misses the point – it's not productive and would never work. So you're guided by looking at the specific capability area; are we trying to improve external communication, or resource allocation, or strategy etc.?

*B: Yes.*

A: So my framework is aimed at: we know where we are and what we want to improve – how can we facilitate this improvement through a growth in maturity by using knowledge management?



*B: Yes, okay. The reason I'm giving you this extra literature is because it supports a lot of you research. It will be difficult to incorporate it all, but nevertheless.*

[Author and Mr Botha discusses that a thesis should keep a clear storyline and should not be cluttered with unnecessary information.]

[Mr Botha proceeds to discuss the I-Space theory of Boisot and the author comments that it reminds her of Nonaka's knowledge spiral and Mr Botha affirms this. They touch on the concepts of N(ewtonian)-learning and S(chumpeterian)-learning ]

[Author and Mr Botha discuss how Boisot's I-Space theory could relate to her identified knowledge creation growth path.]

*B: But I think that I've said enough. Now I don't have to answer your evaluation questions anymore. [Jokingly]*

A: I am still going to ask you a few questions.

*B: You're completely on the right track with your work, and I think this has the potential to be an excellent piece of work; just watch out that you do not make it too complex, that it doesn't approach a PhD level at this point.*

A: This is something I'd like to ask you; given the context of an M study, do you agree with my reasoning and how I developed the framework?

*B: Yes.*

A: I'd like to quickly go through the questions with you; but what I'd like to take away from this meeting is whether you agree with this framework? But that there is scope for expanding it through further research towards a much more complex study?

*B: Yes, I agree.*

A: Okay.

*B: You must always question your sources. A student of mine wrote a very successful thesis where he takes on Boisot's evolutionary curve and argues that it is in fact not evolutionary.*

A: I think this is where we might have very different angles to our research.



*B: If you use only Nonaka, you could create the impression that you think there is nothing else.*

A: Okay. So it would be wise to, when I write about socialisation, about transferring tacit to tacit knowledge or tacit to tacit knowledge, to highlight what is my understanding, given what others have written, not only Nonaka?

*B: Yes.*

A: So that every process in this knowledge creation growth path has a lot more literary context?

*B: That's correct. That's why I had this discussion with you. I personally think this [Boisot] can be used as a supportive argument for Nonaka; that you're in any case correct whether you're using Nonaka or Boisot.*

[Mr Botha proceeds with an example of inductive reasoning.]

A: Just to clarify; my research isn't based on Nonaka's whole philosophy. I went and used the fact that Nonaka describes tacit and explicit knowledge in a specific way. And his SECI processes are widely accepted. The fact that he has a linear rather than a dynamic approach doesn't feature in my work, as I made the comment that all the processes are always present. My path just highlights the key process needed for growth between certain maturity levels.

*B: Okay, yes. This is why most people are critical of Nonaka; he has a linear approach; that is why he is part of the first wave. But he did know what he was doing; he laid a very good solid foundation.*

A: So it'll be fine if I just have a very clear discussion point of the fact that I see these processes as very dynamic and not linear?

*B: Yes.*

[Mr Botha proceeds to discuss how one can provide boundaries for your study, as long as you can motivate them.]

A: Okay, so to get back to the questions. Do you agree that one can use these knowledge creation processes to grow from one maturity level to the next?



*B: Yes.*

[Mr Botha proceeds by discussing Snowden's Cynefin framework.]

A: So the rest of my questions are aimed at the framework. If we read the descriptions of the different maturity levels; do you agree that the knowledge growth path that I identified accurately addresses the key requirements for growth stipulated by the maturity level descriptions?

*B: Yes.*

A: Okay.

*B: It's just important that you make a definite point of stating that you know that institutionalisation does not mean bureaucracy, because a lot of people see it that way.*

[Author and Mr Botha proceed to discuss this and affirm that they both agree on what the term means.]

A: I think the other question I have, has been answered throughout today's discussions. Regarding the specific tool requirements listed in my framework: we spoke about the frequent face-to-face contact, about culture, about the fact that we have to know who knows what, about diffusion - here I have disseminate. Do you agree with these tool requirements?

*B: Yes.*

A: Okay, and then I think we've covered the further comments question fairly thoroughly.

*B: Yes.*

A: The last question is; do you think that this framework is usable?

*B: Absolutely.*

[Mr Botha proceeds with relating to his radar personal experience example.]

A: Yes. So the goal for me with this framework is to provide a checklist for "as is", and "to be".



*B: Yes, “to be” is important. In the course I teach we also ask “why for?”, vs the “how to” of an MBA course.*

[Author and Mr Botha discuss the idea of imitation, referring to the work of Thomas Arvid on intellectual property.]

*B: They [Arvid] talk about imitation as a source of knowledge. You also talk about your clients as a source of knowledge, and that is true.*

A: Yes. It is a very strong idea of sources internal and external to the organisation.

*B: Yes, and even though you can’t go and consult every client eyeball-to-eyeball, but you have a lot of channels for sourcing that information.*

A: I agree. My framework states that you have to identify people with the appropriate knowledge; but to keep it concise, it doesn’t explicitly state: “do not try to contact every single client”. You have to at least have a sense of prioritisation that relates to the capability.

*B: Yes. Okay, next question?*

A: That’s it. The important questions for me was; did you agree with the reasoning of how I developed the framework?

*B: Yes.*

A: And do you agree with the structure of the framework?

*B: Yes.*

D: Obviously, every block in the framework can be expanded on in more detail during a future study.

*B: Yes.*

A: I mean, identification of people with the appropriate knowledge can be a study all on its own.

*B: Yes.*



[Mr Botha suggests a chapter sequence for the thesis, and the author affirms that she is indeed writing it in that order: innovation, knowledge management, how to link the two fields, the framework, evaluation and summary. He also adds how this study could be taken further.]

[The interview ends with Mr Botha remarking that: he wrote the first article on knowledge management in South Africa; that he has lectured in Moscow, presented research in India, Las Vegas etc.; that he usually writes for the Journal of Business Management.]

D: I'm going to go ponder what we've discussed today, but I think my framework will stay unchanged as we did agree on its applicability and detail, as well on my approach.

*B: Yes.*

D: I will however go and think about how I describe some of the literary concepts; maybe add a bit more context.

*B: Yes. All I tried to show you today is that there are other writers in your field; that think the same way as you do; that you are correct; whether you're calling it maturity or dominant design etc.*

[The interview ends with formalities; thanking the interviewee for his time and insight.]



**Appendix D**  
**Part 3**

**Research  
evaluation**

**Mr L Labuschagne**



## Mr L Labuschagne

Enterprise Architect and Training Manager – Real IRM

Evaluation questions: written answers received on 22 September 2010

### 1) Interviewee background contextualisation

- a) Occupation / Industry?
  - *IT Consultant / Professional Services Industry*
- b) Previous exposure to the field of knowledge management?
  - *Experience with establishing Communities of Excellence at client sites*
  - *Responsible for mentorship and establishment of an intern development programme within an consulting services environment*
  - *Configuration of Sharepoint Portal Server as knowledge management platform*
- c) Previous exposure to the fields of Capability Maturity Models and/or innovation capability maturity?
  - *Exposure to CMMI® within a Software development environment*
  - *Currently using maturity models within an Enterprise Architecture domain to measure Enterprise Architecture Management within an organisation.*

### 2) Research methodology related questions

- a) To what extent do you agree/disagree that to maintain its competitive advantage an enterprise needs to grow and mature its innovation capability in order to innovate on a constant and sustainable basis?
  - *Completely Agree*
- b) To what extent do you agree/disagree that knowledge creation processes act as critical enablers for the innovation process?
  - *I agree that the transfer processes are required to create the basis set of knowledge that is required to allow people to innovate within the organisation*





c) Is it logical to therefore aim a study at investigating how knowledge management tools can be applied to grow innovation capability maturity?

- *I am not convinced that tools will have a significant impact.*

d) To what extent do you agree/disagree with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next, as the cornerstone of research towards a knowledge management framework to grow innovation capability maturity?

- *Agree that it would assist organisations with formalising the process of innovation.*

### 3) Framework related questions

a) To what extent do you agree/disagree with the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels?

- *I don't agree with the alignment of processes to the maturity levels. I would suggest that all the processes are required on all the maturity levels to a certain extent. You need a more granular innovation processes to allow you to identify activities must be mastered or achieved on the different maturity levels to allow the company to claim mastery of a maturity level.*

- *I would suggest that you have a look at the OMG Business Process CMM as additional input to assist you with the mapping of the processes to the maturity model.*

Do these identified knowledge creation processes accurately address the key maturity level description requirements for growth from one maturity level to the next?

- *No*



- b) To what extent do you agree with the knowledge management tool requirements detailed in the framework?

- *Very high-level*

To what extent do you agree with the structure of the framework? [Synthesised to provide an input, output and supporting perspective to the requirements for the specific knowledge creation process(es)].

- *I think the structure is good with the right perspectives, I just don't agree with the mapping or detail*

- c) Please comment on the applicability and usability of this framework, from your professional viewpoint, to provide guidelines for the use of knowledge management to advance innovation capability maturity Growth.

- *Not very practical in the current format*

#### 4) Further comments

- *I think you should re-evaluate your use of the maturity model and the levels of maturity. If your aim is to only have 3 maturity levels, then rather label them as level 1, 2 & 3 and leave scope for future improvement or refinement where you could through experience or future research identify an additional level 4 (I would start with level 0 – no innovation) giving you 4 levels for now.*



## Mr L Labuschagne

Enterprise Architect and Training Manager: Real IRM

Feedback-orientated interview

Interviewed via Skype<sup>21</sup>

23 September 2010, 09h00

Author (A): We both agree that an enterprise has to improve its innovation capability and reach maturity regarding its innovation capability in order to innovate on a consistent and sustainable basis. We also agree that knowledge creation processes play a role in the innovation process.

*Mr Labuschagne (L): Yes.*

A: I think however that you don't agree or that you're not sure, that knowledge management tools can help improve an enterprises innovation capability maturity, as well as with my specific use of Dr Essmann's ICMM, and how I synthesised the model to provide a link between the two fields.

*L: Yes.*

A: Should we start with a discussion of your suggestions? My goal with this conversation is to get an idea of your perspective, to learn as much as possible.

*L: I would like it if we can start with you taking me through the document; how you got to the framework. I'm not sure how important you think the products, the IT contribution, are in providing support. I think the processes are important, and I don't want to imply that it's not important, but it can't function alone. If you can take me through your reasoning when coming up with the framework, we can discuss it further from there.*

A: Okay.

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<sup>21</sup> Translated from Afrikaans to English. Interview duration: 36 min.



[Author proceeds with explanation of research in the same order and level of detail as presented in the document in Appendix A: describes research purpose, scope and methodology, as well as why she wanted to link the fields of innovation capability and knowledge management]

[Concerning the reasoning applied when deriving the key knowledge creation path enabling innovation capability maturity growth:]

A: My question was, in terms of knowledge management, what is the key process without which growth to the next maturity level would be impossible? I completely agree with your comment that all the knowledge creation processes must be present; from a knowledge management perspective this is 100% correct.

*L: Yes, okay.*

A: I identified that, in order to grow from maturity level 1 to maturity level 3 the enterprise needs to formalise its innovation related activities; make this soft tacit knowledge explicit; capture what we're busy doing. But obviously we still need the other processes, for example reworking existing knowledge, reworking existing documents and processes. The issue was, for me, to be able to answer: "what is the key process without which growth to the next maturity level would be impossible?" Again, going from level 3 to 5, from something that is formalised but not integrated and institutionalised, that isn't part of the daily activities: when reading Dr Essmann's descriptions for the generic requirements for maturity level 3 and 5 we see that we have to constantly rework these practises and procedures that we have formalised, but we also want employees to actually adopt these principles. So there is a sense of rework, but also of learning.

*L: Yes.*

A: But as we're working with people, the issue for me was to indicate that there is a strong socialisation process that supports innovation capability maturity growth throughout; from an organisation that isn't really aware of what it's doing innovation-wise, to an enterprise that has an integrated approach and is agile and mobile to adapt to its circumstances.

*L: Yes, yes.*



A: After identifying this knowledge growth path, I asked myself: given that we're working with these knowledge creation processes, what do we know of these processes that will help, for example, a company which establishes that its activities regarding external parties, clients, are a bit chaotic? What type of check-list can I provide that will help him decide whether the tools that he is currently using are maybe not matching up to the requirements for moving forward - that he might actually need to incorporate something that creates dialogue opportunities between him and his clients? The output of the framework is therefore not to provide a list of all the specific tools you could use.

*L: Yes.*

A: We could make a list of current concepts such as workflow management, CoP, etc., but for me it was important to rather provide tool requirements that would stay relevant longer as the technology and tool landscape changes, so that when we get new tools we can measure them against the core fundamental requirements for growth between maturity levels.

*L: Yes, I understand.*

A: So this, in a nutshell, is what my research was about.

*L: Now I understand. The information in your document doesn't highlight this very well. I understand where you're headed with this.*

A: Okay.

*L: When I read your document it wasn't very obvious that all knowledge processes are present from level 1. Your explanation and interpretation of the framework seems like you understand this very well, but I'm not sure whether you've written it down as clearly, or I didn't read it that well.*

A: It is stipulated in a footnote [footnote 7, page XI], but it is important that you point this out; that I should maybe make it a very definite point of discussion.

*L: Yes. I've sent you a document that I've attached<sup>22</sup>. What I've worked with before is the Business Process Maturity Model: you'll see there that they look at evaluating*

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<sup>22</sup> The Business Process Maturity Model of the Object Management Group.



*processes in an organisation. You'll see a level 5 organisation, a very mature organisation, will be innovative regarding their business processes. It's not exactly what you're doing, but the way they've structured that model makes it very practical to apply in an environment. So what I'm saying is that, as you've explained to me, you've approached the problem correctly, I just didn't see it as clearly [as with the model in this attached document].*

A: Okay.

*L: What that model says, is on a certain maturity level you need very specific processes and activities to be successful and move to the next level. And this was exactly your approach as well; it just wasn't as clear without our discussion.*

A: Obviously this is just a summary document for the purpose of the research evaluation phase of my thesis, and in the thesis itself everything will be covered in much more detail and context. But it is a valuable comment that I should really "hammer the message home", repeatedly stating the core purpose of the framework.

*L: Yes. Also, if I have read the document without our discussion, I would have assumed there was no maturity level 2 and 4, because I can't see it anywhere. I would've assumed that you tried to adapt the usual CMMI® models, but didn't have time to detail level 2 and 4.<sup>23</sup>*

A: I understand what you mean; so I should just state everything a lot clearer?

*L: Yes. I just want to understand, when we look at your framework, is the goal at the end of the day to enable me to evaluate products that will help me manage innovation? Is that an output?*

A: One part of the output is to evaluate whether what you are using currently complies with the requirements to sustain your maturity level, but also when moving forward, with what requirements your products should comply.

[Author proceeds to explain the CMMI® Capability Requirement Questionnaire as described on p. VI, emphasising that the idea was to provide formalised generic guidelines for knowledge management as a vehicle for innovation capability maturity growth.]

<sup>23</sup> This aspect is covered in the section "What is an Innovation capability Maturity Model".



*L: So your framework takes the maturity level indication after this analysis was done, and due to the maturity level of the organisation, we should be using this products with these types of requirements.*

A: Yes.

*L: Okay, now I understand.*

A: But for me, and this might be a little ideological, I would like to think that the framework can be a guideline for an enterprise that hasn't necessarily gone through such a formal audit. Someone who has a little common sense and realises that how we interact with external parties, clients, has an impact on our innovation capability; do we have a procedure regarding this activity or not? If not, then we are aiming for a maturity level 3 and we should be using tools complying with the following requirements.

*L: Okay. One last thing about your framework; how do you understand the term capability? Did you define it somewhere?*

A: Yes. On page four, the third paragraph.

*L: Okay.*

A: "Common processes and previously acquired knowledge and competencies, supported by the appropriate organisational structures, strategy, climate, culture..." So, to me, it's about the ingredients that enable an enterprise to innovate. The combination of those ingredients enables us to innovate, not only one, although we should be able to focus on the ones that need improvement.

*L: Yes. So it's the organisational structures etc., but somewhere there should be technology. Let me quickly read here; "Innovation capability is the organisational means with which innovation outputs are generated".*

A: Yes, so there is definitely a technology component. On a practical level, how you use your technology, but also defining your technology strategy.

*L: Yes, I understand. That wasn't very clear to me when I read the document. I now understand the output of your framework, and I think... No, not I think. It is valuable, and there is a great need for this. To understand where the enterprise lies, and to*



*understand, without going through a complex process, how you should be sharing knowledge, and what you should be asking for to support this.*

A: Yes, it is an important comment that I should contextualise my research output more, especially for examination purposes. I'd hope that it would be clearer when reading a longer document such as a thesis.

*L: The thing about examiners is that they do not have time to read a lot, and sometimes just scan parts. So your introduction should be well explained.*

A: Okay.

*L: After the conversation we just had, I understand your work, and I really think it is very good. I think you chose a very good topic and it is in today's environment an important topic to address and understand.*

A: If you reconsider the questions I've sent you, would you conclude that this is an applicable and useful framework?

*L: Yes, completely. I felt like I was missing some context, but after our conversation I think it's very applicable, and on the right level of detail. I find it practical.*

A: Thank you, that's great to hear! Are there some aspects of the BPMM document you sent me that you would like to highlight?

[Mr Labuschagne proceeds to explain some interesting background aspects of the BPMM of the OMG.]

*L: I think the thing about your work is contextualisation; it can be difficult to explain to someone, who doesn't have the same background and level of knowledge on the subject as you have; where it fits in and how it works.*

A: Was the level of detail I used to describe my research to you during this conversation, sufficient?

*L: Yes. I think the challenge is to find a way to express yourself on paper with the same efficiency.*





A: So when we take a last look at my framework, do you agree with the key knowledge creation path that I identified to enable innovation capability maturity growth from one level to the next?

*L: Yes, I completely agree; it makes sense.*

[The interview ends with formalities; thanking the interviewee for his time and insight.]



**Appendix D**  
Part 4

**Research  
evaluation**

**Mr PWJ van Zyl**



## Mr PWJ van Zyl

Strategy consultant – Nedbank

Business consultant – Demix Business Development

(No written answers received)

Feedback-orientated interview

Interviewed via Skype<sup>24</sup>

5 October 2010, 16h00

Author (A): I think we start with the background contextualisation. What you're busy with now as well as how much exposure you've had to the fields of knowledge management and Maturity Models.

*Mr Van Zyl (Z): Okay. I have a very thorough understanding of maturity models. I am a High Maturity Lead Appraiser of the SEI. I am certified by the SEI to perform CMMI® assessments. I can perform a SCAMPI; on CMMI® development, and I'm busy with the process of being certified to perform it on CMMI® acquisition. I am certified to instruct and train people in CMMI® development, as well as SCAMPI B and C, and I'm also busy being certified to train people towards CMMI® acquisition. I've also, in a professional context, built my own CMMI® enterprise architecture, so I understand it very well. I am rather interested in the ICMM that I've seen in your document.*

A: Yes, Dr Essmann's work.

*Z: Yes. It would be great if you can put me in touch with him; I would like to talk to him. Okay, that's it from a maturity point of view. In terms of knowledge management, if I have a look at what you're saying here; tacit and explicit knowledge and how we can capitalise on this in companies. Part of CMMI®, maturity level 3, is the gathering of lessons learnt; organisational knowledge collection. CMMI® level 5 is about*

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<sup>24</sup> Translated from Afrikaans to English. Interview duration: 42 min.



*incremental and innovative improvements, so this demands that you continuously improve yourself. So I understand this well.*

A: Okay.

*Z: And you have then the tools available: LinkedIn, there is knowledge sharing there, and you have your websites, Google and Yahoo.*

A: Yes, but also that knowledge management is an organisational tool rather than just an ICT tool.

*Z: Yes, of course.*

A: Okay.

*Z: Okay, so that is the background contextualisation.*

A: Okay. Are there any specific questions that you would like to ask? Or should we just start with my evaluation questions and work our way through them?

*Z: Yes, let's go through the questions.*

A: Okay. A bit of background contextualisation from my side: I started my studies with BComm Operations Research, then followed with my honours in that field, and then did a Post Graduate Diploma in Engineering. From there I was upgraded to an MScEng in Industrial Engineering. I started reading more about the innovation landscape as I didn't have that background, and I came across something that really triggered me: innovation capability. This really interested me, that in order to maintain its competitive advantage an enterprise needs to grow and mature its innovation capability in order to innovate on a constant and sustainable basis.

*Z: Yes.*

A: One interviewee remarked that my research methodology related questions are actually non-questions, they are facts. But it is still necessary that I ask the question: did I follow a solid methodology? So, you can tell me to what degree do you agree with me when I see innovation capability as an integral part to the sustainability of an organisation; as well as regarding the strong link that I see between knowledge management and innovation?



*Z: Yes, I think it is very important. I don't know who you've talked to, but if you have a look at the corporate world: organisations have the inability to learn from themselves.*

[Mr Van Zyl elaborates by discussing the Groundhog Day phenomenon; what has happened now has happened before; organisations have the inability to learn from themselves.]

*Z: So I think that what you're doing is very relevant. One can definitely use the ICMM, but a very important component what you've identified is the learning element. So I think your link is very relevant.*

A: Okay, good. So then, at point number c, do you agree that a study which is directed at investigating how knowledge management can be used to improve our innovation capability?

*Z: Yes, absolutely.*

*[Mr Van Zyl proceeds to suggest that his colleague at Nedbank contact me, as he's doing relevant work that he would like to generate some discussions and debates for.]*

A: Okay, then, the crucial question that could lead to a difference of opinion: my dilemma was to find a way of linking innovation capability and knowledge management. It seemed like a good idea as these knowledge creation processes are critical enablers to innovate, but what does this tell us? The idea then came to align the requirements for maturity growth according to the innovation capability maturity level description of Dr Essmann's ICMM with the knowledge creation processes that are needed to innovate. Do you agree with this idea? If we have a look at Figures 6-1 and 6-2, do you think this is a logical way of linking the two fields?

*Z: I'm going to give you a bit longer answer. If you have a look at maturity models, they are usually "what" models, so they tell you what is necessary. So a maturity model will tell you that you need a plan; what that plan is, is up to you. You can have a MS Project plan, Excel, Word, on paper; that is the "how". Now the maturity model asks for example for the collection of improvements. So what I'm getting at is that the knowledge management guidelines that you provide can be a "how"; here is a good way of doing it, here is a "how". So it is a practical implementation of those requirements.*



A: Yes.

*Z: So this is the one way to approach it. If you don't approach it this way, but you approach it from a best practise angle then you'll enhance and extend the maturity model with good knowledge management best practices; if you understand what I mean?*

A: Yes.

*Z: So these are the two approaches. So one way is to enhance and extend the maturity model with knowledge management best practices; the other is to use knowledge management to achieve the maturity model's practices. And this is what you're saying here, and I think this is a good view of the "how"; using knowledge management to improve from maturity level 1 to 2 to 3 to 4 to 5. So this is absolutely meaningful.*

*A: Yes. And also to be able to say that, when we recognise that we are at a certain maturity level of a specific capability or for a prioritised overall assessment, the framework gives us certain tool requirements to adhere to in order to at least sustainably maintain this level of maturity. We'll need to address this and this before we can even think of maturity growth.*

*Z: Yes.*

*[Mr Van Zyl elaborates with a SCAMPI industry example highlighting the applicability of knowledge management.]*

A: Okay. Then, moving on from the research idea and reasoning to the framework itself. If we look at the specific knowledge growth path that I've identified; for example when we're improving from maturity level 1 to maturity level 3, from an ad hoc to a formalised state, for a specific innovation capability or overall, do you agree that the key knowledge creation process to facilitate this would be to be able to capture, to make tacit knowledge explicit?

*Z: Yes, 100%*

A: Okay. Another interviewee rightly commented that he thinks all knowledge creation processes should be present at all times, and I completely agree. This growth path simply highlights the key processes without which maturity growth would be



impossible. You have to have some indication of where your core focus should be, you can't simply go and try and improve everything all the time; you have to know to what process to pay specific attention to.

Z: Yes.

[Mr Van Zyl proceeds to elaborate with an example of how someone would typically use a software CMM book to design a maturity model. Through this he highlights that practices and procedures are formalised at maturity level 3. Author and Mr Van Zyl discuss that the original CMMI® has predictability at maturity level 4 and not at 3 as with Dr Essmann's ICMM; but here a level 4 is implicitly defined between 3 and 5 as a result of case studies done during his PhD studies.]

*Z: Yes, okay. I haven't read his research, and don't get me wrong, I'm sure that it is obviously of great value. I'm just saying that, if we're being purists, and we look at the original CMMI® of the Software Engineering Institute, then there are a few things that I usually pick up when people build maturity models that deviate from the framework and principals of the, let's call it standard, CMMI®. So I'm just mentioning this to you to make you aware of it.*

A: Okay, thank you. This will probably come in handy during our final examination colloquium, but also in finalising my thesis.

*Z: Yes, you could get someone who'll get very finicky concerning the maturity model. So, yes, you could have used two approaches; you can use knowledge management, the concept as you have it here, and you can implement in in the standard CMMI® core processes of the SEI, or you can implement it in the ICMM, which is also good. You can use both those approaches; you've chosen to do it in the ICMM which is fine. It would be nice to see that you, when you're done with this research, refine this research to apply it for the standard CMMI®; there could also be a lot of value there. Okay, let's move on.*

A: Yes. The next question was, but I think we've addressed this already, whether you agree that this knowledge creation path accurately addresses the key requirements for growth between maturity levels? Because we've talked about the fact that we want to capture between maturity level 1 and 3, and you have also mentioned that, between maturity levels 3 and 5, we want to rework what we've formalised.



Z: Yes.

A: But also at level 5, everything is institutionalised, and your whole organisation is agile and mobile regarding innovation and adaption to perform these procedures. That's why I've also identified learning as a key process to address between levels 3 and 5.

Z: *Okay, yes, I agree, that is correct.*

A: Okay, then the next question is whether you agree with the specific tool requirements in my framework. I would like to have your opinion on the specific requirements in my framework.

Z: *Okay, obviously no framework is perfect. So, talk me through your framework.*

A: Okay. So if we have a look at the framework: between maturity level 1 and 3 I have identified that the key knowledge process to enable growth is to capture, when we want to improve from ad hoc to formalised.

Z: Yes.

A: So there I identified as an input requirement to the knowledge process; that we have to be able to get this knowledge that we want to capture from somewhere. So the key requirement that we need, either in an organisational tool or an ICT tool, is that we have to find out where this knowledge is. So with obtain and convey, we have to be able to identify people with the appropriate knowledge, but we also have to enable them to convey this knowledge. And as an output we need to be able to transform this tacit knowledge into a format that we can understand and use.

Z: *Yes, that's perfect, 100% correct. What happens in an ad hoc environment is that people have the knowledge in their heads and there are no defined processes and procedures; and you have to get this knowledge from them in some way to document it and move to level 3, when we're talking about level 1 vs. level 3, where we have defined procedures and standards. And this is exactly what you're saying.*

A: Yes. Just a note; I realise that each of these input, output and supporting requirements can be a study on their own. Enabling identification of people, internal and external to the organisation, with appropriate knowledge is not easy; to do knowledge profiling is a post graduate study in its own right. So this is just a





conceptual framework to link the fields of knowledge management and innovation capability.

*Z: Yes, that's right, I understand. And you're 100% right when you say that we work with people; we have to work with change management. If you have someone working for one since day 1, and he's been doing support and maintenance on a system for 30 years, and this is his knowledge, and his knowledge is what secures his job. When we want to go and document that process, we rob him of his only leverage, his knowledge; and there you'll get resistance. So I agree with you, it can be a study in its own right.*

A: Yes! Initially I thought to expand each input, output and supporting perspective into a detailed manual, but soon realised that I'll have to register for another degree for that!

*Z: Yes, or a few. [Laughs]. Okay, talk me through 3 to 5.*

A: Between maturity levels 3 to 5, there are two knowledge processes that are key to innovation capability growth. To, as we've discussed before, be able to rework what we've captured in the previous growth phase, it is important to firstly be able to identify what it is that has to be reworked; given that the goal of an innovation capability audit is to prioritise certain core competencies capability. So identify and locate that knowledge, also tying in with what we've mentioned about resistance to change, here we want to have a culture that minimises knowledge hiding as well as make sure everyone knows what their role is during this phase. This enables us to work towards an output where we're able to disseminate to organise and improve; so that this knowledge that we've captured and reworked is accessible to everyone and everyone knows exactly what's expected of them. And this closely relates to the learning process; as we're disseminating this reworked information, who has to know what, who has to have access to what, what everyone's responsibility is, we have to have a very good structure to be able to learn.

*Z: Yes, that's perfect.*

A: ICT supported and face-to-face learning, whether in a group setup or on your own. When you're for example receiving a document stating a new procedure, you have to know and understand exactly how this affects how you do your job.



*Z: Yes. That's correct. I think this is very good, I agree 100% with what you've got here. What you'll also find in the standard CMMI® is that on a maturity level 3 they have an organisational training process area for specifically the same reason that you've got here, so this is where organisational learning comes in. So you're 100% correct.*

A: Then the right-hand side column shows the process, which in my mind should be present throughout all the growth phases; that we have to be able to support socialisation; we have to support the exchange of tacit knowledge.

*Z: Yes.*

A: Throughout the growth phases, from maturity level 1 to 3 and 3 to 5, we have this people component; firstly to enable them to convey what they know, and then after formalisation to adapt these procedures and make it part of their day to day work environment; you have to manage and support that.

*Z: Yes.*

A: So there the input requirement is that we have to firstly be able to identify who has to know what, who has to be talking to whom, but as an output we need to be able to facilitate this in order to sustain frequent occurrences of intensive communication. So this closely ties with the learning process, but it is a specific indication that we have to manage and facilitate a people component.

*Z: Yes. I think it is very good and I agree.*

[Mr Van Zyl mentions that the standard CMMI® has the following process areas; organisational training, organisational process definition and organisational innovation and deployment.]

A: Then the last question before we get to the applicability question; do you think that the structure of the framework is meaningful? Having an input, output and supporting perspective for the growth path?

*Z: Yes, it's good, I'm 100% with you on this; it's very good work. Obviously one can always refine something, in context of the standard CMMI® that I train and learn and assess, I would've liked it if you had rather based your framework on specifically that one rather than the ICMM. [Laughs].*



A: Okay.

Z: *But yes, this framework is very good, I'm 100% with you, and I think it is very valuable.*

A: Okay, good. So this relates to question c; you say that you would've preferred if I had rather used the CMMI®, but would you still say that this is a usable framework?

Z: *Yes, I think so.*

A: Do you think it is more applicable for use with specifically Dr Essman's ICMM?

Z: *You see, this was done within context of the ICMM, and you'll have to use it within that context. And I think, within the context of the ICMM, it is very useful, very valuable. And I think you can with little effort, after you're done with this study, refine your framework for the CMMI® and write an article about it.*

A: So do you think someone with a lot of experience with the CMMI® could use this framework, even if they don't use the ICMM?

Z: *Hmm... I'm not sure. You'll have to put it in context as someone can get confused with some of the concepts; predictability being at level 3 instead of level 4 as in the standard CMMI®, and we see the concept of institutionalisation differently. Institutionalisation is when you get in the car and you just drive, changing gears without even thinking about it; the practice has been institutionalised. Now someone who's a Formula 1 driver, would for example get in a car and drive it differently than you; better than you. His practices are also institutionalised. But his practices are institutionalised on a higher level than yours.*

A: Okay.

Z: *So we use the concept of institutionalisation as anything that you do without thinking; it is ingrained. But you could have institutionalised practices on different maturity levels.*

A: Yes.



*Z: So where your knowledge management guidelines come in, is in saying: rather do it this way or that way; until it becomes an ingrained way of doing something, and then you have improved your maturity level and institutionalised your best practices.*

A: Okay, I understand what you mean.

*Z: So if you look at the ICMM concept of institutionalisation at maturity level 5, which will be strange to someone who is used to the standard CMMI®; the terminology differs.*

A: Okay.

*Z: So to get back to your question, in the context of someone who understands the CMMI® very well, your framework will be very useful. So I suggest you keep it this way.*

A: Okay

*[Author and Mr Van Zyl discuss her studies and her articles published.]*

*Z: When you're done with this study, I would like to write an article with you; and refine this framework for the CMMI®.*

A: Yes, that sounds interesting.

[Author and Mr Van Zyl discuss that she should write an article on this framework for publication, with the goal of augmenting that to publish another article on the refined framework for use with the CMMI®.]

*Z: Yes, okay, I think this [the framework] is fantastic, keep it as it is. Your last question; it is definitely usable and valuable within the context of the ICMM, and I think with a little adaptation, it will be valuable to the CMMI® community as well.*

A: Okay, wonderful, thank you. I think this has been a valuable conversation, especially for the final refinement stage of my thesis document as well as for examination purposes; to make sure that I not only highlight the history of maturity models, where the ICMM comes from, but also how and where it differs from the standard CMMI®.

[The interview ends with formalities; thanking the interviewee for his time and insight.]



**Appendix D**  
**Part 5**

**Research  
evaluation**

**Ms H Smuts**



## Ms H Smuts

General Manager – MTN

Evaluation questions: written answers received on 4 October 2010

### 1) Interviewee background contextualisation

#### a) Occupation / Industry?

- *General Manager at MTN, mobile telecommunication*
- *Manage a team of 109 people: 50% of team is business analysts where knowledge sharing and KM are key components to building IP and deep understanding of the business and enterprise architecture*

#### b) Previous exposure to the field of knowledge management?

- *KM is research passion, holds MSc degree in KM and currently busy with PhD in KM (title: towards a knowledge management framework for IT Outsourcing)*
- *Had the opportunity to work with Dr Karl Erik Sveiby (well known KM authority) at MTN in SA where we developed an intangible asset monitor*
- *Member of the KM society of SA*
- *Accountable for KM implementation at MTN via a cross-functional team*
- *Already published 4 papers on KM*

#### c) Previous exposure to the fields of Capability Maturity Models and/or innovation capability maturity?

- *Managed Process and People CMM project during 2004-2006 where CMM audit was done and gap to CMM level 3 was closed through the project*
- *Currently involved in CMMI® project and training with MTN IS and IBM (MTN's IS outsource partner) to "move" IS processes to level 3 by Q1 2011*

### 2) Research methodology related questions

- #### a) To what extent do you agree/disagree that to maintain its competitive advantage an enterprise needs to grow and mature its innovation capability in order to innovate on a constant and sustainable basis?



- *Totally agree. (1) Innovation in the telecommunication industry leads to differentiation in a market where operators have very similar products, technology, networks and services. (2) Innovation is not just coming up with new ideas; it is also about optimising old ones. Some of the best innovation cycles that I have seen started with an idea that others (cross-functional, from different disciplines) build on to through collaboration and engagement. (3) With the rapid change of technology in this industry, your innovative capability is key to maintaining and growing market share.*

b) To what extent do you agree/disagree that knowledge creation processes act as critical enablers for the innovation process?

- *Totally agree. Each employee brings certain knowledge and applies it within their frame of reference. Without sharing knowledge and learning, employees will not expand their frame of reference and that will stifle innovation. Learning, sharing and thinking together creates those unique innovative ideas. Another perspective to this is “sound-boarding”; when sharing knowledge and bouncing ideas off someone, an innovative idea is often generated and expanded upon. I also believe that innovation should form part of what I do, the way of work. I don’t do my job and then innovate as a parallel process; it should be integrated into what I do.*

c) Is it logical to therefore aim a study at investigating how knowledge management tools can be applied to grow innovation capability maturity?

- *Agree.*

d) To what extent do you agree/disagree with the idea of aligning knowledge creation processes with the requirements for innovation capability maturity growth from one maturity level to the next, as the cornerstone of research towards a knowledge management framework to grow innovation capability maturity?

- *Agree*



### 3) Framework related questions

a) To what extent do you agree/disagree with the reasoning applied when identifying the specific knowledge creation process path as a key enabler of growth between innovation capability maturity levels?

- *It is difficult for me to question the reasoning as I do not have enough detail to be able to follow your logic. To my mind, Nonaka's knowledge creation processes, as well as the CMM model are two independent models / frameworks (I use the words very loosely!) that can stand alone and what you have done is to "link" up the two – according to my understanding any way. However, there is a lot more to innovation than just the knowledge management processes, like culture for e.g. If you have limited your scope to KM / innovation only, then I feel your proposal is the best "link" as key enabler between the two.*

Do these identified knowledge creation processes accurately address the key maturity level description requirements for growth from one maturity level to the next?

- *I would agree with internalisation, systemisation and externalisation – while socialisation is an interesting one. I can, with the information at hand, "derive" how you define the movement between 1 and 3, 3 and 5. What I am missing is your reasoning from figure 6-1 showing socialisation below 1 to 3 to the final model (last page) with the column defined to the right. Does it imply that it runs across all CMM levels? As it deals with tacit knowledge (most difficult one!), what does it mean for innovation? My thoughts around this is that you need Socialisation to sustain innovation and here I would specifically use a co-creation process for example where the organisation, customers and suppliers "co-create" to achieve shared experiences that will facilitate "better innovation". What is difficult is that Socialisation implies that you have similar cultures and close proximity – something that is not true in general in organisations. So I guess the question from an organisational perspective is how do we overcome these barriers in order to sustain innovation at level 5?*





b) To what extent do you agree with the knowledge management tool requirements detailed in the framework?

- *Refer answer above. In addition – if you mean system tool as well – then there are more characteristics in inputs and outputs that may be considered as part of system enablement. I am not going to expand on that now as your scope may not include that layer. I feel however, that technology is a key enabler of knowledge management and facilitate e.g. collaborating among virtual teams, enable things like skills directories, ask an expert, etc. etc. – all components that will support your SECI Model.*

To what extent do you agree with the structure of the framework? [Synthesised to provide an input, output and supporting perspective to the requirements for the specific knowledge creation process(es)].

- *Refer answer above. I like the framework – only the socialisation component, exactly where it fits in (across 1 to 5 or for 5 only) as described above is not clear to me.*

c) Please comment on the applicability and usability of this framework, from your professional viewpoint, to provide guidelines for the use of knowledge management to advance innovation capability maturity growth.

- *I will definitely be able to apply the framework in practice. However, I have prior knowledge about both CMM and KM and find it easy to translate your guideline into what it means for us as an organisation and our innovation objectives. We deal with very fast moving technology changes (you can just compare handsets from 5 years ago to one's you get today to get a feel for that!). I have given one of the people in my team the last page of your document (model) and asked there comment about it (they do not have any prior theoretical knowledge about CMM or KM). She understood the model and found it interesting, however it was difficult for her to do the next level translation of how to apply it in our specific situation and what steps to follow to move from level 1 to 3 for e.g. To my mind though for your thesis and scope thereof, I feel you have achieved your objective of applicability.*



#### 4) Further comments

- *I enjoyed reading your documentation. It is well written and presented and I can see applicability from an organisational perspective.*

*Please let me know if I have to clarify any of my thoughts prior to us talking over the phone.*



## Ms H Smuts

General Manager – MTN<sup>25</sup>

Feedback-orientated interview

Interviewed via Skype<sup>26</sup>

6 October 2010, 10h00

Author (A): The first section [of the evaluation questionnaire] was about interviewee background contextualisation, and then there was the section research methodology. It seems that you don't have any objection to my methodology?

*Ms Smuts (S): No, everything is fine; very good.*

A: Good. One interviewee told me that these are non-questions, but I find that it useful to still ask them to make sure that you've connected the dots correctly.

*S: Yes, one has to confirm that.*

A: Okay, if we then move over to the framework related questions. At 3a the question was to what degree do you agree with the reasoning plied when I identified this specific knowledge creation path that is key requirement in enabling growth between maturity levels? There you responded by saying that you agree with the link I made, but that you feel there is a lot more to innovation than just knowledge management.

*S: Yes, that's it.*

A: And I agree with you completely. The angle of the framework should be seen as one way of linking the two, specifically by linking the fields of innovation capability and knowledge management.

*S: Okay, 100%. That's correct.*

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<sup>25</sup> Please note: all opinions expressed by Ms Smuts is done in a strictly personal capacity, based on her own experience, academic research and personal opinion, and do not reflect data obtained from, or the opinions of MTN, her employer.

<sup>26</sup> Translated from Afrikaans to English. Interview duration: 19 min.



A: I mean, in order to provide an integrated innovation plan from all possible fields would be quite a few post graduate studies.

*S: Yes.*

A: So you do agree with the specific alignment that I made?

*S: Yes, that's correct.*

A: Okay, good. Then the next question under 3a is; do the identified knowledge creation growth path accurately address the requirements for growth between maturity levels as indicated by the maturity level descriptions of levels 1, 3 and 5? I see that you have written quite a long response to this question, thank you. You indicated that you were unsure about what I meant with my use of the socialisation process in the framework; whether it is just at level 5, or present across all three levels?

*S: Yes, that's correct.*

A: With the socialisation aspect; I don't want to say that it was intuitive, but what I did was evaluate my knowledge creation path enabling growth between the maturity levels, having just the capture growth perspective between maturity level 1 and 3 going from ad hoc to formalised, and rework and learn growth perspectives between maturity level 3 and 5, going from formalised to institutionalised. And I realised that something was missing. During each of these key processes we strongly rely on people, yet with the growth path as it was, we are not specifically supporting the people component which is an integral part of the success of growing between maturity levels. But to me, the socialisation process, the people component, comes in when we consider learning; it's not just embodying explicit knowledge, but it goes further than that towards also necessitate interacting, sharing tacit knowledge. This strongly ties to Senge's Learning Organisation, advocating that in order to be a learning organisation, people have to constantly adapt their mental model against the mental models of others by interacting; through socialisation.

*S: Yes, that's right.*

A: Now when we go to the framework, the right-hand column's heading show's that the socialisation process goes from maturity level 1 trough to maturity level 5. With this I mean that it should be managed from the start.



*S: Yes, that's correct; that is what I wanted to confirm with you; that is exactly my opinion. So visually I would suggest, and this is maybe just the way my mind works, that you put the socialisation across all three levels. Do you know what I mean?*

A: So you would have put a socialisation column at every level?

*S: No, at the bottom of the framework, across all the levels. So that it visually tells you that the process runs across all the maturity levels.*

A: Okay, I hear what you're saying.

*S: You have to remember that you have done a whole study on this. And I have just read your 15 pages, which I thought was very good; it's a very good abstract of your research. I first looked at it from a visual perspective, the framework, and then went through your work, your approach etc.*

A: That is a valuable comment. Your approach to my document could very well also be an examiner's approach – not reading everything from start to finish, but focus first on the framework and then go into the detail of the thesis.

*S: Yes, that could be. But this is what I wanted to confirm, that the socialisation process runs over all 5 levels, and you confirmed this, so it's fine. I also think it will be difficult to satisfy everyone; so if this was what your intention, it's correct.*

A: Okay. I could maybe re-evaluate the visual aspect of it; it was quite a dilemma to present all the information in a framework that, at a glance, makes sense.

*S: Yes. Usually when we work with behavioural change management or knowledge management, where we have a process or a phase diagram, then you place it in long lines across the process. So I encounter this in my work, and I would have placed it from your first light green column across to the end of your dark green column at 5; but that is just a visual comment.*

A: Okay. Then at 3b; I would like it if you could expand on your comment about system tools.

*S: Yes, okay. What I make of your work is that innovation enables an organisation to make a difference in its competitiveness, market share etc. And that knowledge management is an enabler of innovation; it is one of the key components of innovation.*



*So then, system enablement, in other words to use application, software, systems etc. in turn enables knowledge management. Now, [at my job] we deal with huge volumes of data, millions of records are generated each day. So you can't function without an IT system; so when I talk about system tools, this is what I refer to. So my perception is that you did not consider applications or system tools; you've rather used the knowledge processes of Nonaka to link innovation capability maturity.*

A: Yes. What you've said is correct; I identified innovation capability as a critical factor in a firm's sustainability and competitiveness, and then singled out knowledge management, and particularly knowledge creation processes, as enabling to the innovation process. My reasoning was then that we need some logical way to link these two; by aligning the requirements for growth as described by the maturity level descriptions, with knowledge management, with the knowledge creation processes, and then to specifically highlight the key processes without which maturity growth would be impossible. So when I specified the tool requirements for each growth perspective, I went and tried to determine the specific requirements for that specific knowledge creation process. So for externalisation I reasoned that we need to get the tacit knowledge from somewhere, but we also need to enable those people so share it and it would be critical that we then make it available in a usable format. So that was the angle of my approach.

*S: Yes, that's correct.*

A: For me, it [the framework] has to serve as a guideline for organisational tools, our culture and day-to-day approach, but also for ICT tool requirements, enabling us to evaluate new software products etc. Obviously this framework isn't the only thing you'll consider when selecting new software, it has to be functional for the task at hand, but if we want to consider a holistic knowledge management approach, it [the software] has to also address the specific requirements listed in the framework.

*S: Yes, that's correct, now I understand. So the implication of what I asked you [in my answer of evaluation question 3b] is then, when we consider your collaboration requirement; that you would then also use ICT to support collaboration?*

A: Yes.



*S: Where I work we have more than 20 operations across the globe. I can't constantly fly to Yemen or Iran to physically collaborate. So when you say we have to collaborate, it implies that we have to use software tools that enable collaboration and support virtual teams, something that you can for example share large data files with. And you didn't detail that. So where I've written, "and then there is more characteristics that you should consider", this is what I meant. But I understand that you work with a generic framework and not just software tools as they are specific to every organisation.*

A: Yes. It was difficult, for the purposes of this document, to keep it concise and yet provide enough detail. For the purposes of my thesis I will of course explain in detail for each input, output and supporting perspective exactly what I mean.

*S: Okay, that's right.*

A: Okay, the second question at 3b, you referred back to your previous socialisation remark. The question here was whether you agree with the structure of the framework; that it has a growth, input, output and supporting perspective?

*S: Yes, that's right. I wrote there that I like it.*

D: So there I just have to make sure that, visually, the reader gets the right perspective on the framework at first glance?

*S: Yes.*

D: Yes, then at 3c, you commented that the framework is applicable, but that it is also very generic.

*S: Yes. It [the framework] is definitely something that I can personally very easily use in my work environment. So if you say, as an input requirement "identify and make accessible in right format", I can translate that to our organisational processes. So I would easily be able to translate it to how I can apply it in our organisation. I went through every block in the framework, asking what the input and output was, and how we can support that, and it was very easy for me to make that links; it works very nicely. What was also very interesting was that it enables you to identify gaps; if you for example say "identify, locate, obtain and integrate", I can for example go and check that, yes, we can identify, locate and obtain, but integration is a bit of an issue; so to use it as a bit of a rough analysis. So that was very cool.*



D: Okay, good.

*S: So I have a team of over a 100 members, of which half are business analysts on different levels. What I did was, I gave the framework to a junior member in my team who doesn't have a lot to do with the field of knowledge management, but I gave it to her based on his profile as a business analyst. And she could explain very clearly what she understands at each block in the framework as well as the flow, which is nice. She could not link it back to the organisation, but that is more due to internal knowledge of the organisation; that she hasn't been working here long.*

D: Okay good, as you have a lot more experience and understand the organisation as a whole a lot better.

*S: Yes. So I really think that is a very good thing [that the framework is interpretable]. So I definitely think that one can apply the framework fairly easily.*

D: Okay, good. That's nice to hear. I checked your LinkedIn profile; you have a lot of experience in knowledge management, and it's nice to know that my work has been evaluated by someone from a critical angle.

[Ms Smuts discusses some of her previous experience, her PhD studies, articles published etc.]

[The interview ends with formalities; thanking the interviewee for her time and insight.]