Toward Innovation Capability Maturity

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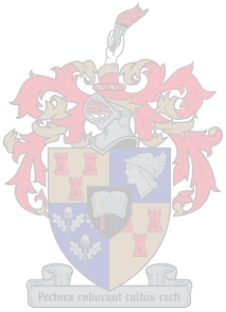

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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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Synopsis

This research has its roots in Industrial Engineering, where the premise of improving and managing efficiency, effectiveness, productivity and quality is the most common and accepted source of organisational sustenance and furtherance. This dissertation, however, addresses the evolutionary and revolutionary imperatives of a new paradigm for competitive advantage – innovation. The notion of innovation is considered many things. First and foremost, however, it has become the primary differentiator of organisational competitiveness, rendering it the source of sustained long-term prosperity.

What may seem ambiguous in the title of this dissertation is essentially the imperative of every organisation functioning 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.

In working towards the fulfilment of this objective, the Maturity Modelling approach was recognised for its ability to describe organisational progression in terms of innovation capability. An Innovation Capability Maturity Model, with the intention of describing generic and evolutionary plateaus of innovation capability maturity, was developed from a comprehensive literature study.

This model was evaluated with an initial case study which led to a rigorous refinement initiative that included further literature study, a mapping and comparison exercise, and a detailed analysis of innovation capability themes using a Latent Dirichlet Allocation-based topic modelling approach. The consolidation of these activities and integration with the initial model resulted in the second version thereof – ICMM v2.

This second version was then utilised in an additional 5 case studies that would serve to evaluate and validate the content and structure thereof, but also make a fundamental contribution to the application of the model – captured in the so called Innovation Capability Improvement Methodology. The case studies provide evidence that the content and structure of the ICMM v2, including the approach used to convey these aspects, fulfil their intended purpose by appropriately identifying the innovation capability strengths and weaknesses of the represented organisations.

The ICMM v2 and accompanying methodology provides an organisation with a systematic approach for identifying organisational innovation capability strengths and weaknesses and a framework for identifying and prioritising innovation capability improvement opportunities in an organised and coordinated manner. This dissertation concludes with a few fundamental findings pertaining to innovation and a discussion of potential future collaboration and research opportunities.

Opsomming

Hierdie navorsingsprojek het sy oorsprong binne die bedryfsingenieursdomain. Bedryfsingenieurswese is primêr gerig op die verbetering en bestuur van doelmatigheid, doeltreffendheid, produktiwiteit en gehalte. Dit is voorts 'n vry-algemeen aanvaarde bron van organisatoriese volhoubaarheid en verbetering van maatskappye. Hierdie navorsingsverslag spreek die evolusionêre en revolusionêre vereistes van 'n nuwe paradigme vir mededingendheid, naamlik innovasie, aan. Die term innovasie beteken verskillende dinge vir verskillende mense. Dit is sedert die 1930's intensief nagevors. Meer onlangs het innovasie ontwikkel tot 'n primêre onderskeider van maatskappy-mededingendheid. Dit is vinnig besig om te ontwikkel in 'n sleutelbron van volhoubare, langtermyn welvaartskepping.

Die titel van hierdie proefskrif mag aanvangklik dubbelsinnig klink, maar dit beskryf eintlik die fundamentele vereistes van elke organisasie wat binne die mededingendheidsdomain funksioneer. Aanvanklik is innovasie en organisatoriese volwassenheid as teenstrydige konsepte beskou. Die versoening van hierdie twee oënskynlike teenstrydige konsepte is egter fundamenteel tot die ontwikkeling van langtermyn organisatoriese mededingendheid en gepaargaande welvaart. Mededingendheid word tans verseker deur die tempo en volhoubaarheid waarmee maatskappye hulle innovasie-vermoeë beoefen en uitbou.

Die konsep van volwassenheidsmodelering is identifiseer as 'n belangrike element om die innovasie volwassenheid van maatskappye volledig uit te bou, asook om organisatoriese groei in ten opsigte van innovasie-vermoeëns te beskryf. 'n Eerste orde innovasie-vermoeë volwassenheidsmodel (ICMM v1) is met behulp van 'n uitgebreide literatuur-ondersoek ontwikkel. Hierdie model het ten doel gehad om generiese en evolusionêre plateau's van innovasie-vermoeë volwassenheid te beskryf.

Die aanvanklike model is geëvalueer met 'n gevallestudie waarna dit drasties verfyn is, deur gebruik te maak van 'n sekondêre literatuurstudie, die kartering en 'n vergelykende evaluering, asook 'n gedetailleerde ontleding van innovasie-vermoeë tema's. Dit is gedoen deur gebruik te maak van "Latent Dirichlet Allocation"-gebaseerde konsepmodellering. Hierdie aktiwiteite is gekonsolideer en geintegreer met die eerste model in 'n weergawe twee, wat bekend staan as ICMM v2.

Hierdie weergawe is verder ontplooi in vyf opvolg-gevallestudies wat gebruik is. Die doel hiervan was om die nuwe model te evalueer en valideer ten opsigte van die inhoud en struktuur daarvan. Voorts het die ook 'n fundamentele bydra gemaak tot die toepassing van die model waartydens resulutate van die model vervat is in 'n sogenaamde innovasie-vermoeë verbeterings metodologie. Die onderskeie gevallestudies het bevestig dat die inhoud en die struktuur van die ICMM v2 hulle aanvanklike doelwitte volledig bereik het deur beide die innovasie-vermoeë sterkpunte en swakpunte van die organisasies te identifiseer en uit te lig.

Die ICMM v2 en gepaardgaande metodologie bied aan 'n organisasie 'n sistematiese benadering tot die identifisering van organisatoriese innovasie-vermoeë sterkpunte en swakpunte. Dit voorsien verder 'n raamwerk vir die identifisering en prioritisering van innovasie-vermoeë verbeterings geleenthede binne maatskappye. Hierdie proefskrif word afgesluit met 'n aantal fundamentele bevindings met betrekking tot innovasie en 'n bespreking van toekomstige samewerking ten opsigte van navorsingsgeleenthede.

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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 facilitate in developing a plan for the improvement thereof.
Capability Requirement	Topics of organisational practice that bring about the development of innovation capability, pertaining to a specific Innovation Capability Area or combination thereof. (Also referred to as an Innovation Capability Requirement.)
Domain of practice	An area of business activity that may be an organisational core competence (e.g. an organisation specialising in project management or a primarily project-orientated organisation), or a business unit that is tasked with those activities. 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.
Impact Mapping	An activity relating the perceived impact of the practices described within a maturity model to the phases of a specific lifecycle.
Innovation Capability	The organisational means by which innovative outputs may be facilitated.
Innovation Capability Area	The highest, generic level of innovation capability aggregation; describes the organisational factors that contribute toward innovation capability.
Lifecycle	Describes the evolution of an entity or system constituting several phases, including a beginning and an end.
Lifecycle phase	A description of a particular state of an entity or system that exhibits an evolutionary nature.
Maturity level	A well-defined evolutionary plateau of domain of practice capability maturity.
Organisation	Used synonymously with enterprise.
Requirement Practice	Generic practices pertaining to a specific Capability Requirement at a specific maturity level, and which contribute to the fulfilment of that Capability Requirement at the given level of maturity. They are the fundamental building blocks of innovation capability maturity.

Preamble

With innovation having been recognised as the means for creating and sustaining competitive advantage within an increasingly complex and changing environment, it has become essential for organisations to proactively strive towards consistent, and persistent, innovation. However, doing so is immensely complex due to the abundance of barriers associated therewith, and the specific and interrelated organisational capabilities that are required therefore. An Innovation Capability Maturity Model (ICMM) developed through this research specifies these fundamental and generic innovation capabilities and describes their interrelatedness and impact on the organisation. The model and accompanying methodology aim to provide an organisation with a systematic approach for identifying organisational innovation capability strengths and weaknesses and a framework for identifying and prioritising improvement opportunities in a systematic and integrated manner.

It is necessary to understand the positioning of this model in relation to other organisational improvement models such as the Excellence Model from the EFQM (European Foundation for Quality Management), CMMI (Capability Maturity Model Integration – discussed in Chapter 1), 6σ, TQM (Total Quality Management), Theory of Constraints from the Goldratt Institute, JIT (Just-in-Time), Lean Principles, etc. These models, including the ICMM, play a fundamental role in creating and sustaining a competitive enterprise. However, the contribution of each of these models varies substantially from that of the ICMM.

Figure 1 is based on a high-level diagram conceptualised by Indutech (Pty) Ltd[1] in which different organisational modes are depicted. The modes, ranging from *Operate* to *Radical & Disruptive Innovation* (and including *Green Fields* design) represent the different states in which an organisation, business unit or new business initiative may reside. Importantly, the organisation resides in several modes at any given time and changes between these modes based on its existing status and drive for competitive advantage.

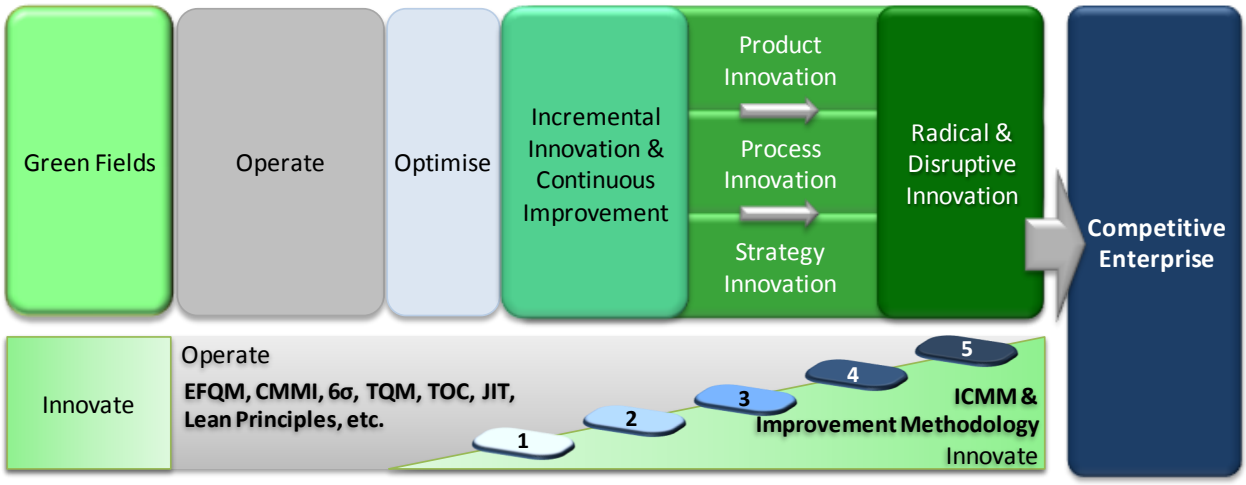

Figure 1 – Modes of the enterprise and improvement models

[1] www.indutech.co.za

The diagram conveys the notion that the other improvement models (EFQM, CMMI, 6σ, TQM, TOC, JIT, Lean Principles, etc.) are focused primarily on the operations-based activities of these modes. While these activities do extend through to the *Radical & Disruptive Innovation* mode, recognising that many of the models do mention and provide a certain degree of support for innovation, they remain operations-centric and do not comprehensively address organisational innovation capability. This is where the ICMM and the associated improvement methodology complement the continuous organisational endeavour to be more competitive – in specifying the fundamental organisational requirements for innovation and in describing the means to best fulfil those requirements given the unique circumstances of the organisation.

Note that the innovation capability maturity levels 1 though 5, as vertically aligned with the different modes, loosely depict the organisation's ability to consistently deliver innovative outputs. Where maturity level 1 organisations would typically have an ad hoc innovation process, level 5 organisations demonstrate a consistent ability to execute and succeed in radical and disruptive innovation projects. This does not imply that a level 1 organisation will not be successful in radical and disruptive innovation projects, but rather that they will be less consistent therein.

The remainder of this preamble provides a brief description of the content of this dissertation – ultimately, an account of the development and evaluation of the abovementioned ICMM. The document, and essentially this research, was divided into 3 phases as depicted in Figure 2[2] and described in the paragraphs below.

Phase I constitutes the preliminary literature review and research proposal (Chapter 1). Thereafter, the approach known as Maturity Modelling is scrutinised for its representation of organisational maturity and its ability to depict innovation capability maturity (Chapter 2).

Phase II began with a detailed literature review of innovation fundamentals (Chapter 3). This research led to the development of the first version of the ICMM. Thereafter, a case study was performed in which the ICMM v1 was evaluated, resulting in several refinement objectives (Chapter 4). Essentially, the content was found to be comprehensive, but the application of the model was overly complex and laborious to deploy.

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 (Chapter 5). The consolidation of these activities would lead to the second version of the model (Chapter 6). Subsequently, a series of evaluation and validation case studies were executed using the ICMM v2 (Chapter 7), and in the process, providing the foundation for an Innovation Capability Improvement Methodology (described in Chapter 6). The dissertation concludes with several findings pertaining to innovation and a discussion of potential future collaboration and research (Chapter 8).

[2] Diagrams that are embedded will not necessarily be clear until the reader has progressed through the document itself.

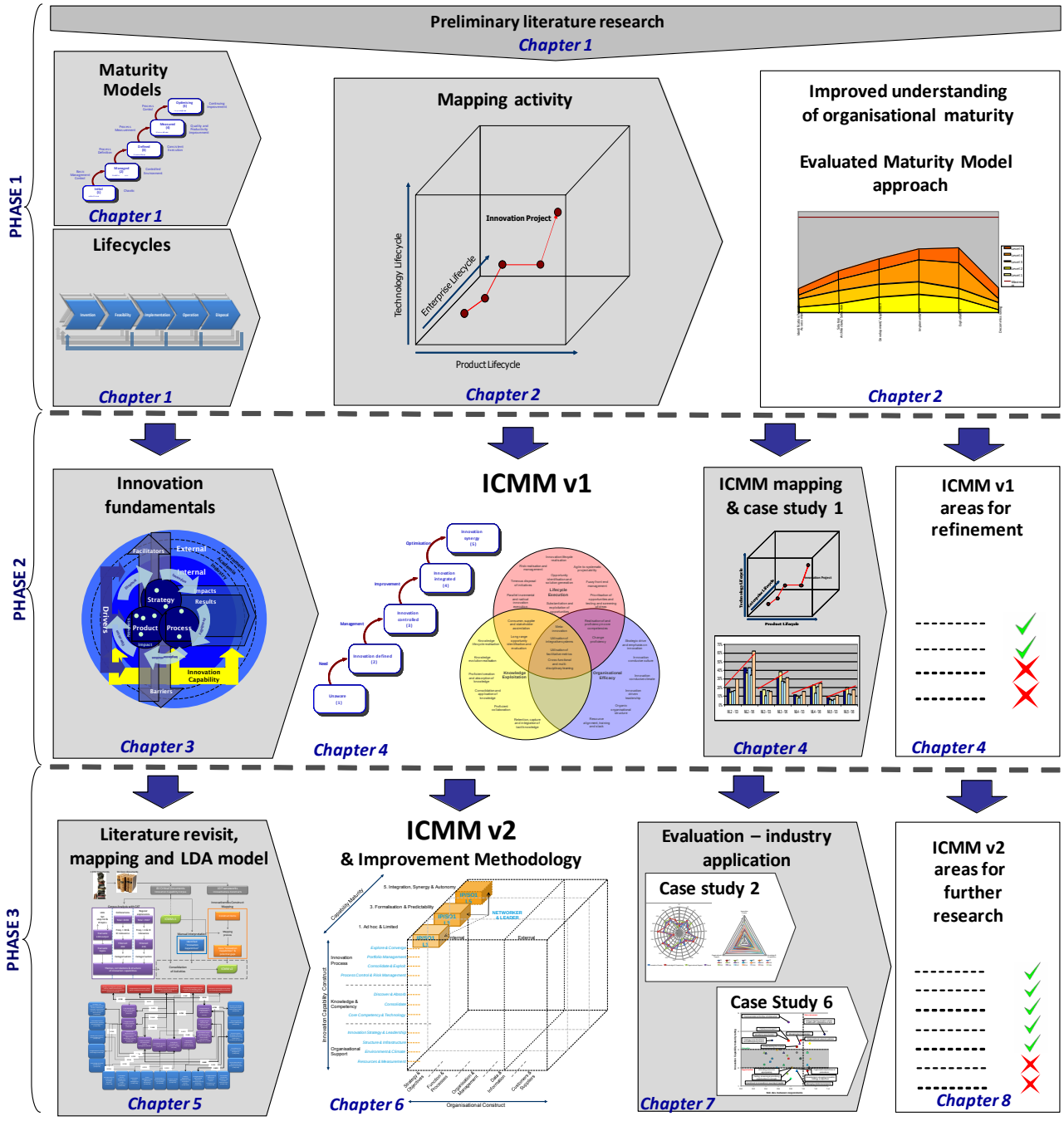

Figure 2 – Research progression

On a final note, this dissertation is written in a chronological manner – in line with the progression of the PhD study. The purpose hereof is to bring the advancement of the research field and this study into context. Changes in the field of innovation assessment models over the duration of this project have been significant to say the least. The author has removed unnecessary duplication resulting from new and/or changed insight, but maintained the fundamental story-line behind the activities to highlight the maturation of both the field and the study itself.

1. Preliminary Literature Research & Proposal

The following concepts were extracted from literature as being significant to the understanding of innovation, maturity models and enterprise design. Discussion of these concepts often follows the specific literature extracts. This research was instrumental in the development of the proposal for this dissertation and in sketching the broad picture necessary to instigate further research. The reader should note that this text has not changed significantly over the duration of the study. This is because it was the basis for the research proposal discussed at the end of the chapter.

1.1 Innovation

Innovation is a discipline, concept, notion or theory that enjoys relentless academic debate. Note the years of references throughout this text; from the early works of Joseph Schumpeter in 1934 to now (13/11/2008), when the Google hits tallied around 36 million (results of a search for "innovation management"). More significantly, a single academic research database (Emerald: www.emeraldinsight.com) returned 22130 publications addressing this subject – where just 2 years earlier, only 12463 hits were obtained. The truly consistent and successful application of innovation principles, however, remains the privilege of only a few. They are the Google's and the Apples of the world; those that persistently position themselves ahead of the rest.

Academic deliberation on innovation constitutes the higher strategic levels, through to scattered understanding of intricate innovation dynamics, facilitated by the organisational complexity and chaos theories. Yet the field of study remains opaque, probably caused by the lack of consolidation. Consensus exists on factors such as drivers, facilitators, barriers, basic principles and the need to be innovative. The science of innovation, however, remains undefined. James Utterback (1986) stated: "*The innovation research theory matter is highly dispersed. It was not adopted by any of the science fields. … There is no sufficient data set for building an innovation prediction model.*" However, one prominent actuality permeates this extensive literature, binding practically all related research: *Innovation is imperative for creating and sustaining competitive advantage.*

The problem though, is that innovation is not easy – on the contrary, it is extremely difficult to be consistently innovative. This is due to the enormous amount of challenges that hinder the innovation process and an organisation's ability to innovate. According to Smith (2005), "*At every stage – from conception of a new idea, through development to commercialisation and eventually to marketing and business coming in – hundreds of problems must be resolved. The innovation process is littered with hurdles, both high and low, from new science to creative means of delivery to detailed product architecture, to service concept, to business model. These problems are what innovation is, and it is up to the individual and the teams they work within to solve them.*"

Technology has been regarded as the primary driving force of growth (Dismukes, 2005). Innovation, constituting the processes of invention through to commercialisation, is the source of technological advancement (Merrifield, 1999). Geoffrey Moore (2005) 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 (Zairi, 1995). Thus, innovation is not only a current issue, it is a perpetual one. According to Moore (2005), *"To innovate forever, in other words, is not an aspiration; it is a design specification. It is not a strategy; it is a requirement."* The prevailing question, however, persists: What exactly is innovation?

1.1.1 Innovation defined

The first mentions of the notion of innovation stem from the works of Joseph Schumpeter as early as 1934, with the publication of his *Theory of Economic Development*. His subsequent works directly addressed the vague (which until today it remains) concepts of innovation. Schumpeter (1939) defined innovation 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. Furthermore, he distinguished between five types of innovation: those that result in new products, new methods of production, new sources of supply, the exploration of a new markets, and new ways to organise business.

The conceptual works of Peter Drucker (1985) proposed a broader definition. Innovation was considered the process of equipping in new, improved capabilities or increased utility. He further stated that innovation was not a science or technology, but rather a value that is measurable through environmental impact. Focal to Drucker's (1985) discussions was the need for market orientation. He argued that product-oriented efforts tended to result in "technology miracles" or inventions that often fell short of the market required benefits.

Nohria and Gulati (1996) define innovation to include any policy, structure, method, process, and product or market opportunity that the manager of an innovating unit perceives to be new. Damanpour (1991) defined innovation to be "*the generation, development, and adoption of novel ideas on the part of the firm*". Zaltman et al. (1973) defined it as *"any idea, practice, or material artefact perceived to be new by the relevant unit of adoption".*

The European Commission (1995) defines innovation to be *"the successful production, assimilation and exploitation of novelty in the economic and social spheres"*. This definition is similar to that of the Lisbon European Council's perception of innovation and competitiveness (Szmytkowski 2005). Further description by the European Commission (1995) states it to be *"the renewal and enlargement of the range of products and services and associated markets; the establishment of new methods of production, supply and distribution; the introduction in changes in management, work organization, and the working conditions and skills of workforce".*

The abovementioned definitions of innovation, when consolidated, convey two fundamental aspects that may characterise an innovation. Summarised, they are: a novelty or newness associated with innovation activities, and the presence of an inherent process. Thus, for an initiative to be considered innovative, a

certain degree of novelty or newness must be evident in that initiative, and a process (or lifecycle) must be executed to ensure fruition of that initiative. So if an enterprise fulfils these requirements, is it then capable of innovating? Bigoness and Perreault (1981) present a convincing argument that the adoption of a single process, product, or business concept by an enterprise does not equate with a tendency toward innovativeness. They suggest that it is the enterprise that consistently adopts innovative ideas that appropriately demonstrates innovative characteristics. The abovementioned definitions may therefore lack a dimension describing the necessary perpetuation of innovative activity to entirely represent innovation.

The notion of initiative success as part of the definition is an ongoing debate. Certain individuals contend that the definition should include success as a critical qualifier for an initiative to truly constitute an innovation. They argue that the use of the term should be limited to a new idea that has experienced successful commercialisation (Krasner 1982). It is important to realise that this commercialisation may be either direct in nature (products and services), or indirect (processes and strategies). Taking this a step further, the definition should stipulate an eventual positive impact on environmental and/or socio-economic circumstances. It is possible that an enterprise may extract benefit from an initiative that may eventually have a negative impact on the environment, its community or the economy at large. This should not qualify as an innovation.

Others share the belief that to be innovative is based on *when* the adopter acted upon a novelty relative to the initiator (inventor) and other adopters. Rogers (1983) suggested that the first 2.5 per cent of those to adopt a given innovation within a reference group may be considered innovators. Midgley and Dowling (1993) proposed that as many as the first 29 per cent of adopters that acted upon a given innovation, demonstrate the characteristics of innovators.

Another debate that roams the literature is the question as to whether innovation is a process or a discrete event (Cooper 1998). Those who see innovation as a process focus on the various stages that the potential adopter goes through over the course of an innovation initiative. These stages may include: identifying problems, evaluating alternatives, arriving at a decision, and putting innovation into practice (Rogers 1983). According to this approach, specific tasks and roles of organisational participants change as the process of innovation continues in an enterprise (Burgelman and Sayles 1986). Advocates of innovation as a discrete event do not completely reject the notion of an innovation process. They argue, however, that an initiative qualifies as an innovation once there is actual acceptance of risk and the commitment of resources (Cooper 1998). Thus, differentiation between innovators and non-innovators emerges as innovation is institutionalised within the enterprise. Questions of concern involving innovation often take a macro approach, including organisational characteristics (e.g. firm size or age), and the conditions of the industry that facilitate or impede innovation (e.g. market concentration), or the maturity of the industry. Further debate focuses on the types of organisations more prone to the adoption of innovation, or in what types of organisations the adoption will be more or less successful (Cooper 1998).

The abovementioned discussions concerning the definition of innovation represent a minor subset of the vast and related literature. Definitions vary from being tremendously similar in scope and diction, to

addressing seemingly unrelated issues. No hard and fast evidence exists allowing one to adopt or disregard any single definition. Innovation is not a science, yet it remains complex in nature and diverse in application, thus requiring a tailored definition for a specific application.

The definition of innovation for the purpose of this dissertation is addressed in Section 3.1.1. Through the remainder of this dissertation, the author will revisit the meaning of innovation, highlighting the insights that this particular study has had on the understanding of the word "innovation". The final discussion is, therefore, postponed until the conclusion – Chapter 8.

1.1.2 Types of innovation

The literature refers to many seemingly different types of innovation. Innovation in terms of products, services, processes (both operational and administrative), strategy or business concept, marketing, financial, value, etc. have been discussed and defined. These quite obviously and regularly overlap in definition.

Schumpeter (1939) distinguished between five types of innovation and sources of competitive advantage: new products, new methods of production, new sources of supply, the exploration of new markets, and new ways to organise business.

This classification may be further simplified. With sufficient argument, innovation can be categorised into three basic types based on the primary object of the initiative. Categorisations may be described in terms of products, processes and strategy (Hamel and Prahalad 1994; Hamel 1996; Baker 2002; Stjernholm 2000; van Zyl 2006). The object of the innovation is thus a product, process or strategy-related matter. Furthermore, it is possible that a given instance of innovation is best described by a combination of the abovementioned types. For instance, a proposed new strategy may initiate a new process, which in turn may enable in the development of new products.

The literature covered did not comprehensively address these innovation types in terms of the following aspects: the nature of products, processes and strategy; what constitutes an innovation relating to these types; and a means of differentiating between these types. The author will therefore briefly discuss these aspects as they are used later in the study. Reference to literature is provided in cases where these aspects are addressed.

1.1.2.1 Product innovation

Product refers to any organisational output delivered, conveyed or served to a consumer. The output may be tangible or intangible in nature. Services and product/service combinations are therefore included. The enterprise generally receives compensation for the uptake of that output. Governmental, social service and other non-profit organisations do not necessary receive compensation directly from the consumer, but they do receive some form of sustenance. As counter-performance, they need to generate a satisfactory output and continue to improve it. Therefore, non-profit organisations also need to innovate (European Commission, 1995). The consumer and the organisation should both draw (direct or indirect) benefit from

the interaction and/or exchange. For a product initiative to constitute an innovation, the product itself needs not to be new in its entirety. According to Rothberg (1981), product innovation from the perspective of an organisation encompasses a *"change in, or an addition to the entities that comprise its product line".* Product innovation may create competitive advantage in the form of sought-after products that are sufficiently differentiated to claim a portion of a current market or assert an unidentified or untapped market.

1.1.2.2 Process innovation

Process refers to any course of action, procedure, technique, practice or modus operandi that can be established and executed within an organisation in an effort to transform or support the transformation of resources. The process may be manual or automated in nature. Moreover, a process may be of a high-level managerial nature (such as "Management Innovation" of Hamel (2006)), or an extremely detailed set of sequential tasks to fulfil an operational need. For a process initiative to constitute an innovation, the process itself need not be new in its entirety. Change in, or an addition to a process, successfully institutionalised and rendering sufficient improvement to competitively position the organisation, may constitute an innovation. Process innovation may create competitive advantage in the form of organisational improvements that bring about differentiation in the form of quality, time-to-market, after-market support, etc. (i.e. external aspects regarded by clients as product distinguishers). According to Schilling (2005), process innovations are often associated with improving the effectiveness or efficiency of production. Therefore, process innovations do not always generate client perceivable differentiation. Such initiatives, including knowledge management, change management and organisational learning and have an internal effect that is transferred to the client in less obvious ways, but still create competitive advantage from within.

1.1.2.3 Strategy innovation

Strategy refers to the higher echelons of organisational governance, i.e. the positioning and direction of the organisation. This includes the mission and vision, policies, business models, etc. In various literature, strategy innovation is often referred to as Business Concept Innovation (Hamel 1996; Baker 2002). Once again, strategic innovation does not require strategic change in its entirety, and can include a change in or addition to a previous business concept, so long as it can be successfully institutionalised and ensures strong market positioning. Strategy innovation may therefore create competitive advantage in the form of direction and positioning that serves to create long-term differentiation, and/or filter through to and facilitate in the innovation of products and processes. Differentiation on a strategic level can create new markets, anticipate future markets, or revitalise old markets so that an organisation can pre-emptively position itself for competitiveness (Hamel 1996; Baker 2002).

1.1.3 Other dimensions of innovation

The categories and dimensions that have been used to describe innovation and its dynamics are vast (Cooper 1998; Gopalakrishnan and Damanpour 1992; Utterback 1994). Thus, over and above the previously mentioned types of innovation, there exist numerous other dimensional categorisations. They are often

described as initiatives demonstrating specific levels of innovative attributes, or a balance between two opposing attributes.

A commonly accepted means for describing an innovation initiative is to place it on a scale ranging between the extremes: *incremental* and *radical* (Hamel 1996; Cooper 1998; Baker 2002; van Zyl 2006). This distinction primarily focuses on the extent of newness of the initiative. According to Cooper (1998), the distinction can be made based on the *"degree of strategic and structural change that the firm must undergo to accommodate the innovation in question".*

An innovation that represents a relatively small change in, or addition to, an existing product, process or strategy, but still serves to establish a certain degree of differentiation, may be considered incremental. Note that "relatively" is used to exclude from this definition basic improvements and optimisation associated with regular operational activities. According to Tushman and Anderson (1986), incremental innovations *"enhance and extend the underlying technology and thus reinforce the established technical order".*

On the other side of the innovation newness spectrum are radical initiatives. They represent advances from the norm of such consequence that *"revolutionary alteration of the organization and its support networks must occur to accommodate and implement change"* (Cooper 1998). With increased radicalism comes a substantial increase in risk as the initiative deviates considerably from existing (known and understood) practices. Radical innovation can cause turmoil in established markets and spawn the growth of new ones.

Irrespective of the above mentioned, the generic lifecycle requirements of an initiative remain similar, although specific activities within each phase may differ (Williams, Bernus, Uppington and Nemes 1998). The invention phase of a radical initiative often exhibits a degree of extreme newness or novelty. Associated with this is ambiguity, uncertainty and complexity (Katz 2006). According to Schumpeter (1934), radical innovations shape big changes in the world, whereas incremental innovations continuously sustain the process of change. An innovation initiative need not be either one or the other. This description represents a continuum onto which an initiative may be mapped according to the perceived extent of change necessary (Cooper 1998) or the perceived degree of newness (Katz 2006). This is an important realisation – innovation is not a black or white matter. Moreover, the scope for interpretation of such a categorisation does not permit a simplistic "either-or" description.

According to Baker (2002), this categorisation is unable to explicitly distinguish between newness and impact. The impact of an innovation initiative may range from relatively small improvements in products, processes or strategy, through to a fundamental transformation in products and/or processes of an industry as a whole, and possibly even a complete revolution of a market and/or economy. Consider the impact of the cellular phone on the beeper market – extremely new and with enormous impact. Now consider vehicles with hybrid drives – new, but their impact on the internal combustion engine has yet to be significant. This may change however, as the impact is also a function of other factors such the requirement for new infrastructure, or the environmental impact which may soon render the internal combustion engine inappropriate.

Christensen (1997) furthered the understanding of innovation with the introduction of a dimension that disentangled these concepts of newness and impact. Radical innovations do not necessarily cause significant impact (although they require significant internal change). Christensen thus differentiated between *sustaining* and *disruptive* innovations.

Sustaining initiatives improve established products, processes and/or strategy. Disruptive initiatives bring to market very different products, or deliver revolutionary processes and/or strategy to an industry, market and/or economy that typically undermines the established products, processes and/or strategy. With this in mind, a disruptive innovation does not inevitably deliver greater utility over that which has been established (Baker 2002). On the contrary, it may result in an output that under-performs its preceding equivalent. The momentum of ongoing sustained innovation may drive product and process functionality beyond what the customer may require. Thus, functionality eventually exceeds a large segment of the market requirements (Baker 2002) and does not deliver on the anticipated results. This, therefore, presents an opportunity for a less-refined, but more exciting entrant to satisfy a need in a new way.

Moore (2005) discusses 14 different types of innovation relating to the Technology Adoption- and Category Maturity Lifecycles. He describes how they become relevant (or "get traction") at the different phases of the lifecycles and how consistently innovative organisations exploit these types at the right time to consistently position themselves ahead of their competition. The innovation types include: application innovation, platform innovation, line extension innovation, integration innovation, experiential innovation, etc.

1.1.4 From invention to innovation and the Innovation Lifecycle

Invention has been around since the beginning of time. Inventive efforts have generally been directed towards the enhancement of human existence and society in general. Obviously, this is not always the case, as the invention of nuclear fission has demonstrated. Initially, research was supposedly directed towards the generation of energy:

> *First of all it is obvious that the energy released in this new reaction must be very much higher than all previously known cases. ... This in itself might make it possible to produce power by means of nuclear energy, but I do not think that this possibility is very exciting, for the cost of investment would probably be too high to make the process worthwhile. I see ... possibilities in another direction. These might lead to large-scale production of energy and radioactive elements, unfortunately also perhaps to atomic bombs.*
>
> Leo Szilard, having read the Hahn-Strassman paper, January 25, 1939

The technology ultimately resulted in the development of nuclear weapons, not widely considered to have enhanced the long-term good of society. Nevertheless, the concepts surrounding invention have evolved and been improved over the centuries with techniques such as TRIZ and I-TRIZ (Arciszewski and Zlotin 2006). Inventions are extensive (Norman 2006). Every day, people stumble upon problems and/or opportunities that spawn new ideas for improving the way business is carried out, the way we go about doing our daily

errands, or simply improving our standard of living. Humans are by nature extremely creative beings (Moore 2005), obviously some more than others. The problem then is not invention itself, but rather making a commercial success of that invention (Norman 2006). This is the major filtering process – the transition from invention to innovation.

To briefly distinguish between invention and innovation: invention is the generation of newness or novelty, while innovation is the derivation of value from that novelty (Szmytkowski 2005). A chasm must therefore exist, since the quantity of inventions exceeds that of innovations by several orders of magnitude. Hamel (2006) states, *"Innovation in whatever form follows a power law: For every truly radical idea that delivers a big dollop of competitive advantage, there will be dozens of other ideas that prove to be less valuable".* A reason for this is typified by a statement made by Patterson (1993): "*Translating a market opportunity into a new product requires perhaps 15 percent invention. The remaining 85 percent of the work involves previously learned processes that often are undocumented and undisciplined."*

Inventions can be conceptualised practically anywhere: universities, industry, home garages, on serviettes in a restaurant, or even the shower for that matter. They spawn from the creative thoughts of the inquisitive mind. Innovations, on the other hand, require significantly more supportive structure. In order to bridge the chasm between invention and innovation, considerable knowledge, capability, resources and supportive (but not stifling) structure is required to facilitate the process of substantiating and implementing ideas. Ineffectual identification and deployment of these requirements results in the innovation funnelling paradigm of Figure 3 (Berth 1993), where the number of ideas successfully commercialised is significantly lower than the number of original ideas.

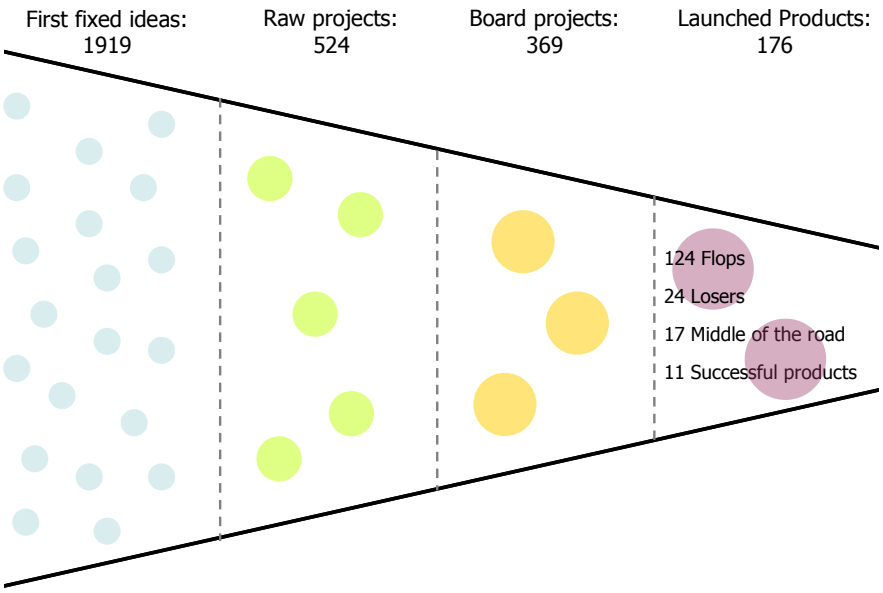

Figure 3 – The innovation funnelling paradigm (*Source:* Berth 1993)

This presents evidence that innovation may be characterised by a process (Fagerberg 2004) that bridges the invention-to-innovation chasm. By definition, a process requires time, resources, capabilities, knowledge, and structure to be executed and to ensure sound output. Furthermore, a process may be represented by a

lifecycle of phases requiring execution, and to ensure the desired outputs, all the phases should be executed. A basic and generic representation (Figure 4) of the innovation lifecycle may include the following phases: invention, feasibility, implementation, operation, and finally disposal (van Zyl 2006).

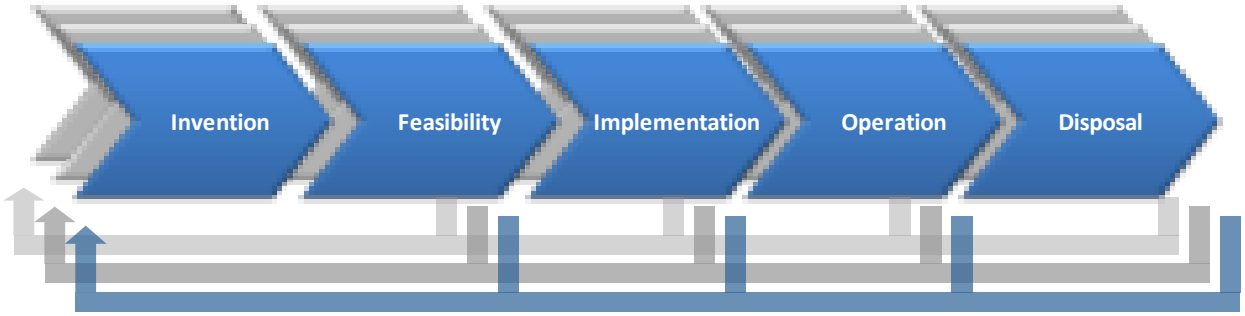

Figure 4 – The basic Innovation Lifecycle

Invention represents the phase of opportunity identification, idea generation, and general creative activity. The idea may address aspects pertaining to products, processes and/or strategy (business concept). The *feasibility* then needs to be determined with the rigorous testing and screening of ideas. Furthermore, the specification, functional analysis and initial design are executed.

The *implementation* phase then addresses detailed design and the manifestation thereof. A realisation that must be made at this point is that this lifecycle is not a replacement for the more traditional design methodologies and processes. Rather, it seeks to bring them into context with the innovation process. Comprehensive design methodologies will always be required, although the necessity to shorten the time-to-market (Mori 1999) may bring about the compacting of previously tedious, and often unnecessarily iterative, design processes.

Once the process has delivered a commercially viable (either internally or externally) output, the phase of *operation* is undertaken. Activities such as production and quality control of products, and monitoring and optimisation of processes are performed. After the desired (maximum feasible) utilisation has been attained, the innovation process enters into its final phase – *disposal*. This marks the conclusion of the innovation, and focuses on reflecting and learning from the process and fulfilling final (legal, environmental, etc.) obligations.

Note that learning forms an integral part of the activities in all innovation lifecycle phases. With the conclusion of each phase, there is an opportunity to learn from the successes and failures of that phase. The conclusion of an exercise, however, allows one to examine the final outcomes relative to the initial planning and ultimate execution, and to reflect on their success and failures. Furthermore, *disposal* does not refer to the conclusion of the innovation process, but rather to the closure of the particular initiative. It is imperative that the innovation process continues (Moore 2005) in order to sustain and improve on any competitive advantage derived from previous initiatives, with new and promising opportunities.

The innovation lifecycle is also of such a nature that the phases may be revisited – to re-execute certain activities or refine certain aspects and improve upon the initiative. This is part of the learning process.

Consider, for example, an initiative that has reached *operation.* In an effort to sustain competitive advantage, it is necessary to make incremental improvements to that operational innovation. The organisation may then revisit the *concept* phase to initiate improvements and/or additions, in an effort to continue to differentiate the initial offering.

The stacking of the lifecycles (shaded grey behind the original in Figure 4) demonstrates the notion of concurrent innovation initiatives in an enterprise. It is not sufficient for an organisation to be addressing the need to innovate with a single initiative – this would be like "putting all eggs in one basket". According to Salvendy (1992), the definition of innovation constitutes many creative acts. It is further necessary that once a given initiative reaches disposal, a new initiative is undertaken to ensure continued improvement and ultimately sustained competitive advantage.

On a final note with respect to the innovation lifecycle, the actual phases and the manner in which they are structured is a severe over-simplification when one considers the dynamics behind innovation. This representation may lead one to believe that the innovation process is a linear one, when in actual fact, much of the literature is moving toward a more integrated approach. The complexity involved in executing the process and the delicate support systems and structures necessary to facilitate that process, do not permit a linear approach. The lifecycle, nevertheless, presents a basic and generic depiction of innovation activities.

1.2 Capability Maturity Models

The original Capability Maturity Model® for software (SW-CMM®) is a widely accepted set of guidelines for developing high-performance software organisations (Le Vasseur 2001). Watts Humphrey and colleagues at IBM developed the original concept behind CMM in the early 1980s. He had established that the quality of software was related directly to the quality of the process used to develop it (Le Vasseur 2001). The emphasis for improving software development was thus placed on the process.

The original SW-CMM® was, however, developed by the Software Engineering Institute (SEI) of Carnegie-Mellon University. The model was first published in 1993 as Version 1.1 under the sponsorship of the United States Department of Defence (Cooke-Davies 2004; Shrum and Phillips 2004). The latest offering from the SEI is the Capability Maturity Model Integration® or CMMI®. This model is a consolidation of the Software Development, Systems Engineering, Integrated Product and Process Development, and Supplier Sourcing bodies of knowledge (or domains of practice). More detail on these models is presented in Chapters 2.

Since then, the concept of the Capability Maturity Model, or just maturity model, has diffused into many organisational domains of practice. A domain of practice refers to an area of business activity. The domain may be an organisational core competence (e.g. a company specialising in project management or a primarily project-orientated organisation), or a business unit that is tasked with those activities. Domains include: Project Management, Product Development, Knowledge Management, Systems Engineering, and of course the original, Software Development – to mention a few.

Before continuing with this section, it must be mentioned that the literature pertaining to this field of research stems primarily from the designers of the models themselves or advocates of the maturity model approach. Only a single article could be found that critically discussed this approach. This section therefore begins rather cynically, posing many questions and presenting several discussions on matters that initially bothered the author.

1.2.1 Why Maturity Models?

The concept of the maturity model was found through research into effective means of improving organisational innovation capability. The first part of this chapter identified the need for organisations to continuously innovate to remain competitive. This requires an innovation capability or innovation competence (Hamel 2000; Baker 2002; Dismukes 2005). The search for "capability improvement", "competence improvement" and other related subjects often returned these maturity models and literature about them. The initial impression of the approach was that the subject warranted further investigation.

1.2.2 An initially cynical perspective

There are a steadily increasing number of maturity models becoming available to measure and improve on various essential organisational activities (Cooke-Davies 2004). The total maturity models available by 2002 had already exceeded 120 (Champlin 2003) and amongst the myriad models remains a complexity that is yet to be successfully addressed. This complexity centres around consensus as to the constitution of a mature organisation (Cooke-Davies 2004). The maturity models vary substantially in terms of scope, resolution, approach and depiction of organisational maturity. To clarify, the variance spoken of here does not pertain to the specifics of the domain of practice, but refers to the generic depiction of organisational maturity that the models present.

From the above argument, the question must be asked: Why is organisational maturity non-consensus an issue? In the opinion of the author, to strive for the goal of organisational maturity, where the goal itself, maturity, proves ambiguous, is a futile exercise. Yet, the actual experience of organisations utilising maturity models is positive. In fact, the benefits experienced by some are significant (see Section 1.2.7 and Goldenson and Gibson (2003)). One possible explanation may be that an organisation implements a specific maturity model that addresses a particular domain of practice. Consequently, as a single depiction of organisational maturity is presented, the goal is unambiguous. Other models are probably not utilised, although no proof could be found of this. It is, however, logical to consider that an organisation with a software development or project execution core competence would implement only the maturity model pertaining to that domain of practice.

Although the possibility of encountering ambiguity is eliminated by exposure to a single model, one may want to question the foundation of this practice. The organisation will no doubt see initial improvement, but as higher levels of maturity are reached, improvements may be dampened by the misdirection resulting from an objective invalid in its content, i.e., the prescribed highest level of maturity is inaccurate in its depiction of organisational maturity. Note that the author's intention is not to disparage the utility of maturity models.

They have been proven to be useful (Section 1.2.7). The intention is rather to emphasise the importance of clarity in what is meant by organisational maturity.

Unfortunately, the abovementioned issue is not the only complexity adding to the difficulty of understanding organisational maturity and the numerous models describing its attributes. The paths for progression to achieve organisational maturity provided by the models also vary quite significantly (Cooke-Davies 2004). This, however, may not be as significant an issue as the previous one. It is common knowledge that many paths lead to a given destination. It would, however, be ideal if the most effective and efficient path could be chosen, as significant effort and resources could be saved.

1.2.3 Maturity: A discussion and attempt at definition

Given the abovementioned discussion, defining maturity may seem ambitious. The need is, however, crucial for the continuation of this project. The definition will primarily be based on the work of Terence Cooke-Davies, whose extensive research (primarily in project management maturity models) addresses the abovementioned issues.

In general, maturity has a meaning that is dependent on the reference domain. In terms of financial application, maturity may refer to the date on which debt obligation must be finalised or on which the principle amount of an investment becomes available. It may refer to adulthood; a period of time in a person's life when a certain level of physical and mental development has been attained. The Oxford Advanced Learners' Dictionary (2004) has several descriptions of the noun *mature*. They include: 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 question remains: What does maturity mean in terms of the organisation, and the organisational domain in question?

A multitude of research resources were extensively explored for literature that would possibly lead to an answer to this question. These include a network of university libraries, multiple journal databases, and finally, the Internet. The results were generally disappointing and did not address the elusive concept of organisational maturity. The Internet search ultimately generated the most useful results, primarily returning examples from the myriad maturity models, but one article in particular, from Cooke-Davies (2004), seemed to contain the most useful mention of this matter.

According to Cooke-Davies (2004), maturity conveys a meaning of *fully developed*, or *perfected* in its application in maturity models. He argues further that, initially, these two descriptions may sound synonymous. However, with deeper investigation, these descriptions are found to embody fundamental differences.

Fully developed is based on an organic metaphor – the idea that, in the course of time, biological processes will unfold and bring to fruition a design that is enfolded in the genetic structure of the organism that is maturing. (Cooke-Davies 2004)

Perfected on the other hand, implies an external designer or thinker, who is outside of the system being designed, but is capable of assessing the extent to which these are fit for purpose, meaning, of course, the purposes of the designer or thinker. (Cooke-Davies, 2004)

The similarity exists in the common assumption that a perfect status exists, and that the status is attainable. Reaching the highest level of organisational maturity would thus imply *perfected*, or *fully developed*. It is common knowledge that an enterprise does not operate in isolation, let alone perfect itself. The notion of self-development is thus not applicable to the enterprise, and *fully developed* is disregarded.

The notion of the *perfected* organisation stresses the need for external intervention. External here does not refer to its common understanding, i.e. other organisations, consumers, suppliers, government, etc., but rather refers to the individuals of the organisation who are able to make changes to that organisation.

Based on Cooke-Davies' (2004) definition of *perfected*, the following definition of maturity from an organisational or domain perspective will be carried further into this dissertation: *a system assessed to be optimally fit for its purpose, as described by its designer.* This definition is generic in nature and does not address the content of the system purpose.

1.2.4 Innovation and Maturity Models

Today's enterprises evolve continuously. This evolution is sometimes exceeded by complete revolution. The change is driven by forever-evolving factors including: customer requirements, suppliers, competition, technology, the global economy, the socio-economic environment, and various others (Baker 2002; also see Section 3.1.2.3). It is a world where the situation today is not what it was yesterday, and there is no guarantee of the situation tomorrow. The capabilities of an organisation therefore need to be dynamic (Teece, Pisano and Shuan 1997). This is a reality that every competitively-oriented organisation must face. It is thus by implication that the perfected enterprise yesterday, is not necessarily the perfect enterprise today, or tomorrow. From the definition of maturity presented above, the system purpose is continuously changing. Therefore, how can it be possible to define levels of organisational maturity, when the foundation on which that definition is built is continually changing? Is it possible to describe the mature enterprise on a level sufficiently generic, so as to compensate for the incessant evolution and revolution?

One would think that maturity models would approach this dilemma by assembling domain-focused process areas implied to be sufficiently generic in nature that they collectively embody a depiction of organisational (or domain) maturity that is independent of change. This is, however, not explicitly stated within the models.

Innovation has been strongly tied to evolution and revolution (Hamel 2000, 2006; Moore 2005). It results in evolution and revolution, but is also necessary because of evolution and revolution. The CMMI® has addressed the issue of incessant change by necessitating innovation. The problem, however, is that this requirement is only addressed by organisations having attained a level 4 maturity and who are striving for a maturity level 5 (CMMI-SE/SW/IPPD/SS, v1.1). Maturity models are therefore saying that innovation is reserved only for organisations of the higher orders of capability maturity. 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? According to the Software Engineering Institute (SEI) of Carnegie Mellon University, the distribution of maturity levels of organisations utilising the CMMI®, are as follows (Figure 5):

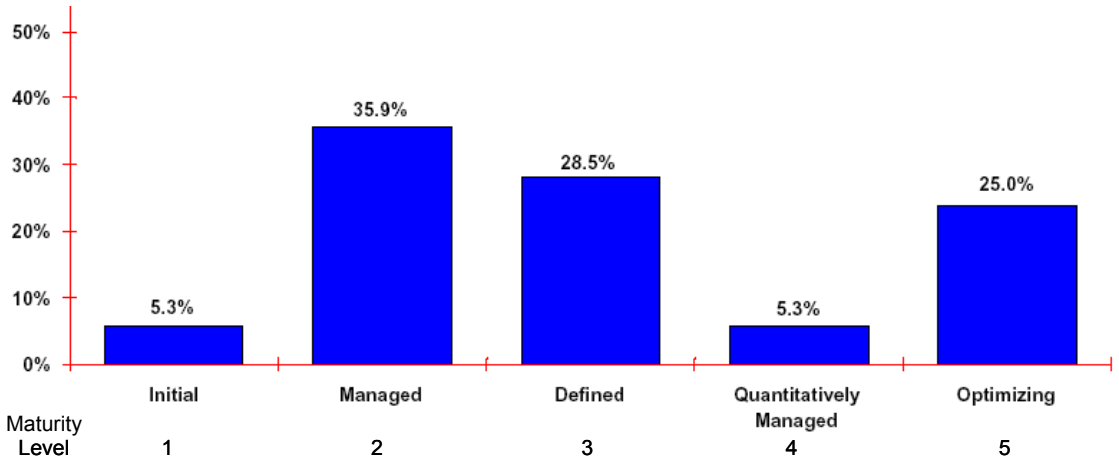

Figure 5 – Maturity level distribution of organisations *(Source:* CMMI Product Team 2005)

This states that 69.7% of organisations (levels 1, 2 and 3) are not addressing innovative ways of executing domain specific activities. This is representative of a single maturity model. It is, however, the successor of the maturity model on which most other maturity models are based – the SW-CMM®.

According to Kostoff, Boylan and Simons (2004), being innovative does not imply correlation with the size and inherent maturity of an organisation. Large organisations do not necessarily exhibit a persistent ability to innovate, or an inability to do so. Kostoff et al. (2004) state that there is evidence of smaller, more entrepreneurial, inherently less-mature firms being more willing to take advantage of disruptive technologies and redefine current markets. This therefore repeals the notion of reserving innovative activity for more mature organisations.

One must then ask: How do the organisations that are using these models remain competitive? They innovate in terms of their products, process and strategy irrespective of their level of domain specific maturity. Global giants such as Accenture, AT&T Labs, Boeing, Bosch, Ericcson, General Motors, Honeywell Corporation, IBM, Intel, Motorola, Nokia and many more are all participants in CMMI® activities (Shrum and Phillips 2004) and remain global giants today. It is unlikely that they postponed innovation efforts until they had attained a substantially mature status in terms of the CMMI® domains of practice.

The question then is: Are the concepts of innovation and domain-specific maturity independent? Furthermore, can innovation not have its own depiction of maturity progression? Innovation is fundamental in the quest for survival and sustained competitiveness, and should thus not be relegated to the final levels

of organisational maturity. So, either it must be addressed at earlier levels of maturity within the existing models, or an innovation capability maturity model is required. This dissertation will take the latter approach.

One may then ask: Why is it not possible to skip to the highest level of maturity and immediately address the innovation imperative? The CMMI explicitly states that maturity levels should not be skipped (Shrum and Phillips 2004). It is advised that an organisation using a maturity model, follow the path as prescribed by the model, the reason being that certain seemingly basic requirements may be omitted and result in fundamental omissions in terms of domain practices. The author believes this to be a valid argument. Levels should not be skipped. The levels build upon the elemental assumption that preceding levels are fulfilled.

Innovation through all maturity levels is critical to enterprise survival and may thus represent a fundamental omission in the original SW-CMM®, its successor CMMI®, and the entourage of maturity models that are based thereon. An opportunity is therefore presented to develop a model that describes an innovation capability maturity improvement path for competitively oriented organisations.

1.2.5 The purpose of Maturity Models

There are two fundamental purposes of maturity models. The first is to establish the capability maturity of an organisation in terms of a specific domain of practice. The second is based on the results of the first; to facilitate in establishing a direction and course for improvement that will best suit the enterprise and that is in accordance with the prescribed best practices of the domain.

To establish capability maturity in terms of a specific domain of practice is an exercise that is critical in understanding the current positioning of an enterprise relative to both its competitors and to successful enterprises in other industries. Furthermore, it is unlikely that the best course for improvement will be established if current positioning is unknown and not understood. It is therefore critical to benchmark oneself against the best (or as close as possible) or against what is known to be successful, in order to determine the answers to "how much" and "in what direction". Benchmarking is a well-known practice but often presents a problem in that enterprises are reluctant to expose their competitive secrets. Maturity models are, however, available from creators who have expended many resources in establishing best practices for a specific domain and it is against these best practices that an enterprise should benchmark itself.

As mentioned earlier in this section, maturity models have been developed for many applications including Software Development, IT Management, Project Management, Data Management, Business Management, Knowledge Management, etc. (Champlin 2003). The enterprise thus has a wide selection from which to choose, not only between applications, but also within each application. The Software Development environment, for instance, had a total of 34 maturity models at their disposal in 2003 (Champlin 2003). The majority of these models, however, are based on the initial SW-CMM® of the SEI.

Once an enterprise has been benchmarked, it can go about developing a plan for improving its capability maturity in terms of the specific domain of practice. In most instances, particularly in the SEI models, the

means for improvement is prescriptive and explicit. Much of the research went into determining what an enterprise should look like, but how the enterprise should get there (Rassa 1999) – discussed as implementing and institutionalising practices in Section 1.2.7. Best practices were thus also established to achieve the various levels of maturity. They considered, however, that what works for one enterprise, may not necessarily work for another. For this reason, the institutionalising practices are of a fairly generic nature, accounting for a preferred and institutionalised means of eliciting change.

1.2.6 Basic structure and maturity level characteristics

The basic structure of most maturity models is very similar. A 5-level maturity scale is common, with descriptions of each level often coinciding with one another. This is likely as a result of the fact that the SW-CMM® formed the basis for the majority of other maturity models. A maturity level may be defined as a *"well-defined evolutionary plateau of process improvement"* (CMMI-SE/SW/IPPD/SS, v1.1, p10). An often-observed depiction of these maturity levels is presented in Figure 6.

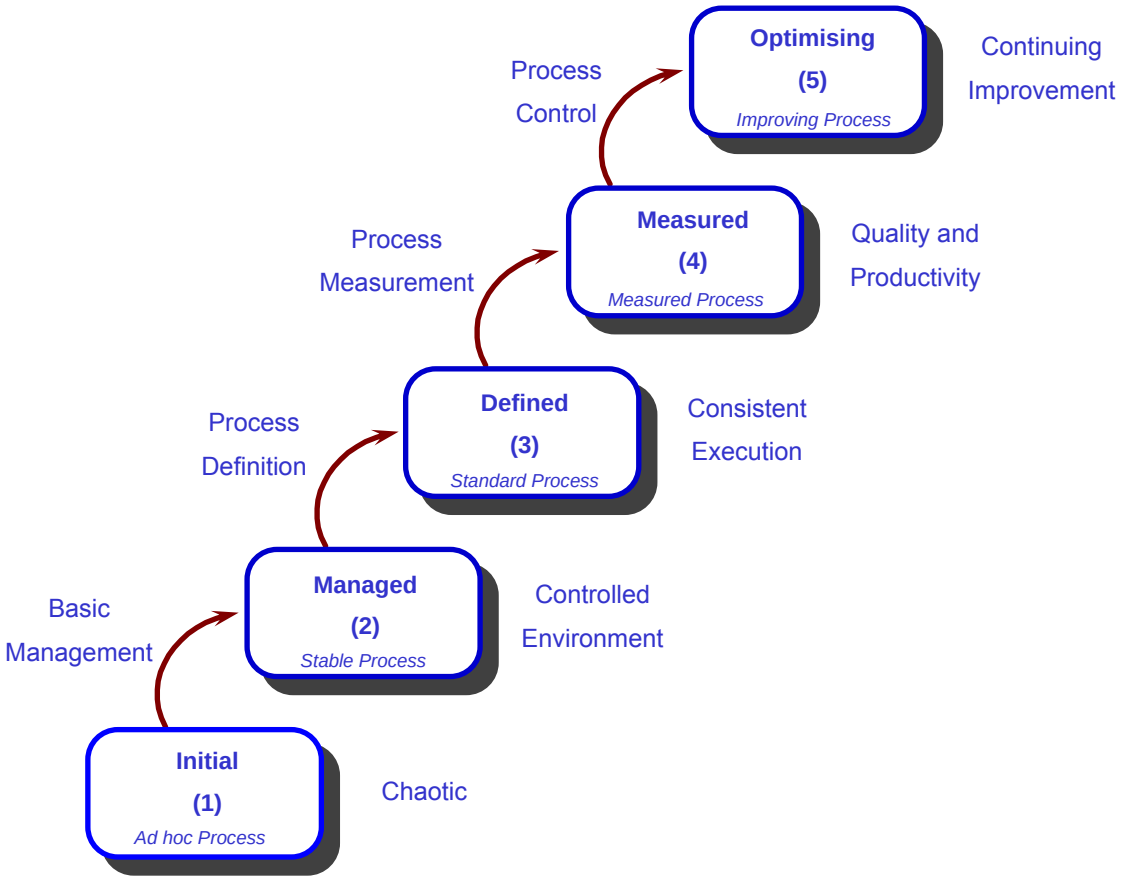

Figure 6 – Common maturity level structure *(Based on:* Champlin 2003)

Several reasons exist for the process being identified as the first dimension of organisational capability improvement. These include (SE-CMM, v1.1):

- The process is an integrative function of people and technology.
- Process focus improves predictability of performance, and performance itself.

- Research into improving process capability translates well from other fields (e.g. from software engineering to systems engineering).

Although Figure 6 may indicate as such, 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 of the requirements at each of the levels are assumed to have been fulfilled for each of the successive levels. Thus, to have attained maturity level 4, all requirements of levels 2, 3 and 4 must have been consistently fulfilled and become institutional. Level 1 does not imply that any requirements are fulfilled, as it serves as the launch pad for successive levels.

What follows is a typical description of the 5 maturity levels, extracted and summarised from the SEI's Capability Maturity Model Integration (CMMI-SE/SW/IPPD/SS, v1.1).

1.2.6.1 Maturity level 1 – initial

At this level, processes are generally ad hoc and chaotic. The enterprise does not provide stability of environment. Success is often as a result of the competence and heroics of individuals, and not due to the utilisation of proven processes. Projects often exceed budgets and overrun schedules. There may be a tendency to initially over-commit processes, but abandon them in times of crisis. Repeat of past successes is unlikely.

1.2.6.2 Maturity level 2 – managed

At this level, projects have ensured that requirements are managed and processes are planned, performed, measured, and controlled. Process discipline ensures that existing practices are maintained during times of crisis. Projects are performed and managed according to their documented plans.

Requirements, processes, work products, and services are managed. The status of the work products and the delivery of services are visible to management at defined points (for example, at major milestones and at the completion of major tasks). Commitments are established among relevant stakeholders and are revised as needed. Work products are reviewed with stakeholders and are controlled. The work products and services satisfy their specified requirements, standards, and objectives.

1.2.6.3 Maturity level 3 – defined

At this level, processes are well characterised and understood. They are described in standards, procedures, tools, and methods. The standard processes, the basis of maturity level 3, are established and improved over time. They are used to establish consistency throughout the enterprise. Projects define processes by tailoring standard processes according to tailoring guidelines and project requirements.

Management establishes process objectives based on standard processes and ensures that these objectives are appropriately addressed. A critical distinction between maturity level 2 and maturity level 3 is the scope of standards, process descriptions, and procedures. Maturity level 2 standards, process descriptions, and

procedures may be quite different for each specific instance of the process. Maturity level 3 project standards, process descriptions, and procedures are tailored from the standard processes to suit a particular project or organisational unit.

Another critical distinction is that maturity level 3 processes are typically described more rigorously. They are managed more proactively using an understanding of the interrelationships between process activities and detailed measures of the process, work products, and services.

1.2.6.4 Maturity level 4 – quantitatively measured

At this level, sub-processes are selected that contribute significantly to overall process performance. They are controlled using statistical and other quantitative techniques. Quantitative objectives for quality and process performance are established and used as criteria for managing processes. They are based on the needs of the customer, end-users, enterprise, and process implementers.

Quality and process performance is understood in statistical terms and managed throughout the process lifecycle. Detailed measures of process performance are collected and statistically analysed. Causes of process variation are identified and corrected to prevent future occurrence. Quality and process performance measures are incorporated into a measurement repository to support fact-based decision-making.

A critical distinction between maturity level 3 and maturity level 4 is the predictability of process performance. The performance of maturity level 4 processes is controlled using statistical and other quantitative techniques, and is quantitatively predictable. Maturity level 3 processes are only qualitatively predictable.

1.2.6.5 Maturity level 5 – optimising

At this level, processes are continually improved based on a quantitative understanding of the common causes of variation inherent in processes. Focus is on continually improving process performance through both incremental and innovative technological improvements. Quantitative process-improvement objectives are established, continually revised to reflect changing business objectives, and used as criteria in managing process improvement. The effects of deployed process improvements are measured and evaluated against quantitative process-improvement objectives. Both defined processes and standard processes are targets for measurable improvement activities.

Improvements to address common causes of process variation are identified, evaluated, and deployed. Improvements are selected based on a quantitative understanding of their expected contribution to achieving the organisation's process-improvement objectives versus their cost and impact. Process performance is continually improved. Optimising processes that are agile and innovative depends on the participation of an empowered workforce, aligned with organisational values and objectives. An ability to rapidly respond to changes and opportunities is enhanced by finding ways to facilitate accelerated and

shared learning. Improvement of processes is inherent in work descriptions, resulting in a cycle of continual improvement.

A critical distinction between maturity level 4 and maturity level 5 is the type of process variation being addressed. Maturity level 4 processes are concerned with addressing special causes of process variation and providing statistical predictability in the results. Though processes may produce predictable results, the results may be insufficient to achieve the established objectives. Maturity level 5 processes are concerned with addressing common causes of process variation and changing the process (that is, shifting the process performance mean) to improve process performance (while maintaining statistical predictability) to achieve the established quantitative process improvement.

1.2.7 Published benefits of Maturity Models

Each of the maturity models lays claim to various benefits that may be realised in their specific domain of application. To list the claimed benefits of even a fraction of the models would be a tedious and unrewarding exercise. To determine the common, core benefits, however, at this stage, would be of value. According to Rassa (1999), deputy-chair to the CMMI® project, there is a common basis of process improvement amongst the multitude of models. He states that improvement in any discipline is a function of *"implementing practices that reflect the fundamentals of a particular topic (e.g. configuration management)"*, and *"institutionalising practices that lead to sustainment and improvement of an implementation"*. Assuming the abovementioned is inherent in maturity models, their benefit must exist in the progression of maturity, i.e. evolving from a level of low maturity to a level of high maturity in the specific domain of application.

There is, however, a motive over and above the improvement of processes that essentially warrants the implementation of such models. It is the benefit all management is ultimately in search of. An initiative, even if indirectly or in the long run, must generate value and, ultimately, profit. It is only profit that will sustain an enterprise. This does not mean taking a short-sighted approach by focusing solely on today's profit. It refers to long-term generation of profit, overall, which may mean short-term losses. Nevertheless, this is not a discussion of profit strategies. It is a discussion of the complex problem of balancing and effectively executing the appropriate combination of processes to generate profit. Disparate and misaligned processes will not ensure sustained profitability. If harmonised, however, the correct processes have enormous potential for value creation and profit generation. This is then the task and objective of maturity model implementations – to progressively ensure the institutionalisation of domain best practice and facilitate process harmonisation.

There are certain telltale signs of process harmonisation. They include: reduced cost, improved customer satisfaction, increased productivity, improved quality, and timeous delivery. The question therefore is: Which of these signs, and to what degree, can maturity model implementation elicit?

A comprehensive document describing improvements from SW-CMM® and CMMI® implementations (both products of the SEI) has been published (Goldenson and Gibson 2003). These improvements were realised by enterprises that include Accenture, Boeing Australia, General Motors Corporation, Lockheed Martin,

Northrop Grumman, Thales, Bosch, JP Morgan Chase & Company and Sanchez Computer Associates. These improvements include:

- Cost – Six cases provide nine examples of cost-related benefits, including reductions in the cost to find and fix a defect, and overall cost savings.
- Schedule – Eight cases provide evidence of schedule-related benefits, including decreased time needed to complete tasks and increased predictability in meeting schedules.
- Quality – Five cases provide evidence of measurable improvements in quality, mostly related to reduction of defects over time or by product lifecycle.
- Customer Satisfaction – Three cases show improvements in customer satisfaction, including demonstration of customer satisfaction through award fees.
- Return on Investment – Three cases claim a positive return on investment from their CMMI-based process improvement, and two of these provide the actual results of their calculations.

It must be noted that these are benefits from only two maturity models, both products of the SEI. These results do thus not speak for all maturity models, but they do provide an indication of the potential that may be inherent in the maturity model approach.

1.2.8 Capability Maturity Model conclusions

W. E. Deming once said, "All models are wrong, but some are useful". To clarify this statement, models are never 100% accurate in their representation of that which is being modelled. They may, however, be useful in improving the understanding of that which would otherwise be extremely complex to understand. Models provide us with different "goggles" through which we can view the systems that we are trying to model, and create perspective that is new and, hopefully, facilitative in grasping the dynamics that are at play within the system.

With this in mind, the arguments of Sections 1.2.2 and 1.2.3 pertaining to the inconsistency in the definitions of organisational maturity are brought into context. So long as a model offers a degree of utility that can be translated into real benefits, that model has served its purpose. Evidence does exist of real benefits, as presented in Section 1.2.7.

An opportunity has also presented itself through these discussions: to present a model that describes a progressive innovation capability maturity improvement path and provide new insight into the complexities associated with innovation – essentially, an Innovation Capability Maturity Model.

1.3 Enterprise Engineering fundamentals

This section presents an overview of fundamental concepts extracted from the field of Enterprise Engineering. These are concepts that have been identified as essential for the furtherance of this project.

Enterprise Engineering is defined as:

> *that body of knowledge, principles, and practices having to do with the analysis, design, implementation and operation of an enterprise. In a continually changing and unpredictable competitive environment, the Enterprise Engineer addresses a fundamental question: "how to design and improve all elements associated with the total enterprise through the use of engineering and analysis methods and tools to more effectively achieve its goals and objectives.*
>
> Liles, Johnson and Meade 2005

It is clear from this definition, that any effort to understand the enterprise itself requires a basic understanding of the fundamental concepts of Enterprise Engineering. Two concepts have been identified as essential to the furtherance of this project. They are the concepts of: lifecycles and enterprise reference architectures.

1.3.1 Lifecycles

Any entity that experiences a change in state, exhibits a lifecycle that is comparable with others, and independent of both content and detail (Williams et al. 1998). The lifecycle constitutes several phases, including a *beginning* (initiation) and an *end* (closure), that describe the evolutionary states of that entity. This pertains to self-evolving and externally manipulated entities (relating to the definition of maturity – Section 1.2.3).

Such progression is captured in a graphical or narrative description referred to as the *lifecycle*. Since such a description can capture the progressive stages in the lifetime of any entity, it must, by definition, be able to describe the necessary steps in the development of any future entity (Williams et al. 1998).

Van der Ven and Poole (1995) describe the lifecycle as:

> *The typical progression of change events in a life-cycle model is a unitary sequence (it follows a single sequence of stages or phases), which is cumulative (characteristics acquired in earlier stages are retained in later stages) and conjunctive (the stages are related such that they derive from a common underlying process). There is such a progression because the trajectory to the final end state is prefigured and requires a specific historical sequence of events. Each of these events contributes a piece to the final product, and they must occur in a prescribed order, because each piece sets the stage for the next. Each stage of development is seen as a necessary precursor of succeeding stages.*

1.3.1.1 Lifecycle representation

All systems within the enterprise can be modelled using an applicable lifecycle. This includes (but is not limited to) products, technologies, processes, strategies and the enterprise as a whole (Williams et al. 1998). Lifecycles can thus provide the basis for the preparation of a methodology for carrying out the development

of a "new enterprise", including all enterprise matters mentioned previously (Williams et al. 1998). A brief discussion of a generic lifecycle and its application to Enterprise Engineering will follow.

Note that the lifecycle depictions discussed here are from a specific viewpoint, and several other viewpoints may also exist. It is thus possible that the lifecycle phases of other studies differ from those of this study, although certain elemental phases are identifiable and should constitute a significant portion of many organisation specific viewpoints and lifecycles.

The elemental phases, identified by the IFIP-IFAC Task Force (1999) during the construction of their *Generalised Enterprise Reference Architecture and Methodology* (GERAM – see Section 1.3.4 for more on Enterprise Reference Architectures) are illustrated in Figure 7. The IFIP-IFAC Task Force (1999) states that the phases shown represent the *"types of activities that are pertinent during the life of the entity".*

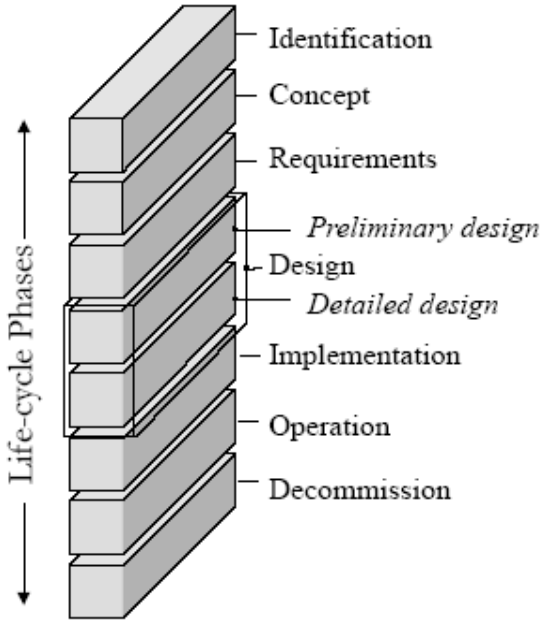

Figure 7 – GERAM lifecycle phases of an entity (*Source:* IFIP-IFAC Task Force, 1999)

Identification represents the activities that identify the content of the particular entity under consideration. This is in terms of scope and its relation to the internal and external environments.

Concept represents the activities required to develop the underlying conceptual requirements of the entity. This includes the definition of the entity's mission, vision, values, strategies, objectives, operational concepts, policies, business plans, and so forth.

Requirements represent the activities necessary for the development of descriptions of entity operational requirements, the relevant processes and a collection of all functional-, behavioural-, informational- and capability necessities.

Design embodies all tasks that support the specification of the entity and all subcomponents necessary to satisfy the stipulated requirements. The scope of design tasks includes the design of all human and

automated activities concerned with products and/or services and the related management and control functions.

Implementation embodies the definition of the tasks necessary for the construction or re-construction (i.e. manifestation) of the entity. This comprises implementation in the broadest sense, including:

- commissioning, purchasing, (re)configuring or developing all service, manufacturing and control software and hardware resources.
- hiring and training personnel, and developing or changing the human organisation.
- component validation and testing, systems integration and release into operation.

Operation embodies all tasks necessary for the operation of the entity while producing the products and/or services (which may be its special mission) along with all those tasks needed for monitoring, controlling, and evaluating the operation. Thus, the resources of the entity are managed and controlled in order to ensure process execution and mission fulfilment.

Decommission embodies all tasks required for the re-commissioning, retraining, redesign, recycling, preservation, transfer, disbanding, disassembly, or disposal of all or part of the entity, once the limits of their usefulness have been reached.

1.3.1.2 Entity life history

The IFIP-IFAC Task Force (1999) states the life history of a business entity to be the *"representation in time of tasks carried out on the particular entity during its entire life span".* Relating to the lifecycle of an entity (as described previously), the concept of life history allows for the identification of tasks pertaining to these different phases. It must be noted that the lifecycles being discussed here are of a virtual design nature. They are thus not directly descriptive of the time-based order of events, as the phases depict the design process as opposed to time itself.

To illustrate this concept, the entity may move to an earlier phase in the lifecycle as a result of a re-engineering initiative, while remaining in the *Operation* phase to ensure continued current design support. Phases are thus not necessarily sequentially executed (see Figure 8). This demonstrates the iterative nature of the lifecycle concept compared with the time-based sequence of a life history. These iterations characteristic of a life history serve to identify different change processes required on the operational processes and/or the product or customer services (IFIP-IFAC Task Force 1999).

It is possible for multiple change processes to be executed at any given time, all of which occur simultaneously throughout the operation of the entity. Furthermore, these change processes may interact with one another on various levels of detail. To provide an example, the engineering design and implementation processes may be concurrently executed within an enterprise engineering process and would occur simultaneously with the operation of the enterprise.

Life histories of entities are all unique, but all histories are made up of processes that in turn rely on similar lifecycle phases, as described and depicted in Section 1.3.1.1 and Figure 7. Lifecycles thus serve as a constructive abstraction in the understanding and execution of an entity's life history (IFIP-IFAC Task Force 1999). Figure 8 illustrates the relation between the lifecycle and the life history of an entity.

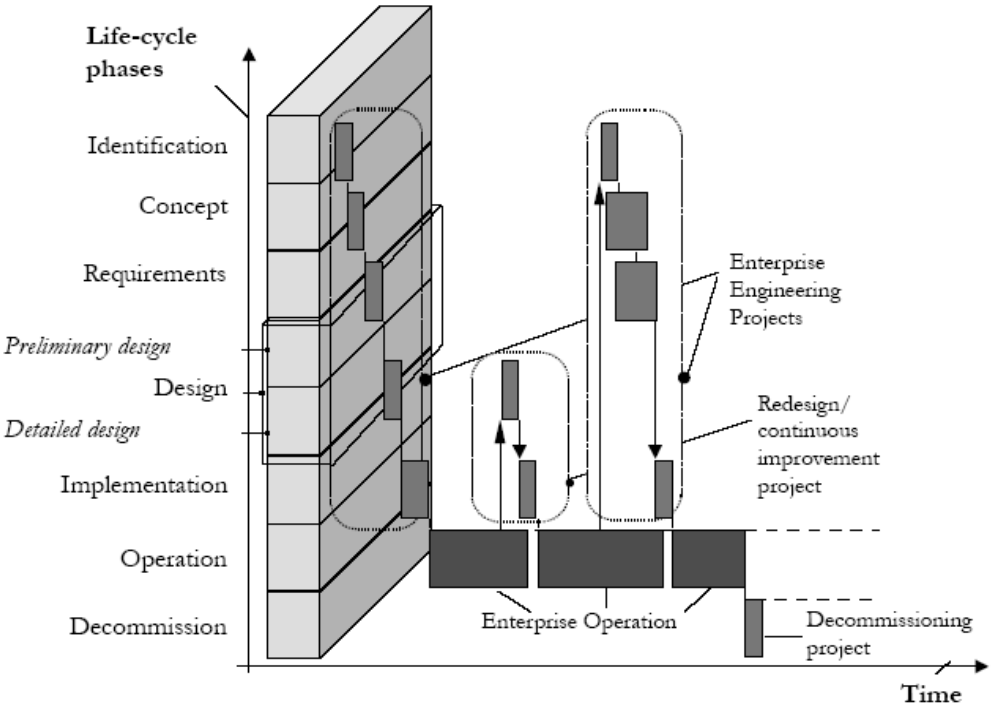

Figure 8 – Parallel processes of entity life history (*Source:* IFIP-IFAC Task Force 1999)

1.3.1.3 The spiral representation

Another means (see Figure 9) for depicting the execution of lifecycle activities within the enterprise is that of the Spiral Model (Sage 1992). The model builds on the concept of a linear lifecycle (Figure 7), but factors in the reality of revisiting some of the lifecycle phases. Even within the execution of a small project, various regions (or quadrants as Figure 9 depicts) are revisited several times over before conclusion. These regions are represented by the quadrants: Formulation (identify objectives, alterables and constraints), Analysis (refine alternatives, and identify and resolve risks), Interpretation-1 (develop and evaluate alternative), and Interpretation-2 (plan for next cycle). Collectively, these four quadrants represent a single cycle of the complete Spiral Lifecycle. This cycle is executed as many times as is necessary to fulfil the objectives of the initiative.

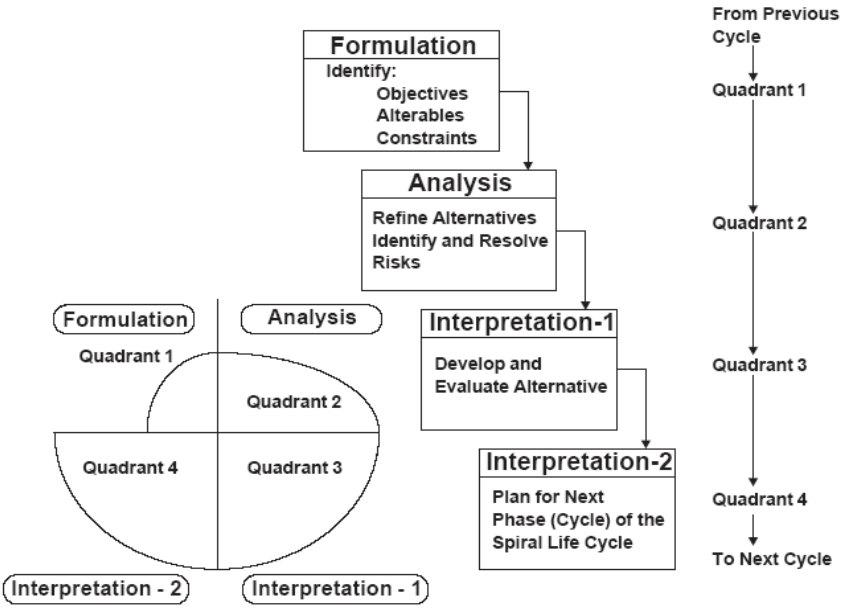

Figure 9 – Activity flow of the Spiral Model (*Source:* Sage 1992)

In its original form this model has been fairly successful in its ability to generically represent the practical execution of an initiative (Williams et al. 1998). A Software Engineering implementation of this approach is depicted in Figure 10.

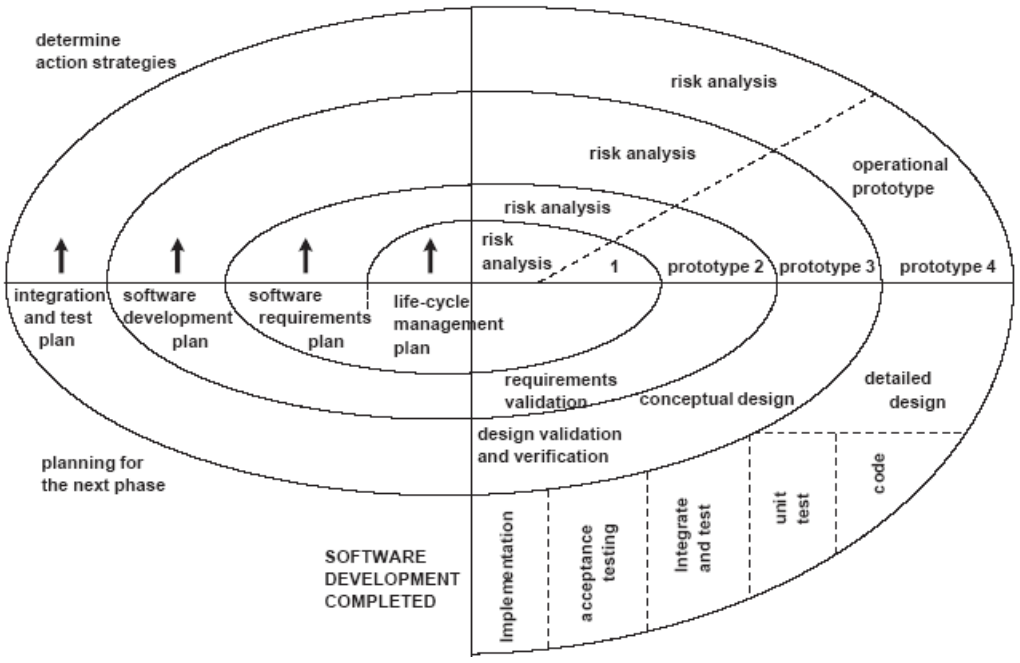

Figure 10 – Spiral model for Software Engineering (*Source:* Sage 1992)

Note that the initiative constituted 4 cycles before implementation of the system had been reached. Once implemented, the cycles may have continued as a means of continuous system improvement (not depicted in Figure 10).

1.3.1.4 The relevance of Lifecycle Management

An integrated, process-centred, and disciplined approach to lifecycle management may provide tangible benefits to the applicable stakeholders of any project related activity (NASA 2006). By performing early trade studies and cost- or risk-benefit analyses, combined with the application of established software, hardware, and system engineering principles, the inherent risks related to the timeous and correct delivery of products, within budget, is mitigated (NASA 2006). This study list many benefits, including (NASA 2006):

- Timely detection of interoperability requirements and constraints.
- Complete, unambiguous and documented functional requirements.
- Bounded and clearly defined functional expectations and appraisal criteria, fully understood and agreed upon by all stakeholders.
- More accurate, credible and defensible scope, cost and schedule estimates.
- Timely risk identification, supporting improved risk mitigation.
- A basis for properly quantifying, evaluating, and controlling the acceptance of changes requests (i.e., precluding "scope creep").
- Improved reliability, adaptability, usability, performance, maintainability, supportability and functionality of final outcomes.
- Improved visibility (fewer surprises).
- Shorter development cycle and more efficient project management (focusing resources on the most pressing issues).

Enterprises are facing ever-increasing complexities in modern business. As an example, consider the massive amounts of marketing data available, requiring extensive analysis and transformation before any value may be derived. One could simply avoid this complexity, but this would inevitably result in poor market positioning, as the competitors would surely master it. A lifecycle approach provides a framework for this environment by segmenting the life phases of a product or service (or any enterprise entity) into stages that require different activities to ensure that subsequent stages are reached. This emphasises the relevant issues of a specific lifecycle phase and provides an opportunity to address such issues at the appropriate time (Järvenpää and Airola 2001).

1.3.2 The Innovation Solution Space

The design of any business entity, at any level of aggregation, may be related to prospective or current products, the technologies employed and the enterprise status quo. This relation may be presented using a lifecycle approach. Through such lifecycle mappings, an understanding of the enterprise status quo may be

established in terms of its own lifecycle and those of the technologies employed and products developed (and to-be developed). Thus, an integrated Product-, Technology- and Enterprise Lifecycle matrix, conceptualised in Figure 11 (Du Preez 2004; Louw 2005), is valuable in understanding the necessary lifecycle requirements for the engineering or re-engineering of an enterprise and its entities. This conceptualisation assists in developing a holistic as-is understanding of the enterprise, and in (re-)designing the to-be status for the enterprise. It also assists in ensuring alignment between the products, technologies and the enterprise (including strategy, mission and vision) on the basis of the lifecycle. Alignment and harmonisation of all organisational components (including people, processes, products and technology) is essential if an enterprise's objectives are to be achieved.

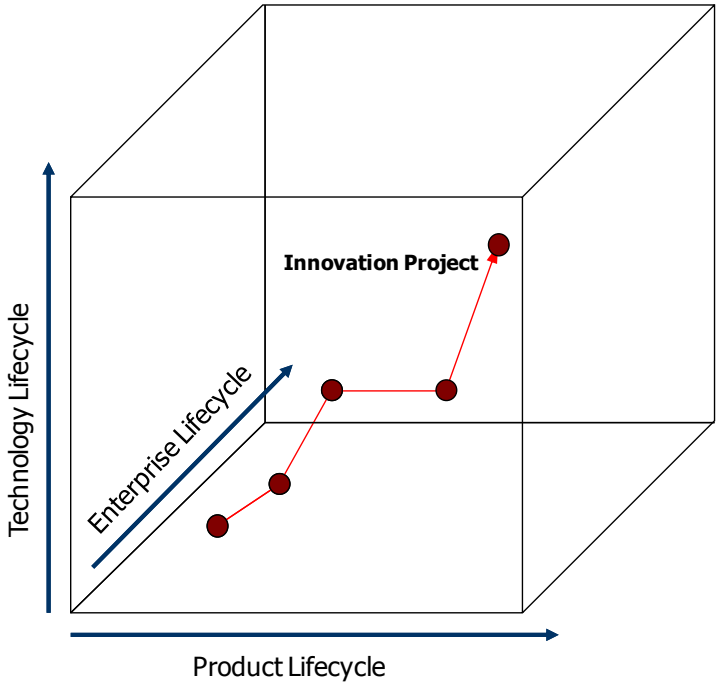

Figure 11 – Innovation Solution Space (*Based on:* Du Preez 2004)

Note that the lifecycles referred to here are all of a virtual design nature, i.e., not descriptive of the time-based order of events (relating to the discussion on a entity's life history – Section 1.3.1.2). Any initiative that is newly undertaken, in progress or nearing finalisation, may be mapped onto the Innovation Solution Space. At any given time (although time is not depicted in the three dimensional space), an initiative may be described in terms of the Enterprise-, Technology-, and Product Lifecycles. Note that progress does not necessarily propagate linearly along the axes as lifecycles are of a virtual nature. A planned progression may be plotted in the solution space for a proposed initiative, highlighting the necessary convergences in terms of the enterprise, its products and technologies. Thus, this approach may be used as a mechanism for planning and controlling the coordination of enterprise entities during the executing of an initiative.

It is clear that the Innovation Solution Space stimulates greater understanding for the interrelatedness of the three lifecycles and for the management thereof. For this reason, and for its ability to visually describe the relations between the Enterprise-, Product-, and Technology Lifecycles, this concept has been discussed.

1.3.3 The generic nature of the lifecycle

According to Williams et al. (1998), "any entity that experiences a change in state, exhibits a lifecycle that is comparable with others and independent of both content and detail". Van der Ven and Poole (1995) are of the same opinion. This independence of content and detail renders the lifecycle a generic tool for comparing different entities that exhibit a change in state and provides a fundamental basis from which to view and evaluate organisational activities and the methodologies tasked with guiding and improving those activities. This nature of the lifecycle will prove vital for the furtherance of this thesis (see Chapter 2).

1.3.4 Enterprise Reference Architectures

An architecture is a means of describing the structure or framework of a system, showing the interrelationships of all parts and/or functions of that system (Bernus, Nemes and Williams 1996).

A reference architecture is a collection of the generic parts, functions, descriptions, or behaviours of a system and the associated structures or frameworks (Bernus et al., 1996). It serves as an intellectual paradigm, facilitating the accurate analysis, discussion, and specification of a given area of discourse, i.e., a manner of viewing, conceiving, and discussing a matter of concern (Vernadat, 1996).

Finally, an Enterprise Reference Architecture is defined as:

> *… the body of classified knowledge for designing, building, operating, and modeling enterprises. The architecture contains guidelines and rules for the representation of the enterprise framework, systems, organisation, resources, products, and processes.*
>
> Bernus et al. 1996

The different levels of aggregation and the varied scope of application of an enterprise engineering effort requires the definition of 3 types of Enterprise Reference Architecture, each pertaining to a different level of functional applicability. They are (Williams and Li 1998):

- Type 1 – Specific implementations in a specific industry at a specific lifecycle phase.
- Type 2 – Generic Models, applying to all industries and enterprise lifecycle phases.
- Type 3 – Partial Models, applying to a few industries and/or enterprise lifecycle phases.

Of the abovementioned types, only Type 2 architectures provide the generic approach necessary for this project. Type 2 models include: GRAI-GIM (GRAI Integrated Methodology), GERAM (Generalised Enterprise Reference Architecture and Methodology) and PERA (Purdue Enterprise Reference Architecture). Of these models, PERA is the most generic in the sense that it provides a lifecycle-based framework for enterprise design without prescribing specific tools, techniques and methodologies for each of the specific lifecycle phases. The PERA user is thus free to utilise those tools with which the enterprise is familiar and in which it is competent. PERA is, thereof, the preferred Enterprise Reference Architecture for this dissertation.

PERA was developed by the Institute of Interdisciplinary Engineering Science, Purdue University. An extension of this architecture, known simply as the Extended PERA, is the specific model for application in this project. This adapted reference architecture, developed by the GCC (Global Centre for Competitiveness) at Stellenbosch University, provides a straightforward yet comprehensive, lifecycle-based approach to enterprise design.

1.3.4.1 Purdue Enterprise Reference Architecture (PERA)

Because PERA is a Type 2 reference architecture, it is suitable as a reference framework for modelling any enterprise (Williams and Li 1998). It depicts the steps and structure necessary for the analysis, design and development of an enterprise integration initiative (Williams et al. 1996). The structure is lifecycle based and incorporates the necessary lifecycle concepts inherent in any developing enterprise-related entity. PERA describes the following three major components (sub-architectures) to be the basis of any enterprise (Williams and Li 1998):

- Manufacturing Equipment Architecture – equipment performing physical manufacturing functions or tasks.
- Information Systems Architecture – equipment performing information functions or tasks.
- Organisation and Human Architecture – human execution of functions or tasks in either or both cases.

The Extended PERA furthers on these components to include a fourth, namely: the Decision Architecture – pertaining to decision-making protocol (Katz 2005). The concepts of the Manufacturing Equipment Architecture are also applicable to the creation of intangible products, i.e. services, in the Extended PERA.

The lifecycle phases of the architecture are: concept, function analysis, implementation, operation, and recycle and disposal. These are similar to those mentioned in Section 1.3.1 (GERAM), with only slight differences at certain phases. For example, *Implementation* in PERA includes the detailed design activities, which is separate in the case of GERAM. Figure 12 provides a graphical representation of the Extended PERA.

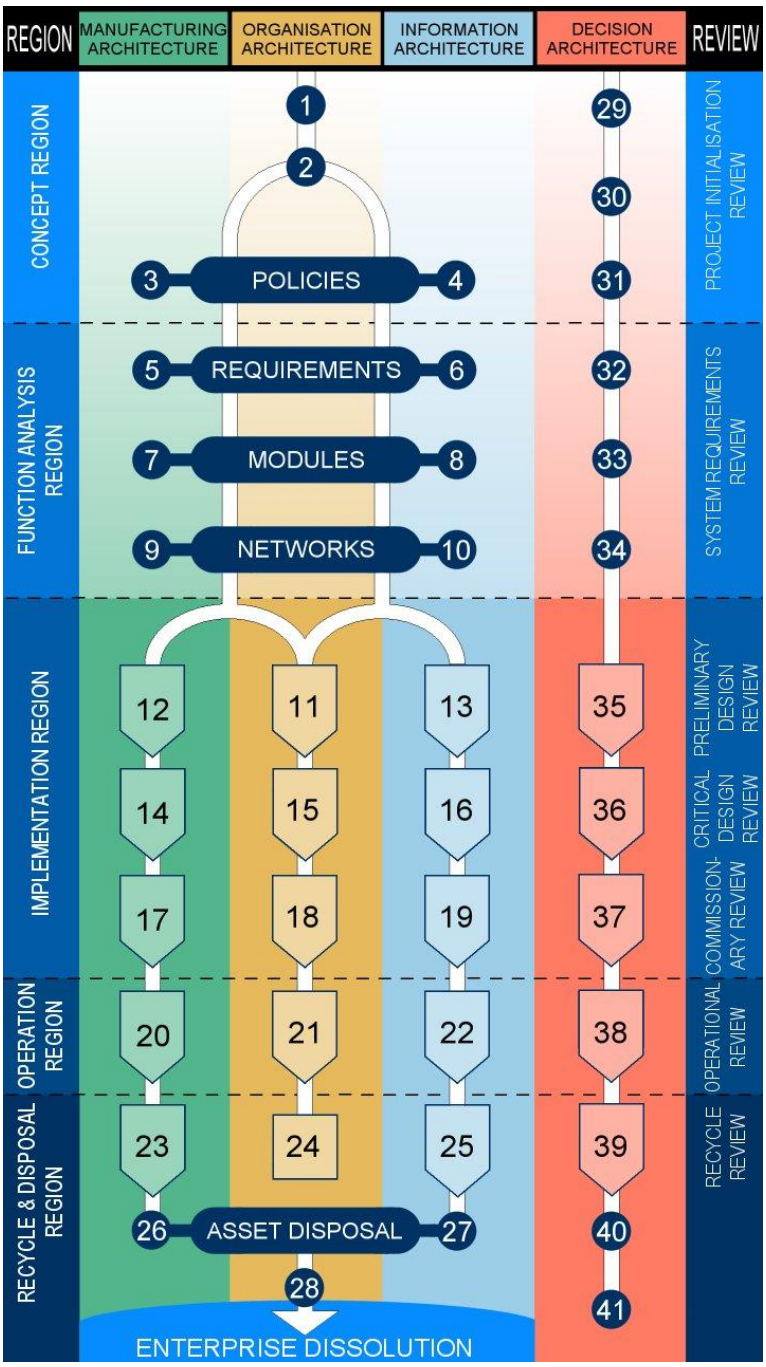

Figure 12 – Extended PERA (*Source:* Katz 2005)

1.3.5 Enterprise Engineering fundamentals conclusion

There are two elemental concepts that will be extracted from the discussed subject matter. The first is the lifecycles concept and its relevance as a generic description of enterprise activities that form the basis of enterprise change and design. The second is the fact that the enterprise may be divided into three primary sub-architectures, namely the Manufacturing Equipment (of products and services), Information Systems, and Organisation and Human Architectures. These concepts are used on numerous occasions throughout this study as reference frameworks for instigating organisational change – essentially, a major impact of innovation on an organisation.

1.4 Research proposal

This section takes a consolidated view on the initial literature research of the previous sections to propose further research and the initial objectives for this dissertation. This includes the rationale behind the proposal and a problem definition.

1.4.1 Rationale

The innovation imperative is a topic discussed in a considerable amount detail throughout Section 1.1. It is, however, worthwhile mentioning once again, that in order to create and sustain competitive advantage, innovation must become an intrinsic part of an organisations way of doing things. The principles of innovation must be applied to products, processes and strategy. Innovation must become integral to the models and methodologies tasked with organisational improvement and renewal. In summary, the organisation must develop a fundamental capability to innovate.

Maturity models are used to establish the capability maturity of an organisation in terms of a specific domain of practice and, based on the determined maturity, assist in establishing a direction and course of improvement best suited to the organisation. This would be done in accordance with the prescribed best practices of the maturity model. Certain models are used by successful, global enterprises and have been found to provide both quantitative and qualitative benefits (see Section 1.2). However, an elemental omission became evident in the foundation of the maturity models' depiction of organisational maturity progression (see Section 1.2.3 and on). The innovation imperative is insufficiently addressed within the models, becoming relevant at only the highest level of capability maturity. Current maturity models are thereby implying that innovation is reserved for organisations of only the higher orders of maturity. This notion was repealed in the discussions of Section 1.2.4.

To avoid duplicating any work in the field of innovation capability maturity, research was conducted to ascertain what models already exist, to determine the nature and availability of these models, and to understand them. The reader should note that this research was conducted in 2006. At that time, innovation capability was a domain that lacked the same level of attention as the domains of Software Development, Project Management, etc. In the search for such material, the peer-reviewed and accredited journals and research databases returned no content in this field (or any related fields). Google™ however returned several hits, all leading to four particular instances that resembled an innovation capability maturity model.

The first model, a development from Product MASTERS (Product MASTERS website 2006), has been developed specifically for product innovation (and does not address process and strategy innovation). Furthermore, the model is not in the public domain as it forms part of the Product MASTERS consulting methodology. The second model was from CreatingMinds.org (Straker 2006). The content of this model was, however, of a trivial nature, providing no detail of innovation capability maturity practices and the progression involved. The third model was (at the time) under development through the collaborative efforts of IBM and Product Development Consulting Inc. (PDC News Letter 2004). Due to the continued developments, the model had not been released. The fourth and final model was written in French (Club

Gestion des Connaissances 2006), and no English version could be found. Both Product Development Consulting and Product MASTERS were contacted, but no replies were received.

While this research was completed in 2006, and the situation has changed substantially since then, at that point in time a gap was identified in terms of innovation capability maturity models. The material that was available from the abovementioned sources was lacking in more than just detailed model content. Aspects such as a definition of innovation capability maturity, descriptions of the levels of maturity, and motivation for the relevance of the models to the organisation were lacking.

Therefore, innovation capability maturity was and still is a research domain that lacks the attention of the other maturity model domains. An opportunity was thus identified and pursued.

1.4.2 Research problem and objectives

The innovation oversight inherent in the definition of organisational maturity progression discussed in Section 1.2.4 and the lack of detail from the "innovation capability maturity models" available creates an enormous field for further research. And the fact that innovation itself is so poorly understood, just adds further motivation (and certainly complexity) to pursue the topic.

An understanding of organisational maturity is essential in order to relate innovation capability to maturity progression. This is therefore the first objective. Moreover, efforts to further the current understanding of organisational maturity (as depicted by existing maturity models) by highlighting the role of innovation capability in maturity progression will be endeavoured upon. Inherent in this objective is the definition of innovation capability, in terms of the organisation, and the progressive stages of organisational maturity.

The lifecycle concept will be incorporated into this process because of its ability to provide a generic description of the activities of the enterprise. According to Van der Ven and Poole (1995) and Williams et al. (1998), any entity that experiences a change in state exhibits a lifecycle that is comparable with others and independent of both content and detail (see Section 1.3.3). This generic nature of the lifecycle has prompted its application in determining the ability of the maturity models, and the approach in general, to holistically capture organisational maturity and provide support for the organisation throughout its lifecycle.

A selected group of maturity models, sufficiently representative of the spectrum of domains of practice, will be mapped onto the phases of the Enterprise Lifecycle. The intention is to create a landscape of the various maturity models describing the applicability and impact that each of the models has on the Enterprise Lifecycle and its phases. Thus, domain maturity (e.g. Software Development) will be brought into context with the greater objective of organisational maturity, on the basis of a lifecycle. A further function of this could be the identification of possible gaps in the maturity model approach and the fundamental definition of organisational maturity. This same mapping will be performed on the Product and Technology Lifecycles, due to the interrelatedness that exists between these lifecycles and their role in enterprise change and design.

These mappings will further serve to evaluate the maturity model approach's applicability to innovation and its ability to depict organisational progression in terms of innovation capability. This objective is strongly related to the next objective.

Assuming the maturity model approach is found to be appropriate, the primary objective of this dissertation would then be to develop the foundation for an Innovation Capability Maturity Model. Findings from research in the fields of Innovation Management, domain and organisational maturity, and Enterprise Engineering, would be consolidated and integrated in an effort to capture the innovation imperative of the modern competitive enterprise, and to translate that into a depiction of progressive innovation capability maturity. The purpose of this Innovation Capability Maturity Model would be to describe innovation capabilities (requirements and practices) in a progressive manner that would depict a natural progression in innovation capability maturity, so that it could be used as a tool for evaluating and improving an organisation's innovation capability.

The final objective of this research would be to gauge the industry perception of the Innovation Capability Maturity Model through the application and utilisation of its components in specific case studies.

2. Maturity Model Lifecycle Impact Mapping

This chapter describes, summarises and derives conclusions from the maturity model lifecycle impact mappings, as initially described in the research proposal (Section 1.4.2).

The objective of the mappings was to improve the understanding of the maturity models in terms of their ability to impact and support the enterprise throughout its lifecycle. Impact is thus described in terms of enterprise-relevant lifecycles (Enterprise, Technology and Product Lifecycle), their constituent phases, and their interrelatedness. An improved understanding of the interaction between the various lifecycles according to the maturity models could also be established. Furthermore, the mappings could be used to identify the maturity model process areas, and/or combinations thereof, that support the innovation lifecycle.

Any entity that experiences a change in state, exhibits a lifecycle that is comparable with others and independent of both content and detail (Williams et al. 1998; Van der Ven and Poole 1995). It is this generic nature of the lifecycle that prompted the use thereof in determining the applicability of the maturity model approach to generically describe organisational maturity.

The aim was to use these impact mappings as an evaluation of whether the maturity model approach is able to achieve the primary objective of this research. The approach will thus be scrutinised for its ability to depict a model that can consistently support the innovation activities of an organisation throughout the Enterprise, Product and Technology lifecycles. This outcome is discussed Section 4.3.

The basics of maturity models (purpose, structure, level descriptions, benefits, etc.) were discussed in Section 1.2. In order to re-establish context, the two primary and generic purposes of maturity models will be reiterated. The first is to establish the capability maturity of an enterprise in terms of a specific domain of practice. The second is based on the results of the first; to facilitate in establishing a direction and course for improvement that will best suit the enterprise and that is in accordance with the prescribed best practices of the maturity model.

Note that this chapter assumes a basic knowledge of maturity models. In an effort to reduce the content of this dissertation, the detailed descriptions of the mapped maturity models have been removed. For those who are interested in these details, see: CMMI-SE/SW/IPPD/SS, v1.1, P3M3, v0.1 and SE-CMM, v1.1. Furthermore, basic knowledge of generic lifecycles and the Enterprise-, Product-, and Technology Lifecycles in particular is required. If the reader is unfamiliar with these concepts, it may be worthwhile to refer to Van der Ven and Poole (1995), Williams et al. (1998), Williams, Bernus, Uppington and Nemes (1998), Du Preez (2004), Louw (2005) and Katz (2005).

2.1 Maturity Model selection

The choice of maturity models from which to select for the purpose of this mapping exercise was extensive. The number of maturity models developed by the year 2002 had already reached 120 (Champlin 2002). The

types of models are also diverse, covering the domains of: Software Development, Business Development, Project Management, Information Technology Management, Data Management, Systems Engineering, Knowledge Management, etc. A selection had to be made as to which maturity models to analyse. Having spent a considerable amount of time wading through the high-level content of approximately 15 models, the eventual choice was based upon the arguments presented below.

The first constraint, although an unfortunate one, immediately narrowed down the selection. Only certain models were public domain. Documentation pertaining to these models was and is readily available. Those models not in the public domain were generally proprietary to the developing organisation and often formed part of a consulting methodology. These models were therefore excluded.

The selection logic that followed was of a qualitative nature and considered (in no particular order) the following aspects: origin and relationship with other models, model detail available, domain of application (i.e. Systems Engineering, Knowledge Management, etc.), industry acceptance of the model, and type of model (staged or continuous representation – see CMMI-SE/SW/IPPD/SS, v1.1). These criteria could not be evaluated in all the models, but played a strong role in at least several selection decisions.

The first of an extensive list of maturity models was developed by the Software Engineering Institute (SEI) of Carnegie-Mellon University, under the sponsorship of the United States Department of Defence (Cooke-Davies 2004; Shrum and Phillips 2004). The Department of Defence identified the need for a more mature and structured approach to Software Development. Development of the first Capability Maturity Model® for Software (SW-CMM®) commenced around 1986, based on the original works of Watts Humphrey (see Section 1.2), and was first published in 1993 (Version 1.1). Continued revision arising out of workshops and ongoing feedback continued until 1992. Following this, the growth in maturity models really took off and numerous models were eventually created in various domains of practice. The vast majority of these models were based on the initial works of the SEI (SW-CMM®, v1.1).

Considering the abovementioned origins of maturity models, it was logical to select at least one of the SEI products. This too is a fairly extensive list, including: Software Development, Systems Engineering, Integrated Product and Process Development, Workforce Management, People Management, etc. (CMMI-SE/SW/IPPD/SS, v1.1). The eventual selection was that of the Capability Maturity Model Integration®, Version 1.1, or CMMI-SE/SW/IPPD/SS, v1.1. This is the latest development of the SEI and endeavours to integrate the domains of Systems Engineering, Software Development, Integrated Product and Process Development and Supplier Sourcing. Industry acceptance and support for the model is extensive and it enjoys application in various industries and in organisations of varying size (Goldenson and Gibson 2003; see Appendix A).

The next model selected was that of the Portfolio, Programme and Project Management Maturity Model, Version 0.1, or P3M3, of the Office of Government Commerce (OGC). Extreme interest from within organisations as to the most effective means of measuring project performance has become evident (Cooke-Davies 2004). This is particularly true for organisations concerned with governance, portfolio management,

and enterprise-wide project management (Cooke-Davies 2004). It is also common knowledge that all enterprises, at some time, will employ a project approach to execute and fulfil objectives. It was therefore logical to select a maturity model designed to assess and guide the improvement of project management capability. The names of several such models could be obtained (such as PM Solutions' Project Management Maturity Model and the OGC's Prince2™ Maturity Model), but the detail of P3M3 was most readily available. P3M3 is strongly based on the original products of the SEI (P3M3, v0.1), and thus utilises the same model structure as that of the SEI's staged representation.

The third and final model selected was the Systems Engineering Capability Maturity Model®, or SE-CMM®, also a product of the SEI. This model was published in 1995 and was one of the original works of the SEI, closely following the release of SW-CMM® (Version 1.1) in 1993. Although specific domain practices of Systems Engineering were later integrated into the consolidated CMMI® (one of the selected models), there were two primary reasons for selecting this model. The first is based on the maturity model representation type of the SE-CMM®. This model employed the continuous approach rather than the staged approach employed by the previous two selections (although CMMI is also available in the continuous format). SE-CMM is available in only this format due to the structuring of Systems Engineering domain practices. The second reason for selecting the SE-CMM was based on the nature of the Systems Engineering domain. Systems Engineering principles are generic in their application, where "system" can refer to practically any *"construct or collection of different elements that together produce results not obtainable by the elements alone"* (Rechtin, 1999). By implication then, the model constitutes a generic nature that is of obvious valuable in better understanding maturity models and organisational maturity in general.

Selecting more than three models was considered briefly, but the idea was later rejected in an effort to concentrate analyses on a smaller selection of models and develop a better understanding of those models.

2.2 Mapping activity explained

Various aspects needed consideration before and during the execution of the mappings and these will be discussed in this section.

2.2.1 Granularity of mappings

It is generally a difficult task to determine the appropriate granularity of comparison between models. A high-level mapping may not deliver sufficient insight into similarities and differences, or bring the desired understanding of the models themselves. At a low level, resultant data may be overwhelming and generally fail to accurately clarify model association.

It was thus logical to map the chosen maturity model level of detail directly onto the relevant lifecycle phases. A more detailed mapping (onto lifecycle phase activities for example) may have proven tedious and not adequately more insightful. It is the lifecycle phase impact and support that was of interest to this study, and not the impact on individual activities within each phase.

The necessary maturity model level of detail required a slightly more complex decision process however. There were basically three levels of detail from which to select: the maturity levels (or capability levels in the case of continuous representations), the process areas, or the specific and generic practices.

With the level of detail at maturity/capability levels, a holistic understanding of the process areas and practices would have needed to be established and consolidated for each of the levels. This would have been extremely challenging, considering the complex interaction of process areas and practices within each level, and each having a different impact on the lifecycle phases.

The mappings would have contained an extremely large amount of impacts (relations) at a specific and generic practices level of detail. Specific practices are also focused towards achieving the specific objectives of a given process area. Thus, lifecycle phase impacts of these practices may not even have differed for a specific process area.

Given the above arguments, it appeared logical then to select the process areas as the appropriate level of detail for the mappings. This would sufficiently deconstruct the maturity/capability levels to extract the desired information and describe the impact profile of the maturity models on the lifecycles phases. To establish the impact of a specific maturity level, on a specific phase, the impacts of the individual process areas within that maturity level could then simply be aggregated.

2.2.2 Definition of impact and support

Impact may be defined as evidence of direct or indirect relation between the specific process area and the specific lifecycle phase, determined through a comparison of the relevant summaries. The degree of impact (rating) is the perceived level to which this direct or indirect relation is observed during the comparison of summaries (see Table 1). The aggregated effect of all process areas in a specific maturity/capability level on a specific lifecycle phase is also referred to as impact.

Support is the aggregated effect of all process areas, in all maturity levels of a specific maturity model on a specific lifecycle phase. It is thus the total impact of the maturity model on the specific lifecycle phase. It provides an indication of the maturity model's overall ability to facilitate the various activities of a specific lifecycle phase.

2.2.3 Grading of mappings

There are two basic factors that were considered in determining the level of impact of a specific process area on any lifecycle phase. The first is the necessity to perform process area activities in the lifecycle phase, as specified by the process area itself, and so facilitate the execution of that phase. If the specification was not explicitly made, interpretation was required based on an understanding of both the specific lifecycle phase and the specific process area. This was achieved through the simultaneous comparison of the process area and lifecycle phase summaries.

The second factor considered in deciding on a level of impact was that of either a direct or indirect positive effect of the successful execution of a process area on the specific lifecycle phase. Thus, process area activities do not necessarily need to be executed within the phase. The effects of activities executed within others phases, but that have a significant consequence on the specific phase, are captured in the level of impact.

The actual impact rating of a process area on a specific lifecycle phase is assigned based on the abovementioned factors. The rating is between 0 (zero) and 4 (four) and graded as follows:

Rating	Description
0 (zero)	Zero perceivable impact – no evidence of process area and lifecycle phase relation
1 (one)	Small perceivable impact – evidence of weak indirect relation between process area and lifecycle phase
2 (two)	Moderate perceivable impact – evidence of moderate direct or indirect relation between process area and lifecycle phase
3 (three)	Strong perceivable impact – strong evidence of moderate or strong direct relation between process area and lifecycle phase
4 (four)	Extremely strong perceivable impact – very strong evidence or specific mention of direct process area relation with lifecycle phase

Table 1 – Impact grading

2.2.4 Normalisation of mappings

An issue that needed to be compensated for was that of fewer process areas with increasing levels of maturity (not as a general trend however, but as an ad hoc occurrence). This was, however, believed to have no correlation with the difficulty or amount of time required to achieve a specific level of maturity. For example, the CMMI prescribes 14 process areas for maturity level 3, while only prescribing 2 process areas for level 4. According to the SW-CMM and CMMI statistics (Shrum and Phillips 2004), it takes a median of 21 months for an enterprise to achieve a level 3 maturity and 25 months to achieve a level 4 maturity. This demonstrates that the number of process areas does not have a direct effect on the difficulty associated with attaining a specific maturity level. The possibility of a statistical analysis of this is hindered by the scarcity of actual data.

Successful fulfilment of a certain process area is based primarily on two interrelated factors. The first is the difficulty and complexity of performing the process area. This is affected by the difficulty and complexity of the specific and generic practices of the process area. The second, and possibly more important factor, is the maturity level status quo when attempting to fulfil this particular process area. An enterprise with maturity level 1 characteristics will likely find it significantly more difficult (if not impossible) to achieve a level 4 process area than a level 3 enterprise may. The maturity models strongly recommend that enterprises move progressively through the maturity levels rather than skip levels (thereby also skipping critical capabilities that are needed to achieve later process areas and higher levels of maturity).

In an effort to address the abovementioned issue, the impact mappings were normalised based on the amount of time it takes to achieve a specific maturity level. This factors in the difficulty and complexity associated with the process areas of a given maturity level, and the current maturity level of an enterprise having achieved all preceding levels. Statistics according to and based on implementations of the SW-CMM conducted from 1992 to 2003 are as follows (Table 2 – Shrum and Phillips 2004):

Maturity level transition	Median time taken (months)
Level 1 - 2	22
Level 2 - 3	21
Level 3 - 4	25
Level 4 - 5	15

Table 2 – Median time to achieve maturity levels of SW-CMM (1992 – 2003)

Unfortunately no significant statistics could be obtained for the mapped maturity models (CMMI, P3M3 and SE-CMM) for various reasons. These models are either relatively new (CMMI) or not implemented to the same extent as the SW-CMM (P3M3 and SE-CMM) and do thus not possess similar statistics. The reason, however, that these statistics were considered for normalising the mapped models is that the SW-CMM forms the basis of the majority of maturity models and the three mapped models in particular. CMMI and SE-CMM were developed by the same institute as SW-CMM, the Software Engineering Institute of Carnegie-Mellon University (CMMI-SE/SW/IPPD/SS, v1.1; SE-CMM, v1.1), and P3M3 regularly quotes, makes reference to, and claims to be derived from the initial works of the Software Engineering Institute (P3M3, v0.1). Process area structuring of the three selected models is thus extremely similar in nature. This structuring has probably the strongest impact on maturity level progression, which therefore allows for the consideration of the abovementioned statistics.

Furthermore, it was anticipated that more value would be derived for the maturity model lifecycle impact mappings if these median transition times were used to normalise the impact values aggregated per maturity level, even though the statistics used were not directly derived from the appropriate maturity models. Mappings not normalised present an extremely skewed picture of the impact of maturity levels, with the full lifecycle impact and support of maturity levels 2 and 3 far exceeding those of levels 4 and 5.

It can be argued that this is accurate when one considers the benefit brought about by later maturity levels. As the enterprise embarks on a mission to improve capability, the initial benefits experienced are large. The rate of improvement, however, slows with higher maturity levels, and thus slows the experience of benefits. This mapping is, however, not one of benefits, but rather one of lifecycle impact and support, both direct and indirect. Although impact and support could be considered benefits, they are often not linearly correlated and the benefits are often unquantifiable. It is felt that the impact on lifecycle activities is therefore better correlated with the time it takes to fulfil a certain maturity level, rather than the number of process areas within that maturity level. However, it is unfortunately not currently possible to test this

hypothesis, as there are no available statistics describing the impact of maturity levels on lifecycle phases. This study thus presents the first attempt.

2.3 Summary of mappings

In an effort to minimise the content of this dissertation, the detailed mappings have been omitted and replaced with a summary thereof. The intention of this summary is to condense the information depicted therein, and extract only what is crucial to fulfilling the objectives of the mapping process.

There are two types of summaries. The first (Table 12 – Appendix A) is a basic, tabulated extraction of the impacts of the maturity model levels (aggregation of the process area impacts) on the phases of the three lifecycles and then the total support (aggregation of maturity level impacts) provided by the maturity models for each of the phases of the three lifecycles.

The second summary constitutes three tables (Table 4, Table 5 and Table 6) – one for each of the selected models. Each table is sub-divided into the three lifecycles onto which the maturity models were mapped. Each of the sub-divisions is then further divided into four descriptive categories (columns) that collectively summarise the impact (or lack thereof) of a maturity level on a specific lifecycle. These categories are as follows:

- Impacted Phases – Lifecycle phases exhibiting an aggregated and normalised impact of more than or equal to 75% of the maximum aggregated and normalised impact for a specific maturity level and lifecycle.

- Primary KPA Contributors – Key Process Areas (or just process areas) that were found to be significant in their contribution to the realisation of the abovementioned impacted phases. Certain rules were devised to create a boundary that would separate impact contributing process areas from non-impact contributors (see Table 3).

- Non-impacted Phases – Lifecycle phases exhibiting an aggregated and normalised impact of less than or equal to 40% of the maximum aggregated and normalised impact for a specific maturity level and lifecycle.

- Comments – A brief description of the impact profile of a specific maturity level on the various phases of a specific lifecycle based on the abovementioned findings.

Aggregation, as mentioned above, refers to the summation of all process area impacts within a specific maturity level for each lifecycle phase. Normalisation was then performed for each aggregated maturity level impact based on the amount of time it takes to fulfil the requirements of a specific maturity level (see Section 2.2.4). A percentage of the maximum aggregated and normalised maturity level impact (for the specific lifecycle and maturity level) was then determined for each of these aggregated and normalised maturity level impacts.

Note that analysis of and comparison between lifecycle phase impacts was performed on a relative basis. The various phase impacts of a maturity level were compared with the phase receiving the highest perceived impact (percentage thereof calculated) for the specific maturity level. All summaries and interpretations will thus be made in relative terms, i.e., relative to the most significantly impacted phase.

Table 3 provides the minimum combinations of phase impacts of specific process areas on those lifecycle phases identified as impacted phases (above 75% of maximum). Note that not all possible combinations were considered, but rather only those that were encountered.

No. of phases identified as impacted at a specific maturity level	Minimum process area impact RATING combinations
1	3
2	4/1, 3/3
3	4/1/1, 3/3/2
4	4/2/1/0, 3/3/2/2, 3/3/3/0
5	4/2/2/1/0, 3/3/3/2/1, 3/3/2/2/2

Table 3 – Minimum process area impact combinations

The summarising tables (Table 4, Table 5 and Table 6) that resulted from this process, with the intention of condensing the findings of the mapping process, are presented on the following page.

2.4 Organisational Maturity Model discussions

One of the objectives of this dissertation was to evaluate the maturity model approach for its ability to generically describe organisational maturity and so establish an improved understanding thereof. In an effort to fulfil this objective, three maturity models were analysed for their ability to impact and support the various phases of the enterprise, product and technology lifecycles. The analysis constituted the mapping of maturity model process areas onto lifecycle phases based on the perceived impact of the process areas on those phases. A discussion of the findings will follow. The lifecycle was used as a base because of the generic manner in which it describes the activities of an enterprise, i.e. a lifecycle is evident irrespective of the circumstances of the organisational change.

It must be noted that the mappings are not indisputable in terms of their content. Subjectivity as to the impact of process areas on lifecycle phases is extremely difficult to eliminate. Every effort was made to accurately execute the mappings by simultaneously considering descriptions of both the process area and lifecycle phase in question. The mappings are thus a first attempt at bringing the maturity models into an organisational lifecycle context, in an effort to better understand organisational maturity and to present an area of further possible research.

Maturity Level	Enterprise Lifecycle				Product Lifecycle				Technology Lifecycle			
	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS
Level 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Level 2	(2), Implementation, Operation	Requirements Management, Project Monitoring and Control, Measurement and Analysis, Process and Product Quality Assurance, Configuration Management	(2), Concept, Recycle & Disposal	Concept impact very weak – enterprise conceptualisation not impacted. Emphasis on Implementation and Operation phases. Recycle & Disposal impact weak.	(3), Industrialisation, Production, Distribution & Logistics	Project Monitoring and Control, Supplier Agreement Management, Measurement and Analysis, Process and Product Quality Assurance, Configuration Management	(3), Concept, Definition, Disposal	Concept impact weak – product conceptualisation not impacted. Definition impact weak-moderate – defining of product requirements not impacted. Operational phases (Industrialisation, Production, Distribution & Logistics) strongly impacted. Disposal impact weak.	(3), Development/ Acquisition, Implementation, Exploitation	Project Planning, Project Monitoring and Control, Supplier Agreement Management, Measurement and Analysis, Process and Product Quality Assurance, Configuration Management	(2), Identification/ Needs Assessment, Decommissioning	Identification/Needs Assessment impact weak-moderate – technology identification not well impacted. Emphasis lies between technology Development/Acquisition and Exploitation. Decommissioning impact weak.
Level 3	(3), Functional Analysis, Implementation, Operation	Requirements Development, Technical Solution, Product Integration, Verification, Organisational Training, Integrated Teaming, Decision Analysis and Resolution, Organisational Environment for Integration	(2), Concept, Recycle & Disposal	Concept impact weak-moderate – improved impact for enterprise conceptualisation. KPA's show enterprise requirements development and process focus. Mid-life phase of enterprise impacted. Recycle & Disposal impact weak-moderate.	(4), Definition, Design, Industrialisation, Production	Requirements Development, Technical Solution, Verification, Integrated Project Management for IPPD, Integrated Teaming, Organisational Environment for Integration	(0)	Concept phase moderate-strongly impacted. Definition very strongly impacted. Full lifecycle impact. Emphasis shifts 2 phases earlier (Definition and Design). Impact remains strong over Industrialisation and Production phases however.	(4), Solution Architecture/ Selection, Development/ Acquisition, Implementation, Exploitation	Technical Solution, Risk Management, Integrated Teaming, Integrated Supplier Management, Organisational Environment for Integration	(0)	Identification/Needs Assessment impact moderate-strong. Full lifecycle impact. Emphasis on Development/Acquisition and Implementation.
Level 4	(2), Implementation, Operation	Organisational Process Performance, Quantitative Project Management	(2), Concept, Recycle & Disposal	Zero Concept phase impact – enterprise conceptualisation not impacted at all. Extreme implementation and operation process emphasis. Zero Recycle & Disposal phase impact	(1), Production	Organisational Process Performance, Quantitative Project Management	(3), Concept, Definition, Disposal	Concept impact weak – product conceptualisation not impacted. Definition impact weak – defining of product requirements not impacted. Production and product support phases impacted strongly. Disposal impact weak.	(2), Implementation, Exploitation	Organisational Process Performance, Quantitative Project Management	(2), Identification/ Needs Assessment, Decommissioning	Identification/Needs Assessment impact weak – technology identification not impacted. Strong emphasis on Implementation and particularly Exploitation. Decommissioning impact weak.
Level 5	(2), Implementation, Operation	Organisational Innovation and Deployment, Causal Analysis and Resolution	(2), Concept, Recycle & Disposal	Concept phase impact weak. Extreme implementation and operation phase emphasis. Recycle & Disposal phase impact weak	(4), Definition, Design, Industrialisation, Production	None	(0)	Concept phase moderately impacted. Full lifecycle impact – slightly weak on later phases (Product Support & Maintenance, Disposal). Emphasis on product definition and (at a later stage) production of the product.	(1), Exploitation	Organisational Innovation and Deployment, Causal Analysis and Resolution	(0)	Identification/Needs Assessment impact weak-moderate. Virtually full lifecycle impact. Emphasis on Exploitation and later phases.
Overall	(2), Implementation, Operation	N/A	(2), Concept, Recycle & Disposal	Concept support very weak – enterprise conceptualisation not generally supported. Functional Analysis support moderate – defining of enterprise requirements moderately supported. Strong emphasis on Implementation and Operation. Recycle & Disposal phase impact weak. CMMI shows strong process focus in terms of ELC – phases supported where definable processes are most prominent.	(2), Production, Distribution & Logistics	N/A	(2), Concept, Disposal	Concept support weak-moderate – product conceptualisation not supported on the whole. Definition support weak-moderate – defining of product requirements not well supported. Very strong emphasis on Production phase. Product and system design and product support phases' have moderate-strong support. Disposal support weak. CMMI shows process focus in terms of PLC – phases supported where definable processes are most prominent.	(3), Development/ Acquisition, Implementation, Exploitation	N/A	(2), Identification/ Needs Assessment, Decommissioning	Identification/Needs Assessment support weak-moderate – technology identification not generally supported. Solution Architecture/Selection support moderate. Development/ Acquisition support strong. Very strong emphasis on Implementation and Exploitation. Decommissioning support weak-moderate. CMMI shows process focus in terms of TLC – phases supported where definable processes are most prominent.

Table 4 – CMMI impact mapping interpretation

Maturity Level	Enterprise Lifecycle				Product Lifecycle				Technology Lifecycle			
	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS
Level 1	(3), Concept, Functional Analysis, Implementation	Project definition, Programme management awareness	(2), Operation, Recycle & Disposal	Strong emphasis on Concept and Functional Analysis phases. Operation impact weak-moderate – day-to-day operational processes not well supported. Zero Recycle & Disposal impact.	(1), Definition	Project definition	(4), Production, Distribution & Logistics, Product Support & Maintenance, Disposal	Concept impact weak-moderate. Very strong emphasis on Definition – defining product requirements. Rest of lifecycle shows weak-moderate impact.	(2), Identification/ Needs Assessment, Solution Architecture/ Selection	Project definition	(3), Implementation, Exploitation, Decommissioning	Identification/Needs Assessment impact strong. Emphasis on Solution Architecture/Selection. Development/Acquisition impact moderate.
Level 2	(2), Functional Analysis, Implementation	Business case development, Programme organisation, Programme definition, Project establishment, Requirements management, Configuration management, Programme planning & control, Capacity management, Centre of Excellence role deployment	(2), Concept, Recycle & Disposal	Concept impact weak – enterprise conceptualisation not impacted. Emphasis on Functional Analysis. Strong Implementation impact. Operation weak-moderate impact. Recycle & Disposal impact weak.	(4), Concept, Definition, Design, Industrialisation	Business case development, Programme organisation, Programme definition, Project establishment, Project planning, monitoring & control, Requirements management, Programme planning & control, Organisation portfolio establishment	(0)	Concept phase strongly impacted. Primary emphasis on Definition, Design and Industrialisation. Virtually full lifecycle impact. Weak –moderate impact on later phases.	(4), Identification/ Needs Assessment, Solution Architecture/ Selection, Development/ Acquisition, Implementation	Project establishment, Project planning, monitoring & control, Requirements management, Risk management, Programme planning & control, Capacity management,	(1), Decommissioning	Identification/Needs Assessment impact very strong. Emphasis on Solution Architecture/Selection and Development/Acquisition. Implementation impact very strong. Exploitation impact moderate. Emphasis extension toward later phases. Decommissioning impact weak-moderate.
Level 3	(1), Implementation	Transition management, Information management, Process definition, Training skills & competency development, Lifecycle control, Inter-group co-ordination & networking, Quality assurance	(2), Concept, Recycle & Disposal	Concept impact weak – enterprise conceptualisation not impacted. Emphasis on Implementation phase. Operation moderate-strong impact – improved day-to-day operational process support. Recycle & Disposal impact weak.	(4), Definition, Design, Industrialisation , Production	Transition management, Information management, Training skills & competency development, Inter-group co-ordination & networking, Quality assurance	(0)	Concept moderate-strong impact. Emphasis on Design and Industrialisation (product and production systems design). Balanced/full lifecycle impact (at least 50% impact – Disposal phase)	(4), Solution Architecture/ Selection, Development/ Acquisition, Implementation , Exploitation	Transition management, Information management, Process definition, Training skills & competency development, Inter-group co-ordination & networking, Quality assurance	(0)	Identification/Needs Assessment impact moderate. Solution Architecture/Selection impact strong. Emphasis on Development/Acquisition, Implementation and Exploitation – emphasis shift to later phases.
Level 4	(3), Functional Analysis, Implementation, Operation	Quality management	(2), Concept, Recycle & Disposal	Concept impact weak – enterprise conceptualisation not supported. Emphasis on Functional Analysis, Implementation, Operation. Zero impact on Recycle & Disposal.	(3), Design, Industrialisation , Production	Management metrics	(1), Concept	Concept weak-moderate impact – shift of impact to later phases. Emphasis remains on Design and Industrialisation. Production impact strong. Later phases show moderate impact.	(3), Solution Architecture/ Selection, Development/ Acquisition, Implementation	Management metrics, Organisational cultural growth	(0)	Identification/Needs Assessment impact moderate. Solution Architecture/ Selection impact strong. Emphasis on Development/ Acquisition and Implementation. Weak-moderate impact later.
Level 5	(2), Functional Analysis, Implementation	Proactive problem management	(1), Recycle & Disposal	Concept impact weak-moderate. Emphasis in Functional Analysis and Implementation. Operation impact moderate. Zero Recycle & Disposal impact.	(4), Concept, Definition, Design, Industrialisation	Proactive problem management, Technology management	(1), Disposal	Concept impact strong. Emphasis on Definition, Design and Industrialisation phases – requirements development and product and production systems design. Virtually full lifecycle impact - except Disposal phase	(5), Identification/ Needs Assessment, Solution Architecture/ Selection, Development/ Acquisition, Implementation, Exploitation	Proactive problem management, Technology management, Continuous process improvement	(0)	Full lifecycle impact. Identification/Needs Assessment impact strong. Emphasis on Solution Architecture/Selection, Development/Acquisition and Implementation.
Overall	(2), Functional Analysis, Implementation	N/A	(1), Recycle & Disposal	Concept support weak-moderate – enterprise conceptualisation vaguely supported. Emphasis on Functional Analysis (requirements development) and Implementation. Operation support moderate – basic support for day-to-day processes. Recycle & Disposal support weak. P3M3 shows a project based process focus.	(3), Definition, Design, Industrialisation	N/A	(0)	Concept support moderate. Emphasis on Definition, Design and Industrialisation phases – requirements development and product and production systems design receive strong support. Moderate-strong Production support. Weak-moderate support for other phases. P3M3 shows a project based process focus, but basic support for full lifecycle.	(4), Identification/ Needs Assessment, Solution Architecture/ Selection, Development/ Acquisition, Implementation	N/A	(0)	Identification/Needs Assessment support strong – technology identification strongly supported. Emphasis on Solution Architecture/ Selection, Development/ Acquisition and Implementation - P3M3 shows a project based process focus. Exploitation support moderate. Decommissioning support weak-moderate. Full lifecycle support.

Table 5 – P3M3 impact mapping interpretation

Maturity Level	Enterprise Lifecycle				Product Lifecycle				Technology Lifecycle			
	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS	IMPACTED PHASES	PRIMARY KPA CONTRIBUTORS	NON-IMPACTED PHASES	COMMENTS
Capability Level 1– Capability Level 5	(2), Functional Analysis, Implementation	Analyse Candidate Solutions, Derive and Allocate Requirements, Evolve System Architecture, Integrate Disciplines, Integrate System, Understand Customer Needs and Expectations, Manage Configurations, Plan Technical Effort, Define Organisation's Systems Engineering Process, Improve Organisation's Systems Engineering Processes, Manage Systems Engineering Support Environment	(2), Concept, Recycle & Disposal	See below	(3), Definition, Design, Industrialisation	Analyse Candidate Solutions, Derive and Allocate Requirements , Evolve System Architecture, Integrate Disciplines, Integrate System, Understand Customer Needs and Expectations, Ensure Quality, Plan Technical Effort, Improve Organisation's Systems Engineering Processes, Manage Product Line Evolution	(1), Disposal	See below	(3), Solution Architecture/ Selection, Development/ Acquisition, Implementation	Analyse Candidate Solutions, Evolve System Architecture, Integrate Disciplines, Integrate System, Ensure Quality, Manage Risk, Plan Technical Effort, Improve Organisation's Systems Engineering Processes, Coordinate with Suppliers	(1), Decommissioning	See below
Overall	(2), Functional Analysis, Implementation	N/A	(2), Concept, Recycle & Disposal	Concept support weak – enterprise conceptualisation not supported. Emphasis on Functional Analysis (requirements development) and Implementation. Operation support moderate-strong – general support for day-to-day processes. Recycle & Disposal support weak. SE-CMM shows a focus toward requirements establishment, design and implementation of an enterprise.	(3), Definition, Design, Industrialisation	N/A	(1), Disposal	Concept support weak-moderate – enterprise conceptualisation vaguely supported. Definition support strong. Emphasis on Design and Industrialisation phases – product and production systems design receive strong support. Moderate Production support. Weak-moderate support for later (product distribution and support) phases. SE-CMM shows a focus toward requirements establishment, design and implementation, and basic attention to production in terms of a product.	(3), Solution Architecture/ Selection, Development/ Acquisition, Implementation	N/A	(1), Decommissioning	Identification/Needs Assessment support moderate – basic technology identification support. Solution Architecture/ Selection support strong. Emphasis on Development/ Acquisition. Implementation support strong. Exploitation support moderate. Decommissioning support weak-moderate. SE-CMM shows a focus toward selecting, developing/acquiring and finally implementing a technology.

Table 6 – SE-CMM impact mapping interpretation

The actual purpose of the analysed maturity models must be mentioned before any further interpretation is made. Basically, their shared purpose is: to establish the capability maturity of an enterprise in terms of a specific domain of practice and, based on the results; to facilitate in establishing a direction and course for improvement that will best suit the enterprise and that is in accordance with the prescribed best practices of the maturity model. The specific domains of practice involved here are: Software Engineering, Systems Engineering, Integrated Product and Process Development and Supplier Sourcing (CMMI); Portfolio, Programme and Project Management (P3M3); and again Systems Engineering (SE-CMM). It is generally accepted that an enterprise will select a maturity model with a domain of practice that best describes the core business of that enterprise. In other words, if an organisation specialises in the execution of projects, it would most likely opt for P3M3. It is possible, however, that an enterprise may require the application and integration of more than one model. This may be a difficult and unfruitful exercise, however, because of the dissimilar overall depictions of organisational maturity. (This does not apply to products of the SEI, as their depictions are more aligned.) A discussion of this inconsistency and why it may be a difficult and unfruitful exercise can be found in Section 1.2. Nevertheless, the purpose of a particular maturity model is to provide the basis for identifying and improving specific capability (or process) areas within an organisation.

The first matter that will be discussed relates to the relation between the domains of practice to the specific lifecycle being mapped. The domains represented in this analysis (such as Project Management) are of an enterprise sub-system nature, i.e., they are not necessarily geared towards holistically addressing the enterprise, particularly throughout its lifecycle. This is especially true for CMMI and, to a lesser extent, SE-CMM and P3M3. Enterprise conceptualisation and disposal are the phases where there is an obviously perceivable shortfall in impact and support. This trend is strong throughout the CMMI maturity levels. In terms of P3M3, maturity levels 1 and 5 are those that ultimately contribute slightly better to the models' support for enterprise conceptualisation. The Recycle & Disposal phase sees extremely weak support from P3M3, however. SE-CMM shows slightly more (although still weak) conceptualisation and disposal support, primarily due to the systems engineering lifecycle approach. This then highlights the lack of support for enterprise conceptualisation and disposal evident in all three models, and could have been anticipated by recognising that these models are focused on enterprise sub-systems, rather than the enterprise as a whole.

The Product and Technology Lifecycles generally receive more support from the three maturity models than the Enterprise Lifecycle. This, again, can be attributed to the fact that the domains are focused on enterprise sub-systems. However, the phases receiving less support remain those addressing conceptualisation and disposal, although the difference between these and the strongly supported phases is less than that observed with the Enterprise Lifecycle.

Strangely, CMMI tends to show the weakest ability to support the full lifecycles, irrespective of the actual lifecycle. This is contrary to what one might have anticipated considering that CMMI integrates four domains of practice. If one searches deeper, however, the following realities are highlighted: CMMI is primarily based on the concepts of the original SW-CMM, and three of the four domains of practice are strongly focused on the product and its design, implementation and operation. The fourth domain of practice, Systems

Engineering, would thus not appear to be as an integral a part of CMMI as the other three domains. This statement is made after considering the far more comprehensive lifecycle support that SE-CMM provides over all three lifecycles when compared with CMMI. SE-CMM goes so far as to mention a full systems lifecycle approach for many of the process areas.

P3M3 lifecycle support is also far better than that of CMMI. This is possibly as a result of the generic nature of portfolio, programme and project management, and the project domains' stronger emphasis on the initial phases of an initiative. Where conceptualisation is weak to very weak in most CMMI instances, P3M3 shows moderate product conceptualisation and even strong technology conceptualisation.

An interesting analysis may be to investigate whether patterns exist in terms of phase impact with increasing levels of maturity. This would highlight progressive lifecycle phase awareness with increasing levels of maturity. For SE-CMM, increasing levels of maturity shows no relative change in impact from one level to another due to the continuous nature of the model, i.e., all process areas are applicable to all levels of capability. This is, however, not the case with CMMI and P3M3. The lifecycle impact profiles of these models therefore differ from one maturity level to another. Relative change patterns are, however, not apparent in the mappings and summaries (See Table 12 – Appendix A).

Far more discussions and interpretations may be extracted from the mappings themselves and their summaries. There is, however, a persisting observation permeating the mappings, their summaries and discussions, and this is the very prominent absence of support for conceptualisation and disposal. This is in varying degrees, but remains consistent throughout. Two questions must be asked: How relevant are these phases and how does this finding relate to the concept of organisational maturity? These questions will be addressed in the conclusion to this chapter.

2.5 Conclusion

To the knowledge of the author, the concepts of organisational- and domain maturity have not been related to the Enterprise Lifecycle, or any other organisationally relevant design lifecycles. Whether an organisation is aware of the lifecycle concept or not, it will proceed through and later revisit various phases in its evolutionary and/or revolutionary quest to create value for its customers. Knowledge and understanding of this process can only facilitate the enterprise in this mission. It must, therefore, be stated that an enterprise capable of effectively managing and executing these phases and coordinating the different activities therein, should be more mature in its ability to realise its vision.

Through the process of performing, summarising and interpreting the maturity model lifecycle impact mappings, the recurring perception of weak impact and support for the concept and disposal lifecycle phases was observed. This was particularly true for the Enterprise Lifecycle, and to a lesser extent, the Product and Technology Lifecycles. The following questions were then posed in Section 2.4: How relevant are these phases and how does this finding relate to the concept of organisational maturity?

The disposal phase of an initiative deals with the decommissioning, recycling and/or disposing of all systems and sub-systems generated by that initiative. This phase is not generally considered to present an opportunity for deriving further value from an initiative. It is, however, necessary, particularly to address various personnel, legal and environmental requirements. Procedures are generally of a standardised and repeatable nature, and therefore do not present much scope for improvement or value creation. The perceived weak impact on this phase is thus not critical, but is rather a reflection of the relative scope for improvement provided by the phase.

Conceptualisation sees the transformation of opportunities, identified through extensive research of applicable markets, into abstract and basic ideas deemed most likely to exploit those opportunities (see Section. Essentially, this is the point where the magnitude of return derived from an initiative to exploit opportunities is decided. This then forms the pivotal argument around the importance of conceptualisation. Radically innovative ideas present the potential to derive enormous returns, while "run of the mill" initiatives offer less return. This potential is presented through the ability to effectively differentiate oneself from the competitor, and to generate a strong competitive advantage. Conceptualisation therefore plays a crucial role in the lifecycle.

Success, however, is not ensured through grand conceptualisation. It is ensured through effective design, implementation, operation and support. In terms of the lifecycle then, design, implementation and operational aspects cannot exist without effective conceptualisation, and the same is true from the inverse perspective. This then reiterates the requirement, mentioned so often in this dissertation, for full lifecycle support and fulfilment.

With this in mind, the maturity models as analysed prescribe and equip an enterprise with the ability to successfully execute the initiatives deemed most likely to exploit identified opportunities. This is apparent in the strong support for the design, implementation and operational lifecycle phases provided by the maturity models. According to the mappings, the models exhibit a strong inclination towards the day-to-day activities of an enterprise and their continuous improvement and optimisation. This is a fundamental component of organisational maturity. It is, however, definitely not the only component.

The generic content of the maturity models from a lifecycle perspective is thus limited to the design, implementation and operational aspects of an enterprise. The support for these phases is substantial in nature, and therefore a strong indication of the generic applicability of the maturity model approach, even though it does not support the complete lifecycle. An opportunity thus presents itself to create a model that provides comprehensive lifecycle impact and support and that could possibly contribute to holistically capturing the notion of organisational maturity. This is further discussed in Section 4.3.

3. Innovation Fundamentals

There is a fallacy pertaining to the understanding of innovation: 100% of innovation is new. 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. This will be referred to as the capability to innovate. This capability must be assessed and improved to sustain, repeat and accelerate innovative initiatives. It is proposed that an Innovation Capability Maturity Model (ICMM) provides a means of capturing and exploiting this capability to innovate. Being able to innovate, and do so on a continuous and sustainable basis, is considered by many to be of utmost importance to organisations functioning within the competitive realm (Schumpeter 1934; Hamel 1996; Christensen 1997, Christensen and Overdorf 2000; Baker 2002; Paap and Katz 2004; Dismukes 2004, 2005; Moore 2005; Du Preez, Bernard, Louw, Uys, Schutte, Candlot and Perry 2006).

This chapter identifies those requirements and practices of innovation that are necessary to create an innovation-capable organisation. Before identifying these requirements and practices however, certain innovation concepts, some mentioned previously (see Section 1.1) and others consolidated through extensive literature review are discussed briefly. The larger part of this chapter, however, deals with what is referred to as innovation capability.

The reader should note that the representation of innovation capability as presented in this chapter is the **first** attempt at understanding the organisational requirements therefore. This research was instrumental in the development of the ICMM v1. Chapter 5 describes the additional activities targeted at improving the understanding of innovation capability and the ICMM v1.

3.1 Innovation contextualisation

The primary role of this section is to sketch a picture of innovation (essentially, the innovation dilemma) that will assist with describing what is required from an organisation to be innovation capable. It will address the notion of innovation, and then describe the environment that a typical organisation active within the competitive realm, and having identified the need to innovate, would have to master in order to be innovative.

3.1.1 Innovation definition revisited

In order to contextualise subsequent sections in this dissertation, the definition of innovation is revisited. Possibly one of the more comprehensive definitions of innovation, and one that adequately addresses its intangible nature, is that of Salvendy (1992):

> *Innovation is not just one simple act. It is not just a new understanding or the discovery of a new phenomenon, not just a flash of creative invention, not just the development of a new product or*

> *manufacturing process; nor is it simply the creation of new capital and markets. Rather innovation involves related creative activity in all these areas. It is a connected process in which many and sufficient creative acts, from research through service, are coupled together in an integrated way for a common goal.*

A more recent definition that is also relatively comprehensive in its coverage of the many perceptions and understandings of innovation is that of the 21st Century Working Group: *"Innovation transforms insight and technology into novel products, processes and services that create new value for stakeholders, drive economic growth and improve standards of living*" (Donofrio 2004).

One may continue to quote from the myriad definitions available. These definitions vary extensively in terms of scope and comprehensiveness. One may also add to this extensive list of definitions by combining, in a unique manner, those factors that are fundamental to the concept of innovation and important for this thesis. The author has, however, decided to use a definition constructed by a fellow researcher. This definition is comprehensive in its coverage of those elemental innovation concepts important for furthering this thesis. According to Katz (2006), the definitions found in literature *"encapsulate similar themes relating to innovation".* These repeated themes suggest innovation as being the (Katz 2006):

> *… 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.*

3.1.2 The innovation environment

The primary objective of this section is to describe the environment in which innovation initiatives are executed. This environment is depicted in Figure 13. The diagram does not claim to be all encompassing, but it does describe certain key attributes that have been identified as having an effect on the innovation initiatives of an organisation. The diagram appears cluttered, possibly an indication of the complexity of the environment in which the continuous execution of innovation initiatives is an imperative. The realisation of this complexity and the associated dynamics at play, and thus the movement away from a linear understanding, is a common subject matter in the literature (Teece, Pisano and Shaun 1997; Pavitt 2003; Leseure, Bauer, Birdi, Neely and Denyer 2004; O'Connor and Ayers 2005; Du Preez et al. 2006).

Christensen and Raynor (2003) sum up the challenge of the innovation environment as follows: "*...business building is unlikely to become perfectly predictable, for at least 3 reasons. The first lies in the nature of competitive marketplaces. Companies whose actions were perfectly predictable would be relatively easy to defeat. Every company therefore has an interest in behaving in deeply unpredictable ways. A second reason is the computational challenge associated with any system with a large number of possible outcomes. Chess, for example, is a fully determined game: After White's first move, Black should always simply resign. But the number of possible games is so great, and the computational challenge so overwhelming, that the outcomes of games even between supercomputers remain unpredictable. A third reason is suggested by complexity*

theory, which holds that even fully determined systems that do not outstrip our computational abilities can generate deeply random outcomes. Assessing the extent to which the outcomes of innovation can be predicted, and the significance of any residual uncertainty or unpredictability, remains a profound theoretical challenge with important practical implications."

3.1.2.1 External and Internal

Internal refers to the systems within the organisation itself, while external refers to those systems outside of the organisation's (sometimes virtual[3]) boundaries. Understanding of the external and the internal and the interactions at play is crucial to developing an innovation competency (Ahmed 1998(1); Neely, Filippini, Forza, Vinelli & Hii 2001; Baker 2002; Dismukes 2005; Moore 2005).

It is not the intention of this section to discuss the actual systems internal to an organisation. The purpose is rather to ensure that the reader has an awareness of the role that the internals of an organisation may have on the overall execution of innovation. It may be an overly obvious statement to make, but these internal systems play a vital role in ensuring successful initiation and execution. The capability to innovate inherently resides within the strategies, processes, values, knowledge and competencies, and people of the organisation (Zairi 1995; Neely et al. 2001; Cormican & O'Sullivan, 2004). External aspects have an effect, but it is the internal that must ultimately learn to rapidly adapt and prosper in a perpetually changing environment.

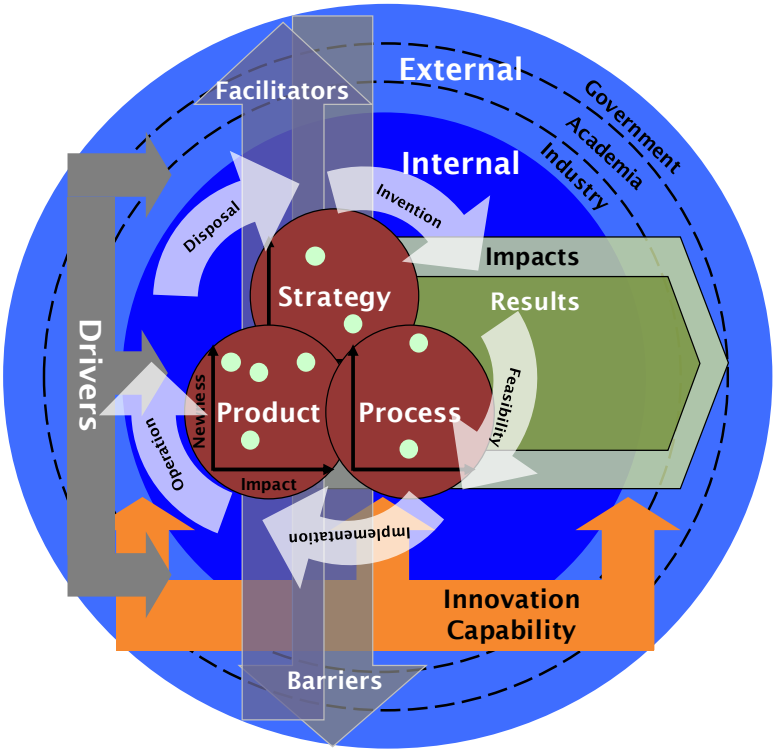

Figure 13 – The innovation environment

[3] The use of the term 'virtual' is to compensate for aspects such as decentralisation, virtual organisations (having no premises), globalisation, etc., i.e., instances where an organisation can no longer define a physical boundary of operation.

The innovation role of the external environment is largely driven by the following role-players: academia, government and industry (Dismukes, 2004, 2005; Du Preez et al. 2006). Academia plays a large role in the instigation of what Du Preez et al. (2006) has referred to as pre-competitive research. This is research into technology not yet applicable to the competitive realm, but that promises an eventual application that will offer significant improvement over the status quo, or a complete turnabout of the existing environment.

The role of government is essential in the general promotion of an innovation-conducive environment within a country – through the implementation of policy, funding schemes, loans and general support for innovation activities. The primary objective of a government would be to assist organisations in matters that would ultimately contribute to the progress of the country, a relative improvement in its competitiveness, and a consequent improvement in the general standard of living.

Industry may play a supportive or competitive role. Organisations may have a collaborative relationship, particularly when both parties derive benefit from this and when they are not in direct competition (such as Silicon Valley in the USA). On the other side of the spectrum, organisations will always have competition. It is seldom that a monopoly exists, and should this is be the case, the fundamental argument for innovation would no longer be relevant. However, through innovation it is possible to create a competitive position that renders an organisation without peer. This sought-after situation is known as rents (Teece et al. 1997), but it is highly unlikely that such a position could last indefinitely. It is also only through continued innovation that this position may be held for any substantial period of time.

3.1.2.2 Types

The literature describes many types of innovation. It can be argued that any of these forms may be categorised into one of the following three broad innovation types: Strategy, Process or Product Innovation. It is also possible that a single innovation constitutes a combination of the previously mentioned types. (These types and their possible combinations were discussed in Section 1.1.2.)

It may, however, be worthwhile to reiterate the inclusion of services within the definition of product innovation. Product innovation refers the outputs of an organisation that are intended to create value for the relevant stakeholders. This includes both products and services or any product/service combinations.

Essential to this discussion is the realisation that the innovation type plays a pivotal role in the initiation and execution of innovation initiatives (Wan, Ong & Lee 2005). Unfortunately, detail pertaining to this role and how to effectively manage it remains unclear.

A further distinction in the different innovation types is that of their level of newness and level of impact (as discussed in Section 1.1.3). These classifications of innovation too play a significant role in the innovation environment and the approach necessary to ensure their successful execution (Ahmed 1998(1); Katz 2006).

3.1.2.3 Drivers

According to Hamel (1996), the "fortifications" that were once in place to "protect" organisations are disintegrating. Realities including deregulation, technological upheaval, globalisation, and socio-economic change account for this. Technology is considered to be the key driver of change since the mid 20th century (Schumpeter 1939; Mensch 1982; Dismukes 2005).

Leseure et al. (2004) have categorised the sources (or sinks) of a need to innovate into those of a *push* nature and those of a *pull* nature. Push sources include: consultants and vendors; attendance of workshops, professional associations, and conferences; regulatory change; supply chain dynamics; government advisory initiatives; technological drivers; and top management and executive training. Pull sources (or sinks) include: low performance; need; crisis; problems; opportunity; and improvement logic.

According to Dismukes (2005), a need to improve the innovation competency of an organisation exists. Motivating factors include: the rising standard of 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 having mutual demands from centres of excellence and consumers.

To continue the list of innovation drivers would not add significant value as the list is already extensive. It is, however, crucial to understand the diversity of innovation drivers. Mentioned above was made of Leseure et al.'s (2004) push-pull categorisation. Further differentiation may exist between the internal and external aspects (as described in Section 3.1.2.1). As an example consider the drivers of regulatory change and low performance. Regulatory change may be considered to be of an external source, while low performance, that of an internal realisation (although it is possible that this realisation stems indirectly from the external environment). Social change may present an example of both an internally and an externally driven innovation imperative. Nonetheless, it is critical to identify the primary drivers of a particular innovation initiative and manage the resulting initiation and execution accordingly (Hamel & Prahalad 1994; Hamel 1996; Baker 2002).

3.1.2.4 Facilitators and Barriers

Facilitators and barriers are antonymous in nature. Facilitators are those factors within the innovation environment that assist an organisation in its quest to successfully initiate and execute innovation initiatives. In opposition, barriers are those factors within the innovation environment that hinder the organisation in that quest. Both barriers and facilitators may be internal or external to the organisation.

If the facilitating factors experienced by an organisation outweigh those of the barriers, it would not be accurate to state that the organisation will innovate, but rather that the organisation may innovate, assuming the presence of a proactive drive to do so – this too being facilitative in nature (Ahmed 1998(1),

1998(2); Cormican & O'Sullivan 2004). The bottom line remains that innovation cannot be taken for granted, and persistence and perseverance will always be prerequisites.

The simultaneous consideration of both facilitators and barriers is as a result of an ability to invert the essence of one with a specific nature, and subsequently observe the opposite nature in the result (or in many instances at least). For example, consider the many levels of authority present within bureaucracy-inclined organisations. This is seen by many to be a major barrier to innovation (Ahmed 1998(1), 1998(2); Moore 2005; Assink 2006; Hamel 2006). Conversely, flat and organic organisational structures are seen as facilitative of the innovation process (Damanpour 1991; Hamel 2000; Cormican & O'Sullivan 2004; Wan et al. 2005). This illustrates that by acting/doing/structuring to prevent the occurrence of what are considered barriers may in actual fact facilitate the process of innovation (and vice versa). One must, however, be cautious, as this is not necessarily the case. The facilitative (converse) situation is not by implication the exact opposite of the barrier, but rather a deviation from it. Consider rigid procedures by which tasks must be executed. This may be considered a barrier to innovation, stifling the necessary creativity of individuals. The opposite would be no guidance as to how tasks must be executed, i.e. complete independence. This would result in chaos and is not likely to produce the desired outputs (if any output at all). A balance is required between the two to ensure space for creativity, but to also ensure that the desired output is realised (Rothwell 1992; Ahmed 1998(2)).

A multitude of factors have been identified that hinder the process of innovation. These include the inability to unlearn, lack of distinctive competencies, obsolete mental models and theory-in-use, unrealistic revenue expectations, a risk-averse climate, lack of creativity, lack of market sensing and foresight, senior management turnover, innovation process mismanagement (Assink 2006); self-imposed barriers, unwarranted assumptions, one-correct-answer thinking, failing to challenge the obvious, pressure to conform, fear of looking foolish (Ahmed 1998(2)); lack of customer focus, lack of shared understanding, poor portfolio management, poor communication and knowledge transfer (Cormican & O'Sullivan 2004); and being satisfied with incrementalism (Hamel 1996). This list is extensive and varying in level of detail. Many more factors may be extracted from the literature, but the intention here is to accentuate the reality of a multitude of potential barriers to innovation – barriers that can so easily be accepted as the norm.

Similarly, numerous factors have been identified that aid the process of innovation. Mention will only be made of a few, as many are inversely related to the impeding factors mentioned in the previous paragraph. Facilitators include an agile and flexible project approach (Damanpour 1996; Baker 2002; Wycoff 2003; Cormican & O'Sullivan 2004; Williams 2005; Katz 2006); focus on core competencies (Prahalad & Hamel 1990; Hamel 2000; Baker 2002; Oke 2004); a capability to create and exploit new knowledge (Leseure et al. 2004); and a capability to re-use old knowledge as raw material (Ahmed 1998(1); Hargadon & Sutton 2000; Du Preez et al. 2006). Once again, this list may be continued. The notion of barriers and facilitators ties in strongly with the concept of innovation capability – a concept that receives considerable attention in Section 3.2 and through the remainder of this report.

3.1.2.5 The Lifecycle

The concept of the lifecycle is one that has been extensively utilised throughout this thesis (Sections 1.1.4, 1.3.1 and Chapter 2). One prominent and crucial aspect has driven this extensive coverage. To reiterate what was mentioned previously, an entity that experiences a change in state, exhibits a lifecycle that is comparable with others and independent of both content and detail (Van der Ven and Poole 1995; Williams et al. 1998). It is this inherently generic description of organisational activity that has prompted this coverage.

As the innovation lifecycle has already been briefly described in Sections 1.1.4, the intention of this section is to highlight the importance of the lifecycle (or process) in the innovation environment. It is only through the successful execution of all lifecycle phases that an innovation initiative may accomplish its objectives (Tidd, Besant & Pavitt 2001; Baker 2002; Oke 2004; Cormican & O'Sullivan 2004; O'Connor & Ayers, 2005; Dismukes 2004, 2005; Assink 2006; Du Preez et al. 2006). The innovation lifecycle thus plays a pivotal role in the innovation environment and will thus receive the warranted exposure further in this dissertation.

3.1.2.6 Impacts and Results

Impacts are the effects of innovation that subsequently lead to results. An innovation initiative may have an impact on the organisation itself (e.g. change in manufacturing process) and on the environment external to the organisation (e.g. the targeted market). This impact may lead to direct or indirect results that are internal (e.g. increased revenue) and/or external (e.g. rival product rendered irrelevant) in nature.

Neely et al. (2001) performed an empirical study of the impacts and results of innovation as perceived by managers and policymakers in two European regions. Impacts (or outcomes of innovation) mentioned were: lower costs, enhancements to existing products, extensions to product range, and improved customer service. Results (or business performance improvements) mentioned were: return on investment, market share, competitive position versus direct competitors, and value to customers. The research suggests that each of the abovementioned impacts and results is considered significant by the policymakers and managers.

Finally, the impacts and results may be used to determine whether an innovation initiative has been successful or not. They are the "outputs" of an innovation initiative and are generally measurable in nature. One must, however, be cautious, as excessive attention to these measures has been identified as a possible barrier to innovation (Harper & Becker 2004; Assink 2006). A preoccupation with measures can easily lead to "short-sightedness".

3.2 Innovation Capability

According to Hamel (2006), "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 will be referred to as the requirements and practices of a capability to innovate (Capability Requirements and Requirement Practices – more on this in Section 4.4.8).

The following text is a summary and consolidation of innovation best practices extracted from the literature. The furtherance of this thesis was reliant on establishing the generic factors associated with the successful execution of innovation initiatives. Generacy is required to ensure broad applicability (see Section 4.4.1). Certain generic innovation capability requirements and practices (see Section 4.4.8 for a definition of requirements and practices) for the model may be extracted directly from the summary to follow, while other practices presented in the literature represent applications of the generic innovation capability requirements and practices. In the latter case, these best practices needed to be converted into their generic equivalents before they were applicable to the model. All that is important to know about the requirements for now is that they are necessary groupings of associated practices that contribute to what is referred to as an innovation capability, and that a particular practice is associated with only one requirement. (For more detail on requirements and practices see Section 4.4.8.)

The literature highlighted three rudimentary categories of innovation capability. These categories will be referred to as Innovation Capability Areas (or capability areas - further discussed in Section 4.4.7). It can be argued that any of the requirements and practices that were identified as facilitative of innovation can be categorised into one of these capability areas or some combination thereof (see Section 4.4.7). The majority of the literature focused on one of these categories, while a few exceptional pieces simultaneously addressed two of these categories. It must, however, be mentioned that these pieces of literature were never intended to holistically capture innovation or innovation capability.

The requirements and practices associated with a single Innovation Capability Area contribute to the fulfilment of that capability area alone, while requirements and practices associated with more than one capability area, contribute to the combined fulfilment of those capability areas. This concept is covered in more detail in Chapter 4.

The Innovation Capability Areas are as follows: Lifecycle Execution (Section 3.2.3), Knowledge Exploitation (Section 3.2.4), and Organisational Efficacy (Section 3.2.5). Those Capability Requirements (or requirements) contributing to the realisation of more than one capability area will be discussed in Section 3.2.6 – referred to as Common Capability Requirements.

Note the strong similarity that exists between the three Innovation Capability Areas and the three primary sub-architectures of the Extended PERA (Section 1.3.4). The Innovation Execution capability area relates strongly to the Manufacturing Architecture. Both address aspects necessary to ensure the creation and realisation of outputs. The Knowledge Exploitation capability area is similar to the Information Architecture in the sense that they both ensure the effective dissemination of information and knowledge to support the creation and realisation of outputs. The Organisational Efficacy capability area and the Organisation Architecture are related in their description of organisational- and human structures that are supportive and facilitative of organisational activities.

The concepts of Innovation Capability Areas, Requirements and Practices are not discussed in this chapter, as the intention is primarily to present different aspects around innovation capability as discussed in the

literature. These concepts (components of the Innovation Capability Maturity Model) and their relation to one another are discussed in Chapter 4.

3.2.1 Contextualisation

Before proceeding onto the core of this chapter, the criticality of innovation capability and the challenges associated therewith are discussed and contextualised.

Dismukes (2005) identified the following motivational factors (mentioned previously, but essential for this section) for developing and improving an innovation competency (or capability): the rising standard of 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.

The capability to innovate has become essential for addressing these factors – factors which are rapidly becoming the norm. It is also vital to be able to consistently generate innovative outputs, purely because innovation is an organisation's primary source of competitive advantage. It is not necessary to elaborate on this point (as it was comprehensively covered in Section 1.1), but it is important in the context of this discussion.

Innovation capability is the organisational means with which innovative outputs may be facilitated. Because an organisation has the capability to innovate does not imply that the organisation will consistently do so. Innovation capability is a necessary but not sufficient condition. In other words, an organisation must have an innovation capability before it can expect to see regular innovative output, but being capable of innovation does not ensure innovative output. A deep-seated and organisation-wide will combined with proactive initiatives to innovate are the catalytic factors that will ensure that an innovation capable organisation innovates[4].

3.2.2 An introduction to Innovation Capability

As a starting point, consideration is given to the dominant paradigms for creating and sustaining competitive advantage. A comprehensive discussion of this may be found in Teece et al. (1997). The primary focus of this publication is on the emergence of a new "Dynamic Capabilities" paradigm for competitive advantage. According to Teece et al. (1997), this paradigm presents a better representation of the sources of competitive advantage, ultimately influencing the creation of competitive strategy. The four dominant paradigms are:

[4] This statement is not an empirically verified one as studies have not yet been done to distinguish organisations with similar innovation capabilities by their will to innovate and their resultant innovative output. However, it is logical that capability is not a guarantee of performance.

- The competitive forces approach developed by Porter which places emphasis on the actions an organisation can take to create a defensible market position and to counter competitive forces.

- The strategic conflict approach which uses the tools of game theory, implicitly viewing competitive outcomes as a function of the effectiveness with which an organisation keeps its competitors off balance through strategic investments, pricing strategies, signalling, and the control of information.

- The firm-level efficiency approach which places emphasis on the building of competitive advantage through capturing entrepreneurial rents stemming from fundamental firm-level efficiency advantages, firm-specific capabilities and assets, and the existence of isolating mechanisms.

- The dynamic capabilities approach which places emphasis on the enterprise's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.

According to Teece et al. (1997), both the competitive forces and the strategic conflict approaches appear to share the view that rents flow from privileged product-market positions (the concept of rents was briefly discussed in Section 3.1.2.1). The latter two paradigms are also similar in certain aspects. The question of which one holds the most value is then of interest to the individual endeavouring to better understand the dynamics of competition, and to organisations functioning within the competitive realm. Teece et al. (1997) state that each of the paradigms is applicable to different scenarios and, therefore, offer value in the context of those scenarios. The emerging dynamic capabilities paradigm is however likely to show significant value in *"regimes of rapid technological change".*

Teece et al. (1997) also state that "*Winners in the global marketplace have been firms that can demonstrate timely responsiveness and rapid and flexible product innovation, coupled with the management capability to effectively coordinate and redeploy internal and external competences.*" This argument substantiates their identification of the new paradigm. Furthermore, they say, "*Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions*" (Teece et al. 1997).

In short then, innovation is the source of competitive advantage and being able to rapidly adapt and change the organisation and effectively coordinate and redeploy competencies to maximally exploit opportunities necessitates these so-called dynamic capabilities. Considering the description of innovation capability in Section 3.2.1, an extremely strong relationship must therefore exist between these dynamic capabilities and innovation capabilities. It is quite likely that they are one and the same thing. The deciding factor is essentially whether or not the innovation capabilities of this dissertation can fulfil their intended purpose, a purpose almost synonymous with that of dynamic capabilities.

Assink (2006) also comprehensively discusses the notion of capabilities and states that, *"Developing distinct capabilities … should be an integral part on a company's strategy for growth".* According to Assink (2006), the term capabilities emphasises *"the key role of strategic management in appropriately adapting,*

integrating and reconfiguring organisational skills, resources and functional competencies to match the requirements of a changing environment."

Other pieces of literature that have clearly conveyed the need for an innovation capability include: Neely et al. (2001), and O'Connor & Ayers (2005). In both instances, innovation capability is said to be the potential of an organisation to innovate. This confirms the statement made earlier that innovation capability is a necessary but not sufficient condition (Section 3.2.1).

Apart from the categorisation of innovation capability into the three areas discussed in this thesis, Ahmed 1998(1) distinguishes between hard and soft innovation capabilities. Hard innovation deals with aspects such as structures, processes, procedures, physical infrastructure, metrics, resources, etc., that are put into place to enhance innovative output. Soft innovation deals with aspects such as culture, climate, leadership, etc., that entails proper and effective management of the hard aspects. Although this distinction is not clearly made within the current structuring of innovation capability, they do form a significant consideration. The Organisational Efficacy capability area, for instance, contains primarily the softer aspects of innovation capability, while the Lifecycle Execution capability area contains primarily the harder aspects (although overlapping is evident).

McKinsey's 7S's model identifies seven variables whose interdependent relationship requires coordinated management for an organisation to function effectively (Zairi 1995). These variables, a description of each, and the Innovation Capability Area into which each may be categorised are as follows:

- Strategy – the plan leading to the allocation of resources (Organisational Efficacy)
- Shared values – the goals shared by all employees (Organisational Efficacy)
- Style – the management style of the organization (Organisational Efficacy)
- Structure – the organisational map or chart (Organisational Efficacy)
- Skills – the strengths and capabilities of all employees (Organisational Efficacy)
- Staff – the people employed (Organisational Efficacy)
- Systems – procedures, guidelines and control mechanisms (Lifecycle Execution, Knowledge Exploitation, and Common Capability Requirements)

It is clear that the McKinsey model is fairly one-dimensional in its coverage of innovation capability, or that it at least places far more emphasis on the organisational aspects that are believed to be supportive of innovation initiatives. The model was, however, not intended to be directly related to innovation capability. The important aspect to mention here is that all factors mentioned within the McKinsey model are well covered within the initial high-level structuring of the ICMM.

3.2.3 Lifecycle Execution

Lifecycle Execution is the Innovation Capability Area (discussed in further detail in Section 4.4.7) tasked with ensuring that all the lifecycle phases of innovation initiatives from conceptualisation through disposal are sufficiently executed to ensure both the success of the initiatives and the sustained competitive advantage of the organisation.

The categorisation of requirements and practices in the following three sections is not the in format in which it was found in the literature. The requirements of a particular capability area and the practices of a particular requirement were often found in seemly-unrelated texts, but were matched because of their shared fundamental contribution to innovation capability. Furthermore, on many occasions the identified innovation best practices were common to several texts. In such cases, a list of the different references is provided. In an effort to keep the summary as concise as possible, the requirements and their associated practices will be briefly mentioned and then the references thereto provided. If more detail is required of a particular requirement or practice, then the referenced text should be consulted. Note that the innovation best practices of these sections are not necessarily in the generic format required for the Innovation Capability Maturity Model, and are presented in no particular order. They therefore required varying degrees of reverse engineering to identify the fundamental aspects that contribute to innovation capability.

The first requirement is a process that addresses all the phases necessary to ensure the successful fruition of an innovation initiative (Tidd et al. 2001; Cormican & O'Sullivan, 2004; O'Connor & Ayers 2005; Assink 2006). This process may take on the form of a lifecycle (Ahmed 1998(1); Leseure et al. 2004; Dismukes 2004, 2005; Du Preez et al 2006). Practices include understanding the lifecycle (Oke 2004; Cormican & O'Sullivan 2004), planning based on a lifecycle approach (Cormican & O'Sullivan 2004, Du Preez et al. 2006), managing that lifecycle (Tidd et al. 2001, Dismukes 2005, Du Preez et al. 2006), deploying facilitative tools and techniques (Dismukes 2005, Du Preez et al. 2006), and integrating the phases and activities of the lifecycles within the organisation to improve the likelihood of successful output (Cormican & O'Sullivan, 2004, O'Connor & Ayers 2005, Du Preez et al. 2006).

The next requirement is the need to have an initially flexible approach to innovation initiatives, and then to appropriately formalise the initiatives to ensure follow-through and completion (Damanpour 1996; Baker 2002; Wycoff 2003; Cormican & O'Sullivan, 2004; Williams 2005; Katz 2006). Practices include distinguishing between the flexible and nebulous (vague) phase and the systematic (formalised) phase (Baker 2002; Cormican & O'Sullivan 2004; Katz 2006), determining the innovativeness of the initiative (Ahmed 1998(1)), identifying and deploying tools and techniques that facilitate each of the phases (Katz 2006), performing regular project appraisal (Rothwell 1992), and structuring the initiatives for effective communication and flexibility (Katz 2006).

Managing the risks associated with innovation initiatives has been identified as crucial (Ahmed 1998(1); Wycoff 2003; Dismukes 2005; Katz 2006). Practices include: encouraging a willingness to take risks (Ahmed 1998(1); Wan et al. 2005), distinguishing between programme and project risk and ensuring there is an

appropriate balance (Ahmed 1998(1); Katz 2006), establishing risk mitigation strategies (Katz 2006), and learning from failures (Wycoff 2003; Katz 2006).

Effective means of identifying opportunities, and developing ideas and solutions for those opportunities, has been recognised as vital to the successful execution of innovation initiatives (Hamel 1996; Ahmed 1998(1); Hargadon & Sutton 2000; Coulson-Thomas 2001; Tidd et al. 2001; Baker 2002; O'Connor & Ayers, 2005; Wind & Crook, 2005; Du Preez et al. 2006; Arciszewski & Zlotin, 2006). Practices include scanning internal and external environments for opportunities (Tidd et al. 2001; Baker 2002; O'Connor & Ayers 2005), effectively generating ideas (Hargadon & Sutton 2000; O'Connor & Ayers 2005; Arciszewski & Zlotin 2006), understanding and managing the stream of ideas (Ahmed 1998(1); Neely et al. 2001; Baker 2002; Reid & de Brentani, 2004), taking new perspective, challenging presuppositions, and dismissing convention (Hamel 1996; Coulson-Thomas 2001; O'Connor & Ayers 2005; Wind & Crook 2005).

Effective management of the flexible and often nebulous initial phases is considered essential in bringing exciting opportunities with great potential to pursuable business alternatives (Cohen & Levinthal 1990; Baker 2002; Reid & de Brentani 2004; Leseure et al. 2004; Williams 2005; Pretium Consulting Services 2005; Katz 2006). Practices include managing the complexities and uncertainties associated with the initial phases of an innovation initiative (Williams 2005; Katz 2006), developing trajectory strategies for initiatives in terms of their role and mission (Ahmed 1998(1)), early anticipation and resolutions of barriers to initiatives (Cooper & Kleinschmidt 1996; Cormican & O'Sullivan 2004).

The need to prioritise opportunities, and rigorously test and screen ideas has been identified as vital for ensuring that the organisation reaches a point of selection and furtherance of opportunities (Zairi 1995; Ahmed 1998(1); Hargadon & Sutton 2000; Tidd et al. 2001; Baker 2002; Cormican & O'Sullivan 2004, Dismukes 2005; Moore 2005; O'Connor & Ayers 2005; Katz 2006). Practices include prioritising organisationally aligned opportunities to create a manageable cluster (Ahmed 1998(1); Baker 2002; Moore 2005; Du Preez et al. 2006), rigorous experimental and/or tangible testing of ideas (Hargadon & Sutton 2000; Wycoff 2003; Katz 2006), discarding unsuccessful ideas (Rothwell 1992; Baker 2002; Moore 2005), ensuring rapid idea turnaround (Ahmed 1998(1), Hargadon & Sutton 2000), and incubating ideas with potential and allowing them to evolve into stimulating business propositions (Hargadon & Sutton 2000; O'Connor & Ayers 2005).

Selected opportunities must be rapidly evolved into exploitable initiatives to generate value (Zairi 1995; Ahmed 1998(1); Cozijnsen, Vrakking and Van Ijerloo 2000; Tidd et al. 2001; Brown 2003; O'Connor & Ayers 2005). Practices include consideration of bottom-line profitability, market responses, required competencies, technologies and resources, etc. (Zairi 1995; Tidd et al. 2001; O'Connor & Ayers 2005), consideration of enterprise architecture and infrastructure (O'Connor & Ayers 2005; Du Preez et al. 2006), understanding the networking behaviour within the targeted market (Coetzer 2006), and effective bridging between the nebulous initial phase and the systematic phase (O'Connor & Ayers 2005; Katz 2006).

Discussed in this paragraph are several requirements that were less explicit within the literature, but are considered nonetheless. It is not sufficient for organisations to execute only radical innovations, as the time between launches is generally long. Incremental innovation is thus vital to sustain the competitive edge on operational activities. It is however crucial that an organisation simultaneously searches for the next radical opportunity. Incrementalism will not be indefinitely sufficient (Hamel 1996) – radical, market-changing innovation will be required to ensure sustained prosperity. Practices to consider during this phase may include parallel continuation of all innovation activities, traditional operational activities – optimisation, refinement, effectiveness/efficiency/quality improvement, and cost reduction (within limits – not to the long-term detriment of operations). These traditional activities are, however, outside the scope of this research.

The final requirement for the Lifecycle Execution capability area is the need to know when to dispose of an initiative. This is not a subject generally addressed within innovation literature. One author, Moore (2005), mentions the organisational practice of having what was once a thriving line of business and unrelentingly milking that business until the market is completely saturated. The question is then: Is this the most effective means of utilising the sought-after resources of an organisation? It is the authors opinion that this is not, and that there are far more effective ways to utilise the resources of an organisation, particularly an organisation that was once (and possibly still is) able to generate innovative output. Practices to consider include establishing the point of diminished returns, ensuring that tacit knowledge created throughout the initiative is captured (both in the heads of people and processes) in order to facilitate organisational learning, and the rapid redistribution of resources.

3.2.4 Knowledge Exploitation

Knowledge Exploitation is the Innovation Capability Area tasked with managing the process of knowledge creation and dissemination. It endeavours to ensure the effective utilisation of knowledge, i.e., to properly address the what, when, where, why, and how of knowledge application, and to facilitate and support the successful and repeated execution of innovation initiatives.

Knowledge is the driving force for decision-making and being innovation capable requires the making of many decisions, often in extremely vague environments and with very little time available. Thus, being effective and efficient with knowledge is an innovation imperative. The literature (Clark 1998; Johannessen, Olsen & Olaisen 1999(2); Pérez-Bustamante 1999; Carneiro 2000; Hargadon & Sutton 2000; Burgelman, Miadique & Wheelright 2001; Du Preez et al. 2006) is adamant on this requirement.

The first two requirements for the Knowledge Exploitation capability area are associated. The organisation must realise that a knowledge process (or lifecycle) exists (Carneiro 2000; MOKA Consortium 2001; Candlot, Ammar-Khodja, Mauchand & Perry 2005; Du Preez et al. 2006) and that knowledge must evolve before it becomes applicable, and continue to evolve to maintain relevance (Patton & Carlsen 1998; Du Preez et al. 2006; Le Bihan 2006). Practices include identification of tools, processes and methods to facilitate lifecycle phases of knowledge (Carneiro 2000; MOKA Consortium 2001; Du Preez et al. 2006), relating knowledge lifecycle phases to innovation lifecycle phases and executing multiple knowledge lifecycles within the

innovation lifecycle (Du Preez et al., 2006), and understanding and managing the evolution of knowledge (Patton & Carlsen 1998; Le Bihan 2006).

Being able to effectively create and absorb knowledge has been identified as crucial to initiating and sustaining the knowledge exploitation process (Clark 1998; Hargadon & Sutton 2000; Baker 2002; Leseure et al. 2004; Dismukes 2005; Du Preez et al. 2006). Practices include pulling information rather than waiting for it to be pushed (Patton & Carlsen 1998), identification of tools and methods that may facilitate the creation and absorption of knowledge (Leseure et al. 2004; Du Preez et al. 2006); and using old ideas and knowledge as a launch pad for new ideas and knowledge (Hargadon & Sutton 2000).

Being able to piece together different knowledge and understanding and uniquely applying this amalgamation to the situation is essential to many innovation activities, including the scanning of environments for opportunities, generating ideas, solving problems, etc. (Cook & Hunsaker 2001; Baker 2002; Du Preez et al 2006; Assink 2006). Practices include identifying tools and techniques to effectively store and structure knowledge (Du Preez et al. 2006), identifying tools to facilitate the retrieval of knowledge in context (Hargadon & Sutton 2000; Du Preez et al. 2006), identifying and integrating complementary knowledge to create new knowledge (Wan et al. 2005, Du Preez et al. 2006; Leiponen 2006), and identifying and utilising tools and techniques that enhance the representation of complementary knowledge (Du Preez et al. 2006).

Knowledge must be made available and interactively disseminated amongst individuals and teams throughout the organisation and external groups with mutual needs (Ahmed 1998(1); Patton & Carlsen 1998; Clark 1998; Hargadon & Sutton 2000; Frombach 2003; Cormican & O'Sullivan 2004; Dismukes 2005; Wan et al. 2005; Du Preez et al. 2006). Practices include establishing groups of individuals with similar needs for interactive knowledge exchange (Patton & Carlsen 1998; Clark 1998; Frombach 2003; Cormican & O'Sullivan 2004; Wan et al. 2005), encouraging an open and trusting environment for interaction (Hargadon & Sutton 2000; Frombach 2003; Le Bihan 2006), establishing mutually beneficial scope and themes for interaction (Clark 1998; Frombach 2003; Le Bihan 2006), establishing groups with external participants to introduce external perspective (Clark 1998; Ahmed 1998(1); Dismukes 2005), identifying and deploying tools and techniques for facilitating collaborative interaction (Zairi 1995; Dismukes 2005; Du Preez et al 2006; Le Bihan 2006), and creating a shared vocabulary and means of knowledge structuring to facilitate interaction and knowledge retrieval (Clark 1998; Wan et al. 2005; Le Bihan 2006).

The ability to capture the tacit knowledge within the minds of individuals and inherent within organisational processes has been identified as essential to improving knowledge exploitation (Nonaka 1994; Ahmed 1998(1); Christensen 2000; Brown 2003; Van't Hof 2003; Du Preez et al. 2006). Practices include identifying and deploying tacit knowledge transfer programs, such as mentorships and collaboration (Prahalad & Hamel 1990; Nonaka 1994, Ahmed 1998(1)), and identifying and deploying tools and techniques for capturing tacit knowledge (Nonaka 1994; Van't Hof 2003; Brown 2003).

3.2.5 Organisational Efficacy

Organisational Efficacy is the Innovation Capability Area charged with ensuring that the organisation is equipped with appropriate strategies, structures, climate, culture, leadership techniques, and resourcing tactics to support and facilitate the repeated and successful execution of innovation initiatives.

An innovation driven strategy has been identified as playing a pivotal role in consistently generating innovative outputs (Hamel 1996, 2002; Zairi 1995; Ahmed 1998(1), 1998(2); Baker 2002; Cormican & O'Sullivan 2004; Oke 2004). Practices include rigorously communicating the role of innovation and the strategic intent to be innovative (Ahmed 1998(1); Cormican & O'Sullivan 2004; Oke 2004), ensuring organisational vision and mission allude to being innovative (Ahmed 1998(1), 1998(2); Wan et al. 2005), ensuring strategic objectives are transparent and shared by all (Ahmed 1998(1), 1998(2); Oke 2004), encouraging individuals to think strategically, i.e. think big and long term (Hamel 1996, 2000, and considering strategy to be inquisitive, expansive, prescient, inventive, inclusive, demanding and not ritualistic, reductionist, extrapolative, positioning, elitist and easy (Hamel 1996).

Before continuing with the Organisational Efficacy requirements and practices, the context in which organisational climate and culture are addressed will be briefly discussed. Although most of the literature has the notions of climate and culture clearly defined and differentiated, extensive overlapping is evident when referring to the specifics of either climate or culture. There is no doubt in this literature, however, of the exceptionally interdependent association that exists between these two organisational fundamentals (Schneider, Brief, & Guzzo 1996; Ahmed 1998(1), 1998(2); Cormican & O'Sullivan 2004). It is not within the scope of this dissertation, however, to further the differentiation of these notions and create an improved understanding of each of them and their interrelatedness. Interpretation of the literature will, however, be necessary to deliver on the objectives of this research, and thus an effort will be made to separate these concepts and depict their interdependencies (see Section 4.4.8.3) with the intent of furthering the Innovation Capability Maturity Model. For the purpose of the ICMM, climate will primarily refer to the policies, practices and procedures of the organisation, while culture will primarily refer to the beliefs, norms, values and patterns of behaviour (Cormican & O'Sullivan, 2004).

Organisational climate has been identified as playing a vital role in facilitating innovative outputs (Kimberly & Evanisko, 1981; Zairi 1995; Schneider et al. 1996; Ahmed 1998(1), 1998(2); Cormican & O'Sullivan 2004). Practices include encouraging individuals to be creative, proactive, challenging of the norm, and to take risks (Ahmed 1998(2); Cormican & O'Sullivan 2004), celebrating success and balancing the intrinsic and extrinsic rewards for both individuals and teams (Schneider et al. 1996; Ahmed 1998(1), 1998(2); Baker 2002; Cormican & O'Sullivan 2004), showing acceptance of failure and motivating learning (Ahmed 1998(1), 1998(2)), ensuring metrics are facilitative of innovative outputs (Katz 2006), ensuring policies, practices and procedures are facilitative of innovative behaviour (Schneider et al. 1996; Cormican & O'Sullivan 2004), balancing autonomous behaviour (Ahmed 1998(2)), and understanding and managing the relation between climate and culture (Ahmed 1998(2); Cormican & O'Sullivan 2004).

Similarly, organisational culture has been identified as playing a vital role in facilitating innovative outputs (Zairi 1995; Schneider et al. 1996; Ahmed 1998(1), 1998(2); Christensen & Overdorf 2000; Hargadon & Sutton 2000; Cormican & O'Sullivan 2004). Practices include promoting a sense of openness, trust and mutual respect (Ahmed 1998(2)), promoting the ability to rapidly learn and unlearn (Cook & Hunsaker 2001; Assink 2006), promoting the belief that innovation is important (Hargadon & Sutton 2000, Wan et al. 2005), ensuring the fear of missing a big opportunity is greater than the fear of failing (Ahmed 1998(2); Brown 2003), encouraging individuals to accept criticism, engage in debate, expect conflict and take ownership of their work/ideas (Ahmed 1998(2)), identifying and cultivating the appropriate cultural beliefs, norms, values and patterns of behaviour (Ahmed 1998(1), 1998(2); Cormican & O'Sullivan 2004), understanding and managing the relation between climate and culture (Ahmed 1998(1),1998(2); Cormican & O'Sullivan 2004).

Leaders are required to be committed to innovation and continuously stimulate, encourage and support innovative behaviour (Kimberly & Evanisko 1981; Rothwell 1992; Zairi 1995; Ahmed 1998(2); Neely et al. 2001; Cormican & O'Sullivan 2004; Katz 2006). Practices include leaders showing strong commitment to innovation (Ahmed 1998(1), 1998(2); Neely et al. 2001; Kostoff et al. 2004), leaders being made aware of the fundamental role of people in generating innovative outputs (Rothwell 1992; Ahmed 1998(1), 1998(2); Cormican & O'Sullivan 2004), leaders establishing and managing the scope for autonomy, leaders being sensitive to creative signals from individuals, and identifying, recruiting, developing, training, encouraging and acknowledging innovation champions throughout the organisation (Rothwell 1992; Ahmed 1998(2)).

Flexible, flat and transparent organisational structure has been identified as being facilitative of innovative activity and output (Kimberly & Evanisko 1981; Damanpour 1991; Zairi 1995; Ahmed 1998(1), 1998(2); Christensen & Overdorf 2000; Hamel 2000; Baker 2002; Cormican & O'Sullivan 2004; Wan et al. 2005; Du Preez et al. 2006). Practices include maintaining decision-making authority as low and as decentralised as possible (Ahmed 1998(2); Cormican & O'Sullivan 2004; Wan et al. 2005), minimising organisational levels of authority and adopting a horizontal management approach (Wan et al. 2005; Du Preez et al. 2006), minimising formal and rigid departmental separation (Ahmed 1998(2)), distinguishing between implicit and explicit adaptation to organisational structure (Größler, Grübner & Milling 2006), and ensuring flexible definition of organisational boundaries to allow for the creation of spin-offs and new workspace (Christensen & Overdorf 2000).

Aligning and effectively managing organisational resources has been identified as crucial for innovation (Ahmed 1998 (1), 1998(2); Leseure et al. 2004; Wan et al. 2005; Moore 2005; Hargadon & Sutton 2000; Christensen & Overdorf 2000). Practices include ensuring (as much as possible) the alignment of individual personality traits and work descriptions (Ahmed 1998(2); Christensen & Overdorf 2000), ensuring sufficient slack in terms of resources (Ahmed 1998(1), 1998(2); Wan et al. 2005), providing continuous training to widen and deepen individual skills (Ahmed 1998(2); Christensen & Overdorf 2000), ensuring diverse mix of individual interests, disciplines and skills (Ahmed 1998(1); Hargadon & Sutton 2000), ensuring that the proportion of resources assigned to innovative and non-innovative activities is appropriate to the situation and objectives (Wan et al. 2005; Moore 2005), identifying and obtaining individuals with personality traits

and cognitive factors that are strongly correlated with the various roles necessary for innovation (Ahmed 1998(2); Christensen & Overdorf 2000).

3.2.6 Common Capability Requirements

The requirements and practices that follow have been identified as contributing to the Lifecycle Execution and Organisational Efficacy capability areas.

The need to understand, manage and continuously improve organisational core competencies has been identified as essential for executing innovation initiatives and for ensuring an innovation facilitative environment (Prahalad & Hamel 1990; Hamel 1996; Ahmed 1998(1); Christensen & Overdorf 2000; Moore 2005). Practices include establishing an understanding of the organisation's core competencies (Hamel 1996; Ahmed 1998(1); Moore,2005), identifying and distinguishing between contextual and core organisational activities (Moore,2005), identifying and managing the sources (resources, processes and/or values) of core competencies (Christensen & Overdorf 2000), continuously identifying and developing next-generation core competencies (Prahalad & Hamel 1990), and managing core competencies as resources and assigning them to activities where they are most likely to generate value (Prahalad & Hamel 1990)

The organisational ability to adapt and change is seen as fundamental to an innovation capability (Zairi 1995; Hamel 1996; Christensen & Overdorf 2000; Cook & Hunsaker 2001; Baker 2002; Größler et al. 2006; Katz 2006) Practices include developing an attitude accepting of change throughout the organisation (Ahmed 1998(2)), early engagement of individuals in the activities leading up to the change process (Hamel 1996), realising that change is a process that needs to be understood and managed (Cook & Hunsaker 2001; Katz 2006), distinguishing between implicit and explicit organisational adaptation and managing them appropriately (Größler et al. 2006), considering the degree of change that is necessary and whether the organisation is capable of such change (Christensen & Overdorf 2000; Katz 2006), and managing the sources of core competencies to facilitate the necessary degree of change (Christensen & Overdorf 2000).

The requirements and practices that follow have been identified as contributing to the Lifecycle Execution and Knowledge Exploitation capability areas.

Involving and integrating consumers, suppliers and stakeholders has been identified as essential for ensuring the relevance of innovation initiatives (Rothwell 1992; Zairi 1995; Ahmed 1998 (1), 1998(2); Brown 2003; Reid & de Brentani 2004; Cormican & O'Sullivan 2004; Kostoff et al. 2004) Practices include establishing and utilising the requirements of customers to drive initiatives (Rothwell 1992; Cormican & O'Sullivan 2004), facilitating and managing communication with external stakeholders (Rothwell 1992; Cormican & O'Sullivan 2004; Kostoff et al. 2004), interacting with the consumers and tapping their ideas and tacit knowledge (Ahmed 1998(1); Brown 2003), and establishing and building relationships with stakeholders, suppliers and consumers (Rothwell 1992; Ahmed 1998(2)).

The ability to identify and evaluate long-term opportunities has been identified as facilitative of innovation (Stopper 2002; Albright 2003; Kostoff et al. 2004; Reid & de Brentani 2004; Dismukes 2005; Pretium

Consulting Services 2005; Phaal 2005; Du Preez et al. 2006). Practices include establishing a future orientation (Ahmed 1998(2); Kostoff et al. 2004), performing wide and deep scanning of diverse environments to identify opportunities and patterns (Stopper 2002; Reid & de Brentani 2004; Kostoff et al. 2004; Dismukes 2005); relating opportunities to the appropriate timelines (Stopper 2002; Kostoff et al. 2004; Dismukes 2005; Phaal 2005; Du Preez et al. 2006), identifying technologies required for opportunities, attaching technologies to timelines, identifying the necessary convergences, and relating to opportunities (Kostoff et al. 2004), and relating opportunities to required core competencies and resources (Stopper 2002).

The requirements and practices that follow have been identified as those that contribute to the Lifecycle Execution, Knowledge Exploitation, and Organisational Efficacy capability areas.

Teams that are diverse in terms of discipline, skills and organisational functions represented are considered facilitative of innovation (Prahalad & Hamel 1990; Zairi 1995; Ahmed 1998(1), 1998(2); Neely et al. 2001; Wycoff 2003; Cormican & O'Sullivan 2004; Dismukes 2005). Practices include populating teams with individuals of varying disciplines, skills and organisational functions (Prahalad & Hamel 1990; Ahmed 1998(2); Cormican & O'Sullivan 2004), ensuring teams are working across organisational boundaries (Prahalad & Hamel 1990; Ahmed 1998(1); Neely et al. 2001), encouraging individuals and teams to interact with one another (Ahmed 1998(1), 1998(2)), and identifying interdependencies between teams, and facilitating interaction and sharing (Ahmed 1998(2); Dismukes 2005).

The concept of innovating in terms of innovation and innovation capability is not extensively covered in the literature. Brown (2003) makes mention of the need to innovate innovation, with specific reference to the business models deployed for innovation. In other words, innovation applied to the business models deployed to ensure (and enhance) innovation. This is very similar to the interpretation utilised in this thesis. Innovating innovation refers to the need to apply the principles of innovation to organisational innovation capability improvement and the Innovation Capability Maturity Model itself. This serves as a mechanism for innovation capability improvement and renewal, and ensures a consistently fresh approach to the improvement of innovation capability maturity. The greatest challenge inherent in the development of a maturity model is attempting to capture the domain best practice in a sufficiently generic manner, such that the model is not rendered extraneous with the unrelenting reality of change. This is in essence a catch-22 – the change that innovation addresses is the same change that necessitates innovating innovation. It is therefore inherently impossible to create a timeless representation of innovation capability. New approaches to supporting and facilitating innovation will be required to further improve innovation capability, as innovating becomes the norm. It is for this reason that the requirement to innovate innovation is included in the model and is essential to improving (relative to the competition) innovation capability.

There are two additional requirements for an innovation capability that were not addressed in the literature (or at least not identified initially), and which were created to close gaps that existed after the initial construction of the ICMM v1 had been completed.

The first is a need for identifying and deploying integrative systems to facilitate the coordination of multiple innovation initiatives in an effort to achieve synergy from the results. The individual systems necessary for the various requirements had been addressed, but the model did not make provision for a system that brought all systems and initiatives together. The need for an integrated approach has been mentioned on several occasions in the previous paragraphs.

The second requirement is the need to identify and implement metrics that are facilitative of innovation activities and outputs. Katz (2006) mentioned the importance of metrics and the vital role that they play in the initially flexible and nebulous phase, and the later systematic phase of innovation initiatives. Furthermore, a saying from E. Goldratt, the father of the Theory of Constraints, specifically addresses the importance of metrics: "*Tell me how you'll measure me, and I'll tell you how I'll behave".* Metrics therefore influence the behaviour of individuals. This presents an opportunity to utilise metrics that are facilitative of innovative behaviour. Innovation metrics is a concept that remains elusive to the greater understanding of innovation, however. The vast majority of literature addressing innovation metrics studies instances of initiative return (Return on Innovation), initiative output (number of patents), or characteristics of individuals aligned with innovative activity (one-dimensional approach). Focus is lacking in terms of metrics designed and deployed to encourage individual and team innovative behaviour. According to Kleysen and Street (2001), a multi-dimensional measure of individual innovative behaviour is required to facilitate innovative activity. The intention of this requirement is, therefore, to ensure that metrics are identified and deployed that address the need to encourage individual and team innovative behaviour while still ensuring that the operational needs of the organisation are met.

3.3 Conclusion

This chapter served to contextualise innovation capability and identify those innovation requirements and practices captured within the literature, and thereby lay the foundation for an Innovation Capability Maturity Model.

An interesting development of this chapter is the realisation that it is inherently impossible (or at least in the long term) to create a timeless representation of innovation capability. One of the initial objectives of the innovation capability requirements and practices was that they represent generic and timeless instances of their applied counterparts, as discussed in the literature. The ability to reverse engineer the requirements and practices of the literature and obtain those fundamental innovation capabilities that the applied requirements and practices fulfil is still possible (see Chapter 4). This will ensure the generic nature of the model and broaden its scope of applicability. It will, however, not ensure the timeless applicability of the model. Change is simply too unpredictable to state that any model can remain relevant in the long term.

4. Innovation Capability Maturity Model – version 1

Mentioned previously was Deming's statement, "All models are wrong, but some are useful". Models are never 100% accurate in their representation of that which is being modelled, but they can add insight into what would otherwise be extremely complex to understand. They provide us with different "goggles" through which to view the systems that are being modelled, and create perspective that is new and, hopefully, helpful in grasping the dynamics that are at play within the system. This is the intention of the Innovation Capability Maturity Model – to add insight to and create fresh perspective for innovation and innovation capability, and provide a means by which organisations can create and sustain competitive advantage through innovation

The intention of this chapter is to describe the attributes of the ICMM v1, developed from a relatively comprehensive study of innovation best practice, various other relevant fields, and the general understanding of organisational maturity and maturity models established through the activities of Chapter 2. Because this version of the model would later be refined (Chapters 5) and a second version developed (Chapter 6), this description will focus on the fundamental aspects that remained consistent throughout. The basics of the ICMM v1 will be briefly described as they will be necessary to understand when working through case study 1 (CS1). The latter sections of the chapter present an evaluation of the model and the proposed refinements as a result thereof.

4.1 Introduction

A significant challenge inherent in the development of any maturity model is attempting to capture the best practice of a domain in a sufficiently generic manner that the model is independent of organisational characteristics such as industry, size, location, etc. Therefore, model content cannot contain the detailed best practice as described in the literature, as it is often organisation-specific. The model must rather endeavour to consolidate those innovation requirements and practices that are fundamental to innovation and generically applicable. According to Moore (2005), **the essence of innovation is the same in any organisation**. It is this essence that must be identified. This task is daunting and would most certainly not be achieved on the first attempt. It was, however, a necessary consideration throughout model development.

Another aspect that is crucial to consider while working through and with this model is its intention with respect to established models and methodologies. The model makes no claim to replace any other model, organisational methodologies, tools and techniques, or any particular areas of expertise such as Knowledge Management, Change Management, Research and Development, Project Management etc. Rather, the model endeavours to describe the necessary extractions from, and interactions between, these methods that are necessary for facilitating innovation and developing an innovation capability.

4.2 Strategies to strengthen Innovation Capability

According to Cook and Hunsaker (2001), and Christensen and Overdorf (2000), three primary strategies exist to create and/or strengthen the innovation capabilities of an organisation.

- Create new capabilities by making new structures that are tasked with initiating new and innovative ventures within the existing organisational boundaries.
- Create new capabilities by initiating and supporting spin-offs, but still retaining an equity investment position in terms of both technology and earnings, with the intention of re-channelling them into the parent organisation at a later stage. This may be appropriate if there is a lack of alignment between the current business model and the business model of the new venture.
- Establish capabilities through the acquisition of other organisations that exhibit those capabilities.

Christensen and Overdorf (2000) argue that the subsequent utilisation of the acquired organisation's capabilities depends upon where those capabilities were situated within the organisation. If these capabilities lie with the resources of the acquired organisation, then the organisations may be merged and the new resources integrated into the parent organisation so as to effectively disseminate these newly acquired capabilities. If, however, these capabilities are intrinsic to the organisational processes and values of the newly acquired organisation, then it would be better to allow this organisation to stand and operate alone to avoid engulfing and dissolving those sought-after but delicate capabilities.

The Innovation Capability Maturity Model is not intended for any particular instance of the abovementioned strategies. Although it may appear as though the model were most applicable to the first of these strategies, it could prove exceptionally valuable in identifying potential acquisitions and the architecting of spin-off organisations by describing the essential capabilities and their interdependencies necessary for innovation.

4.3 The Maturity Model approach

The secondary objective of the maturity model lifecycle impact mapping (Chapter 2) was to evaluate the maturity model approach for its ability to generically depict organisational maturity, thereby ensuring broad applicability of the models utilising the approach.

There are two means with which this requirement may be evaluated. The first is based on the lifecycle of the enterprise (and other enterprise relevant lifecycles). It has been mentioned on numerous occasions that the lifecycle represents a generic depiction of organisational activity. Organisations will always progress though a basic set of phases in the initiation, execution and conclusion of its initiatives. The ability to support these phases is thus considered fundamental to a generic depiction of organisational maturity.

The maturity models used in the mapping were found to provide significantly less support and impact for the conceptualisation and disposal lifecycle phases of the enterprise and its products and technologies than they did for the design, implementation, and operation phases. The importance of conceptualisation was

discussed and found to play a pivotal role in establishing potential return from an initiative. The design, implementation and operation phases were seen to be crucial for ensuring the successful execution of the initiative, and thus the realisation of that return. In short, all the phases are indispensable.

From a lifecycle perspective, the generic content of the analysed maturity models is thus limited to the design, implementation and operational aspects of an organisation. The support for these phases is substantial in nature, and therefore a strong indication of the potential support that the maturity model approach may provide for a given phase, albeit that this support is not consistent throughout the lifecycle.

Based on this evidence, one could conclude that lifecycle support is a function of model content and design. This is not to say that the analysed models were intentionally designed to support only the design, implementation and operation phases of a lifecycle. This is rather as a result of the implemented domains of practice. The domain of practice content of these models is focused on activities within these phases, and the model is subsequently designed as such.

An opportunity thus presents itself to create a model that provides comprehensive lifecycle impact and support by design and implication of the implemented domain of practice. Thus, through the careful collection and integration of model content pertaining to a domain of practice executed over the complete lifecycle, a maturity model may fulfil the requirement of full lifecycle support.

The second means with which to evaluate the maturity model approach for its ability to fulfil the requirement of a generic depiction of organisational maturity is based on the actual content built into the model. This is a function of the content of the domain of practice and is therefore independent on the maturity model approach. The challenge is thus to identify (reverse engineer) generic content from the domain of practice – as described in Section 3.2.3.

In summary, a generic depiction of organisational maturity is not a function of the maturity model approach, but rather a function of the domain of practice implemented. The content from the domain of practice that is captured in the model must be generic in nature to ensure the broad applicability of the model.

4.4 The Model

This section presents certain introductory aspects, the design and the content of the ICMM v1. Again, because this version of the model would eventually be replaced by a second, the descriptions will be concise except if common to both.

4.4.1 ICMM scope of application

Generally, it can be stated that all organisations need to innovate. Some may argue that their operations are small and not very influential, and that they are only concerned with the day-to-day activities of creating sufficient profit for supporting their families and continuing business as usual. Other organisations may argue that their operations are so large, their practices so entrenched and their market share so stable that innovation is not a priority. These arguments are centred on the notions of survival and short-term

profitability. Individuals within these companies are content with merely surviving month after month, year after year. The attitude of, "Why fix things when they are not broken," is common place. The notions of growth, increased profitability and long-term prosperity are simply not high priority. These organisations will claim that there is no utility in an Innovation Capability Maturity Model, or any such model, for their particular purposes.

It can, however, be argued that these claims are not founded on a clear understanding of the long-term needs of their organisations, but rather on an ignorance of the world around them. The world changes along with the creation of technology and the needs of people. It can simply not be stated that a market that exists today, the very market that these organisations are serving, will continue to exist in the future. How then can these organisations continue to survive? They can only survive if they change, but even the smallest of changes requires a certain degree of innovation to overcome the many obstacles presented by change. Essentially then, these individuals simply need convincing of the need to innovate. Once this need has been established, the utility of an Innovation Capability Maturity Model becomes apparent.

According to Kostoff et al. (2004), innovation maturity does not imply correlation with the size of an organisation. Large organisations do not necessarily exhibit a persistent ability to innovate, or an inability to do so for that matter. Evidence does, however, exist of smaller, more entrepreneurial firms without an established customer base, being more willing to take advantage of disruptive technologies and redefine current markets. Larger firms are less willing to cannibalise their own markets through the use of disruptive technologies. This is, however, not a reflection of their holistic capability to innovate, but rather a matter of comfort. Smaller organisations with no customer base do not operate within the same comfort zone as the larger, established organisations, and for this reason, are more willing to adopt disruptive technologies. The issue of improving innovation capability maturity is nevertheless equally applicable to both small and large organisations, as the eventual and incessant need to innovate affects them both.

From the above argument then, it is clear that organisations of all sizes will find a certain degree of utility in the Innovation Capability Maturity Model. Certain areas of the model may, however, prove less applicable to small organisations. This may be attributed to the lesser resources available to smaller organisations. Other factors may also play a role. Nevertheless, the concepts captured in this model are indispensable, even if only to create an understanding of what is required to be innovative. But even this is arguable, as the fundamental principles of innovation remain consistent and are independent of organisation size.

Furthermore, the model is independent of both industry and market. It is equally applicable to the technologically-driven automotive industry and the commoditised sugar industry, so long as they have identified the need to innovate. (If a product is commoditised, increased effort must be focused on process and strategy innovation in order to create the competitive advantage necessary.) The model is also applicable to both products and services, and any combination thereof. Again, this is because the fundamental principles that apply to innovation and innovation capability are consistent throughout the range of industries and organisational offerings.

The model is also independent of innovation type. The type of innovation referred to here is consistent with the discussions of Sections 1.1.2 and 3.1.2.2, i.e. product, process and strategy innovation, or any combination thereof (where product refers to both traditional products and services). The model does not distinguish between these types of innovation. The improved innovation capability brought about by the model is therefore applicable to all innovation types and combinations thereof, again because the fundamental principles remain consistent throughout.

The level of impact and degree of newness of an innovation were discussed in Section 1.1.3. The ICMM is intended to address both these dimensions of innovation. On the ends of the impact scale lie sustaining and discontinuous innovations. On the ends of the newness scale lie incremental and radical innovations. Both direct and indirect consideration of these dimensions, their respective scales, and the importance and role of each is addressed within the model. The model therefore provides context for these dimensions within innovation capability.

Based on the above arguments, the Innovation Capability Maturity Model is applicable to absolutely any organisation. The persistent argument is the consistency of the fundamental innovation principles. The deciding factor is, however, the will and appetite to innovate. Only once an organisation has identified a need to innovate is there scope for ICMM application. It may be that certain requirements or practices are deemed irrelevant for a particular organisation. The fact remains that the organisation will have been made aware of such requirements, and through careful deliberation and improved understanding, will have deemed those requirements and/or practices irrelevant. This already places the organisation in an improved position of innovation capability maturity.

4.4.2 The purpose of an ICMM

The elemental purpose of this Innovation Capability Maturity Model is to cluster the best practices associated with innovation capability into progressive levels that are attainable in an orderly fashion and that (ideally) describe the optimal improvement path for innovation capability.

It must be noted that due the generic requirement for the best practices, specific methods, tools and techniques necessary to achieve the best practices are not prescribed, and rather left to the discretion of the user and organisation making use of the model. These methods, tools and techniques will vary based on preference and application and will certainly not be consistent over time.

Subsequent to this are the following purposes stemming from the original intention of maturity models: to establish the maturity of an organisation in terms of innovation capability, and to facilitate in establishing a direction and course for improvement that is in accordance with the prescribed progression of innovation capability, as depicted in the levels of maturity.

To establish organisational maturity in terms of innovation capability is an exercise critical to understanding the ability of an organisation to competitively position itself in current and potential markets. Only once understanding of this ability has been established can one endeavour to improve thereon.

4.4.3 Motivation for an ICMM

There is no need to discuss the importance of innovating and having the capability to do so. This was comprehensively discussed in Sections 1.1 and 3.2.1. It is, however, necessary to discuss the need for an Innovation Capability Maturity Model and this will be done on the basis of the basic purposes of maturity models mentioned in the previous section (Section 4.4.2).

Assuming the model has the ability to cluster the best practices (requirements in the case of ICMM v2[5]) associated with innovation capability into progressive levels that are attainable in an orderly fashion and that describe the optimal improvement path for innovation capability, then it is possible to derive significant understanding from the model in terms of:

- the natural progression of innovation capability maturity
- a consolidated view of innovation best practices
- the interdependencies of innovation best practices and the manner in which they affect one another
- and the groupings of best practices that are most likely to build on one another and collectively contribute to innovation capability.

There are obvious motivational benefits in being able to establish the maturity of an organisation in terms of innovation capability, and to facilitate with establishing a direction and a course for improvement. This serves to address the perpetual need to innovate and improve innovation capability in order to better position the organisation in current and potential markets. Understanding the need to innovate and executing initiatives in an effort to do so will not suffice indefinitely. The organisation must continually endeavour to improve its ability to generate both radical and incremental innovations. The Innovation Capability Maturity Model provides a graduated and integrated approach to improving innovation capability.

Extensive discussion regarding the need for a generic depiction of organisational maturity has been made throughout this dissertation. The lifecycle support provided by a maturity model was used as a means of evaluating the fulfilment of this need. The maturity models, as analysed in Chapter 2, prescribe and equip an organisation with the ability to successfully execute the initiatives of a specific domain of practice. This is apparent in the strong support for the design, implementation and operational lifecycle phases provided by the maturity models. According to the mappings, the models exhibit a strong inclination towards the day-to-day activities of an organisation and their continuous improvement and optimisation. While this is a fundamental component of organisational maturity, it is certainly not the only one.

To partially fulfil the need for a generic depiction of organisational maturity, a domain of practice is required that presents activities executed throughout the lifecycle of the enterprise and any constituent lifecycles

[5] The ICMM v2 does not prescribe practices, but rather the requirements that need to be fulfilled by the specific organisational practices. The reason for this is discussed in more detail in Chapter 6.

(product, technology, etc). The lifecycle of innovation initiatives is one that directly relates to these lifecycles, as innovation may be applied to virtually any organisational aspect, including the organisation as a whole. The best practice content provided by innovation is therefore complete in its coverage of the enterprise lifecycle, and all other enterprise relevant lifecycles. The Innovation Capability Maturity Model therefore presents an opportunity to partially fulfil the need for a generic depiction of organisation maturity and possibly contribute to an improved understanding thereof.

To complete the need for a generic depiction of organisational maturity, the model content itself must be generic in nature. As has been mentioned, the requirements and practices found in the literature were reverse engineered (where necessary) to identify those fundamental aspects that contribute to innovation capability. (The literature often presented applications of those fundamental aspects.) This is a task that may require several iterations before a truly generic depiction is attained. Nevertheless, this dissertation represents first and second attempts thereat (this chapter and Chapter 6).

4.4.4 Overview of the ICMM v1 design approach

This section describes the design process that was followed to reach the Innovation Capability Maturity Model v1 as presented in this chapter:

- Develop a basic understanding of innovation, maturity models and organisational maturity and enterprise design fundamentals (Chapter 1).
- Perform an Enterprise-, Product- and Technology Lifecycle mapping on three Capability Maturity Models in order to (Chapter 2):
    - Better understand the models
    - Better understand organisational maturity
    - Understand the context of maturity models in terms of the activities of the organisation throughout its lifecycle and other relevant lifecycles
    - Evaluate the maturity model approach for its ability to describe the generic activities of an organisation
    - Evaluate the maturity model approach for its applicability to innovation capability.
- Perform a comprehensive study of innovation best practices and relate these to generic innovation capability requirements and practices (Chapter 3).
- Create a structure within which to categorise innovation Capability Requirements and Requirement Practices (Chapters 3 and 4 – see discussion below).

- Build Capability Requirements and Requirement Practices into the structure and identify and remove unnecessary overlapping (Chapter 4).
- Make a first attempt at assigning and grouping the Requirement Practices to maturity levels based on various factors (Chapter 4).
- Identify interdependencies and dependencies between Requirement Practices (Chapter 4).
- Use interdependencies and dependencies to ensure maturity-level alignment of Requirement Practices and create a second version of maturity-level assignments and groupings (Chapter 4).
- Create peripherals to the abovementioned, such as a consolidated view of the Innovation Capability Areas, Capability Requirements and Requirement Practices and their interaction, ICMM structural overviews, ICMM Questionnaire, and documentation listing and explaining interdependencies and dependencies of Requirement Practices, Innovation Capability Maturity Appraisal Methodology, etc. (Chapter 4).

The construction of the ICMM (components and structuring) was of an iterative nature (see Figure 14 for a high-level description). The process commenced with a review of the literature (Chapter 3). The level of detail being addressed at this phase was high, seeing that the literature referred to innovation best practices witnessed in and/or evaluated for specific organisations and industries. In many instances, the literature went further to state the generic nature of the practices, thereby ensuring their independence from specific companies and/or industries. The vast majority of practices identified within the literature were then validated by ensuring that they were common to several sources (see Section 3.2 – several references quoted for each practices). This resulted in an initial set of generic innovation best practices (referred to as Requirement Practices within the ICMM).

From this initial set of generic practices, it became apparent that the categorisation thereof was not only necessary, but also inherent in the nature thereof. Categorisation was achieved by clustering practices based on the type (field and objective) of literature from which they were extracted, shared higher-level objectives achieved by fulfilling the practices, common areas of organisational (functional, departmental or structural) focus, etc. This resulted in an initial clustering of the generic practices (referred to as Capability Requirements within the ICMM).

Furthermore, it was apparent that the clusters themselves shared aspects that allowed for further grouping. By identifying the common themes within a cluster of practices and categorising them as such, higher-level groupings were achieved. Moreover, the themes were often obvious from high-level topics of discussion within the literature. This resulted in the highest level of aggregation of the ICMM (referred to as Innovation Capability Areas).

As mentioned previously, however, the final ICMM structure was not reached with a single effort. Several iterations were required to bring the model to its current state. After the initial construction, new literature

was covered and old literature revisited, resulting in continued refinement of the model. The iterative nature of this process, the various phases of construction (directly related to model components as discussed above) and the relative level of detail being addressed is depicted in Figure 14.

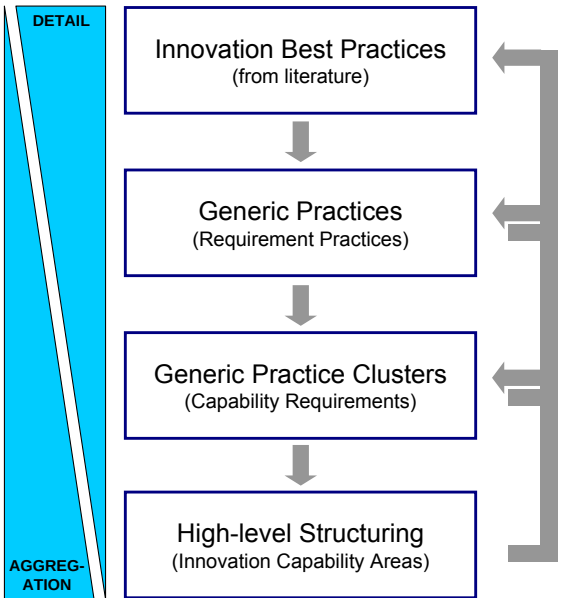

Figure 14 – ICMM construction methodology

It must be noted that although linearity is depicted in Figure 14, the iterations after the initial construction had been completed were not necessarily sequentially ordered as described by the diagram. As the process continued, the phases of construction (and therefore the layers of the model) were addressed in a more ad hoc manner.

Once a virtually final version had been reached, the generic practices had to be graduated into maturity levels. This process is described in more detail in Section 4.4.8.2.

The processes as described above, combined with the other initiatives described in the previous chapters of this dissertation, resulted in the Innovation Capability Maturity Model version 1.

4.4.5 ICMM v1 structure

The Innovation Capability Maturity Model is constructed from the following basic components (as depicted in Figure 15):

- Innovation Capability Areas – high level domains of innovation capability (see Section 4.4.7)
- Capability Requirements – topics of organisational practice for the development of innovation capability relating to a specific Innovation Capability Area or combination thereof (see Section 4.4.8.1)
- Maturity Levels – progressive phases of Innovation Capability Maturity (see Section 4.4.6)

- Requirement Practices – generic practices pertaining to a specific Capability Requirement at a specific level of maturity and contributing to the fulfilment of that Capability Requirement at the given level of maturity (see Section 4.4.8.2).

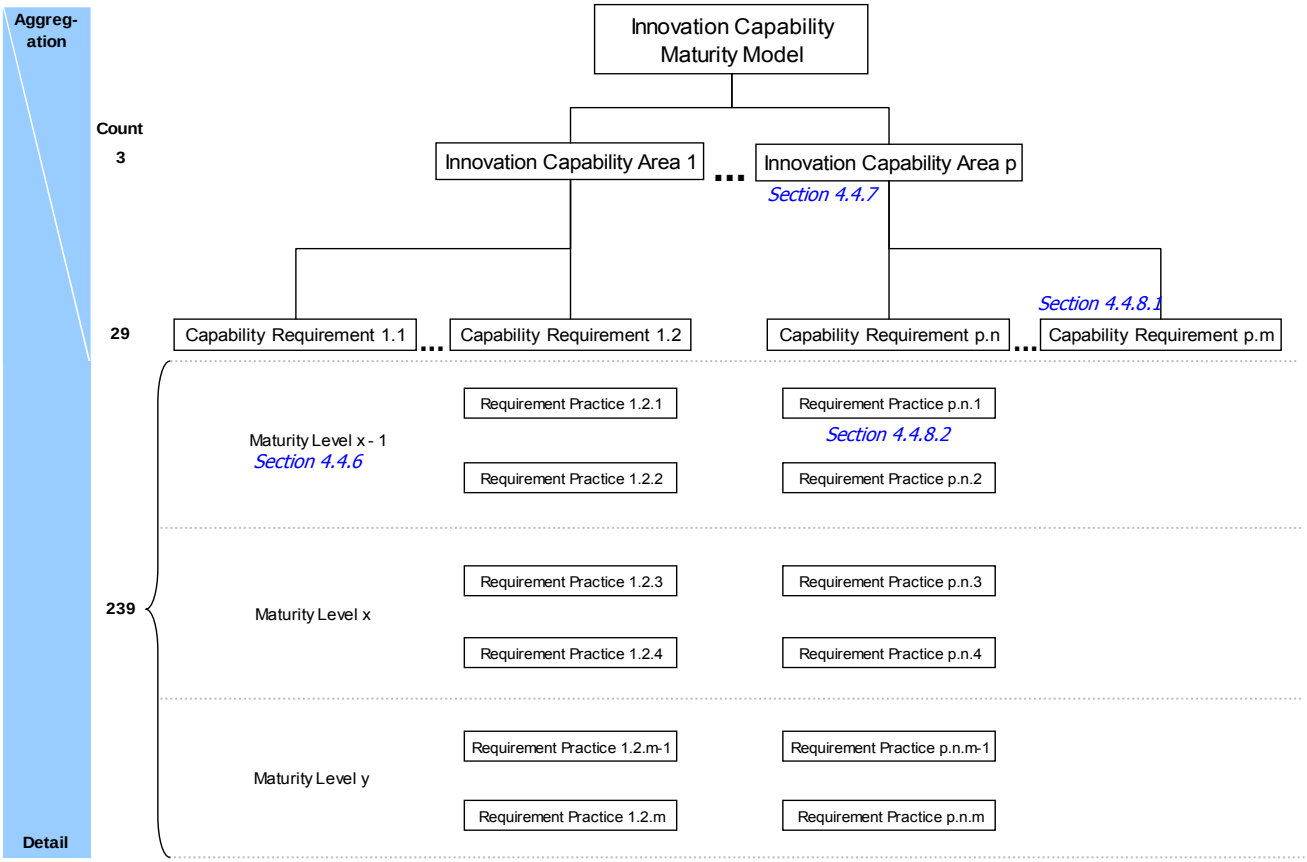

Figure 15 – ICMM v1 Structural Overview

This structural overview is a basic depiction of the hierarchical arrangement of the ICMM v1 components. It is, however, not completely accurate in its representation of the groupings of Capability Requirements under the Innovation Capability Areas. Each Innovation Capability Area has various Capability Requirements that, according to model structuring, contribute to achieving only that area of capability. There are other Capability Requirements, however, that contribute to a combination of capability areas. This concept is graphically depicted in Figure 16.

The use of "Maturity Level x" and "Maturity Level y" in Figure 15 is to account for the fact that the practices of a particular Capability Requirement do not necessarily begin or end with any particular maturity level, so long as they are in ascending order. In other words, the practices may start at maturity level 3 and end at maturity level 4.

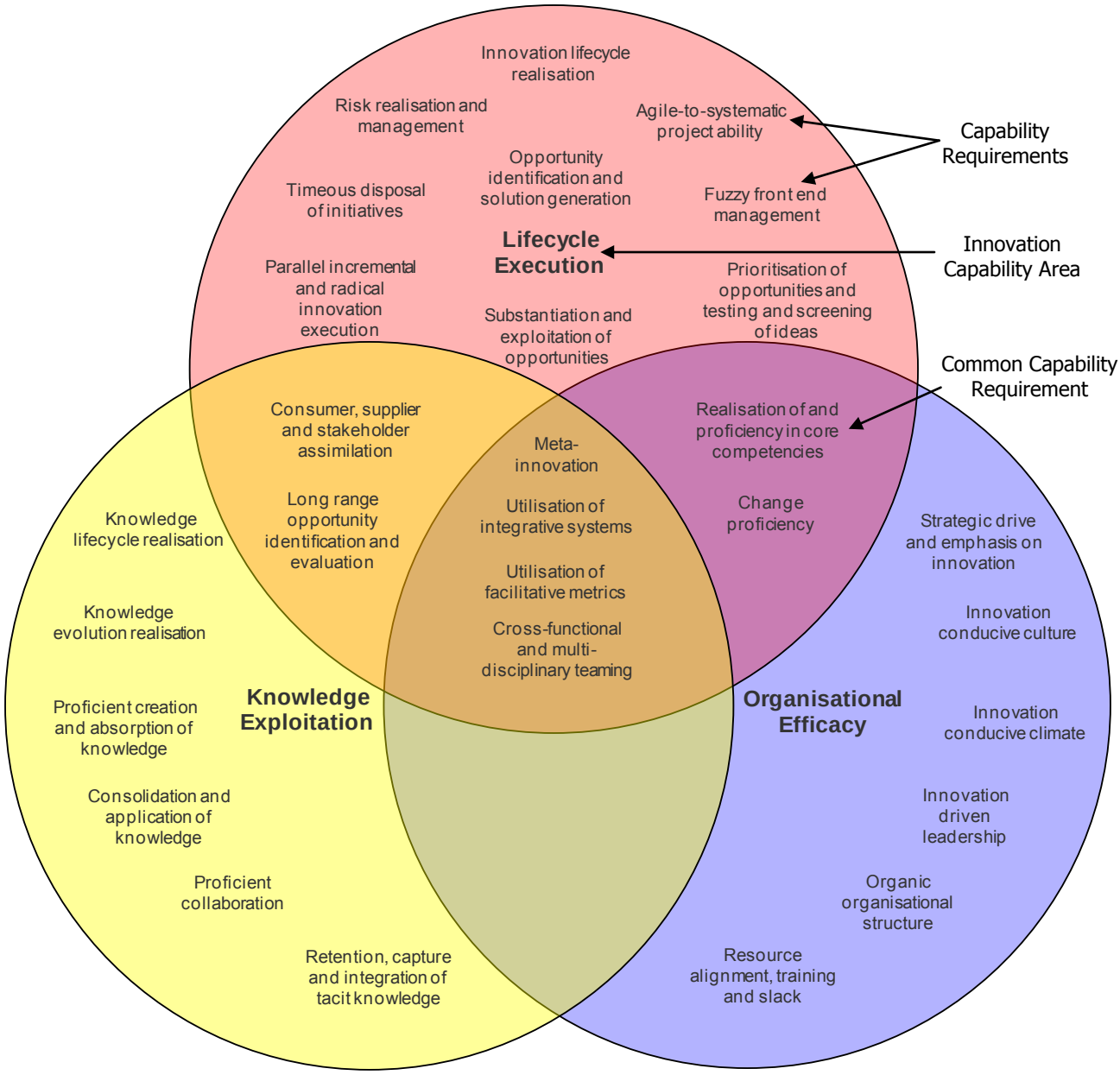

Figure 16 – Innovation Capability Area grouping of Capability Requirements

4.4.6 Innovation Capability Maturity Levels

One of the intentions of a capability maturity model is to group the best practices associated with a specific domain into progressive levels that are attainable in an orderly fashion and that (ideally) describe the optimal improvement path for a specific domain of practice. These progressively ordered groupings are known as maturity levels.

The definition of an ICMM maturity level will be based on the definition from the CMMI® of the SEI. Maturity levels are described as *well-defined evolutionary plateaus for innovation capability improvement*.

Because the maturity level descriptions for ICMM v1 and v2 are so similar, they have only been included in Section 6.1.1.3. There is, however, a fundamental difference between the application of the maturity levels within the models and the inherent implications thereof.

For the ICMM v1, the practices described within a specific level of innovation capability maturity must all be fulfilled on a consistent basis for the organisation to have attained that level of maturity. Furthermore, the practices described within maturity level x are assumed as institutional in maturity level $x + 1$. Many practices within maturity level x require the parallel fulfilment of other practices also within maturity level x and assume that the practices described in maturity level $x - 1$ are consistently fulfilled. The structured and layered fulfilment of these practices is necessary due to the many interdependencies and dependencies that are present between the Requirement Practices (see Section 4.4.8.3) and the varying levels of difficulty associated with achieving the practices.

4.4.7 Innovation Capability Areas

Innovation Capability Areas are high-level domains (or themes) of innovation capability. These areas were identified through studying innovation best practices and by identifying high-level categorisations into which the best practices could be grouped. The areas were not decided upon beforehand – rather, it was an iterative process where the high-level categorisation changed on several occasions (see Section 4.4.4). The final categorisation was capable of describing, at a high-level, the innovation capability landscape.

These areas, therefore, serve as the highest, generic level of innovation capability aggregation. They describe, on a high level, those organisational factors that contribute toward innovation capability. The Innovation Capability Areas are:

- Lifecycle Execution – Ensuring that the complete Innovation Lifecycle of an initiative is efficiently and effectively managed and executed to continuously and concurrently realise successful innovative outputs.

- Knowledge Exploitation – Ensuring the creation, consolidation, diffusion and utilisation of relevant knowledge to support the activities of innovation initiatives.

- Organisational Efficacy – Ensuring an innovation-conducive organisational environment with consideration for strategy, climate, culture, leadership, structure, etc.

Previously mentioned was the overlapping of innovation best practices' contribution to the capability areas. Provision was made for these Capability Requirements contributing to more than one capability area in the form of an area called Common Capability Requirements. The requirements within this area therefore make a contribution to a minimum of two capability areas, with certain requirements contributing to all three capability areas (see Figure 16 above for a graphical depiction of the overlapping structure).

4.4.8 Capability Requirements and Requirement Practices

Capability Requirements are topics of organisational practice for the development of innovation capability pertaining to a specific Innovation Capability Area or any combination thereof. Requirement Practices are the generic practices pertaining to a specific Capability Requirement at a specific level of maturity and that contribute to the fulfilment of that Capability Requirement at the given level of maturity.

These 2 model components were included in the same section because Requirement Practices relate directly to Capability Requirements. In other words, a specific practice belongs to one and only one requirement. Practices may however be related to other requirements through the various dependencies and interdependencies as discussed in Section 4.4.8.3.

4.4.8.1 Capability Requirements

Capability Requirements are one level of aggregation lower than the Innovation Capability Areas of Section 4.4.7 (see Figure 15). They are topics (or clusters) of organisational practice that bring about the development of innovation capability pertaining to a specific Innovation Capability Area or a combination thereof.

As is the case with the capability areas, these requirements were established through a study of the literature and the iterative process described in Section 4.4.4. Section 3.2 presents a consolidation and summarisation of this literature. As mentioned therein, certain Capability Requirements could be extracted directly from the literature, while others were presented as specific applications of their generic versions. These applications required reverse engineering in an effort to extract those generic requirements that the applications fulfilled.

The Capability Requirements, as presented in Appendix B, are described by the Requirement Practices that ensure their fulfilment. Figure 17 describes the different components captured therein.

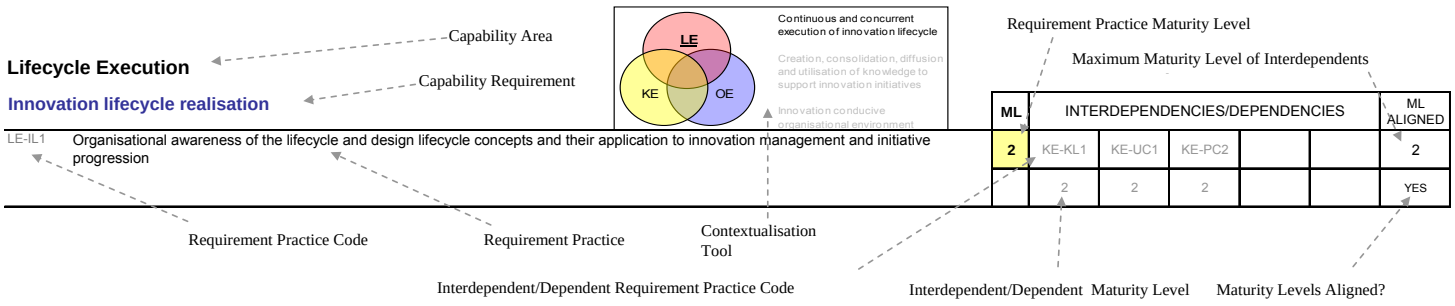

Figure 17 – Model components in Appendix B

4.4.8.2 Requirement Practices

Requirement Practices are one level of aggregation lower than the Capability Requirements (see Figure 15). They are the generic practices pertaining to a specific Capability Requirement at a specific level of maturity

and that contribute to the fulfilment of that Capability Requirement at the given level of maturity. Requirement Practices are therefore the fundamental building blocks of innovation capability maturity. The more practices the organisation fulfils, the more it is contributing to its innovation capability maturity.

Practices should, however, not be fulfilled in an ad hoc manner. Strong interdependencies and dependencies exist between practices within different Capability Requirements and within different Innovation Capability Areas. Certain practices are more difficult, and others almost impossible to achieve without having achieved certain other practices first. Requirement Practices are therefore presented in maturity levels (see Section 4.4.6 and Appendix B) that structure and grade them, and provide a step-wise innovation capability maturity improvement path. All practices within a specific maturity level and all practices within lower maturity levels must be achieved on a consistent basis for the organisation to have attained that level of innovation capability maturity. The organisation therefore utilises the maturity levels as a step-wise guide for improving innovation capability (after having established its innovation capability maturity status quo).

The 239 Requirements Practices of the ICMM v1 are depicted in Appendix B. These practices were identified through a comprehensive study of literature from various fields and the iterative construction process (as described in Section 4.4.4 and Figure 14). The graduation of Requirement Practices into maturity levels was, however, not as straightforward. The perceived level of difficulty and complexity associated with the practices was used to create the first-cut of the maturity level groupings. Integrated consideration of the following aspects assisted in doing so:

- the level of organisational understanding necessary to fulfil the practice.
- the level of integration with other practices necessary to fulfil that particular practice.
- the level of integration of organisational resources necessary to fulfil the practice.
- dependence on other complex practices being fulfilled.
- the level of skill necessary from individuals performing the practice.
- the necessary utilisation of complex systems, tools, techniques or methods, etc.

The result of this process was a first-cut version of the maturity-level grouped Requirement Practices for each of the Capability Requirements. What was, however, evident throughout this process (and as has been previously mentioned) was the existence of strong interdependencies and dependencies with other practices outside of the respective requirement groups. This is addressed in Section 4.4.8.3.

Note the manner in which innovation capability maturity progression is depicted in Appendix B. Maturity levels are sequentially ordered and the practices of each maturity level are grouped together. The blocks filled in light yellow represent level 2, while the blocks filled in dark orange represent maturity level 5 – the heightened level of maturity assigned to an organisation having fulfilled that particular practice. Remember,

however, that to be a complete level 4 organisation, for example, all practices within maturity level 4 must be fulfilled.

4.4.8.3 Requirement Practice dependencies and interdependencies

The nature of maturity models is such that various dependencies and interdependencies exist within a particular grouping of practices – Capability Requirements in this case. These relations are also directional.

To illustrate, consider the practices for a particular Capability Requirement within maturity level x. These practices within maturity level x exhibit mutual dependence with one another, i.e., interdependence. This is obvious considering the need for their collective fulfilment for an organisation to have fulfilled that maturity level for that Capability Requirement. This concept is illustrated in Figure 18.

The practices of maturity level x are, however, only dependent on the fulfilment of practices within maturity level x – 1. This is not a reciprocal relationship because the practices of maturity level x – 1 must be achievable without the fulfilment of practices within maturity level x. This is the nature of all staged maturity models and inherent to the progression of organisational maturity. This concept is also illustrated in Figure 18.

These previously mentioned relations are implicit – they occur as a result of the practices contributing to the fulfilment of the same requirement. There are, however, interdependencies that exist between practices within different Capability Requirements representing the same level of maturity. These practices therefore show a mutual dependency, necessitating concurrent fulfilment efforts in order to achieve one of the practices, but then also implying the achievement of the other. This logic is obvious when considering practices of the same Capability Requirement having implicit relations. Less obvious, however, are the interdependencies between practices from different requirements. In an effort to address this, attempts have been made to make explicit some of these interdependencies (see Appendix B).

The question of whether a bi-directional interdependency or one-directional dependency exists between two practices was ever present. Throughout the exercise of identifying the interdependencies, arguments for a one-directional relationship could be made. Nevertheless, these relationships were also included in Appendix B, so that at a minimum, the link identified between these two practices was recorded. Certain instances were, however, clearer than others. Of the apparent one-directional relations, it was a requirements that one of the practices (the dependent) be in a higher level of maturity than the other, i.e., the practice in level x is dependent on the practice in level x – 1. This is essential; otherwise there would be discrepancy in maturity level alignment.

Thus, this list of interdependencies and dependencies served a further purpose. They were used as a means to ensure the maturity-level alignment of Requirement Practices. It is obvious that if interdependence exists between two practices, then those practices must be in the same maturity level for the interdependence to be executable. This actually proved vital in identifying discrepancies in terms of the first-cut attempt at assigning maturity levels to practices. On numerous occasions, assigned maturity levels had to be adjusted

to cater for interdependencies and dependencies between practices. This obviously created a ripple effect throughout the model because of the large network of interdependencies and dependencies. Such instances could only be corrected using a general understanding of the requirements, their practices, and general logic to assign maturity levels in such a way that alignment was ensured.

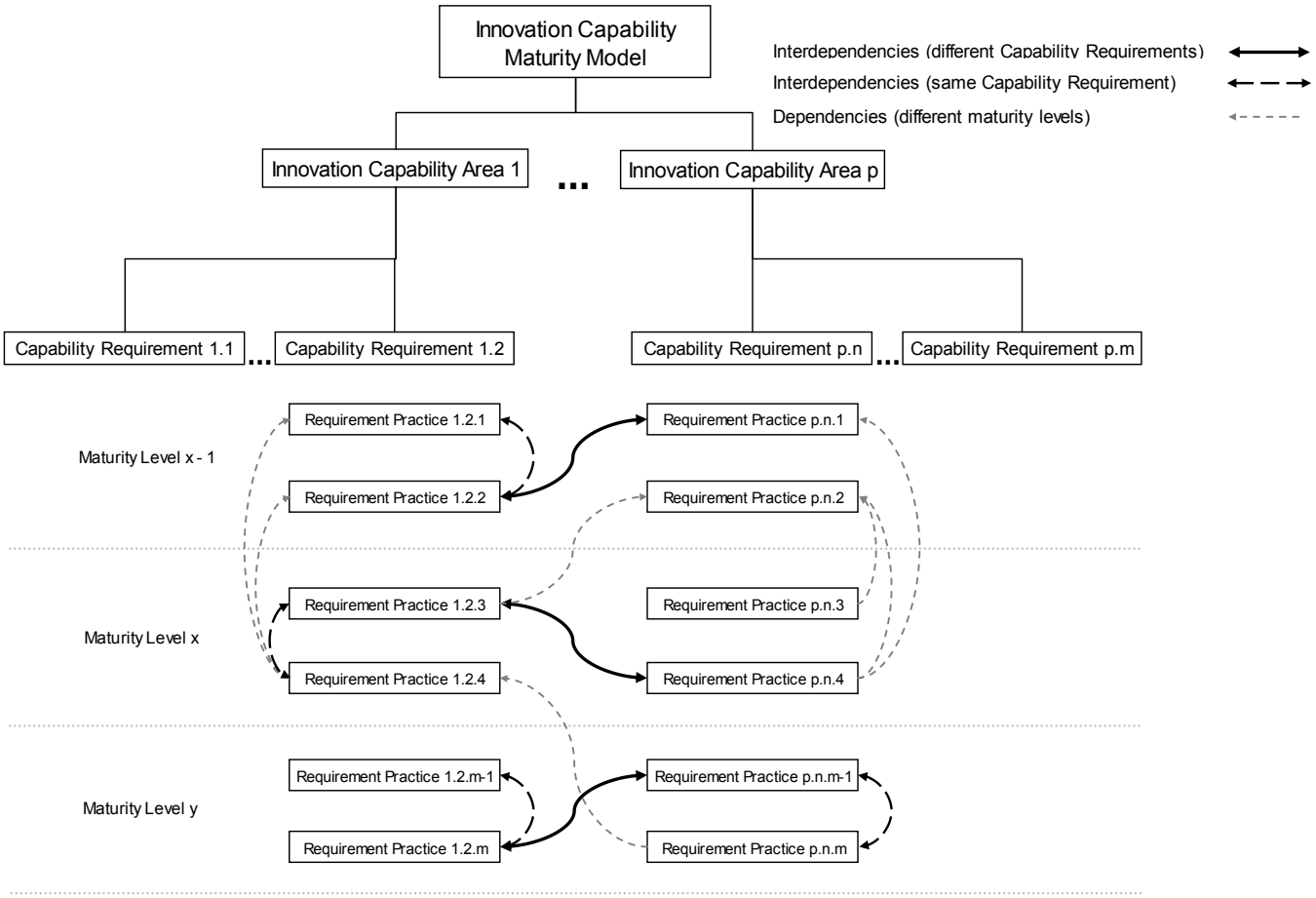

Figure 18 – Dependency and Interdependency explanation

The resultant model (Appendix B) showed complete maturity-level alignment. This is, however, only in terms of those interdependencies and dependencies identified by the author. In fact, the author is quite certain that the model was not perfectly aligned and misalignment could not be identified purely due to limitations in the identification of these dependencies and interdependencies.

4.5 ICMM v1 development summary

The development of the ICMM v1 was based on the extraction and consolidation of academic- and industry-indentified innovation best-practices from the literature. While this literature proved useful in the structuring of the model's content (Innovation Capability Areas, Requirements and Practices), the graduation of practices into maturity levels required the initial application of logic, followed by the utilisation of interdependencies to ensure alignment between the practices' assigned maturity levels. In the next section of this chapter the model, as described above, was evaluated.

4.6 ICMM v1 evaluation

The ICMM v1 was evaluated from 2 perspectives. The first was to conduct a lifecycle impact mapping of the model, similar to the maturity model mapping and evaluation process described in Chapter 2. The second evaluation activity was the utilisation of the model in a case study to evaluate the innovation capability maturity of an organisation. The basic process and the primary findings of these evaluation activities are briefly described in this section.

4.6.1 ICMM v1 vs. generic lifecycle mapping

Chapter 2 presents a mapping process of the impact of three maturity models on the Enterprise, Product and Technology Lifecycles. The same procedure was performed with the ICMM v1 to determine the impact and support that the model presents for the enterprise throughout its lifecycle. It was decided, however, to perform this mapping on a generic lifecycle, but with similar phases to those of the Enterprise Lifecycle. The lifecycle[6] used was that of the high-level Innovation Lifecycle discussed in Section 1.1.4 (Figure 4). This was possible because of the generic nature of the innovation lifecycle – it applies to the enterprise, its products and the technologies deployed.

The mapping of the Innovation Capability Maturity Model was a slightly more complex process than the previous mappings. The other maturity models were either of a staged or continuous representation. The ICMM is however a combination of the two, presenting a complexity when relating the impact of specific Capability Requirements' maturity levels to the lifecycle phases. Certain Capability Requirements do not cover the full spectrum of maturity levels, e.g. the *Long range opportunity identification and evaluation* requirement only addresses maturity levels 3, 4 and 5. Through a normalisation process, the resultant support that the model provides for the lifecycle phases at the different maturity levels could be identified. Values were converted to percentages of the maximum support provided for any particular phase within each maturity level. The total support provided by the model (a consolidated view) was then calculated. Table 7 summarises these values while the complete mapping process and results may be viewed in Appendix C.

		Generic Lifecycle				
		Concept	Functional Analysis	Implementation	Operation	Recycle & Disposal
ICMM v1	Level 1	0.0%	0.0%	0.0%	0.0%	0.0%
	Level 2	94.9%	100.0%	91.5%	78.0%	66.1%
	Level 3	93.3%	100.0%	94.7%	82.7%	70.7%
	Level 4	93.3%	100.0%	93.3%	81.3%	69.3%
	Level 5	94.3%	100.0%	92.9%	80.0%	65.7%
	Total	**93.9%**	**100.0%**	**93.2%**	**80.6%**	**68.1%**

Table 7 – Summary of ICMM lifecycle impact mapping

[6] The *Concept* and *Invention* phases are used synonomously, representing the same detailed activities.

From the summary presented in Table 7, it is clear that the impact and support provided for the lifecycle ranges from moderate to strong (based on the ratings used in Chapter 2 – Table 1). The weakest support provided for any phase is therefore perceived to be moderate in comparison to the phase receiving the most support. The weakest support provided is once again for the Recycle & Disposal phase. The discussions of Section 2.5 attributed this to the nature of the phase – it does not present significant opportunity to derive competitive advantage. The support provided by the ICMM is, however, substantially more than the support provided by the models analysed in Section 2.

The reason for this was identified in the *Timeous disposal of initiatives* capability requirement (see Appendix B for details). It is stating that although an organisation will not be able to create a competitive advantage by disposing of a particular business element, by not disposing of that business element once infeasible, competitive positioning could be negatively affected. This highlights the importance of executing the complete lifecycle of an initiative.

The final major difference between the ICMM and the other maturity models is the very strong support provided for the conceptualisation phase. This phase was emphasised as crucial for ensuring potential for significant returns from organisational initiatives. Within the *Concept* phase, the magnitude of the return that may be generated is decided. The *Functional Analysis*, *Implementation*, and *Operation* phases are necessary to ensure the fruition of this return. All these phases are crucial in terms of generating consistent innovative outputs. The models analysed in Chapter 2, however, exhibited a lack of impact and support for the conceptualisation phase, an issue that has been addressed in the ICMM. It is, however, important to reiterate that these models were designed to support the organisation in the design, implementation and operational aspects of initiatives, a matter that is evident in the domains of practice addressed by the models.

In summary, the ICMM impact and support for the complete generic lifecycle is more comprehensive than that provided by the maturity models of Chapter 2. This may be attributed to the integral role of the innovation lifecycle in the design and content of the model, thus fulfilling the requirements stipulated therefore in Chapter 2.

4.6.2 Case Study 1

This case study presented the opportunity to scrutinise the ICMM v1 from the diverse perspectives of multiple individuals. This would be an invaluable exercise in ensuring the improved robustness and broader applicability of the model. Ultimately, it would provide the objectives for the ICMM v1 refinement activities of Chapter 5.

The majority of the case study is based on a workshop that was held around the ICMM v1 and a questionnaire (see Section 4.6.2.2) developed therefore. The purpose was to evaluate the content and user friendliness of the model and the process of applying it. In addition to this, the workshop served to perform an Innovation Capability Evaluation of the organisation, i.e., determine its innovation capability maturity, and identify those Capability Requirements and Requirement Practices needed for the organisation to progress to

the next level. This case study and those of Chapter 7 are therefore bi-directional in purpose – and intended to be mutually beneficial.

4.6.2.1 Description of case study

As previously mentioned, the case study was primarily based on the proceedings of a workshop. It was conducted with the retail department of a major South African insurer at an off-site location. This would ensure that the setting was conducive to open discussion and free from the interruptions of the normal working environment.

Details of the organisation will not be provided to ensure confidentiality. However, it is important to describe the basic profile of participants, as it impacts the interpretation of results. Ten questionnaires were completed of which 6 were completed by senior-level executives within the organisation and 4 by consultants who had played a significant role in a recent radical innovation initiative.

It had been decided up-font that the maturity evaluation would address two periods. Each question would therefore be answered twice – once for the organisational status around October 2003, and once for the status around October 2006. These periods were related to the pre- and post- implementation of the radical innovation initiative. By doing this, any improvement or deterioration in innovation capability over this period could be identified.

The workshop commenced with an overview of the concept of innovation capability maturity. A brief period of discussion on the basic concepts then followed. Thereafter, the questionnaires were completed, initially in an interactive manner, but later on an individual basis. Participants were, however, free to ask questions. On several occasions, a group discussion on one of the questions would ensue. Once the questionnaires had been completed, further discussion was held. These discussions are presented in Section 4.6.2.3.

4.6.2.2 Maturity evaluation and questionnaire

As mentioned, the maturity evaluation (from now on referred to as an appraisal) was based on a workshop-type exercise and a questionnaire that was used as the basis for establishing the innovation capability maturity of the organisation. The questionnaire was constructed directly from the ICMM v1 with the questions being reworded Requirement Practices (see Figure 19 and Appendix B).

The intention was to determine whether the organisation performed a particular practice by simply asking whether it was the case. Provision was made for instances where a participant may have been unsure of practice fulfilment, or where a participant believed the question to be irrelevant to the organisation. The options available to the participants were:

- YES – that which is described in the question is almost always fulfilled by the organisation and done so on a continuous basis.
- NO – that which is described in the question is never or hardly ever fulfilled by the organisation.

- UNSURE – the participant is uncertain of whether that which is described in the question is fulfilled or not.

- IRRELEVANT – it is the participant's opinion that the question does not apply to the organisation.

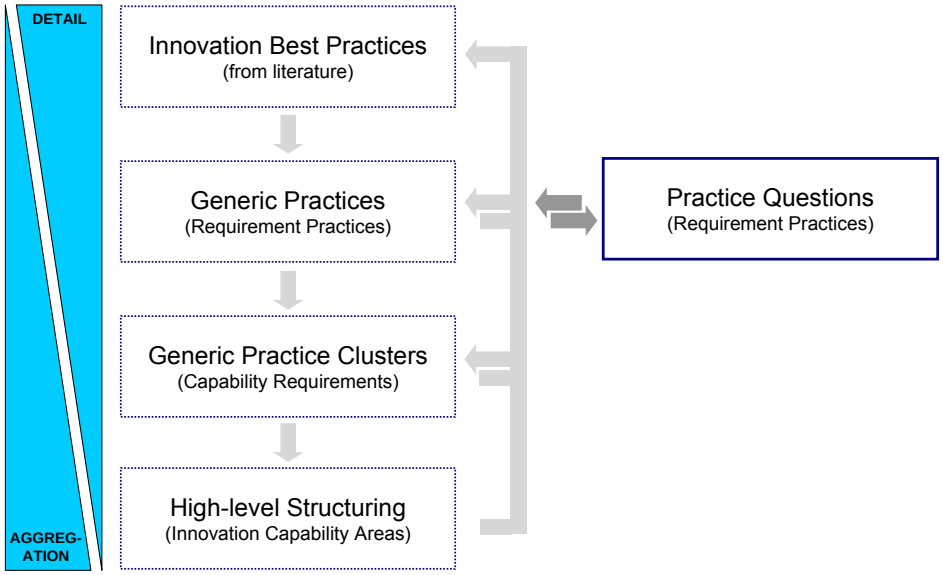

Figure 19 – Practice questions related to ICMM construction

Several other aspects were also covered by the questionnaire including participant details and their role within the organisation, their understanding of innovation, their initial opinion of the organisation's innovation capability maturity (based on a descriptive summary of maturity-level characteristics), and an opportunity for comments about the content and possible omissions. The primary intention was to assist in the interpretation of responses, but would also serve to gauge the participants' opinion of the appraisal process (see Section 4.6.2.4.1).

4.6.2.3 Summary of workshop discussions

The interactive nature of the workshop ensured the discussion of the various aspects throughout the process. A concise summary of the most relevant discussions is presented here.

The first discussion related to the length of the questionnaire. With a total of 239 questions (linking to the 239 Requirement Practices) relating to detailed practices within the organisation, the questionnaire was deemed too long. Several alternatives were discussed, including holding one-on-one interviews as opposed to a detailed questionnaire, integrating the questions in such a manner that fewer were required to portray the same picture, and structuring the questionnaire so that respondents answer only relevant questions based on their previous answers.

An important debate ensued regarding the applicability of the model and innovation in general to different organisations. Some argued that not all organisations need to innovate. This argument aligns strongly with the discussions of Section 4.4.1. The author presented this counter-argument to the group which seemed to

satisfy them. However, not all requirements and/or practices within the model are equally relevant to all organisations (as mentioned in Section 4.4.1) – they require the interpretation of the organisation's individual.

The importance of a respondent's context when answering the questions was discussed. This includes their understanding of innovation, their role in the organisation or organisational division, and their emotional attachment to certain aspects thereof. This had only been partially addressed in the questionnaire by establishing each participants understanding of innovation and their role within the organisation.

One of the participants mentioned that the inclusion of a partial answer, i.e., something in between "YES" and "NO", could improve a respondent's interaction with the questionnaire and the interpretation of results. The original logic was that a practice is either performed or it is not, but in hindsight, the ability to distinguish between degrees of fulfilment would have aided in the interpretation of results and prioritisation of actions.

The final issue that was raised relates to the need for clarity in the roles being addressed in the questions. For example, when "leaders" were referred to in the questionnaire, were they individuals who had a leadership role or were they individuals who exhibited actual leadership qualities?

To conclude, these comments and discussion would play an integral role in the development of the ICMM v2 and, in particular, the next questionnaire. In general, however, the content of the model and questionnaire was found to relevant and comprehensive – if not overly comprehensive. This point would form the basis of the refinement activities of Chapter 5.

4.6.2.4 Interpretation of completed questionnaires

This section addresses the interpretation of the completed questionnaires. This would serve 2 purposes: to establish the Innovation Capability Maturity of the organisation, and to evaluate the ICMM v1 and appraisal process. Only the latter will be discussed as it relates to the objectives of this research.

4.6.2.4.1 Innovation Capability Maturity calculation

An important aspect of an Innovation Capability Maturity appraisal (and any appraisal 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 being appraised.

In this case, the innovation capability maturity of the organisation was to be established for two different periods. The first period appraised was October 2003 – before the implementation of a large and radical innovation initiative. The second period appraised was October 2006 – after the implementation of the radical innovation initiative.

The participants were thus tasked with distinguishing between these two points in time throughout the questionnaire. Therefore, the innovation capability maturity of the organisation for each of these periods

could be established. Furthermore, any improvement or deterioration in innovation capability over the lifecycle of the radical initiative could be identified.

4.6.2.4.2 Summary of results

The consolidated results from all participants for the periods ending in October 2003 and October 2006 are presented in Table 8 and Figure 20. A particular value from the table represents the percentage of Requirement Practices that are fulfilled within a particular maturity level, for a particular period (column) and for either the entire model ("OVERALL"), or for a particular Innovation Capability Area (row). Figure 20 is a graphic depiction of Table 8 to assist with the interpretation of the results.

All Participants	*ML2 - '03*	*ML2 - '06*	*ML3 - '03*	*ML3 - '06*	*ML4 - '03*	*ML4 - '06*	*ML5 - '03*	*ML5 - '06*
OVERALL	**18%**	**43%**	**15%**	**31%**	**11%**	**21%**	**8%**	**16%**
INCREASE	**25%**		**16%**		**10%**		**8%**	
LIFECYCLE EXECUTION	14%	37%	18%	39%	10%	23%	6%	20%
KNOWLEDGE EXPLOITATION	15%	43%	10%	28%	8%	13%	5%	13%
ORGANISATIONAL EFFICACY	16%	34%	16%	26%	11%	21%	7%	12%
COMMON ICRs	30%	63%	15%	32%	16%	25%	11%	17%

Table 8 – CS1: Appraisal Results for all participants

The first trend evident in the results is the increase in the percentage of practices fulfilled from 2003 to 2006 (solid red lines). This trend is apparent through all capability areas, and thus also for the model as a whole ("OVERALL"). This presents strong evidence that, overall and based the consolidated results from all participants, the innovation capability maturity of the organisation had improved from October 2003 to October 2006.

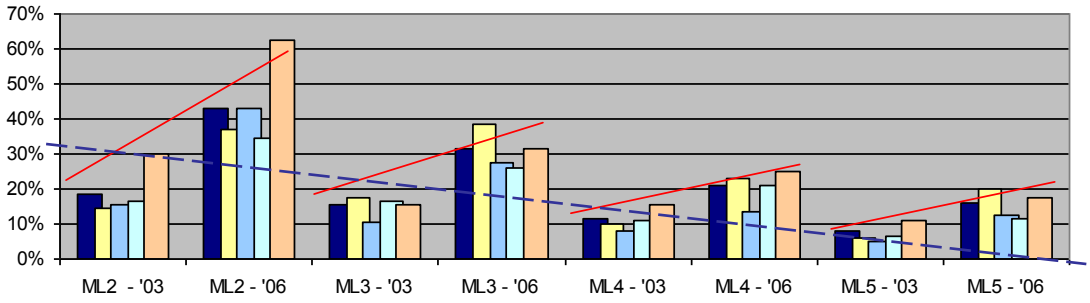

Figure 20 – Appraisal Results: *All Participants*

The second trend that is apparent is the decrease in the percentage of practices fulfilled with increasing levels of maturity (dark blue dashed line). This presents strong evidence that, overall and based on the consolidated results from all participants, the Requirement Practices of subsequent maturity levels are progressively less achievable from the perspective of the participating organisation's members. The reader may question the fact that practices were fulfilled in level 5, when the practices of level 2 were not all fulfilled. One may conclude that it is unrealistic to assume that all organisations will progress in the same manner. An organisation will have strengths and weakness, and in this particular example the level 5

practices that are performed may be deemed strengths, while the unfulfilled level 2 practices may be deemed weaknesses and opportunities for improvement.

Various other perspectives were taken on the results including: the separation of organisational participants and consultants, and the removal of outliers in various combinations. In all cases, the conclusions were the same as those discussed in the previous paragraphs.

4.6.3 ICMM v1 evaluation conclusion

The primary intention of this section was to evaluate the ICMM v1 from two perspectives. The first evaluation was for the ICMM's ability to support the organisation throughout its lifecycle and the lifecycles of its sub-systems. Based on the mapping activity of Section 4.6.1, the ICMM v1 was found to provide adequate support for the organisation throughout its lifecycle and those of its sub-systems.

The second perspective for evaluating the ICMM was though the utilisation of the model in an Innovation Capability Maturity appraisal of an organisation in the insurance industry. From the results of this appraisal, 2 trends were found to provide support for the model's relevance.

The trend of decreasing percentage of practices fulfilled with increasing maturity levels (dashed blue line – Figure 20) presents evidence that there was an associated increase in the level of maturity needed to fulfil those practices. Thus, the initial attempt at describing a progressive and staged path for innovation capability maturity did exhibit a certain degree of success.

The organisation's improved innovation capability maturity from 2003 to 2006 may be viewed from two perspectives. The first is that of the organisations', where the efforts to implement a radical innovation initiative had improved their innovation capability.

The second takes the perspective of the model. It may be stated that an organisation that had successfully implemented a radical innovation initiative that was new to both the organisation and the market, should have improved its innovation capability through that initiative. In such a case, the model would be tasked with identifying that improvement. The clearly discernable improvement in innovation capability maturity shown in the results (solid red lines – Figure 20) presents evidence that it was able to do so.

Even with these initial findings providing positive evidence of the model's relevant representation of innovation capability maturity, various aspects required refinement. The majority of these refinements would be relatively simple to implement in a new version of the questionnaire or with minor refinements to the model. However, a fundamental aspect that had to be addressed related to the time it took to complete the questionnaire. Furthermore, the procedure for evaluating the innovation capability maturity of an organisation had to be made more pragmatic without compromising the comprehensiveness of the model. These fundamental aspects would form the basis for the refinement activities of the following chapter.

5. ICMM v1 Refinement

This chapter discusses the activities undertaken to refine and improve the first Innovation Capability Maturity Model. The basis for this refinement was provided by the evaluation of the model described in the previous chapter. Before describing these activities, a brief summary of the work completed to this point is provided:

- A literature study of Innovation Management, Maturity Models and Enterprise Design principles laid the foundation and set the objectives for this research.
- An evaluation of the maturity model approach deemed it relevant to the innovation capability domain.
- Comprehensive literature review on innovation, including the identification, consolidation and integration of innovation requirements and practices provided the foundation for a first-cut ICMM.
- An evaluation of this ICMM v1 deemed the basic content to be, under the specific circumstances, a relevant description of innovation capability maturity. However, the approach used to evaluate an organisation's innovation capability based on the model was found to be impractical and tedious.

An elemental realisation upon nearing the end of this process was that the constituents of the model should describe the necessary considerations and circumstances under which innovation capability exists – i.e. the **requirements** for innovation capability. The model should **not** prescribe specific practices and activities as these would invariably differ between organisations, industries, product/service types, etc. and cause the model to become excessively large in an effort to cover this variation. From these findings, an extensive review and refinement of the ICMM v1 was instigated.

5.1 Reductionism

The concept of reductionism will be briefly discussed in light of the realisation mentioned above. It is not used as a methodology, but rather as the theme and context for the objectives of this refinement process.

Reductionism has two basic definitions: (1) an approach to understand the nature of complex things by reducing them to the interactions of their parts, or to simpler or more fundamental things; (2) a philosophical position that a complex system is nothing but the sum of its parts, and that an account of it can be reduced to accounts of individual constituents. This can be said of objects, phenomena, explanations, theories, and meanings. Reductionist thinking and methods are the basis for many of the well-developed areas of modern science, including much of physics, chemistry and cell biology. (Wikipedia 2008(1))

While the detailed principles of reductionist theory are not essential for this discussion, it is worthy to note that many of the traditional sciences were formulated through a process of identifying and understanding the interactions between the fundamental constituents of complex systems. In essence, refinement of the ICMM as described in this chapter, was a process of identify and understanding the fundamental

constituents of innovation capability. This theme served to guide and control the activities throughout this process.

5.2 Objectives for refinement

While the notion of reductionism discussed above served as the guiding principle during refinement, the specific objectives were based on the findings of the case study described in Section 4.6. The ICMM, as represented in version 1 and utilised in this case study, provides an evaluation and improvement framework for innovation capability that, although relatively comprehensive in nature, is tedious and laborious to deploy. Thus, the objectives for this refinement process were to:

- Present the model, its structure and contents in a more pragmatic manner – improve the applicability and practicality of the model.
- Maintain and/or improve the comprehensiveness of the model – ensure that the fundamental constituents of innovation capability are addressed.

5.3 Refinement activities

The high-level process and associated activities performed to refine the ICMM v1 are presented in Figure 21. Each of the high-level activities individually depicted in blue, purple and orange, is a meta-analysis that provided additional insight into the content and structure of the ICMM v1 and the evaluated literature (see Section 5.3.1). 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 in Section 5.2.

The first observation to be made from Figure 21 is that the model itself, although central to the process, 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 (see Section 5.3.3) and content with which the outputs of the other activities were compared during consolidation (see Section 5.4).

The consolidation process, although not depicted as one of the major analyses in Figure 21, was a crucial activity that warranted a separate diagram and discussion (see Section 5.4). This process, represented in Figure 21 by the dotted grey box, is depicted in more detail in Figure 27.

5.3.1 Literature used for refinement

The literature surveyed prior to the refinement process, and throughout the duration of this project, constituted approximately 650 documents. Subjects addressed therein are broad, covering many innovation related subjects including: strategy, management models, competencies, measurement, competitive advantage, products, services, knowledge management, etc. Other subjects not directly linked to innovation, but essential to a holistic understanding of the landscape include: maturity models, quality management, excellence models, organisational complexity, enterprise design, etc. A subset of this documentation was

used in the development of the first version of the model, while part thereof was unique to the second version.

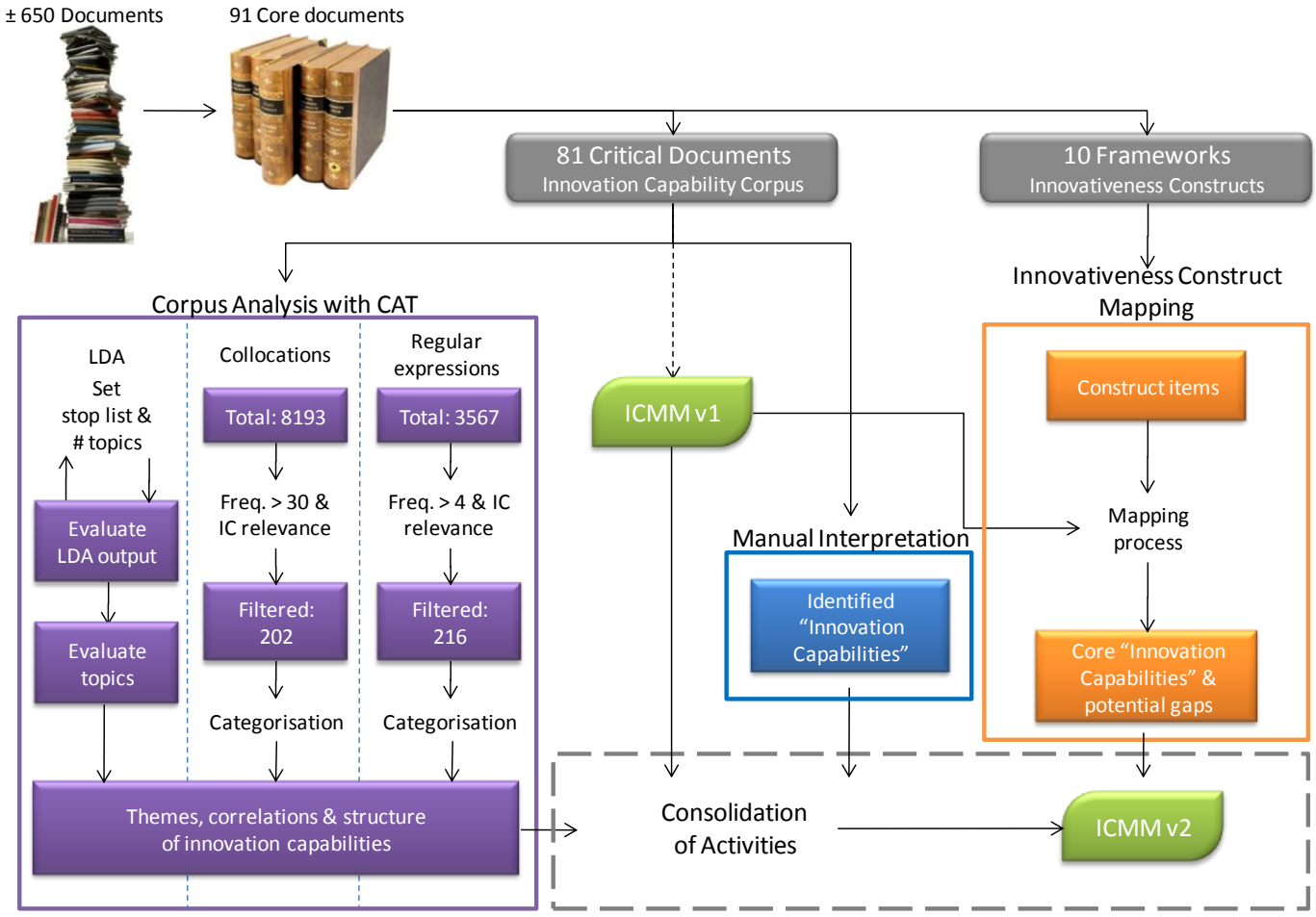

Figure 21 – ICMM v1 refinement process

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, and the internet.

The 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 used in the analyses discussed in Sections 5.3.2 and 5.3.4. All 81 documents were electronic in format to enable the later mentioned analysis. The remaining 10 documents contained so called "Innovativeness Constructs" that were used in the mapping and comparison exercise discussed in Section 5.3.3.

5.3.2 Manual interpretation of Innovation Capability Corpus

The 81 critical documents, referred to as the Innovation Capability Corpus, were reviewed in detail to identify and summarise the core organisational innovation capabilities that were researched and presented therein. This "Manual Interpretation", as it is referred to in Figure 21, resulted in the completion of the following columns of Table 13 presented in Appendix D:

- Article name – the title of the article analysed and summarised
- Author(s) – the author(s) of the article
- Keywords – the specified keywords for the article, such as articles from peer reviewed journals
- Themes of innovation capability – the "innovation capabilities" being discussed and researched within the article as identified by the author.

The table presented in Appendix D contains several other columns that are not relevant to this activity, but do form part of the consolidation process. In these columns, the outputs of Section 5.3.4 are related to the outputs of this analysis to identify possible relations between the manually identified themes and those of Section 5.3.4. This will be discussed in more detail in Section 5.4.

The process of identifying the themes of innovation capability from the corpus is obviously a relatively subjective one, even if all efforts are made to avoid being influenced by presumption. However, the activity could not be eliminated as it was essential to develop the authors understanding of the innovation capability landscape (obviously supplementing the understanding established in developing the ICMM v1), but also in providing a framework by which the outputs of the analyses discussed in Sections 5.3.2 and 5.3.4, and the content and structure of the ICMM v1, could be evaluated.

5.3.3 Innovativeness Constructs and ICMM v1 mapping

Of the original 91 core documents, 10 where identified to contain so called Innovativeness Constructs (Kohli et al. 1993, Tang 1998, Baker and Sinkula 1999, Calantone et al. 2002, Ohme 2002, Cormican and O'Sullivan 2004, Hult et al. 2004, Wang and Ahmed 2004, Lin 2007 and Terziovski, no date). Although only a few of these articles actually referred to their proposed frameworks as constructs, the fact that a formalised structure containing at least 2 tiers and multiple categories had been presented, placed these 10 articles in a similar position for analysis.

They all discussed and described various organisational requirements that support innovativeness. This section briefly discusses the mapping exercise that was conducted to compare the ICMM v1 with these Innovativeness Constructs.

5.3.3.1 Objectives for mapping

The structured approach taken by these studies ensured that they each prescribed a candidate framework with which to evaluate the ICMM v1. Evaluation, from a content point of view, would be possible by mapping the contents of the ICMM onto these constructs. The objective of this mapping activity was twofold:

- By mapping the content of the ICMM 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.

- By tracking the extent of the mapping, it would be possible to identify the core innovation capability requirements – certain Capability Requirements from the ICMM 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 is potentially redundant. This correlates directly with the overall objectives for the ICMM v1 refinement process described in Section 5.2 – to make the model more pragmatic by eliminating the non-essential while maintaining comprehensiveness.

5.3.3.2 Confirmatory Factor Analysis

The academic nature of 7 of these articles resulted in the statistical technique referred to as Confirmatory Factor Analysis being applied to evaluate the validity of the proposed frameworks. The intention of this section is not to provide the details of the statistical technique, but rather to highlight the significance of the technique to the mapping activity. Details on this technique and the context in which it was used may be obtained from the 7 studies that utilised it: Kohli et al. 1993, Baker and Sinkula 1999, Calantone et al. 2002, Hult et al. 2004, Wang and Ahmed 2004, Lin 2007 and Terziovski (no date).

Briefly defining the technique, Factor Analysis refers to statistical data reduction techniques used to explain variability among observed random variables in terms of fewer unobserved random variables called factors (Wikipedia 2007). It is a "*generic term that we use to describe a number of methods designed to analyze interrelationships within a set of variables or objects* [resulting in] *the construction of a few hypothetical variables (or objects), called factors, that are supposed to contain the essential information in a larger set of observed variables or objects...that reduces the overall complexity of the data by taking advantage of inherent interdependencies* [and so] *a small number of factors will usually account for approximately the same amount of information as do the much larger set of original observations*" (Reymont and Joreskog 1993, p. 71)

Confirmatory factor analyses, a subset hereof, are theory-testing as opposed to theory-generating methods. Here, the researcher begins with a hypothesis that specifies how certain variables will be correlated with certain factors and how these factors are correlated with one another. Primarily, the hypothesised model is based on a strong theoretical and/or empirical foundation (Stevens, 1996). Evidence of model validity is present when the pattern of correlations among the variables and factors conforms to what has been predicted by the researcher and the theoretical or empirical base (Cronbach 1970).

In the majority of cases, the validity of the models or constructs was supported by the results of the factor analyses, barring one or two of the factors (see the studies themselves for more details.) And while the results of these separate studies did not always provide sufficient evidence to support all the factors within the prescribed constructs, the nature of this technique and the context of the analyses imply that the constructs need not be disregarded. Those factors that are supported may be considered relevant, while even those not supported within the given analysis, may be supported under different circumstances. The studies themselves discuss possible reasons for certain factors not having sufficient support, often citing the

peripheral circumstances of the data collection. For these reasons, it was decided to use the constructs as prescribed by the studies before the implications of the results had been factored in.

5.3.3.3 Granularity of mapping

During a mapping exercise of this nature, it is crucial to make comparisons at a level of detail that provides sufficient insight into the landscape of relations between the compared entities. Too much detail and the mappings are difficult to interpret and laborious to execute, while too little detail results in gaps in the analysis or relevant factors being eliminated. The second challenge surrounding granularity is to compare similar levels of detail within the different models. This is dependent on the structuring of the models themselves.

Fortunately, the lowest level of detail of the constructs was similar in nature to the Innovation Capability Requirement level (2nd level of detail) of the ICMM v1. Thus, the constructs do not present specific innovation capability practices as does the maturity model, taking a less detailed approach to the description of innovation capability. The lowest level of detail in the constructs is referred to as "Indicators" in the mapping output (Appendix E).

During the mapping process, it became apparent that the indicators were not addressed by single capability requirements of the ICMM. To elaborate, for a particular indicator, multiple capability requirements in combination would "relate" to that indicator. At first, it appeared as though the compared levels of detail were different. Later, however, it became apparent that it was not the level of detail alone, but also the manner in which the ICMM was structured and the interrelatedness thereof. The construct indicators therefore did not relate directly to the capability requirements in terms of aggregation or content. This is apparent in Appendix E, where the majority of the construct indicators are addressed by several capability requirements.

5.3.3.4 Reading the mappings table

As mentioned above, Appendix E contains the actual mappings table showing the related ICMM and innovativeness construct components. This table contains 5 columns in. The first column states the author(s) of the papers in which the constructs were defined and analysed. The second and third columns describe the structure of the constructs as presented within the relevant papers. On occasion, a construct within a specific paper (referred to as "Construct Name" in the table) is based on the work of other authors. In this case, the authors are stated in the second column. The fourth column, referred to as "Indicators", presents the content of the constructs and represents the level of detail at which the mapping exercise was performed. Thus, for each indictor within the constructs, the corresponding capability requirement(s) of the ICMM are presented in the fifth column.

As discussed above, in the majority of cases, any particular construct indicator is addressed by several ICMM capability requirements. The interpretation of this is that the combined influence of the multiple capability requirements addresses the required innovation capability described by the construct item. To clarify this

aspect, an example will be presented. Consider the construct of Calantone et al. (2002) – an extraction from Appendix E is presented in Table 9.

Author(s)	Construct Name	Construct Items	Indicators	Relation to ICMM		
Calantone et al. 2002	Learning Orientation (Adapted from Sinkula, Baker and Noordewier 1997)	Shared vision	There is a commonality of purpose in my organization	OE-SD	OE-ID	OE-RA

Table 9 – Construct vs. ICMM mapping example

The "Relation to ICMM" column suggests that 3 capability requirements are relevant to this construct item:

- OE-SD: Strategic drive and emphasis on innovation - Ensuring that strategy is innovation focused and facilitative of long term innovative capability, and that organisational vision and mission is collectively embraced by all individuals.
- OE-ID: Innovation driven leadership - Ensuring that leadership drive and encourage innovative behaviour, that they serve as organisational role models for such behaviour, and exude energy and openness.
- OE-RA: Resource alignment, training and slack - Ensuring the resourcing of innovation initiatives is sufficient to allow freedom for creativity and room for failure, the alignment of individual capabilities and interests with work description, and the training of individuals in innovation related principles and practices.

Thus, to achieve "commonality of purpose in my organization", the ICMM requires that there be strategic drive and a common vision and mission, support and encouragement from leadership, and alignment of the "right" individuals with the "right" task and who share the organisational values.

5.3.3.5 Results and implications

As discussed, this mapping activity had 2 basic objectives: to identify the gaps in the ICMM v1 and to highlight potentially core capability requirements. This section will briefly describe the results of this exercise and the implications thereof.

5.3.3.5.1 Gaps in ICMM v1

The first objective was to identify potential gaps in the first version of the maturity model. This was done by acknowledging that certain construct items were not addressed by any specific ICMM capability requirements or, in some cases, poorly addressed. In Appendix E, these construct items are marked in red on the right hand side of the table. The poorly addressed areas were:

- Rewards and motivation – incentives for teams and individuals for good performance and to stimulate innovative behaviour (Cormican and O'Sullivan 2004, Lin 2007).

- Intellectual property management – the innovation process generates new IP which needs to be protected and managed in an appropriate manner (Ohme 2002).

- Risk management – innovation is inherently risky, primarily as a result of the uncertainty of whether the proposed products, processes and/or strategies will address the identified needs (Ohme 2002).

While the rewards and motivation, and risk management factors were addressed to a limited degree, the matter of managing intellectual property was not covered by the ICMM v1. With this said, these factors were not simply added to the maturity model by implication of their appearance in the innovativeness constructs. Rather, these aspects were acknowledged as potential gaps within the model and were considered during the final stage of ICMM v2 development – the consolidation process described in Section 5.4.

5.3.3.5.2 Core capabilities

The second objective of this mapping activity was to identify which of the capability requirements within the maturity model were "more important" than the others, i.e., identify the core capability requirements. Before going further, it is worthwhile to clarify what this means and how the results were interpreted.

The mechanism used to distinguish the more relevant from the less relevant content was to count the number of times that the capability requirements were mapped onto the innovativeness constructs. Basically, this may be interpreted as a higher count is more relevant than a lower count. However, taking this count too literally would be an error. The counts are obviously dependent on the constructs utilised in the mapping process, which may or may not have certain biases toward certain factors. To eliminate this, a statistically significant sample size, certainly larger than the 10 constructs used here, would be required. To achieve this statistical significance is, however, not the objective of this exercise. Establishing an improved understanding of which are core and non-core capabilities is the objective, for which this mapping exercise was sufficient. Thus, these results are interpreted as relevant in the context of the utilised literature and not overly literally.

The results were therefore not immediately and blindly implemented in the ICMM v1. As is the case with the gap analysis, the results were considered as part of a more comprehensive and elaborate consolidation process, in which the outputs of multiple analyses were integrated and implemented in the development of the ICMM v2 (Section 5.4).

One of the outputs of the mapping process was a table (Appendix F) that contained all of the ICMM v1 capability requirements and the counts representing the number of times each of the requirements was used to address a construct indicator. It became clear that a means was required by which to categorise the capability requirements based on these counts. To retain the simplicity of this process and avoid using complex analytical techniques, a simple histogram was generated of the results with the objective of highlighting potential patterns in the data. One of the 3 histograms generated is presented in Figure 22. These 3 histograms (with count intervals 2, 5 and 10) each highlighted a very similar pattern.

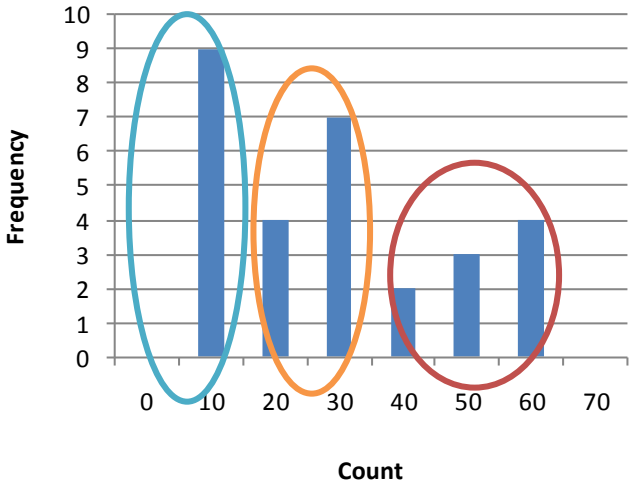

Figure 22 – Histogram of mapping counts

Three distinct groupings could be identified as depicted in Figure 22. These groupings were then used to categorise the capability requirements into 1 of 3 levels: core capabilities – more than 40 mappings, essential capabilities – more than 20, but less than or equal to 40 mappings, and peripheral capabilities – less than or equal to 20 mappings. The mappings and categorisations are presented in Appendix F.

5.3.3.6 Mapping conclusion

It is important to mention again that the results of the gap analysis and mapping exercise were not directly and immediately implemented. They were considered as part of a more holistic consolidation and refinement process.

An interesting observation from the articles used in this mapping exercise relates to their perception of the innovation process and the definition of innovation. Generally, the articles refer to the creative, "loose" and chaotic parts of the innovation process centred on idea generation, market scanning, etc. They however fail to address the need to bring those ideas to the market through rigorous development capabilities. This was confirmed by the mapping results in Appendix F (*LE-OI: Opportunity identification and solution generation* receiving 53 mappings in comparison to *LE-SE: Substantiation and exploitation of opportunities* receiving only 17 mappings).

This supports the argument to see these results in the context of a bigger picture. However, even with this in mind, these innovativeness constructs provided comprehensive and substantiated frameworks with which to compare and refine the ICMM v1.

5.3.4 Innovation Capability Corpus analysis using CAT

The Enterprise Engineering research group of the Global Centre for Competitiveness at the Department of Industrial Engineering, Stellenbosch University is the group under which this study is being conduct. This research is also being conducted in collaboration with the innovation management firm Indutech (Pty) Ltd. Another PhD research topic currently underway between these partners is the development of a framework

and tools to support the information and knowledge management requirements for organisational innovation.

A tool that has been developed by Indutech and that is likely to form part of this framework was used to analyse the 81 documents of the so called Innovation Capability Corpus (from Figure 21). In this section, the tool, the Corpus Analysis Toolkit (CAT), and the mechanism that it utilises, Latent Dirichlet Allocation (LDA), are briefly discussed. Further, the actual analysis, its results and the implications thereof are discussed.

5.3.4.1 Introduction to LDA and CAT

The intention of this section is to highlight certain aspects of LDA and CAT that are relevant to the interpretation of results. For a more detailed discussion of the LDA technique, see Blei et al. (2003), or the utilisation of LDA in CAT, see Uys et al. (2008).

5.3.4.1.1 Basics of LDA and topic modelling

Latent Dirichlet Allocation is a generative probabilistic model for collections of discrete data (Blei et al 2003). In the context of documentation and text, LDA represents documents as random mixtures over latent topics, where each topic is characterised by a distribution over words in the corpus (Blei et al. 2003). LDA is therefore a useful model for identifying structure in otherwise unstructured text (Blei and Lafferty 2006).

The work of Uys et al. (2008) discusses how topic modelling, for which LDA is utilised, may be applied to assist knowledge workers in digesting large collections of textual documents. A simplified explanation of the topic modelling process, based on LDA, is presented below (Uys et al 2008):

"Firstly, a list of stop words [words having no real significance, e.g. 'a', 'an', 'like'] is identified for the corpus to be analysed. All words are then extracted from the document corpus and stop words are eliminated. This results in the corpus vocabulary. The model also maintains a reference of where (i.e. in which document) words occur, and with what frequency. The topic model calculates a number of topics [the number of topics desired is specified by the user], consisting of words as found in the corpus vocabulary. Each word in the corpus vocabulary is then associated with one or more topics with a probability, as calculated by the model. As part of the output of the LDA run, the topic-word matrix presents the topics calculated by the model as well as the words associated with each topic. Each topic is further associated with one or more documents in the collection with a given mixing ratio based on the occurrences of words per document. Also part of the output of the LDA run, the document-topic matrix represents the likely allocations of documents to the topics calculated. On inspection of the resulting topics, each topic may be given a descriptive label by the analyst by evaluating the words and terms allocated to the specific topic (e.g. the label "project management" was given to topic in [Figure 23]). [Figure 23] below illustrates the concept of a (non-hierarchical, non-dynamic) topic model. Since the LDA model usually allocates a given document to more than one topic, the most significant topics associated with a given document can be estimated by considering those topics that correspond to the given document with the largest mixing ratio. With LDA, the

similarity of a given document to other documents can be estimated by identifying other documents that were allocated to the same topic as the given document with high mixing ratios."

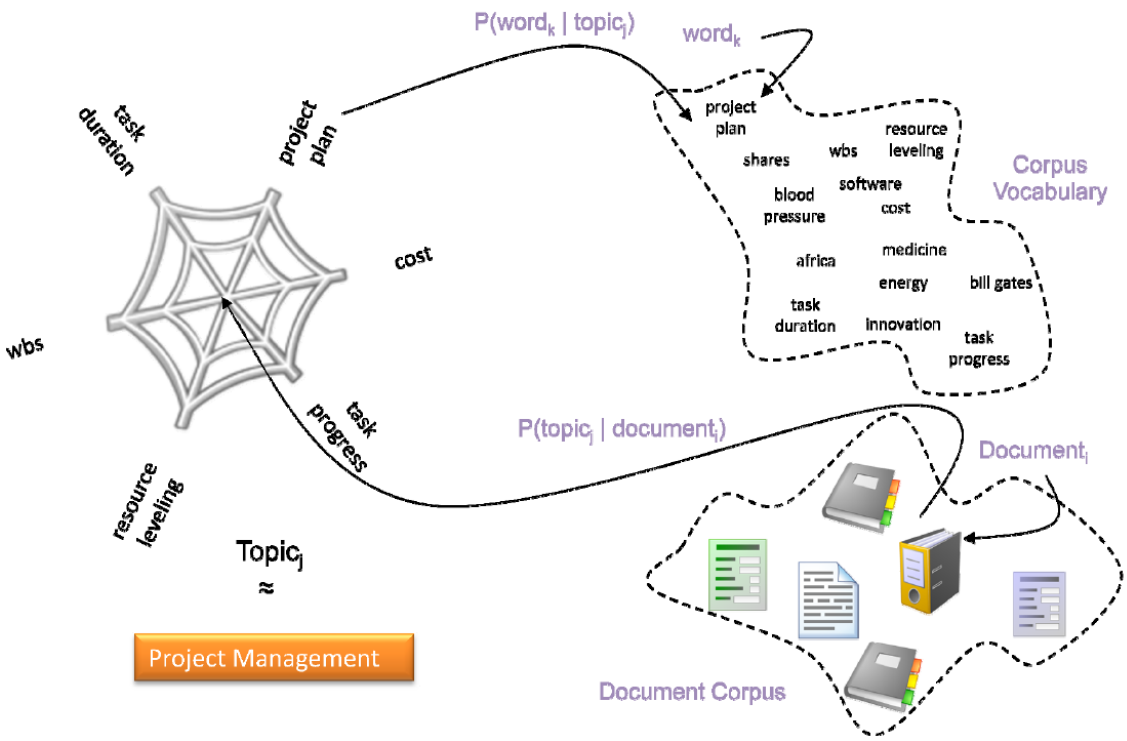

Figure 23 – The topic modelling process (*Source:* Uys et al. 2008)

Topic modelling serves as an extremely useful mechanism for identifying and characterising various concepts embedded within a document collection, enabling a researcher to navigate and understand this corpus in a topic-guided manner (Blei and Lafferty 2007, Uys et al. 2008). For this reason, the topic modelling approach based on LDA was utilised as a mechanism to provide additional insight into the concepts of innovation capability. This insight would come from an additional perspective on the literature – that of the LDA model.

5.3.4.1.2 CAT and its outputs

The Corpus Analysis Toolkit is an LDA-based topic modelling software application developed by Indutech (Pty) Ltd. It is continuously being refined and improved based on the outcomes of its utilisation. At the time when this analysis was performed, the CAT outputs were as follows:

- Topic-word matrix – presents the topics as calculated by the model and a list of the words associated with each of the topics.
- Document-topic matrix – represents a probable allocation of documents to topics in the form of a mixing ratio that is based on the occurrences of words per document.
- Regular expressions – list of expressions that are identified from the text based on specific patterns.

- Collocations – list of two word combinations which co-occur more often than would be expected by chance.

The first 2 outputs are based on the LDA model, while the latter 2 are based on separate techniques that were implemented to provide additional understanding of the analysed corpus.

5.3.4.2 Objectives for CAT analysis

The statistical nature of the CAT output provides a perspective of objectivity towards the literature that is not possible for a human being to achieve. Further, the traditional application of this technique is to provide understanding of a large, previously unstudied corpus. However, in this case, the corpus had been studied by the author in detail – Appendix E presenting a summary thereof. The objects were therefore not centred on understanding, but rather on generating a new and objective perspective on innovation capability. The specific objectives of this analysis were to:

- Identify the core concepts pertaining to innovation capability according to the LDA-based topic modelling process.
- Through the execution of 3 separate CAT runs, specifying each of 5, 10 and 20 topics to be identified from the corpus, identify hierarchical structure within the topics of innovation capability.
- By relating topics to one another based on their inclusion of similar words, obtaining an improved understanding of the interrelations that may exist between the concepts of innovation capability.
- Provide a framework by which to compare and evaluate the content and structure of the ICMM v1.

These objectives align strongly with the objectives of the overall ICMM v1 refinement process, particularly in terms of improving the overall structuring of the model. While, to a certain degree, the outputs of this analysis could assist with ensuring comprehensiveness of content, the identification of interrelations between innovation capability themes (referred to as CAT topics) and the inherent hierarchy therein, would prove vital in improving the structure of the first maturity model.

5.3.4.3 Preparation for analysis

The nature of this LDA-based topic modelling process is such that the outputs may be improved by tweaking 2 specific parameters:

- The list of stop words – words deemed to be irrelevant such as "a", "and" and "like".
- The number of topics that the model must extract – a pre-specified variable stating the number of topics into which the LDA model must categorise the corpus.

The reason for tweaking the stop words was, firstly, to eliminate the noise words (such as "accesstotech" and "scientificinterpreter") that occur as a result of erroneous text capturing when exporting to the portable

document format (PDF), as most authors do. The second reason was to remove words that were so generic to the corpus that they portrayed little meaning (such as "journal", "manufacture", "business", "profit", etc.). The third and final reason was to remove names that may bias the interpretation of the topics because they were attached to certain concepts (such as "ibm", "ideo", "seagate", "christensen", "chesbrough", etc.).

These stop words where identified through several CAT runs, each time the above mentioned rules being applied to identify additional stop words that were then added to the stop word list. By the fifth CAT run, the words representing the topics were deemed sufficiently void of noise and "meaningless" words and names.

The number of topics was not tweaked, as were the stop words. As mentioned previously, it was decided to perform 3 CAT runs – one for each of 5, 10 and 20 topics. The reasoning behind this was to establish whether hierarchy exists within the topics. However, the 20 topic run was selected as it was close to the maximum number of topics that were possible. The nature of the LDA implementation is such that if more topics are requested from the LDA output than are inherent within the corpus, the results tend to degenerate (Blei et al. 2003). If this occurs, the outputs are completely nonsensical – all of the requested topics have the same words in the same order, depicting 1 relevant topic. Test runs were performed on 30, 25 and 22 topics, each of which degenerated. At 20 topics, the CAT run no longer degenerated and the results appeared promising.

5.3.4.4 Post-run processing

Once the 3 CAT runs had been performed, various analyses were performed to improve the interpretation of, and add value to, the results. The most influential of these analyses will be briefly discussed.

5.3.4.4.1 Topic labelling

This is a basic process whereby the researcher (the author in this case) assigns a label to a topic that is represented as a list of words. These words are listed in ascending order of their probability of being representative of the specific topic. This facilitates the process for the researcher by making the identification of relevant words easier, although the words with the highest probability were not by implication more relevant.

Consider the words "innovation" and "management". These words, and a few others, were represented in virtually all of the topics in each of the 3 CAT runs. They therefore had no influence on determining the most relevant topic labels and were ignored in the process.

Table 10 presents an extraction from the 20 topic CAT run highlighting the topic labelling process. Words that were used in the labelling thereof are highlighted in blue, while the post-processing stop words (such as "innovation") are highlighted in grey. Note, that for each of the 20 topics from which this particular extraction was made, CAT generated 40 words to describe the topic – again in order of their probability of describing the particular topic.

Topic Label	Quality and Control of the Innovation Process	Organisational Learning and Change	Communities of Practice and Knowledge Networks	Innovation Process Management	Idea Management and Opportunity Identification
Relative Coverage	6.5%	6.3%	5.9%	7.6%	9.9%
Relative Dependence	6.7%	7.0%	5.4%	8.5%	6.7%
Topic words (CAT output)	innovation	innovation	knowledge	innovation	innovation
	product	management	innovation	process	organization
	management	learning	community	management	process
	process	strategy	network	products	strategic
	organizational	product	practice	product	ideas
	entirely standards	process	networks	market	old paradigm
	quality	market	people	processes	market
	tqm	pioneer	management	projects	product
	research	strategic	members	organization	products
	innovation process	capabilities	important	technology	external
	study	products	organization	project	growth
	innovations	service	time	innovation process	management
	adoption	innovation management	information	success	organizations
	innovation management	loop	complexity	ideas	organizational
	relationship	disruptive	work produce	managing	opportunities
	organization	organisation	communities	factors	radical
	structure	processes	process	result	approach
	practices	change	change	successful	time

Table 10 – Example of topic labelling

These topic labels could be considered the different themes of innovation capability, as identified by the generative probabilistic model LDA from the 81 core innovation capability-related documents. These themes provided a fundamental step towards better understanding the innovation capability landscape and the different concepts that the literature addresses therein.

5.3.4.4.2 Relative coverage and dependence

These are two measures that provide context for each of the topics in terms of their overall coverage of the 81 document corpus and their relation to the other topics identified within the corpus. These measures are presented in Table 10 for each of the topics therein.

Relative coverage can be considered the portion that a specific topic addresses of the overall subject matter contained within the corpus. It is calculated from the document-topic matrix (as discussed in Section 5.3.3.6.), where the mixing ratios for each of the documents within the corpus for a specific topic are summed and normalised (so that the sum of these figures for each of the topics within a particular CAT outputs is 100%). The researcher is, therefore, able to understand each of the topic's coverage of the corpus in relation to that of the other topics'.

For example, consider the topics "*Communities of Practice and Knowledge Networks"* and "*Idea Management and Opportunity Identification*" from Table 10. The first topic has a relative coverage of 5.9% in comparison to the latter's 9.9%. The concepts of idea management and opportunity identification are, therefore, more broadly covered within the 81 core innovation capability documents than the concepts of communities of practice and knowledge networks. Note, that this is **not** stating that the second topic is more important than the first, but rather that it is covered by more of the corpus's content.

Relative dependence can be interpreted as an overall measure of the dependence (inverse of independence) of any topic in relation to the other topics within the corpus. This measure is calculated based on the correlations between the topics (which is described in more detail in Section 5.3.4.4.3). The calculation of this measure for a specific topic is as follows:

1. Sum the correlations of a topic with all other topics (excluding itself)
2. Sum the absolute values of each topic's value from calculation (1)
3. Divide the value from calculation (1) by the value from calculation (2)

The resultant value represents the relative dependence of the topic – the sum of these values for each of the topics is 100%. Again, consider the previous example of the topics "*Communities of Practice and Knowledge Networks"* and "*Idea Management and Opportunity Identification*" from Table 10. Their respective relative dependence values are 5.4% and 6.7%, indicating that the second topic is slightly more related to the other topics within the 20 topic CAT run than the first.

Both the relative coverage and dependence measures need to be considered in context with the total number of topics extracted from the CAT run. This proportionally influences both the relative coverage and dependence values. As an example, consider the relative coverage of the 20 topic CAT run – the average will always be 5% (10% in the case of 10 topics and 20% in the case of 5 topics). Further, it is useful to calculate the standard deviation of the values and view the results in the context thereof. A summarised view of these discussions for the relative coverage of the 20 topic CAT run is presented in Figure 24.

Similar views for each of the 3 CAT runs for both the relative coverage and relative dependence measures were used to provide improved understanding of the topics, as determined by the LDA-based topic modelling outputs and their relative representation within the overall 81 document innovation capability corpus.

5.3.4.4.3 Topic correlations (intra-run interrelations)

To understand any topic's specific relation to any other topic, the correlations between topics were calculated. It is important to note the background of this calculation and the implications thereof.

The assumption is made that if 2 topics have the same descriptive words, then there is a relation between these 2 topics. This means that if two topics were described by exactly the same words, irrespective of the order of the words, then the correlation between the 2 topics would be one (although this is not possible

unless degeneration occurs). Inherent to this point is the assumption that if two topics have the descriptive word, "idea" for instance, then the meaning of idea is similar in both situations. Although this is not an ideal assumption to have made, it is not completely irrelevant in light of the fact that this analysis is being performed on a specific research field in which the researchers tend use similar jargon. This was an important consideration during the topic labelling process discussed in Section 5.3.4.4.1.

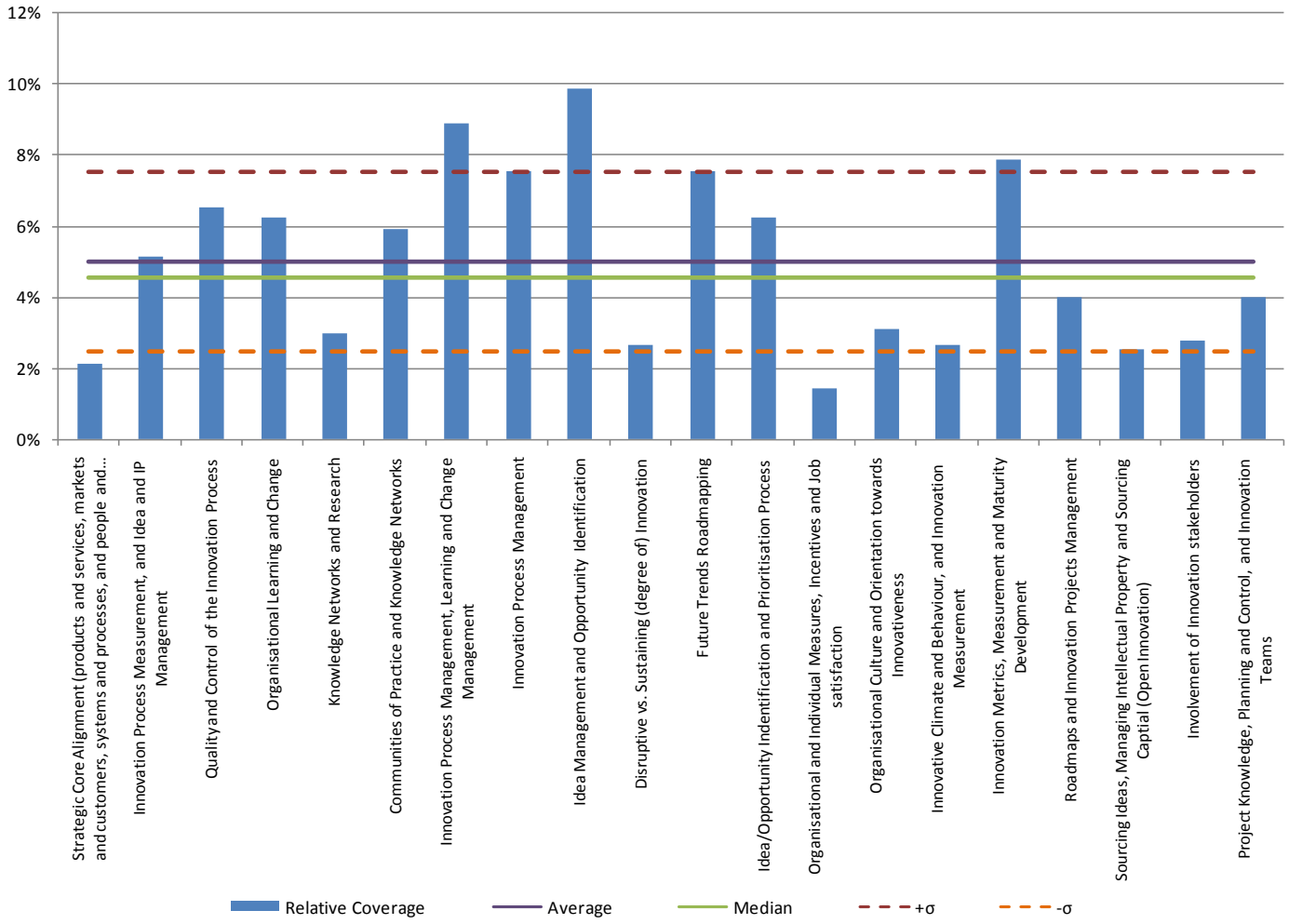

Figure 24 – Example of relative coverage: 20 topic CAT run

At the time that this analysis was performed, the CAT output was not able to provide the probabilities of the descriptive words being related to each topic. If it were able to, it would have been possible to calculate the correlations between topics based on their having the same descriptive words and the relative probabilities of these words being descriptors of the relevant topics.

Given the abovementioned assumptions, these correlations were not interpreted overly literally. Rather, they were used as a "loose" indication of the interrelations that exist between the different topics from each of the 3 CAT runs. Figure 25 presents an example of these correlations for the 20 topic CAT run.

Similar tables for each of the 3 CAT runs were used to understand the interrelations between topics within a given LDA output. Even with the loose interpretation hereof, the improved understanding that was derived

from identifying these potential relations between the themes within the innovation capability landscape proved instrumental in the refinement of the ICMM v1.

	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8	Topic 9	Topic 10	Topic 11	Topic 12	Topic 13	Topic 14	Topic 15	Topic 16	Topic 17	Topic 18	Topic 19	Topic 20
Topic 1	1.000	0.299	0.046	0.130	-0.038	0.158	0.074	0.214	0.214	0.214	0.270	0.074	-0.066	0.102	-0.038	0.214	0.158	0.158	0.102	-0.010
Topic 2	0.299	1.000	0.270	0.299	0.046	0.214	0.299	0.383	0.270	0.186	0.270	0.270	0.074	0.214	0.074	0.411	0.186	0.355	0.186	0.018
Topic 3	0.046	0.270	1.000	0.355	0.046	0.130	0.299	0.355	0.355	0.158	0.102	0.383	0.074	0.299	0.046	0.299	0.130	0.130	0.074	0.074
Topic 4	0.130	0.299	0.355	1.000	0.018	0.130	0.327	0.299	0.299	0.242	0.130	0.242	-0.010	0.270	0.074	0.355	0.270	0.158	0.102	0.102
Topic 5	-0.038	0.046	0.046	0.018	1.000	0.130	0.074	0.074	-0.038	0.018	-0.010	0.046	-0.010	-0.038	-0.038	0.018	0.102	0.130	0.046	-0.010
Topic 6	0.158	0.214	0.130	0.130	0.130	1.000	0.242	0.186	0.130	0.158	0.214	0.214	0.074	0.046	0.046	0.242	0.158	0.214	0.158	0.074
Topic 7	0.074	0.299	0.299	0.327	0.074	0.242	1.000	0.327	0.327	0.158	0.186	0.242	-0.010	0.186	0.018	0.327	0.327	0.214	0.214	0.214
Topic 8	0.214	0.383	0.355	0.299	0.074	0.186	0.327	1.000	0.383	0.299	0.242	0.214	0.046	0.214	0.046	0.299	0.383	0.299	0.186	0.186
Topic 9	0.214	0.270	0.355	0.299	-0.038	0.130	0.327	0.383	1.000	0.242	0.158	0.186	-0.010	0.214	-0.038	0.299	0.186	0.242	0.102	0.102
Topic 10	0.214	0.186	0.158	0.242	0.018	0.158	0.158	0.299	0.242	1.000	0.130	0.074	-0.066	0.074	-0.038	0.158	0.214	0.130	0.074	-0.010
Topic 11	0.270	0.270	0.102	0.130	-0.010	0.214	0.186	0.242	0.158	0.130	1.000	0.102	-0.038	0.102	-0.038	0.242	0.299	0.186	0.186	0.074
Topic 12	0.074	0.270	0.383	0.242	0.046	0.214	0.242	0.214	0.186	0.074	0.102	1.000	0.186	0.214	0.102	0.270	0.130	0.130	0.046	0.046
Topic 13	-0.066	0.074	0.074	-0.010	-0.010	0.074	-0.010	0.046	-0.010	-0.066	-0.038	0.186	1.000	-0.066	0.018	0.018	-0.010	-0.038	-0.038	-0.066
Topic 14	0.102	0.214	0.299	0.270	-0.038	0.046	0.186	0.214	0.214	0.074	0.102	0.214	-0.066	1.000	0.018	0.214	0.130	0.102	0.018	-0.010
Topic 15	-0.038	0.074	0.046	0.074	-0.038	0.046	0.018	0.046	-0.038	-0.038	-0.038	0.102	0.018	0.018	1.000	0.046	-0.010	-0.010	-0.010	-0.038
Topic 16	0.214	0.411	0.299	0.355	0.018	0.242	0.327	0.299	0.299	0.158	0.242	0.270	0.018	0.214	0.046	1.000	0.242	0.242	0.158	0.186
Topic 17	0.158	0.186	0.130	0.270	0.102	0.158	0.327	0.383	0.186	0.214	0.299	0.130	-0.010	0.130	-0.010	0.242	1.000	0.214	0.130	0.186
Topic 18	0.158	0.355	0.130	0.158	0.130	0.214	0.214	0.299	0.242	0.130	0.186	0.130	-0.038	0.102	-0.010	0.242	0.214	1.000	0.158	-0.010
Topic 19	0.102	0.186	0.074	0.102	0.046	0.158	0.214	0.186	0.102	0.074	0.186	0.046	-0.038	0.018	-0.010	0.158	0.130	0.158	1.000	-0.010
Topic 20	-0.010	0.018	0.074	0.102	-0.010	0.074	0.214	0.186	0.102	-0.010	0.074	0.046	-0.066	-0.010	-0.038	0.186	0.186	-0.010	-0.010	1.000

Figure 25 – Example topic correlations: 20 topic CAT run

To better understand the values depicted in Figure 25, consider the most extreme cases. If the words describing 2 topics are exactly the same, then the correlation value would be 1. If on the other hand, 2 topics shared absolutely no words (i.e. they are totally negatively correlated), then the value would be -1.

Consider the correlation of 0.411 between Topic 2 (*Innovation Process Measurement, and Idea and IP Management*) and Topic 16 (*Innovation Metrics, Measurement and Maturity Development*). This value depicts the similarity between the words that describe each these topics, which is relatively high, based on the other values from Figure 25. These 2 topics are, therefore, considered relevant to one another. What may be interpreted from this specific relation is that innovation metrics and measurement are important, in some way, to the more specific innovation process measurement (and vice versa).

5.3.4.4.4 Hierarchical correlations (inter-run interrelations)

The objective for performing the 3 CAT runs of 5, 10 and 20 topics each, as mentioned above, was to determine whether a hierarchical structure could be identified within the given innovation capability themes. This was specifically directed towards providing a structural view of innovation capability, i.e., given the content thereof, can it be aggregated and broken down into multiple levels of detail?

Determining the correlations between the different topics between the 3 different CAT runs was intended to answer this question. The correlation calculations were performed in the same manner as were the correlations between topics within a specific run's output. Therefore, the assumptions discussed in Section 5.3.4.4.3 also apply to this analysis. The only difference to consider is that these correlations now refer to the similarity between the words that describe 2 topics that are from different LDA outputs.

Figure 26 depicts a sample of the interrelations between the topics from the 3 CAT runs. Shown are those interrelations between the 5 topic (depicted in red) and 10 topic (depicted in purple) runs where the

correlation was more than or equal to 0.4. Also shown in Figure 26 are the interrelations between the 10 topic and 20 topic (depicted in blue) runs where the correlation was more than or equal to 0.5. In both cases, these figures were arbitrarily selected to make the diagram practical to study and view within this document.

Detailed analysis of these hierarchical interrelations was performed from the complete matrix showing all correlations between all topics from all 3 CAT runs, similar to the one depicted in Figure 25. As is the case for the correlations within run outputs (described in Section 5.3.4.4.3), these correlations are not interpreted overly literally due to the assumptions that were made to enable this analysis.

Nevertheless, as was the intention, various interesting observations could be made regarding the aggregation of topics from the 3 CAT runs. Consider the topics *Organisational Environment (work), Metrics and Measurement* (Topic 3, 5 topic CAT run), *Organisational (work) Environment, Metrics and Measurement* (Topic 10, 10 topic CAT run) and *Organisational and Individual Measures, Incentives and Job satisfaction* (Topic 13, 20 topic CAT run). The correlation between the first- and second-mentioned topics is 0.916 and between the second and third is 0.832 – see Figure 26. Because these correlations are so high (as a result of being described by almost the same words) one could conclude that these are the same (or very similar) topics. If this were true, it would mean that this topic presented itself in all of the 3 CAT runs, and was therefore relevant at all 3 levels of aggregation.

Now consider the relative dependence measure for these 3 topics (respectively): 1%, 3% and 1.4%. These are all substantially lower than their respective averages of 20%, 10% and 5%, implying that these topics are relatively independent of the other topics within each of the runs. This argument supports the findings of the previous paragraph.

Further, consider the relation between the relative dependence and the average thereof, for each of the 3 topics (respectively): 1/20 = 5%, 3/10 = 30% and 1.4/5 = 28%. This implies that, at the highest level of aggregation (the 5 topic CAT run), the theme(s) of organisational work environment, metrics and measurement is most independent of the topics at that level of detail. This level of independence then reduces for the more detailed runs, implying that this topic is more related to the more detailed topics of the 10 and 20 topic runs. The final conclusion that could be made here, is that this topic is more likely to be part of the innovation capability framework at the lower levels of detail (10 and 20 topic runs) than it is at the highest (5 topic run).

This and similar "debates" regarding the structuring of innovation capability were the outcome of the analysis described here. They provided added insight into the relations between the topics at the 3 levels of detail relating the 3 CAT runs. And while the results from this analysis were not directly implemented and/or related to the ICMM v1, they did prove useful in better understanding the content of the CAT run outputs.

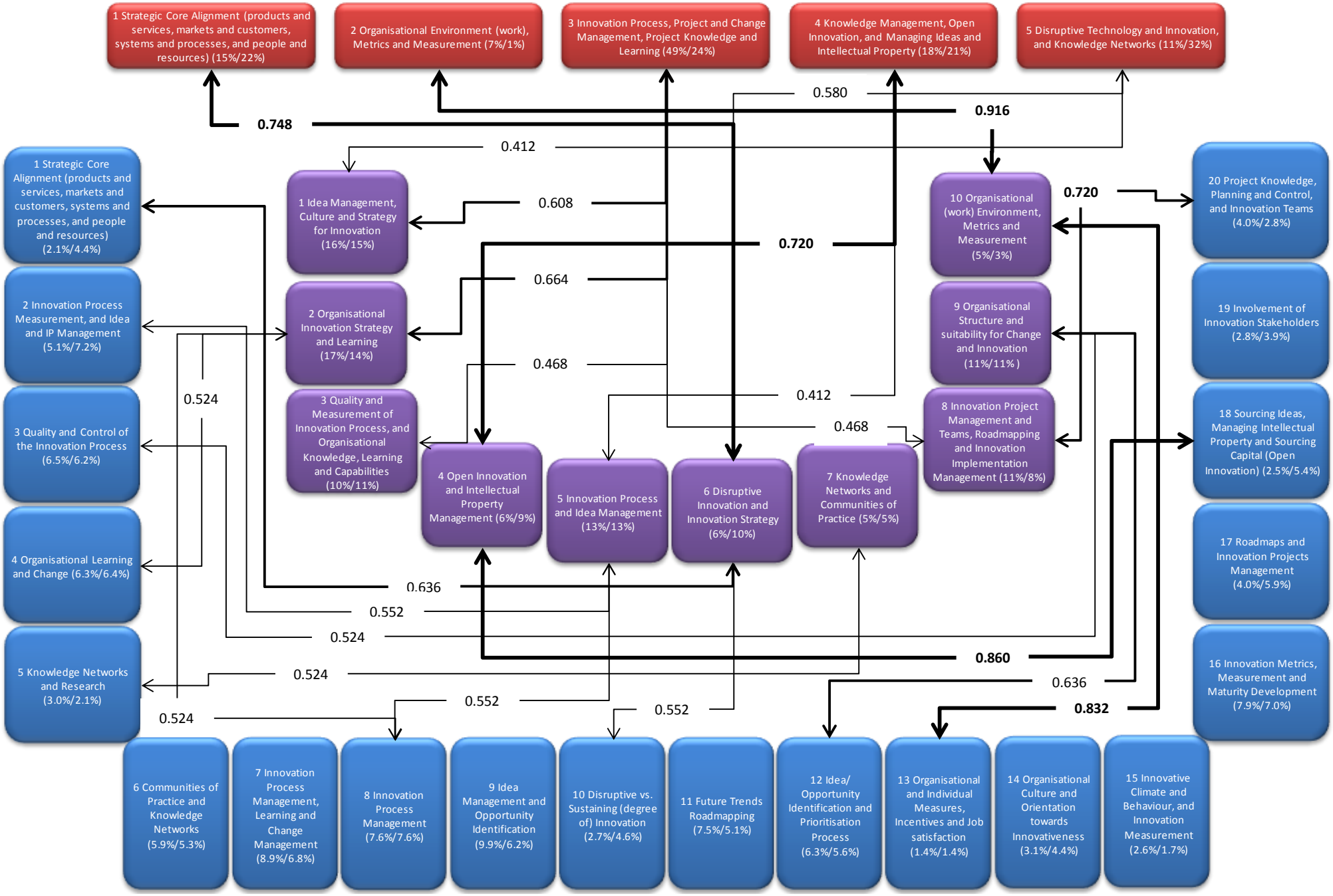

Figure 26 – Sample of hierarchical interrelations

5.3.4.5 Additional CAT outputs

This section briefly describes 2 CAT outputs that are not part of the LDA-based topic modelling approach, but that are part of the CAT software to provide additional insight into the content of an analysed corpus. These outputs are in no way linked to the LDA model output and are, therefore, independent of the topic-based discussions of Section 5.3.4.4. The intention behind their use was exactly the same as the intention for their inclusion in CAT – to provide added understanding of the 81 document innovation capability corpus. This understanding relates purely to the content of the corpus, i.e., it does not provide any insight into the structuring of corpus content. Because these outputs are independent of the LDA model and the identified topics, the results generated by the 3 CAT runs were exactly the same.

5.3.4.5.1 Regular expressions

The first of the 2 outputs is referred to as "regular expressions". It is a list of expressions that are based on some pattern for which an algorithm can be developed to identify that pattern within text. Expressions that can be identified from the text include: email addresses, up to 4 capitalised words, years, URLs, full names of persons, alphanumeric numbers, valid Microsoft Windows filenames, hyphenated bigrams, decimal numbers of up to 5 digits and 2 decimals, etc. For each of these expressions an algorithm is required that defines the patterns in which they occur within the text.

The results generated by the CAT output revealed a total of 3567 regular expressions. The raw results were not obviously useful in their presented form. Each of the regular expressions was listed in ascending order of the number of occurrences thereof within the text. To be useful, the list needed to be filtered. The criteria used to filter the list were:

1. 4 or more occurrences of the expression **and**

2. Whether (or not) the expression could be related to the innovation capability landscape.

After having applied the criteria, a total of 216 expressions were identified as relevant to the innovation capability landscape. In an effort to understand these expressions in context with the ICMM v1 and the refinement exercise as a whole, the 216 expressions were categorised into the high level structure of the first maturity model (the Innovation Capability Areas – see Section 4.4.5). The objective was to determine if any of the relevant expressions would highlight potential gaps within the ICMM v1.

Example expressions extracted from the text that were categorised under the Lifecycle Execution capability area of the ICMM v1 include (number of occurrences in brackets): [fuzzy] front-end (40), problem-solving (33), Product Innovation Lifecycle (33), Radical Innovation (21), Project Execution (20), Idea Management (18), Project Management (18), Project Planning (17), Project Initiation (16), Portfolio Management (14), Project Control (14), Innovation Process (13), mock-ups (13), Innovation Life Cycle (13), Product Life Cycle (12), re-engineering (12), stage-gate (12).

From this particular sample of expressions, 2 were perceived to be insufficiently addressed within the ICMM v1: "project control" and "stage-gate". These concepts both relate to the need to guild (in a balanced fashion) the innovation process. Stage gates specifically address the need for having critical decision points within the innovation process in which crucial decision are made as to the direction of a particular project. Although this is only an example, it highlights the value that was added through the abovementioned categorisation process. Section 5.4 will describe how these results were consolidated with the other refinement activities.

5.3.4.5.2 Collocations

Collocation, within the area of corpus linguistics, is defined as a sequence of words or terms which co-occur more often than would be expected by chance. Collocations refer "to the restrictions on how words can be used together, for example which prepositions are used with particular verbs, or which verbs and nouns are used together". (Wikipedia 2008 (2))

Gledhill (2000) proposes that three perspectives be taken on collocation: (1) co-occurrence – a statistical view, which sees collocation as the recurrent appearance of a node and its collocates within a given text; (2) construction – which sees collocation either as a correlation between a lexeme and a lexical-grammatical pattern, or as a relation between a base and its collocative partners; and (3) expression – a pragmatic view of collocation as a conventional unit of expression, regardless of form (Wikipedia 2008 (2)).

This is a brief description of a relatively complex concept for which a statistical mechanism has been implemented within CAT to identify occurrences of these so called collocations. The collocations output is very similar to that of the regular expressions, with a list being presented in ascending order of the number of occurrences within the corpus. Similar filtering criteria were applied to identify the most relevant collocations from the total of 8193. The 2 factors considered (revealing 202 relevant collocations) were:

1. 30 or more occurrences of the collocation **and**

2. Whether (or not) the collocation could be related to the innovation capability landscape.

These 202 collocations were then categorised into the ICMM v1 capability areas in an effort to highlight potential gaps within the model. From this point on, the process was precisely the same as the process described in the previous section (for the regular expressions). A sample of the collocations extracted from the text that were categorised under the *Lifecycle Execution* capability area include: innovation projects (271), innovation approach (147), technology stage (145), technological uncertainty (137), potential innovations (120), problem solving (107), needs study (105), implementation strategy (103), innovation system (95), incremental [vs.] radical (94), evaluation market (92), process commercialization (86), adoption paradigm (81), patterns diffusion (78), process idea (83), innovations process (81), innovation uncertainty (80). As was the case with the regular expressions, the 202 relevant collocations proved useful in identifying [some of the] important concepts within the corpus and relating these to the outputs of the other refinement activities.

5.3.4.6 CAT conclusion

While the various post-run analyses discussed in Section 5.3.4.4 all provided valuable insight into the concepts of innovation capability, it was the topic labelling exercise (Section 5.3.4.4.1) that proved most valuable in the overall ICMM v1 refinement process. Essentially, the different themes of innovation capability could be identified from a perspective that was fairly unique in terms of application – no literature on innovation was found to have used such techniques; and relatively objective (void of bias) – 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 (relative coverage and dependence, topic interrelations and hierarchical interrelations – Sections 5.3.4.4.2 to 5.3.4.4.4) were regularly used to understand the nature of a specific topic, its appropriate level of detail and how it relates to the other topics. And although their contribution to the overall refinement process was less than that of the topic labelling', the omission of these activities would certainly have reduced the richness of the insight gained from the CAT analysis as a whole.

5.4 Consolidation of refinement activities

The preceding discussions of this chapter have described, in short, various activities that were directed towards developing a better understanding of the innovation capability landscape, thereby providing the foundation for a rigorous ICMM v1 refinement exercise. As discussed is Section 5.2, the objectives were to improve the ability to utilise the initial model in a practical manner, while maintaining (if not improving) the comprehensive of the content. This section will now describe the process of bring the outcomes of these refinement activities together in a coherent manner that would lead to the fulfilment of these objectives and, eventually, to the second version of the Innovation Capability Maturity Model (ICMM v2).

The challenge that was 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 now had to be brought together with the initial model into a new model that had "less" content to describe (and questions in an organisational evaluation), but that was equally comprehensive in its coverage of the innovation capability domain. A simplified depiction of the process that eventually unfolded is presented in Figure 27.

The first point to consider is the descriptive vertical axis that roughly highlights the nature of the activities in terms of their tendency toward subjectivity or objectivity. Note the use of the word "tendency" to convey the fact that nothing can be truly objective or subjective when performing such an exercise. This point is taken further in the conclusion – Section 5.5. The rough depiction presented here is merely intended to show the varying degrees of influence that the author may have had on the interpretation and integration of results.

The horizontal axis basically denotes the sequential assimilation of the outputs of the respective activities – each an activity in itself. Essentially, with each new integration activity, the model would take on a new form in terms of content and/or structure based on the particular outputs being considered and the status of the

model at that stage. While this representation held true for much of the process, the outputs of several activities were revisited (once they had already been addressed) to firm up specific aspects of the model's content and/or structure. This ensured consistency of the aspects that were refined, added and/or removed from the original model.

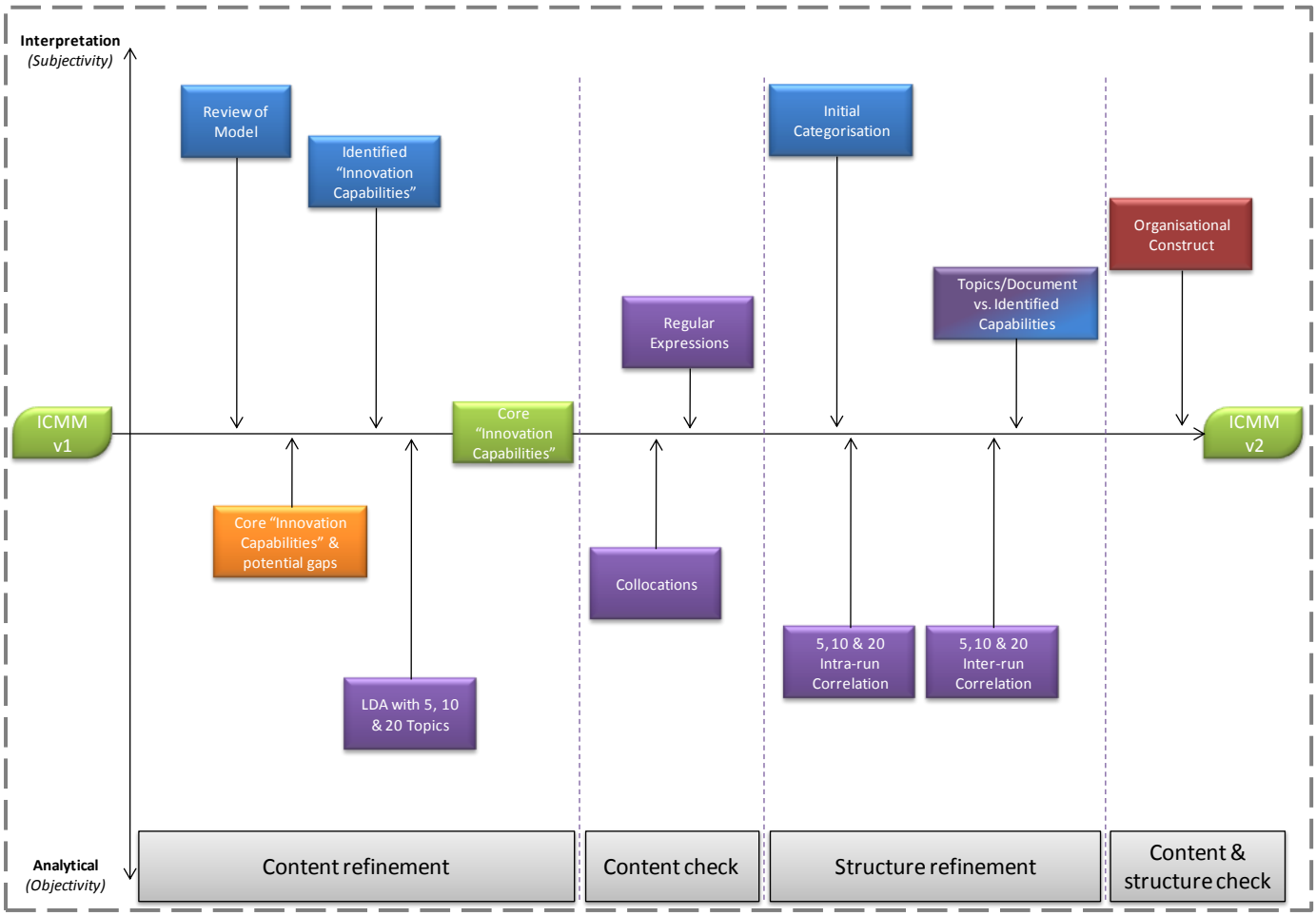

Figure 27 – Consolidation of refinement activities

The activity's outputs depicted as blocks in Figure 27 are colour coded with their respective analyses from the overall refinement process shown in Figure 21. The blue blocks relate to the manual interpretation and summary of the Innovation Capability Corpus (and the author's collective understanding of innovation capability – see Section 5.3.2 and Appendix D), the purple blocks to the outputs of the corpus analysis using CAT (LDA-based topic modelling and other CAT outputs), and the orange block to the Innovativeness Constructs and ICMM v1 mapping. The maroon block represents an aspect not related to any previously discussed activity and is elaborated on in Section 5.4.2.

5.4.1 Content refinement and check

The first and second grey blocks in Figure 27 (from the left-hand side) represent the content-related activities of the consolidation process. The intention is to highlight (through vertical alignment) which of the analyses outputs' were used in the completion of this part of the process.

The first activity of this consolidation process constituted a detailed review of the ICMM v1. The purpose hereof was simply to work through the content of the original model having seen the outputs of the various analyses from this chapter and the added understanding created through the completed activities. The next activity constituted the inclusion of the findings of the Innovativeness Constructs and ICMM v1 mapping exercise (Section 5.3.3). The primary outputs of this analysis were the core Innovation Capability Requirements of the ICMM v1 and the potential gaps therein. Thereafter, the innovation capability themes identified during the manual summarisation (Appendix D) of the Innovation Capability Corpus discussed in Section 5.3.2 were integrated into the content of the model.

The final output to be included in the core content of the refined model was that of the topics identified from the corpus using LDA-based topic modelling. Specifically, the topic labels (described in 5.3.4.4.1) were considered as themes of innovation capability, along with the context that was created for these themes by the various other post-run activities (Sections 5.3.4.4.2 through 5.3.4.4.4).

The green block depicted in Figure 27 represents the culmination of the abovementioned integration activities, the primary output thereof being the so called core "Innovation Capabilities". As a means of testing and verifying this content, the outputs of the Regular Expressions and Collocations analyses (discussed in Section 5.3.4.5) were compared with these core innovation capabilities. Basically, the content of the new model had to address the concepts that were being presented by the expressions and the collocations, either through specific aspects within the content or via a combination of these aspects.

5.4.2 Structure refinement

Once the content had been indentified, refined and established (although never completely – only sufficiently so as to satisfy the author given the context at that specific moment), the structuring process commenced with an initial attempt based on the ICMM v1 structure and the author's basic understanding of the relations between the innovation capabilities.

Once an initial categorisation of the core innovation capability content had taken place, the intra-run (within the 5, 10 and 20 topic runs – discussed in Section 5.3.4.4.3) and inter-run (between the 5, 10 and 20 topic runs – discussed in Section 5.3.4.4.4) topic correlations were used to understand the potential interrelatedness of the core innovation capabilities. This contributed to the structural refinement of the model by highlighting potential capability groupings and revealing any unnecessary overlaps.

The final structuring activity that was performed is represented in Figure 27 by the blue and purple shaded block, referred to as "Topics/Document vs. Identified Capabilities". This activity used the integrated outputs of the CAT document-topic matrix (as discussed in Section 5.3.4.1.2) and the manual summary of the innovation capability corpus presented in Appendix D. From column 5 and on, in Table 13 (Appendix D), the integrated outputs of these two analyses are shown. Basically, for each of the documents within the corpus,

the LDA-based topics that were identified as relevant[7] to those documents (from the document-topic matrix) were listed for each of the 5, 10 and 20 topic CAT runs. When more than one topic within a specific CAT run (5, 10 **or** 20 topics) was found to be relevant to a specific document, then all possible correlations (intra-run – as described in Section 5.3.4.4.3) were shown in Appendix D. These highlight the relevant intra-run or horizontal interrelations. Similarly, all correlations between the relevant topics from different CAT runs (5, 10 **and** 20 topics – as described in Section 5.3.4.4.4) for a specific document are shown in Appendix D. These highlight the relevant inter-run or vertical interrelations.

This made the fundamental link between the author's interpretation of the corpus and the LDA-based topic modelling approach's perspective thereof that was essential to consolidate the results in such a manner that this development process could be made traceable (albeit with a little effort). This implies that the eventual components and structure of the model can be related back to this summary that brings together the manual summarisation of the corpus and statistical analysis thereof. This has positive implications for a methodological approach for improving innovation capability by using Appendix D as a lookup table to identify specific innovation capabilities (see Section 6.1.4.3).

5.4.3 Introduction of an organisational construct

The maroon block in Figure 27 represents the final refinement activity from this portion of the research. The reason for the different colour relates to this activity's independence from the various analyses within this chapter.

During the structure-related consolidation activities (the latter part of Figure 27), it became apparent that a concrete mechanism was required to ensure the comprehensiveness of model content, while minimising the overlapping therein. What eventually surfaced as the most practical and elegant solution, was to create a matrix structure that would ensure the model addresses all the fundamental aspects related to an organisation. The matrix would therefore be formed by two axes: an innovation capability construct and an organisational construct. The relation between these 2 constructs is discussed in more detail in Chapter 6 as part of the ICMM v2.

The construct was developed by combining the fundamental organisational elements of multiple studies including: Zachman (1987), McKinsey's 7 S's model (Zairi 1995), PERA (Williams and Li 1998), GERAM (IFIP-IFAC Task Force 1999), Mugge (2006) and Man (no date). The resultant construct is discussed in more detail in Section 6.1.1.2.

The introduction of this dimension to the structuring of the model was a breakthrough that would prove essential to fulfilling the objectives of this refinement exercise (see Section 5.2). The ability to categorise and refine the content within the resultant framework ensured that the core requirements for innovation capability were aligned with the fundamental aspects of the organisation – thus ensuring the elimination of

[7] Relevant at twice the average mixing ratio – the mixing ratios for a document indicates the spread of the topics over that document. The sum thereof for a document is 1 and has an average equal to the inverse of the number of topics.

content-related gaps and overlaps. This also provided improved understanding of how and where the innovation capabilities would impact the organisation.

5.5 Conclusion

Due to space constraints, and in the theme of keeping the document concise, the discussions of this chapter have been kept short. There is the potentially negative consequence of omitting detail that is important to the outcome of this work. However, while these activities were fundamental to the ICMM v1 refinement process, the process itself is not the intended outcome of this research and, therefore, is appropriately covered by the presented discussions.

One of the observations that can be made from the process discussed in this chapter, as opposed to the process of developing the ICMM v1, is an improvement in traceability. Each of the analyses performed provides a clear path from the literature to the actual components that eventually make up the ICMM v2 discussed in Chapter 6. This serves the purpose of scrutinising the final model, but also serves as a reference mechanism when the time comes to utilise the model in an innovation capability improvement initiative. The methodology behind such an improvement initiative is also discussed in Chapter 6.

The purpose of these analyses and their associated outcomes has been discussed previously. However, it is worthwhile to address this point again in the context of other research. The majority of research is conducted by providing a specific hypothesis and then determining whether there is sufficient evidence to avoid rejecting that hypothesis.[8] Empirical data is then collected, analysed and an evaluation made of the results which leads to a decision on whether to reject or not reject the hypothesis. This was the approach taken by the 7 Innovativeness Construct papers discussed in Section 5.3.3 using the statistical technique Confirmatory Factors Analysis. The purpose of such research is to have an outcome that is as accurate and objective as possible.

While this research does include the findings of these studies, the approach taken was fundamentally different. A proposed model on organisational innovation capability, developed from the literature research of Chapter 3, was compared to the different content- and structure-related outcomes of other research – at least 7 of which are based on empirical studies. Thus, the process of making this comparison was intended to improve the objectivity (and certainly the comprehensiveness) of the model. Thereafter, a LDA-based topic modelling process was used to identify the core themes of innovation capability within a critical corpus of literature (used to develop the ICMM v1, but also including new literature). This too, was intended to improve the objectivity of the model. Therefore, the resultant ICMM v2 is intended to be substantially more objective than the first version thereof. The author is, however, philosophical about the existence of anything truly objective – even empirical studies. Everything is subject to influence from a previous state. Nevertheless, the activities of this chapter eliminated a certain degree of subjectivity from the ICMM v1, and therefore crucially fulfilled an intended purpose.

[8] Based on strict statistical principles, no hypothesis is ever accepted. It is either rejected or not rejected due to a lack of evidence.

6. Innovation Capability Maturity Model – version 2

This chapter will describe the various components of the Innovation Capability Maturity Model in its second version. The model is similar to the first version in terms of content, with a few additions based on the gaps identified through the process described in Chapter 5. However, the model structure, i.e., the categorisation of content and the approach taken to represent innovation capability maturity, has changed substantially. This warrants a complete and thorough description of the refined model, particularly from a structuring point of view. Note that the model presented in this chapter describes the accumulated refinements of the previous chapter (Chapter 5), as well as certain minor refinements derived from the case studies discussed in the next chapter (Chapter 7). A final addition to the second version of the model is a basic Innovation Capability Improvement Methodology – also described in this chapter. Aspects such as the scope and applicability of the model, and the purpose and motivation therefore remain consistent for both the first and second versions thereof. As these aspects are discussed in Section 4.4, they will not be repeated in here.

6.1 Model components

The ICMM v2 components are divided into 3 high-level areas, the first of which being a framework to provide the model with the necessary structure. The second area of the model deals with 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 and final area of the model deals with the organisational roles that are required for innovation.

There are 3 components of the model that do not fall into these 3 areas, but are essential to the utilisation thereof. Effectively, they combine the components of the model into more coherent and pragmatic tools that may be used in the improvement of organisational innovation capability. These components are an Innovation Capability Questionnaire, a response normalisation mechanism and a Capability Requirement Practice lookup table. These components are used in the *Evaluate*, *Plan* and *Improve* stages of the improvement methodology (Section 6.2).

6.1.1 Framework

As mentioned previously, the most significant change from the initial ICMM to the model discussed here relates to structuring. This refers to the categorisation of content, but also to the approach taken to depict innovation capability maturity. The refinement of the model's structure is based on the development of a 3 dimensional framework through the activities of Chapter 5. The 3 dimensions of the framework are: an Innovation Capability Construct, an Organisational Construct and Capability Maturity as depicted in Figure 28.

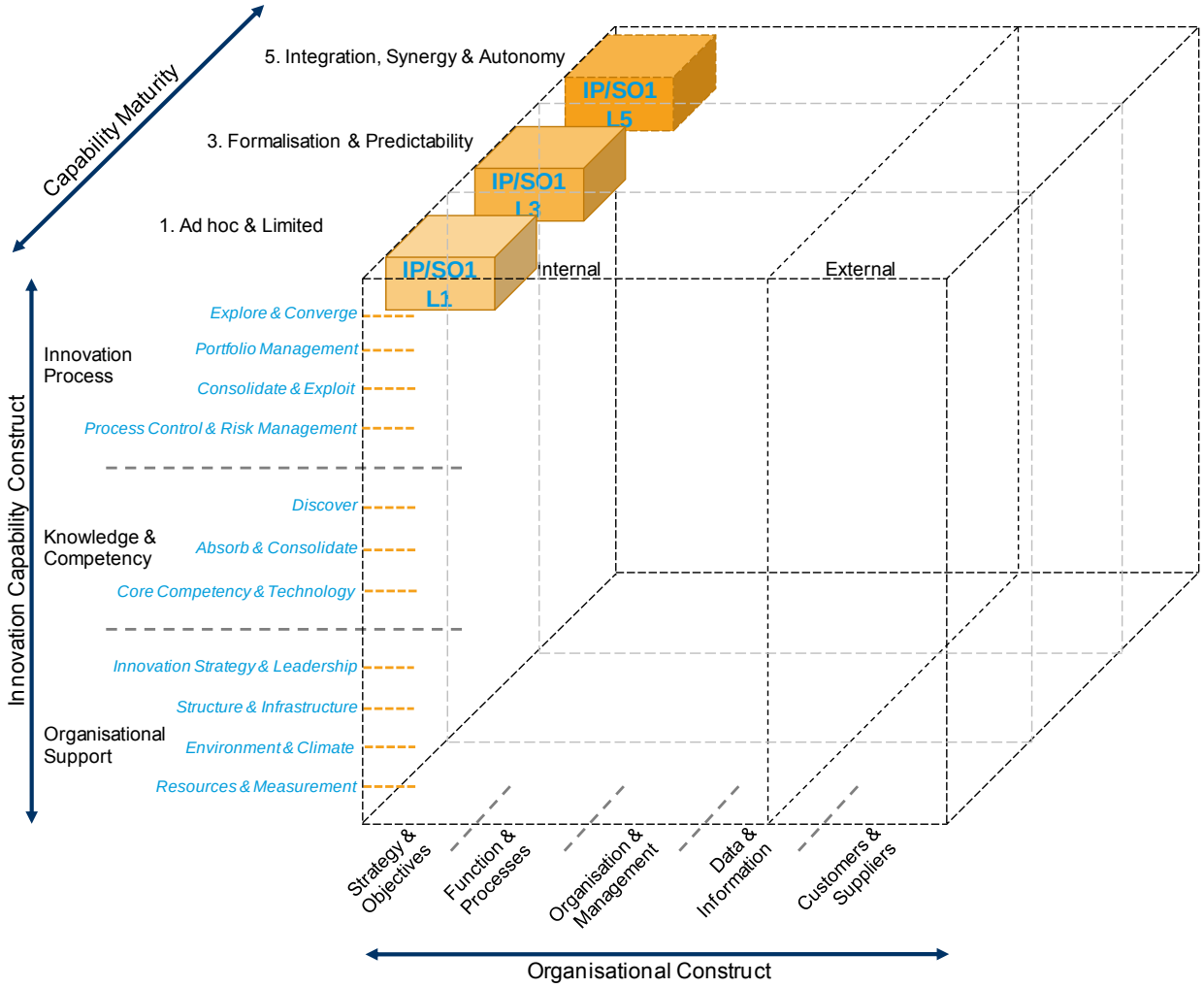

Figure 28 – ICMM v2 framework

This framework was an addition to the ICMM that proved fundamental in fulfilling the objectives for refining the model (discussed in Section 5.2). It enabled easy identification of overlapping aspects and/or gaps in the model's core content. Furthermore, it performs a vital role in demonstrating the interrelations that exist within the model's content.

6.1.1.1 Innovation Capability Construct

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 and the second level components are referred to as Innovation Capability Construct Items.

6.1.1.1.1 Innovation Capability Areas

This high level categorisation of organisational innovation capability is much the same as the one used in the ICMM v1 (see Section 4.4.7). Basically, the model states that there are 3 fundamental areas of innovation capability:

- Innovation Process – the practices, procedures, activities etc. that take ideas and/or opportunities through to concepts, then though development and implementation and eventually to a stage of commercialisation and operation (which may include continuous refinement and optimisation). Basically, it refers to the compete Innovation Lifecycle, as discussed in Section 1.1.4.

- 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.

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

These 3 areas of innovation capability can be represented as a layered set of circles (see Figure 29) depicting the hierarchical nature of the relation between the areas.

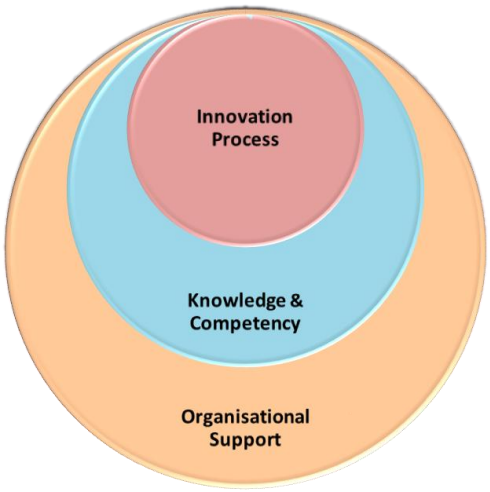

Figure 29 – Innovation Capability Areas hierarchy

The Innovation Process is the essence of an organisation's innovation capability – the actual ability to execute without which there will be no innovation. For this reason, the process is represented on top of the other capability areas and at the core of innovation capability. The next layer is represented by Knowledge & Competency. Innovation is an extremely knowledge- and competency intensive activity – whether sourced internally or externally, available or still under development – the innovation process is supported by knowledge and competency (including technology). Finally, the foundation for innovation lies with Organisational Support. This includes many aspects such as strategy and policies, leadership, functional and team structure, resources, measures, infrastructure, systems, tools, etc. These aspects all contribute in a complex and interrelated manner to an organisational support system (often referred to as culture, climate and/or environment) that enables and encourages innovation.

6.1.1.1.2 Innovation Capability Construct Items

The 3 fundamental areas of innovation capability are subdivided into so called Innovation Capability Construct Items (as illustrated in Figure 28). These items provide a more detailed perspective of the high-level areas and describe the major categories into which the core content of the model (the Innovation Capability Requirements – see Section 6.1.2) is arranged. The Innovation Process items consist of:

- Explore & Converge – searching for opportunities and being receptive to new ideas, and translating these into concepts that could potentially be realised. Also includes developing an understanding of the market and contextualising of opportunities, considering aspects such as technology timelines, regulation, societal changes, etc.

- Portfolio Management – coordinating the organisational resources, the pursued opportunities, prospective opportunities and the existing value offerings to achieve balance within the project portfolio that aligns with organisational strategy and meets objectives. Also includes the testing, screening and prioritising of opportunities and ideas.

- Consolidate & Exploit – effectively and efficiently substantiating, implementing and exploiting prioritised opportunities using appropriate project management techniques.

- Process Control & Risk Management – guiding and controlling the innovation process through effective decision making, and managing and mitigating the risk and uncertainty associated with innovation.

The Knowledge & Competency items consist of:

- Discover – continuous research, networking and collaboration in existing and new fields to improve and build on the knowledge base.

- Absorb & Consolidate – identifying, extracting and capturing relevant information and knowledge in context. Also includes the management of intellectual property.

- Core Competency & Technology – developing and/or acquiring the required competencies and technologies and the management thereof.

The Organisational Support items consist of:

- Innovation Strategy & Leadership – developing and conveying innovation-specific strategy and objectives, and championing and encouraging innovative behaviour.

- Structure & Infrastructure – ensuring that organisational structuring (teams, functional, geographical, etc.) is flexible, adaptable and conducive to innovation, and that the necessary infrastructure is available to support and facilitate innovation.

- Environment & Climate – ensuring that organisational polices, values, practices and procedures contribute to an environment and climate that is conducive to innovation.

- Resources & Measurement – investing sufficiently in innovation, aligning resources with innovation requirements and appropriately measuring innovation-related processes and outputs.

These construct items provide a more detailed view of the factors contributing to organisational innovation capability and were identified through the activities and processes of Chapter 5.

6.1.1.2 Organisational Construct

The original reasoning behind the introduction of an organisational construct and the development thereof was discussed in Section 5.4.3. Essentially, the purpose 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 on these fundamental organisational aspects. The Organisational Construct items are as follows:

- 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.

- 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).

- Organisation & Management – the structures and entities that are tasked with governing and/or controlling the execution of activities in order to fulfil objectives.

- Data & Information – relating to the internal and external environments, the basis for all decision making (from complex strategic decisions to activity-based decisions) and the (communication) link between all internal and external entities (individuals, production lines, departments, management, suppliers, the market, etc.).

- Customers & Suppliers – the customers being willing to pay for the organisation's value offering and the suppliers providing crucial components towards that value offering.

Note that this construct does not pretend to address all the aspects of an organisation. They are however common to all organisations and are necessary considerations to conduct business. As mentioned, by mapping the relations between the Innovation Capability Requirements and these construct items; a much improved understanding of organisational innovation capability is attained.

6.1.1.3 Capability Maturity

The concept of Capability Maturity, used here to represent the third dimension of the framework discussed in this section, is much the same as the concept used in the ICMM v1. Thus, only the aspects that have emerged with the development of the ICMM v2 will be discussed.

Through this development process, it became apparent that a refinement of the generic maturity level descriptions was required (albeit a minor refinement). The most important factor to consider is this generic nature, as the description should relate to each of the 42 Innovation Capability Requirements within the model. The maturity level descriptions that emerged from this refinement process are:

- Level 1 – The organisation is wholly consumed with day-to-day operations – maximising short-term revenue and reducing cost. Individual attempts at being creative or "out-of-the-ordinary" are often dismissed. Innovative outputs are inconsistent and unpredictable.

- Level 2 – The organisation has identified the need to innovate. Innovation is clearly defined. A basic understanding has been established of the various factors that influence innovation. Innovative outputs are inconsistent, but traceable.

- Level 3 – Innovation is supported and managed with appropriate practices, procedures and tools. Individuals are encouraged to be innovative. Innovative outputs are consistent in nature and ensure sustained market share and positioning.

- Level 4 – Practices, procedures and tools for integrating innovation activities are used. A deep understanding has been established of the internal innovation model and its relation to business requirements. Innovative outputs are consistent, diverse and a source of differentiation.

- Level 5 – Innovation practices, procedures and tools are institutional. Individuals are empowered to innovate. Synergy is achieved through the alignment of business and innovation strategy and the synchronisation of activities. Innovative outputs provide sustained competitive advantage in existing and new markets.

Figure 30 provides a graphical illustration of the maturity levels with summarised descriptions thereof. Within this 5 level depiction of innovation capability maturity, it become apparent that only 3 generic descriptions were essential to represent the full 5 level maturity scale. By describing levels 1 and 3, level 2 could be described implicitly as in between these 2 levels. In other words, an organisation thoroughly fulfilling the requirements of level 1, but only conforming to a few of the level 3 requirements, could be categorised as a level 2 organisation. The same argument could be applied to levels 3, 4 and 5. This was important for 2 reasons:

- When providing maturity level descriptions in the questionnaire, the amount of reading that a respondent would need to do to make an assessment of the maturity level for a particular capability requirement could be minimised. This proved essential in reducing the amount of time required to

complete the questionnaire (discussed in Section 6.2.1.2), a major objective posed by the first case study discussed in Section 4.6.

- Respondents completing a questionnaire often provide a status assessment between 2 of the provided options. This was a potential issue confirmed by the Clinical Psychologist from the first case study. Nevertheless, by providing 5 options that are represented by 3 explicit descriptions and 2 implicit middle grounds, such occurrences could be avoided.

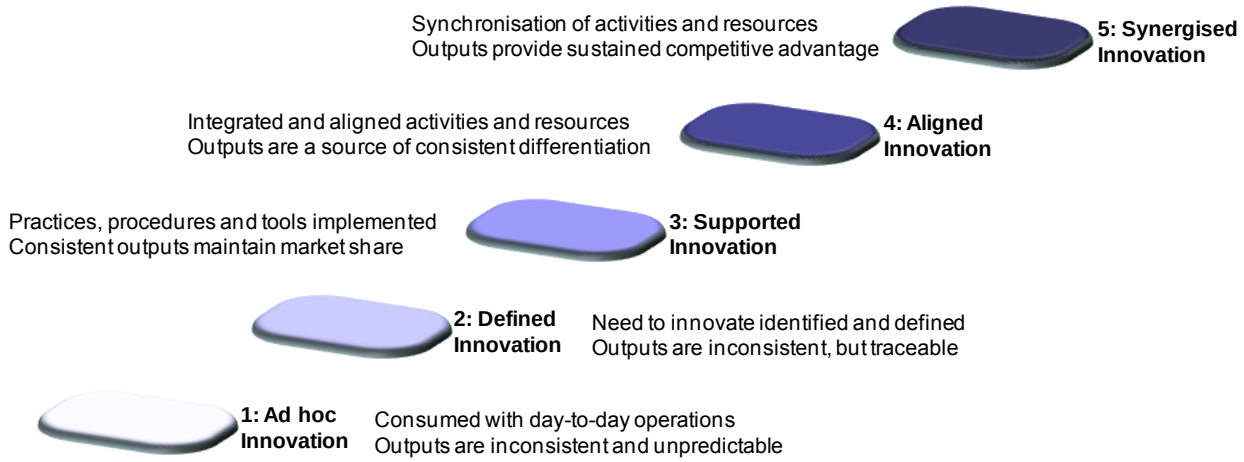

Figure 30 – ICMM v2 Maturity Levels

Generic descriptions of the maturity levels 1, 3 and 5 are as follows:

- **Maturity Level 1:** *Ad hoc & Limited* – innovation related practices and procedures are impromptu and limited in their ability fulfil the requirements for consistent innovation.

- **Maturity Level 3:** *Formalisation & Predictability* – innovation-related best practices and procedures have been indentified and deployed, enabling the consistent fulfilment of the requirements for innovation. This does not imply the deployment of rigid and stifling structure which must be conformed to, but rather a proactive and planned approach to innovating.

- **Maturity Level 5:** *Integration, Synergy & Autonomy* – once formalisation has been attained, institutionalisation of practices emerges, i.e., 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.

These descriptions provided the framework for developing the 3 maturity level descriptions for each of the 42 Innovation Capability Requirements as discussed in Section 6.1.2 and presented in Appendix G.

Figure 31 presents an illustration of how these descriptions translate into the more detailed depictions of innovation capability. The diagram translates these 3 high-level descriptions of innovation capability maturity to the Innovation Process capability area.

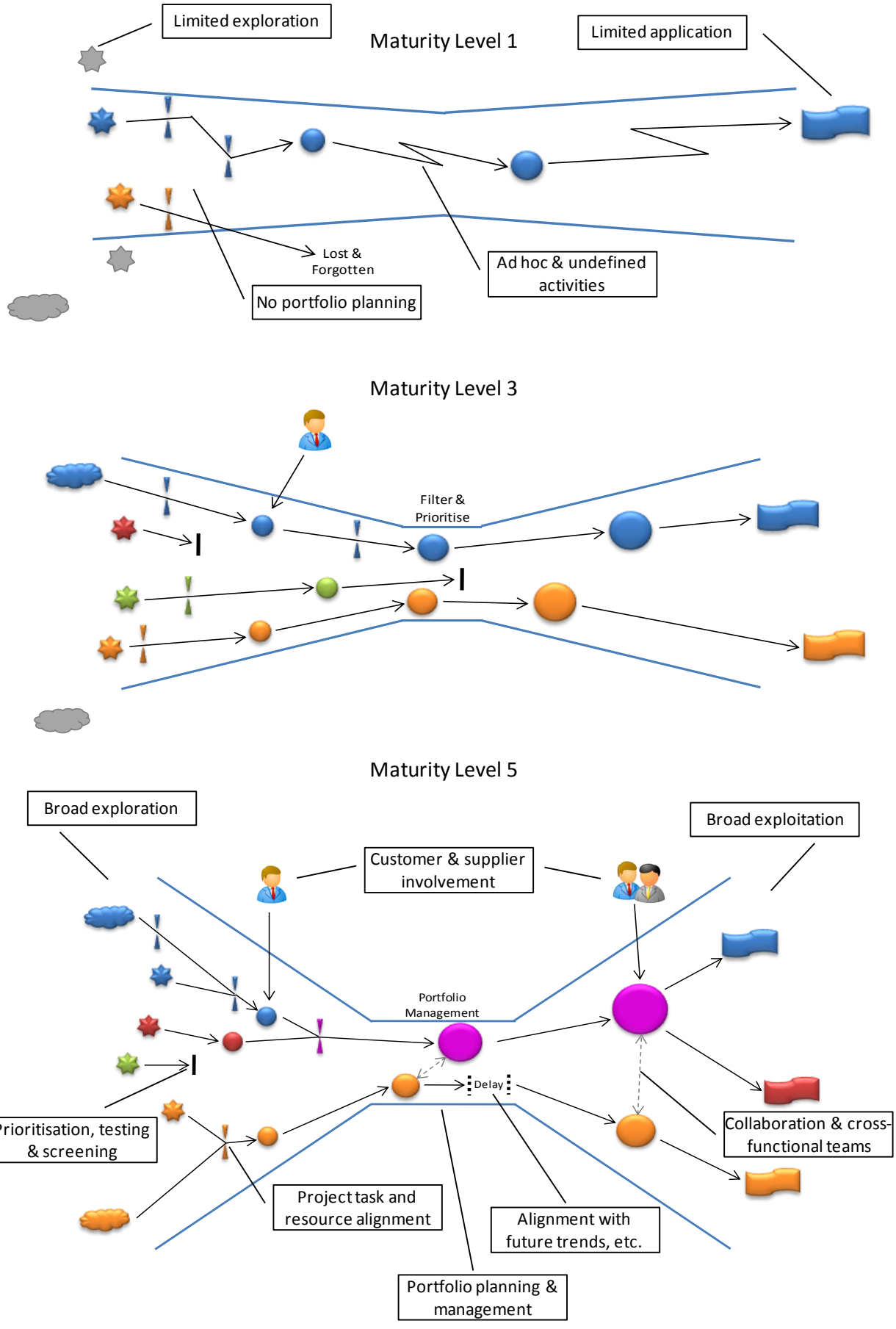

Figure 31 – Illustration of Innovation Process maturity levels

Note: Although seemingly contradictory to the freedom required to think creatively, the development of "formalised" practices and procedures is part of the maturing process. It forces the organisation, leaders and individuals to think about best-practices and the way things should be done. Formalising those practices then ensures that individuals are working in a best-practice manner. Once this has been achieved, improved understanding of, order in, and predictability of these practices would enable an individual to perform tasks in a slightly different manner (more in line with their preferences) that is both beneficial to the individual and organisation.

Additionally, "institutionalisation" can in certain circumstances imply conforming to rigid practices, procedures and structure. In this context, it refers to the acceptance of formalised practices so that the individual, group and organisational behaviours relating to and required for those practices, become second nature – without the need for encouragement. One may then argue that such institutionalisation stifles change within organisations. But, when one of the core requirements for being innovation capable is to be flexible, adaptable and accepting of change, then the behavioural acceptance of this requirement, i.e., the institutionalisation thereof, is facilitative of innovation. Thus, being able to unlearn institutionalised strategies, practices, systems, behaviours, etc. is a requirement that should be "institutionalised". This is an essential consideration in the interpretation of the ICMM.

6.1.2 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 activities and analyses of Chapter 5, 42 requirements were identified as elementary to the assurance of organisational innovation capability.

By way of example, the manner in which these requirements are categorised into the framework (discussed in Section 6.1.1) will be explained. Consider the capability requirement: 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 in total) for this requirement are as follows:

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

Figure 28 (p135) demonstrates how the capability requirement IP/SO1 **–** *Scanning & exploring for latent opportunities*, and the abovementioned maturity levels, are categorised into the model's framework.

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, otherwise there would have been a total of 55 requirements (as a result of the 11 x 5 matrix formed by the 2 constructs). Figure 32 demonstrates how the 42 capability requirements map onto the front-facing 2-dimensional plane of the framework (the matrix formed by the Innovation Capability- and Organisational Constructs).

The mapping onto the matrix in Figure 32 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).

While the model does not specify the nature of the relations, many can be logically deduced (reasoned). As an example, again consider the capability requirement: IP/SO1 **–** *Scanning & exploring for latent opportunities*. As part of the *Explore & Converge* construct item, inherent relations exist with several capability requirements, including: *Contextualising opportunities & concepts* and *Understanding the market.* The relation with the first is an action-oriented one – once opportunities have be identified, it is necessary to add context to the opportunities by understanding them in relation to future technologies, regulation, society, and with the organisation's strategy and existing value offerings. The second requirement has a more supportive relation – opportunities may be more easily identified with improved understanding of the market.

As mentioned above, each of the 42 Capability Requirements is described at 3 levels of capability maturity (levels 1, 3 and 5 – as discussed 6.1.1.3). These descriptions will be used to provide the reader with a better understanding of the requirements. More importantly, however, these descriptions play a fundamental role in the questionnaire (page 1 of which is shown in Appendix I). They provide the scenarios with which respondents may evaluate (compare) their organisation(s). These maturity level descriptions are presented in Appendix G.

6.1.3 Innovation Roles

Innovation-related roles provide an additional means of relating capability requirements to one another and understanding the 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 by adding context to the responses of individual respondents (comprehensively discussed in later sections). This section will discuss how the specific innovation roles were identified and provide a brief description of each of the roles that were eventually used.

Innovation Capability Construct \ Organisational Construct		Internal				External	
		Strategy & Objectives	Function & Processes	Organisation & Management	Data & Information		Customers & Suppliers
Innovation Process	**Explore & Converge**	IP/SO1 - Scanning & exploring for latent opportunities	IP/FP1 - Identifying opportunities IP/FP2 - Developing concepts	IP/OM1 - Contextualising opportunities & concepts	IP.KC/DI1 - Capturing, storing & retrieving data & information IP.KC/DI2 - Formal & informal internal networking & collaboration	IP.KC/DI2 - Formal & informal external networking & collaboration	IP/CS1 - Understanding the market
	Portfolio Management	IP/SO2 - Balancing the innovation portfolio IP/SO3 - Using fundamental principles to guide process & make decisions	IP/FP3 - Testing, screening & prioritising opportunities & concepts	IP/OM2 - Planning & coordinating the innovation portfolio IP/OM3 - Allocating resources appropriately			IP/CS2 - Involving customers & suppliers in the innovation process
	Consolidate & Exploit		IP/FP4 - Substantiating, implementing & exploiting opportunities	IP/OM4 - Using appropriate project management techniques			
	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/SO2 - Establishing intellectual property management & sharing policy	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/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/FP3 - Organisational practices & procedures	OS/OM2 - Creating cross-functional & multidisciplinary teams OS/OM3 - Developing flexible & adaptable organisational structure & infrastructure			
	Environment & Climate			OS/OM4 - Motivating, rewarding & celebrating success			
	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			

Figure 32 – Innovation Capability Requirements categorised into constructs

The literature was surveyed for research on the various roles relevant to innovation. Four pieces were identified as applicable in this regard: IBM (2004), Hering and Phillips (2005), Taylor (2005), and Kelly and Littman (2006). What then commenced was a distillation process that involved combining the overlapping roles and reducing them to the most essential core roles. Reducing them to the core was a primary objective because these roles would be used within the questionnaire, where it would be impractical to provide a lengthy list for respondents to identify with (see Section 6.1.4.1 for more on the implementation of the roles within the questionnaire). The number of roles presented by the literature ranged from 7 in Taylor (2005) to 24 in IBM (2004). As would be imagined, the level of detail at which each of the roles was being represented also differed substantially.

The details of the distillation process are presented in Figure 63 (Appendix H). The roles from the literature were related to one another, consolidated and then reduced to the core innovation roles in this table. The 5 innovation roles and representative descriptions that emerged from this process are as follows:

- 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.

- 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.

- 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.

- 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.

- 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.

As mentioned, these roles were used within the questionnaire to add the necessary context to the individuals' responses and assist with the generation, interpretation and presentation of results.

6.1.4 Supplementary components

As mentioned previously, there are 3 supplementary components of the model that support the execution of the Innovation Capability Improvement Methodology. These 3 components are briefly discussed in this section.

6.1.4.1 Innovation Capability Questionnaire

In order for the innovation capability maturity of an organisation to be determined, a mechanism is required to relate the situation within that organisation to the contents and structure of the ICMM v2. The innovation capability questionnaire is intended to fulfil that purpose. The process is, therefore, reliant on the organisation's members relaying that situation to the analyst via the questionnaire (the effectiveness thereof discussed in much detail in Chapter 7). The first page of the questionnaire appears in Appendix I (the remainder thereof may be deduced from the contents of Appendix G). The questionnaire itself consists of the following sections:

- 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.

- Role description – the innovation role profile of a respondent is determined using the Innovation Roles of Section 6.1.3. Individuals are only exposed to and/or responsible for certain requirements. This influences their responses and needs to be accounted for during interpretation. Therefore, it is essential that the profile provided by the respondent be as accurate as possible.

- Innovation status description – the respondent is tasked with providing a once-off rating of the organisation's innovation capability maturity. Additionally, each progressive description of innovation capability maturity links with a corresponding status of innovation-based outcomes. This once-off rating is later related to the outcomes of the overall results of the case studies to determine the relevance thereof (see Section 7.6.3).

- 42 Capability Requirement questions – there is a question for to each of the Innovation Capability Requirements. The procedure is for the respondent to relate the situation within his/her organisation to the maturity level descriptions (as mentioned in Section 6.1.2) and mark the level that corresponds with the internal situation.

The design of the questionnaire was a fairly basic process with the primary objective of minimising the respondents' time to complete the questionnaire, but still extracting the necessary information. Therefore, only certain basic principles were used in the design thereof as prescribed by Zikmund (2003). The author must concede, however, that the questionnaire, and the mechanisms required to ensure unbiased responses or detect bias, should be addressed further. While the questions are simple and direct, there is no cross-

referencing or reverse coding. Additionally, an infrequency test should be included. These specific improvement areas are discussed in Section 8.3.

6.1.4.2 Role-based and aggregated normalisation of responses

The utilisation of a roles-based normalisation mechanism is based on the premise that individuals, and their specific role within the organisation, are related to capability requirements via their **exposure** to or **responsibility** for those requirements. This would influence the manner in which they answered the questions relating to those requirements. This should, in turn, influence the consolidation and interpretation of their responses. In order to do this, a normalisation process was devised based primarily on the role profile provided by the individuals in the questionnaire.

Other normalising parameters are also applied to aggregate the detailed results and establish the high-level construct-based results (shown in Figure 47 for instance). The 3 parameter sets are as follows (as depicted in Figure 33):

- Parameter Set 1 – based on the participants' roles profiles (obtained from questionnaires) and for a particular role, each of the contributions from each of the participants is normalised so that the sum of all those contributions is 1. Each participant's relative contribution to a particular role is, therefore, the weighting applied to that participant's responses.

- Parameter Set 2 – the different roles have different exposure to and responsibility for the capability requirements. A particular role may be a *primary*, *secondary* or *limited* role-player in the fulfilment of a requirement. Accordingly, the respective weightings of 1, 0.5 and 0.0 (which may be slightly adjusted to accommodate for the requirements of a particular organisation) are applied to the 3 role-player "levels". This role-player level assignment to each of the capability requirements may be seen in Appendix G (columns 3, 4 and 5).

- Parameter Set 3 – as depicted in Figure 32, the 42 capability requirement do not map on a one-to-one basis to the constructs. Therefore, the rating obtained for a particular capability requirement (having implemented weightings 1 and 2) is mapped onto the constructs based directly on the mapping shown in Figure 32. This implies, for instance, that the rating obtained for the requirement *Balancing the innovation portfolio* (IP/SO2) is linearly distributed amongst the *Portfolio Management*, *Consolidate & Exploit* and *Process Control & Risk Management* innovation capability construct items (i.e. each construct item receiving 33.3% of the requirement's rating in contribution to its totals). This weighting, therefore, accounts for the explicit interrelations between the capability requirements and provides a more representative aggregation of the results.

This process, therefore, intentionally biases the responses of individuals that have more exposure to and responsibility for specific Innovation Capability Requirements, thereby reducing the variance in the overall representation of results (seen in the case studies of Chapter 7). The responses of individuals who have less exposure to particular requirements, and whose responses are logically more deviant from the actual

situation, have less influence (weight) on the overall results. The effectiveness of this mechanism is tested with a sensitivity analysis in Section 7.6.2.

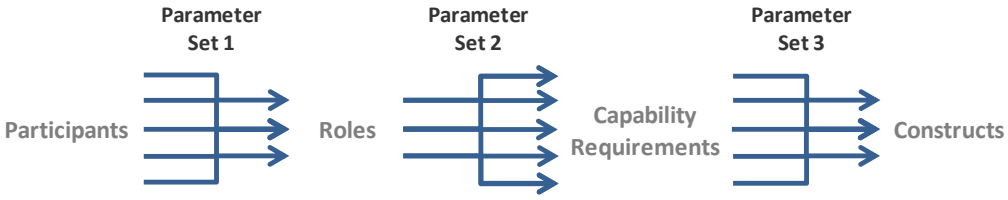

Figure 33 – Normalisation of responses

6.1.4.3 Capability Requirement Practice lookup table

Basically, this table (Appendix D) is one of the outputs generated through the activities of Chapter 5. In short, it relates the manually summarised innovation capabilities of the analysed corpus of literature (discussed in Section 5.3.2) to the LDA-based innovation capability topics identified from the same corpus. This was achieved by listing each of the relevant inter- and intra-run relations (as discussed in Section 5.3.4.4) between topics for each of the documents, where relevance is defined as one of those topics having twice the average mixing ratio for a specific document (where the average mixing ratio for a 5 topic run is 1/5 = 0.2 for instance).[9]

The idea is that an organisation, having completed the Innovation Capability Improvement Methodology to the point that a set of prioritised Innovation Capability Requirements have been identified, uses the lookup table to identify the literature-based best-practices for fulfilling those requirements. This would be the first step in identifying the organisation-specific practices, tools, techniques, policies, etc. to fulfil the prioritised requirements. While the best-practices from the literature would not necessarily fulfil these requirements as-is, they do provide a basis from which to launch an identification and/or development process.

6.2 Innovation Capability Improvement Methodology

The development of an Innovation Capability Improvement Methodology was proposed on completion of the first case study with the ICMM v1. For this model to be beneficial to organisations, a method would be required to improve the innovation capability of an organisation using the model's framework and components as a generic reference of organisational innovation capability. This method should describe the basic activities and their associated inputs and outputs, to take an organisation from one level of innovation capability maturity to the next. The so called Innovation Capability Improvement Methodology presented in this section is intended to fulfil this mandate.

[9] Note that this table is not sorted for effectiveness as a lookup table, but it can be used to identify highly relevant literature relating to specific innovation capabilities and topics.

Before continuing, it is important to note that this methodology is not an extensively researched and refined process. Basically, it is a guideline for using the ICMM v2 to improve the innovation capability of an organisation.

The methodology is a basic, 3 stage process that utilises various components and sub-components of the ICMM v2 (discussed in this chapter), and certain aspects used in the development of the model (discussed in Chapter 5). The stages represent the high-level activities of the case studies presented in Chapter 7. Therefore, the case studies proved fundamental in the development and refinement of the basic methodological framework that evolved throughout the execution thereof. The three stages of the methodology are *Evaluate*, *Plan* and *Improve*, as depicted in Figure 34.

The first observation from Figure 34 is the cyclical nature of the process, represented by each of the stages leading onto the next – including the final stage (*Improve*) leading onto the first stage (*Evaluate*). This implies that the methodology is a continuous improvement-type approach, i.e., the conclusion of one improvement cycle signifies the commencement of the next. Thus, any improvement in innovation capability derived from improvement cycle X, is intended to be measured and accounted for during the *Evaluate* stage of cycle X+1. Then, the *Plan* stage of cycle X+1 takes into consideration the planned improvements of cycle X as well as the results from the evaluation X+1 to develop the new improvement plan. The 3 stages of the methodology will now be discussed in more detail.

6.2.1 Evaluate

The *Evaluate* stage of the methodology serves as the kick-off for an innovation capability improvement initiative. Basically, the organisation's innovation capability is assessed against the Capability Requirements of the ICMM v2.

Individuals from the organisation (or business unit) being assessed are asked to complete a questionnaire that is intended to reveal the potential innovation capability improvement areas. These improvement areas are identified during the interpretation of the completed questionnaires and the gap analysis of the organisation's innovation capability maturity results. The high-level activities of this stage include evaluation planning, an evaluation workshop in which the questionnaires are completed, processing of the responses, interpretation of the results and a gap analysis. These activities are depicted in Figure 34.

6.2.1.1 Evaluation planning

The first activity of the methodology is a meeting in which the basic activities are discussed with the management of the organisation and/or the instigators of the evaluation. In addition to this, certain aspect should be clarified, including:

- Specific organisational objectives for the evaluation – apart from the general objectives of performing such an evaluation, the organisation may have specific aspects that they would like to address.

- Context – ascertain whether the evaluation should address the organisation as a whole or a specific business unit therein. The importance of this should be emphasised with the individuals. (The reason why it is important is discussed in Section 6.2.1.2.1.)

- Specific perspectives on the results – various views may be taken on the responses and results from the questionnaire. This is, however, subject to the relevant data (such as years in business unit, team, etc.) being captured in the questionnaire.

This meeting need not be a lengthy one. Basically, it is used to determine the specific reason(s) for performing the evaluation and to inform the relevant stakeholders of what to expect.

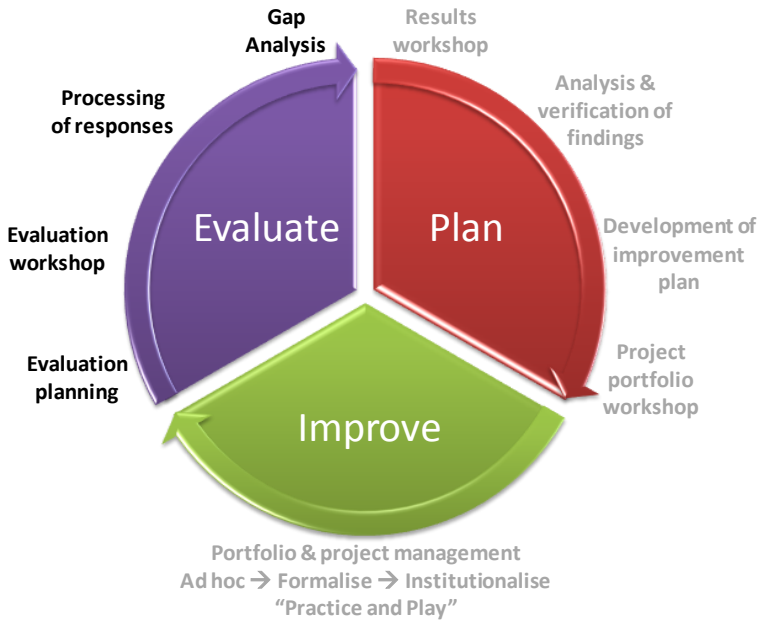

Figure 34 – Evaluate stage of improvement methodology

6.2.1.2 Evaluation workshop

The second activity in the *Evaluate* stage of the methodology is a facilitated session with the individuals of the organisation (or business unit) in which the Innovation Capability Questionnaire is completed. The reason for titling this session a "workshop" is to signify the interactive nature of thereof. The workshop is intended to:

- Create sensitivity for innovation capability requirements – participants are made aware of the requirements for developing an organisational innovation capability.

- Plant the seed for discussion – participants are stimulated to discuss their initial reactions to the questionnaire, while their responses are still fresh.

- Assess the innovation capability maturity – by way of the Innovation Capability Questionnaire, describe the actual innovation capability maturity of the organisation.

- Provide the basis for the improvement initiative – the conclusions from discussions and the assessment provide the input for the later activities of the *Evaluate* stage and during the *Plan* stage of the methodology.

6.2.1.2.1 Introduction and Context

The session commences with a very brief presentation with the sole purpose of clarify potentially unclear aspects within the questionnaire. No information on the ICMM and improvement methodology is offered to avoid any potential influencing and biasing of responses. The participants should respond to the questions as spontaneously as possible (avoiding over-rationalisation and hidden agenda such as considering how one may answer to benefit ones selves). Information provided includes certain definitions of words that have specific meanings within the questionnaire.

The most important part of this introductory presentation is providing the context for answering the questionnaire. The context specifies how participants are to relate the questions to their organisation and what specifically is being assessed – the organisation as a whole, a particular business unit, etc. This would have been established in the earlier meeting with management for instance. The reason why this context is so important is because it provides a common basis for respondents to complete the questionnaire. If one participant considers the Sales Department, while another, the organisation as a whole; their responses become incomparable. The problem is that the analyst (who processes these responses) probably would not even know. It is, therefore, essential that this context be emphasised in the introductory presentation.

6.2.1.2.2 Completion of questionnaire

Once the presentation has been completed and any questions from the participants answered, the participants are introduced to the questionnaire. The first section, the respondents' general information, is completed without (much) guidance.

The next section, however, requires emphasis to ensure that the participants provide answers that are as accurate as possible. This section, the roles description (see Section 6.1.4), provides the analyst with the necessary understanding of the each of the respondents' role within the organisation to better interpret their responses and appropriately calculate the results. Participants are, therefore, carefully guided through this part of the questionnaire.

The remained of the questionnaire, the innovation status description and the 42 Capability Requirement questions, are fairly self explanatory and, therefore, completed by the participant alone. However, a facilitator is required throughout the session to answer any queries that the participants may have.

6.2.1.2.3 Discussions between participants

Apart from the innovation capability maturity results that are presented in a later session, the biggest short-term benefit from such an exercise is the discussion that comes of it. This session and the questionnaire are intended to stimulate discussion, as participants have their responses and relative perspectives of the

organisation fresh in their minds. Individuals present their different views, discuss what they think are the strengths and weaknesses and the possible reasons therefore. Many participants from the case studies (Chapter 7) stated that they found the discussions that ensued as a result of the evaluation process (both in the session and thereafter) interesting and relevant to the challenges that they face as an organisation. It is, thus, crucial that the facilitator (and the analyst) take as many notes as possible while the participants are discussing these aspects. This is particularly important if the analyst has had limited previous exposure to the organisation.

6.2.1.3 Processing of responses

An important aspect of an 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 being evaluated.

Once the evaluation workshop has been completed, the analyst captures the responses and calculates the results, i.e. determines the innovation capability of the organisation (or business unit). However, very little can be extracted from the single maturity rating – 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. In terms of results, the following levels of aggregation may be obtained:

- Overall Innovation Capability Maturity – the highest level of detail, a single rating between 1 and 5 signifying the overall innovation capability maturity of the assessed organisation (referred to as overall, normalised average innovation capability maturity level in the case studies).

- Innovation Capability Areas – the 3 high-level areas of innovation capability represent the second level of detail. A single rating between 1 and 5 is provided for each, signifying the organisation's ability to fulfil the *Innovation Process*, *Knowledge & Competency* and *Organisational Support* requirements.

- Innovation Capability- and Organisational Construct Items – the 11 and 6 respective construct items for innovation capability and the organisation represent the third level of detail. Again, each construct item receives a single rating.

- Innovation Capability Requirements – the lowest level of detail, the 42 capability requirements each receive a maturity rating between 1 and 5 depicting the level at which the organisation fulfils the requirements.

In addition to these levels of aggregation, the results may take on various perspectives that include:

- Participants-based – the results based on the raw responses of participants, i.e., averaged and consolidated without any biasing or normalisation.

- Roles-based – using the roles-based normalisation mechanism to load the participant's responses based on their innovation role profiles captured in the questionnaire.

- Other (management, years in organisation, etc.) – various other views on the results at the request of participants and relevant stakeholders. For instance, in Case Study 2, the view of management was compared to that of the other members of the organisation. The differences between these 2 views highlighted potential communication gaps between the 2 parties (see Section 7.1 for more details).

Figure 35 demonstrates the combinations of results that may be obtained when combining the levels of aggregation and perspectives. Depending on how many "Other" perspectives there are, the total number of different perspectives that could be obtained and analysed is large. This reiterates the importance of determining the specific requirements of the organisation during the initial planning activity.

Note that the perspectives in Figure 35 (participant- and role-based and other) are depicted as mutually exclusive views on the data. This is not always the case. For instance, consider the view of all participants and the view of management – the later is essentially a subset of the former. The figure merely demonstrates that different views may be taken on the same data leading to different depictions of organisational innovation capability.

The ability to take these "Other" views depends on the data captured in the general information section of the questionnaire. It is, therefore, recommended that this be discussed with the instigators of the evaluation before the workshop is conducted, i.e., during the evaluation planning (as discussed in Section 6.2.1.1). It may in certain circumstance be possible to obtain the necessary data after the fact, although this is not ideal as it will mean re-establishing contact with all the participants unnecessarily.

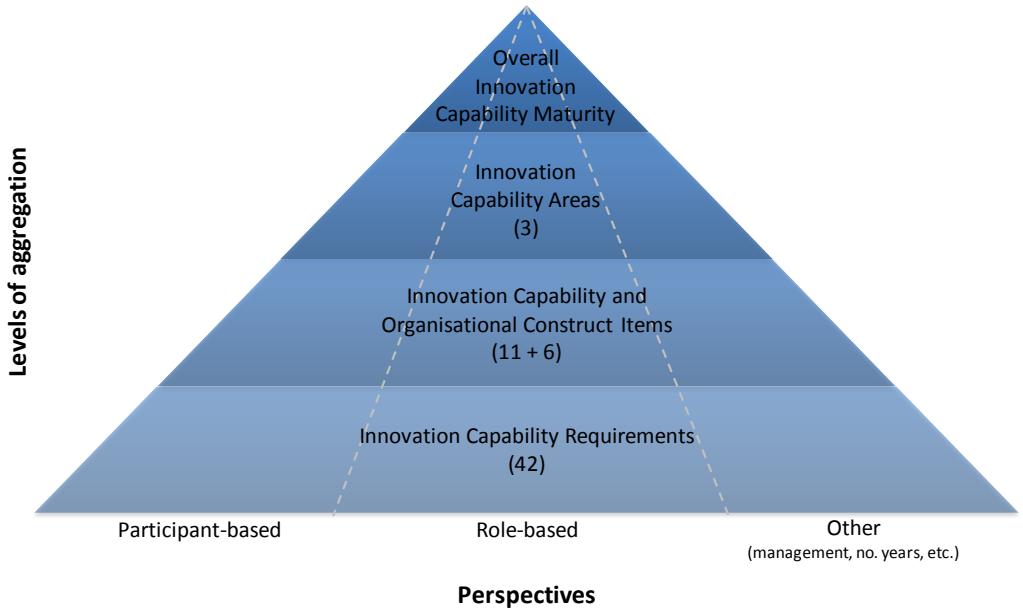

Figure 35 – Evaluation results aggregation and perspectives

6.2.1.4 Interpretation of results

In interpreting the results and identifying the strengths and weakness of an organisation, there are 2 factors that should be considered. The first is the actual rating (or level of maturity) and the second the differences in these ratings between the different perspectives, whether it be between individuals, between management and the rest of the organisation, between the different innovation-based roles or between different departments within the organisation. The differences in ratings indicate differing perspectives that should be addressed, while very similar ratings indicate consensus as to specific areas of strength or weakness. Figure 36 demonstrates how these 2 factors can be graphically interpreted and assists in identifying aspects that may need further consideration.

Firstly, note that the specified boundaries for strength and weakness (above maturity level 3 for the former and below level 2 for the latter) and for the difference in perspective (standard deviation of 1 maturity level between perspectives) are based on basic logic, as opposed to analytical methods or best-practice from literature.

Any maturity level rating above or equal to 3 implies that, for a particular requirement, formalised practices and procedures have been implemented and are (generally) successful in the fulfilment of that requirement. The organisation therefore enjoys relative strength in terms of this capability requirement. However, a capability requirement that is perceived to be fulfilled at a maturity level 2 or less makes a limited and ad hoc contribution to the organisation's overall innovation capability.

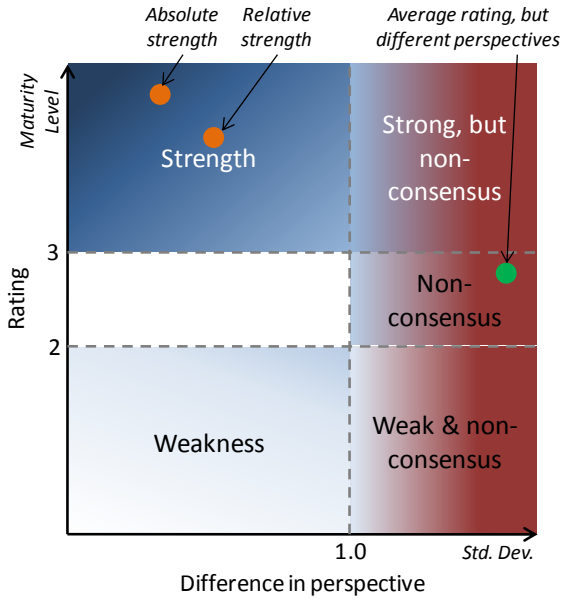

Figure 36 – Rating and difference in perspective matrix

An organisation that has an overall innovation capability maturity level that is high may have many requirements above maturity level 3. Therefore, their absolute strength may lie with specific capability requirements and not with all those requirements that are above maturity level 3. This point is demonstrated

in Figure 36 by the orange circles. Thus, it is important to consider both the relative positioning and the absolute values of the results during interpretation.

The standard deviation between results is used as the measure of difference in perspective when more than 2 entities are compared. When only 2 entities are being compared, such as between management and the rest of the organisation, then a simple difference between their ratings is used.

Figure 36 demonstrates how these differences (in this case based on the standard deviation) can be interpreted with the value of the rating. The green circle represents an average maturity rating (around 2.5), but the standard deviation between the individual ratings is high (above 1.0) and should therefore be investigated. The difference in perspective could be due to several factors including communication gaps, lack of exposure to certain participants, or simply differing opinions. Irrespective of the reason, those results where substantial variation between the responses is identified should be investigated further.

6.2.1.5 Gap analysis

Once the responses have been processed and the results interpreted, the specific opportunities for improvement can be identified. Basically, the objective is to determine which of the Innovation Capability Requirements the organisation should focus on improving. Several factors are taken into account during this activity:

- The organisation's objectives for the evaluation – as stipulated during the evaluation planning (Section 6.2.1.1).
- Various other organisational aspects – including size of the organisation, core business and value offering, strategy, industry and the nature of the competition therein, etc.
- The results viewed from multiple levels of aggregation and various perspectives – as discussed in the previous 2 sections.

This is certainly not an exhaustive list. Each organisation will be unique in some or other way and these uniquenesses need to be taken into consideration when identifying the opportunities for improvement. In short, certain Innovation Capability Requirements may have higher strategic importance to an organisation's core business (and future business). This is a fundamental consideration in the identification of opportunities for improvement.

While those capability requirements showing substantial variation in the results do not necessarily present opportunities for direct capability improvement, they certainly need to be considered during later discussions (see Section 6.2.2.1.1). The differences in perspective and/or opinion should be communicated to and clarified with all participants.

Therefore, simply selecting those capability requirements with the lowest ratings as the candidates for improvement initiatives is an oversimplification. Multiple factors need to be taken into consideration. Much of

the prioritisation is done in combination with the participants, taking into account the unique situation of the organisation and using the respondent's understanding thereof. However, certain basic recommendations need to be made by the analyst when presenting the results (see Sections 7.1.3 and 7.3.3 for examples). These initial recommendations only provide a platform for the participants to work from during the facilitated session in which they are presented. The completion of this activity signifies the end of the *Evaluate* stage of the methodology.

6.2.2 Plan

The *Plan* stage of the methodology constitutes the development of an innovation capability improvement plan based on the outputs of the *Evaluate* stage. The organisation's innovation capability related strengths and opportunities for improvement have been indentified based on the completed questionnaires. Based on these results, the high-level activities of the *Plan* stage of the methodology include presenting the results to the participants, discussing the implications thereof and whether they are valid or not, performing a more detailed analysis within the organisation to verify the findings, developing an improvement plan, and holding a final workshop to discuss the improvement plan and plan the portfolio of projects. These activities are depicted in Figure 37.

Figure 37 – Plan stage of improvement methodology

6.2.2.1 Results workshop

This stage commences with a workshop in which the results generated during the *Evaluate* stage are presented and discussed. Also included in this presentation is some basic information about the ICMM v2 and the associated components. The intention of presenting this is to provide the participants with a basic understanding of the framework behind the questionnaire and the relations that exist between the questions therein (the essence – the requirements for innovation capability).

6.2.2.1.1 Presentation of results

The presentation of results is an essential part of the innovation capability improvement process. Apart from the obvious fact that the participants will better understand their organisation's innovation capability hereafter, buy-in as to the relevance of the whole process is either obtained or forgone at this point. The results mean very little without the individuals within the organisation being able to identify with what is being presented. This does not imply that everything being presented has to be known; otherwise the exercise would have been pointless. It does means that the results need to stimulate a response – someone needs to say, "Oh yes, I understand why this has been happening! It all makes sense now." If this kind of response is not obtained, then something has gone wrong, whether it is inaccuracies in the model, biased responses to the questions, or a host of other potential problems. This buy-in is essential if the improvement initiatives that follow on from these activities are to be successful. Therefore, this session must be an interactive one, involving all the participants and allowing them to discuss the presented results.

The challenge for the analyst is to show the appropriate amount of detail to the participants, without overloading them with information. As discussed in the Section 6.2.1.3, the different levels of aggregation and perspectives can lead to many results that need to be interpreted. Thus, the analyst needs to carefully select and present the most appropriate levels of aggregation and perspectives – essentially those that allowed the analyst to make his/her interpretation of the organisation's innovation capability. If it is difficult to identify which results would be beneficial to the participants, it may be necessary to hold a smaller meeting with a few key individuals in which the detailed results may be presented and discussed. These individuals could assist with the interpretation and selection of the most relevant results to present to the larger group.

A realisation from the case studies of Chapter 7 is that both the opportunities for improvement, as well as the strengths, should be discussed. In part, this has the purpose of ensuring that the participants are not bombarded with purely negative information, but also that they develop a complete understanding of their overall innovation capability. More importantly however, certain strengths may be used as leverage points for the improvement of the weaknesses.

6.2.2.1.2 Prioritisation

The second part of the results workshop involves prioritising which of the opportunities for improvement should be target for improvement initiatives. Essentially, this means selecting for improvement those capability requirements that will bring about the greatest overall improvement in innovation capability with the minimum effort and expenditure of resources. There are several considerations in doing so:

- The Organisational Support capability requirements provide essential support structures, systems and behaviours for the capability requirements of Knowledge & Competency and Innovation Process. Likewise, those of Knowledge & Competency provide the necessary support for the Innovation Process capability requirements. Thus, prioritisation thereof may occur in a bottom-up manner as demonstrated in Figure 38.

- The interrelatedness of the capability requirements and their impact on the organisation must be considered. Figure 32 demonstrates the explicit[10] relations and impacts and should be understood and used during the discussions of this workshop.

- Each organisation is unique. It is defined my several factors that include: the industry in which it operates, size, value offering, strategy and objectives, organisational values, etc. An organisations' appetite for and need to innovate vary – it only needs to be more innovative that its competitors (although the competitors may continuously be trying to improve their capability to innovate). It is therefore not necessary that all organisations improve their innovation capabilities to maturity level 5. Certain capability requirements are strategically more relevant than others at certain stages of growth and development (but none are irrelevant). For this reason, the participants are involved as rigorously and actively as possible in the prioritisation of requirements.

- The organisation's operational environment and the existing innovation project portfolio need to be taken into consideration and aligned with the innovation capability improvement initiative. This is discussed in more detail in Section 6.2.3.3.

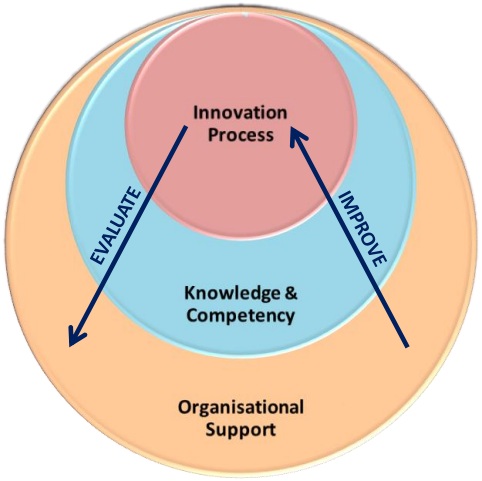

Figure 38 – Innovation Capability Areas prioritisation

Based on the evaluation, the analyst should take the abovementioned into consideration to make a recommendation to the organisation as to what opportunities to prioritise. The participants then should consider this recommendation and then make a final decision as to the specific priorities considering their available resources and specific needs. This concept is highlighted by Figure 39.

The eventual output of this workshop should be a list of the Innovation Capability Requirements that the organisation will target for improvement. The length of this list should be in line with the organisation's need to and appetite for innovation, the resources that are available and can be dedicated to an initiative, the overall innovation capability of the organisation and its relation to its competitors.

[10] Identifying the implicit relations and their impact on prioritisation is an area for additional research and discussed further in Section 8.3.

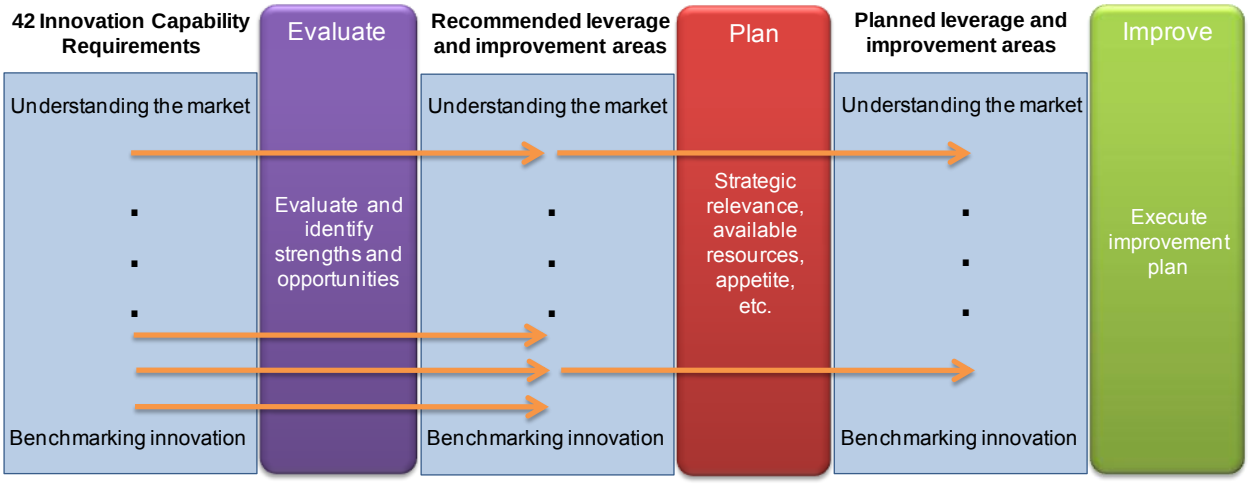

Figure 39 – Organisational influence on prioritisation

6.2.2.2 Analysis and verification of findings

Once the areas for improvement have been identified and prioritised, it is necessary to spend a period of time (possibly 1 or 2 weeks) analysing the actual situation within the organisation to establish the reasons for the perspectives of the participants, i.e., determine what caused them to give the responses they did. This is essential to realise an improvement in the organisation's innovation capability through an initiative. To solve (or rather mask) the symptoms that surfaced during the evaluation will not improve anything, particularly not over the long-term. It is therefore vital that the root causes of these symptoms be identified before specific improvement plans be developed and initiated. Various established techniques can be used in this exercise, including root cause analysis, cause and effect (or fish-bone) diagrams, Theory of Constraints' affinity diagrams, etc.

6.2.2.3 Development of improvement plan

Based on the prioritised requirements and the analysis and verification activity, an innovation capability improvement plan can be developed. This is where the generic nature and applicability of the ICMM begins to reduce substantially in favour of a customised solution that is unique to the organisation. In the case studies of Chapter 7, several discussions were held on the applicability of this approach (ICMM and improvement methodology) to organisations of different sizes, from different industries and with different value offerings. In each case, it was discussed how the Innovation Capability Requirements are relevant to all organisations, but that unique instantiations of those requirements were necessary to realise improved innovation capability within a particular organisation. Therefore, the manner in which an organisation fulfils these requirements is unique to that organisation.

There are however certain aspects of the ICMM v2 that can be used to facilitate the process of identifying the best possible means for fulfilling those requirements. The first is to use the table presented in Appendix D as a lookup for best-practices that have been used previously by other organisations to fulfil their specific (or similar) requirements. Alternately, a benchmark organisation may be referenced which has been

identified as a strong performer in this regard (having completed the *Evaluate* stage of the methodology). This organisation may even be in a different industry with different needs. The point is to ascertain what works for other organisations and, from there, adapt and develop the specific instantiation that is suited to the organisation. Involving the relevant stakeholders from the organisation in this activity is essential to ensure that the eventual solution is an appropriate one.

Other literature and research may also be used as a guideline for fulfilling the specific needs of the organisation. An interesting tool that may be used in the execution of this activity is that of CAT (Corpus Analysis Toolkit – as used in the development of the ICMM v2 and discussed in Section 5.3.4). Having used the tool to identify the various topics within the Innovation Capability Corpus (discussed in Section 5.3.1), it can now be used to search that corpus for relevant literature that relates specifically to the Innovation Capability Requirements being targeted. Furthermore, the corpus should grow over time with the identification of new best-practices and CAT can be used contextualise these practices in light of the existing frameworks.

Note: 2 of the case studies of Chapter 7 reached this stage of the overall Innovation Capability Improvement Methodology and were, therefore, instrumental in the development of the methodology to this point. Remaining discussions propose the necessary activities to complete the improvement cycle.

6.2.2.4 Project portfolio workshop

Having analysed the situation within the organisation and developed the improvement plan therefore, it is now necessary to discuss (in detail) these aspects with the relevant stakeholders within the organisation. This may require a workshop-type environment, where participants can interactively discuss the plan and the implications thereof. The following aspects (at least) should be considered in this workshop:

- The findings of the analysis and verification activity (Section 6.2.2.2), and the implications thereof in terms of the prioritised capability requirements.
- The planned solutions and how they will improve and impact the overall innovation capability of the organisation.
- The project plans to implement those solutions and their impact on the operational environment, existing innovation projects, other projects and the portfolio as a whole, and the resources available to execute those projects.

The outcome of this workshop should be a planned and coordinated portfolio of projects that have been rated according to factors including (but not limited to) strategic alignment (relevance to organisation), importance (potential to improve capability), risk, urgency (timing), and so on. The detailed project plans may require additional refinement given the events and discussions of the workshop. However, the foundation for the innovation capability improvement initiative should have been finalised.

6.2.3 Improve

Basically, this stage of the methodology deals with the execution of the plans developed and discussed in the previous section. As opposed to the previous 2 stages of the methodology, this stage has not been developed and refined through the activities of the case studies. Thus, these activities are proposed based on what would typically be necessary to complete the innovation capability improvement process. This primarily involves the utilisation of established portfolio and project management tools, techniques and methods. Two additional aspects that form part of this stage of the methodology deal with a generic improvement framework for the 42 capability requirements and coordinating the improvement of innovation capability with the actual execution of innovation projects. These aspects are depicted in Figure 40.

Figure 40 – Improve stage of improvement methodology

This stage should typically take longer to execute than the preceding stages, as it may involve the deployment of major organisational changes. Obviously, this is largely dependent on the nature of the planned improvements and should be considered during project and portfolio planning and realised during the execution thereof.

6.2.3.1 Portfolio and project management

Portfolio and project management have well defined and documented tools, techniques and methods that have been used and refined many times over. Having said this, there are aspects therein that are continuously being updated to accommodate for an environment of accelerating change. Extreme Project Management (De Carlo 2004), for instance, presents a comprehensive methodology for managing projects with high levels of uncertainty and/or risk, and contributes to an ever growing literature focussed on the subject. Although this is outside of the scope of this study, and therefore not discussed further, it is important to note that guidelines for effectively managing so called "extreme" projects are available.

There are various other tools, techniques and systems apart from the traditional (such as Gantt charts, work breakdown structures, critical path analysis, etc.) that can assist in the execution, coordination and management of an organisation's project portfolio. These include (but are not limited to):

- Web-based collaboration tools that include document management – such as Indutech's EDEN™ and Microsoft Sharepoint Server.

- Roadmapping techniques – describe the various steps of an innovation project and serve as a guiding framework for execution. As utilised in EDEN™, they facilitate in the capturing and sharing of knowledge within and between project teams and across different projects, ensuring concurrent collaboration throughout the planning and execution thereof.

This is a topic of research in itself and will therefore not be discussed further, but to state that the concepts addressed therein are essential in the successful execution of an innovation capability improvement initiative and its coordination with the organisational project and innovation portfolio.

6.2.3.2 Generic improvement of capability requirements

This section will present a basic framework (Figure 41) for improving each of the 42 Innovation Capability Requirements from ad hoc and inconsistent, to formalised practices, procedures and tools, and finally through to institutionalised behaviour and integrated activities.

It describes, generically, how organisational aspects such as (but not limited to): strategy, objectives and policies; processes, practices, procedures and tools; infrastructure, systems and resources; and individuals and groups, that contribute to organisational innovation capability in interrelated ways, may be improved from an ad hoc, restrictive and ill-defined status to institutionalised, integrated and/or autonomous.

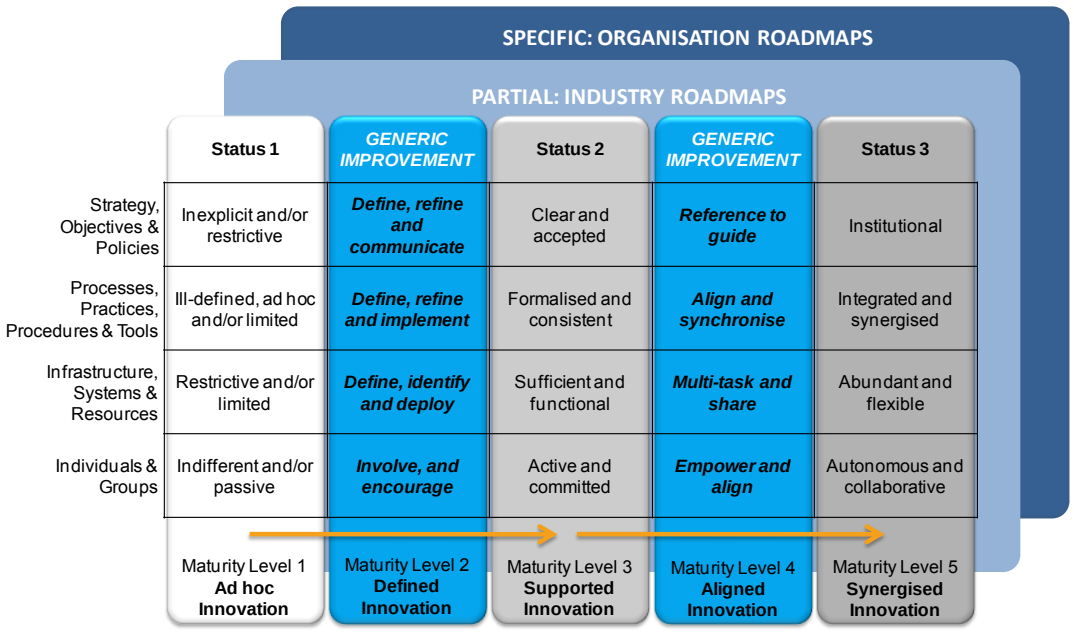

Figure 41 – Capability Requirement improvement framework

The framework does not prescribe specific strategy, practice, system, behaviour, etc. improvement plans however. These specific roadmaps may be developed for an organisation (or even an industry) based on the framework, but addressing their unique situation and needs, and taking into consideration their existing innovation capability.

6.2.3.3 Parallel execution with innovation projects

The following proposal is not based on any completed research. It is basically a recommendation that uses a metaphor to provide justification therefore. In essence, it is recommended that organisations execute innovation capability improvement initiatives in parallel with the execution of actual innovation projects (as depicted in Figure 42).

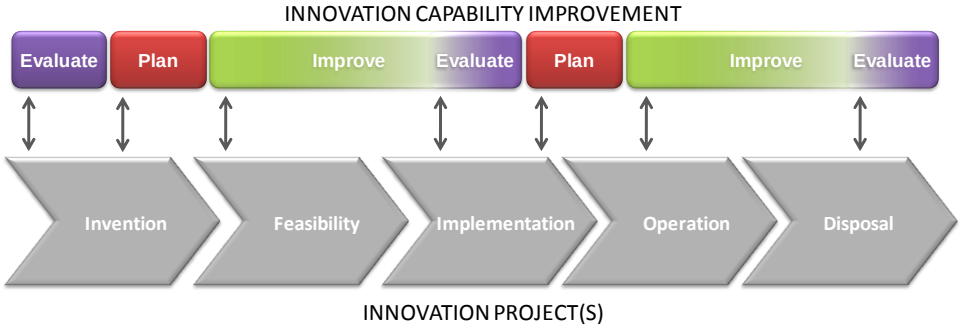

Figure 42 – Parallel execution with innovation projects

A metaphor that relates to sport in general could be used, but for this discussion the team sport of soccer is appropriate. Consider then, the "practicing and playing" patterns of a soccer team. Playing matches on a Saturday is the essences of the sport. The team has to consistently perform better than its competitor during the match to beat them. This is also the performance that is viewed by external parties and the one that creates the image of the team.

This can be compared to the execution of actual innovation projects. The organisation must perform, consistently, throughout this activity to beat the competition – it does not help if a brilliant idea cannot be effectively taken to market. The value offering based outputs of the innovation process (along with branding and marketing) are also the "face" of the organisation and portray a particular image to external parties. Additionally, the more matches a team plays, the better the team becomes at playing matches. In the same manner, the more projects an organisation completes, the better it should get at completing successful projects; even if those projects were unsuccessful (this obviously assumes some degree of organisational learning).

The team's practicing during the week is analogous to an organisation proactively improving its capability to innovate. During practice, a team will work on specific aspects of their game that may be lacking in an effort to improve their Saturday performances. Similarly, the intention of improving innovation capability is to address certain fundamental areas (the Innovation Capability Requirements) within the organisation that may be affecting their innovation performance.

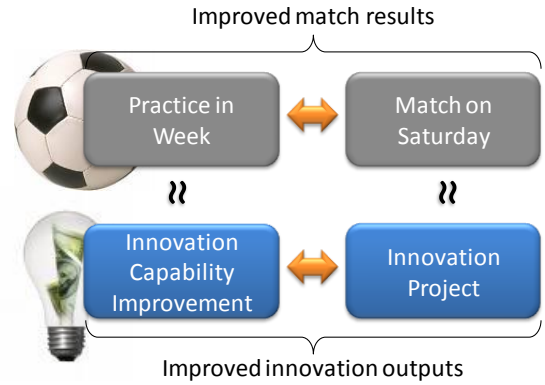

Figure 43 – "Practicing & Playing" metaphor

Based on this metaphor, it is recommended that capability improvement initiatives be executed in parallel with actual innovation projects in an effort to extract maximum benefit from their outputs. The objective is to stimulate mutual learning between the two initiatives and thereby achieve synergy. Thus, it is postulated that the most effective means of improving innovation capability **and** generating innovative outputs is based on the simultaneous execution of projects and improvement initiatives (as depicted in Figure 43).

These parallel processes should interface at several points (as depicted by the arrows in Figure 42) to facilitate cross-initiative learning and improve the outcomes of both. Ultimately, by being innovative, simultaneously improving innovation capability and ensuring mutual learning between the two processes, better results should be achieved.

6.2.3.4 Initiating the next cycle and measuring the benefits

On completion of the improvement activities, the *Evaluation* stage is reinitiated to gauge the effect of the innovation capability improvement exercise (and begin the next improvement cycle – depicted in Figure 42). The overall success of the initiative may be measured against the targeted improvements by recompleting the questionnaire. Preferably, the same individuals should be involved as well as various "unpolluted" individuals that may be used as a reference. These individuals would not have been directly involved in the previous cycle's activities and their responses **should**, therefore, be independent thereof.

Once the impact of the initiative has been gauged, any shortcomings should be traced back though the completed activities to identify the source thereof. Corrective action should be instigated as early as possible (if possible) to avoid complete adoption of ineffective solutions (practices, methods, tools, etc.).

Probably the most difficult part of having completed an improvement initiative is to determine the impact thereof on the organisations bottom line – the growth of which is essentially the primary objective of any organisation (barring non-profits). This is a research question that continues to pervade the literature – the direct impact of innovation on the bottom-line of an organisation. Even linking the long-term effects of a specific initiative is difficult because of the often complex nature of an organisation's portfolio (specific product successes may be an exception at times). As discussed in Section 1.1, the primary objective of innovating is to improve the competitiveness of an organisation. Surely, this has positive implications for an

organisation's bottom line, but the exact impacts remain a topic of further research. Nevertheless, efforts to trace improvements therein to specific initiatives may prove necessary to warrant further improvement initiatives (if not in the short-term, then certainly in the long-term).

6.2.4 Scheduling and resourcing

Figure 44 demonstrates the typical human resource requirements and schedule for executing one cycle of the improvement process. It takes the perspective of a consultancy, as would often be the case in an application of the methodology, offering the *Evaluate*, *Plan* and *Improve* stages as a service to its client. The figure describes when inputs are required from specific individuals or groups.

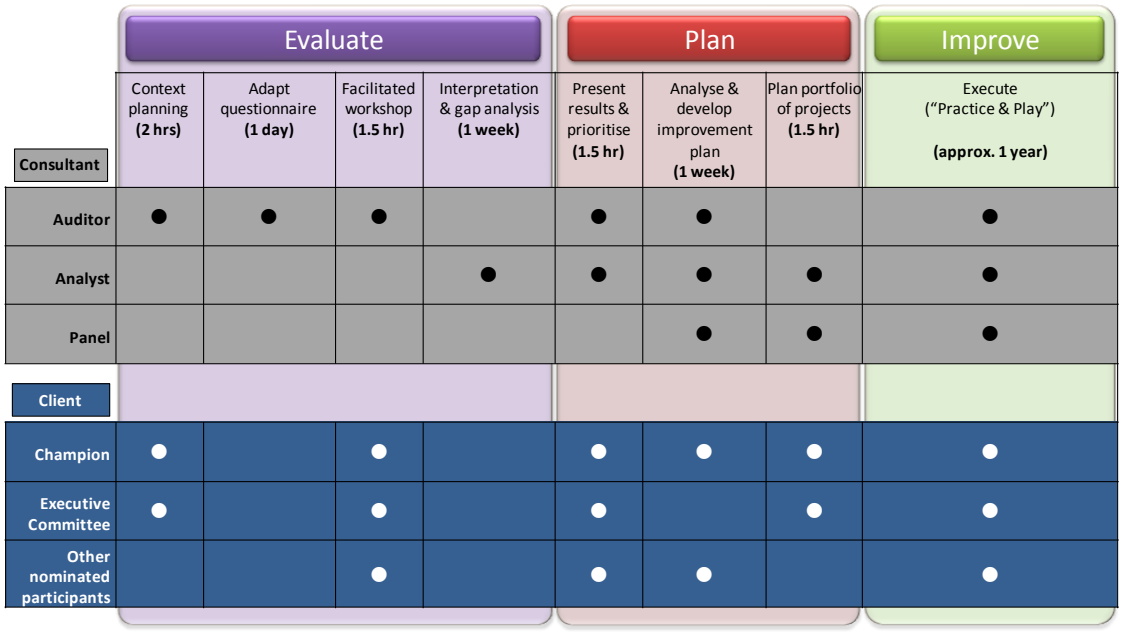

Figure 44 – Methodology scheduling & resourcing

Additionally, it proposes specific durations for each of the activities within each of the stages of the methodology. These durations are recommendations based on the case studies discussed in Chapter 7. They are, therefore, only a guideline and can be adjusted to suit the specific circumstances of a given initiative. The only activity not based on the case studies is that of the *Improve* stage, which requires a lengthy project (or projects) to implement the proposed improvements of the *Plan* stage. The duration of this activity will also show the most variation due to the vast differences between potential projects.

The final remark on Figure 44 pertains to getting involvement and buy-in for the process. If an internal champion from the organisation (client) – someone with a high level of authority – is not obtained, convinced of the benefits and appointed to drive the initiative from within, the intended improvements will, more than likely, not be achieved. This person is essential to give the initiative the necessary credit and demonstrate the importance thereof, drive and motivate individuals to participate and provide the appropriate go-aheads and sign-offs. Additionally, this individual plays a crucial role in the interpretation of results (along with his or her executive committee) and in making (or rejecting) the links between the

analyst's interpretations and the realities of the organisation. The importance of involving such an individual was made very clear through the activities of the case studies (Chapter 7).

6.3 Conclusion

To conclude this chapter, 3 points will be discussed that are important to keep in mind when considering the relevance and applicability of the ICMM v2 and the associated improvement methodology. The first pertains to the generic nature of the model. 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.). This level of detail cannot be directly related to a specific level within the ICMM v1. One of the learnings from the case study with the ICMM v1 was that the lowest level was overly detailed, specifying many practices in an effort to ensure universal applicability. The ICMM v2, however, does not specify any 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 (2005), is the same in every organisation.

The second point relates to the Innovation Capability Improvement Methodology and the fact that it is not an extensively researched and refined process. Basically, it is a guideline for using the ICMM v2 to improve the innovation capability of an organisation that was developed through the case studies. A significant amount of research should still be performed to complete, verify and refine the methodology. The specific areas that should receive the focus of this research are discussed in Section 8.3.

The final point of discussion pertains to the concept of meta-innovation, one of the Innovation Capability Requirements of the model, and its relation to the institutionalisation of the other proposed requirements. It may seem contradictory to propose the institutionalisation of certain practices, procedures, tools, etc. to become more innovative when the ability to adapt to an ever changing environment is the purpose of being innovative. Already discussed in Section 6.1.1.3, as the meaning of "institutionalisation" in this context – the acceptance of formalised aspects so that the individual, group and organisational behaviours relating to and required for those aspects, become second nature, without the need for encouragement. One should not confuse this with the interpretation of enforcing rigid and inflexible structure. The institutionalisation of meta-innovation then, i.e., the adaptation of the innovation model, deals with the need to continuously learn new practices, procedure, tools, etc. and become proficient therein, but then also being able to unlearn those practices, procedure and tools when they become ineffectual or obsolete (and being able to identify when that is).

7. ICMM v2 Case Studies

This chapter discusses the 5 case studies that were executed using the ICMM v2 as described in Chapter 6 and developed through the activities of Chapter 5. The primary purpose of these case studies was to evaluate the content and structure of the model, but also the mechanisms used to translate these concepts into organisational innovation capability improvement. While this would be the ideal validation process, the case studies were not taken through a complete cycle of the improvement process. Certain cases progressed further than others, but none were completed. This is due to the duration of such an exercise, requiring anything from 1 to 2 years. The model would therefore need to be validated from another perspective based on a partially completed process. It was assumed that should the model and the associated methodology appropriately identify the organisation's strengths and weakness, to the extent that participants could relate to the results, conclusions and the recommended actions, then the model would have served its purpose.

Further, the sequential execution of these case studies was instrumental in the development of the basic improvement methodology. As they were conducted, the methodology was progressively refined to the stage in which it is presented in Chapter 6.

7.1 Case Study 2 – Innovation Management consultancy

The second case study of this research (first using the ICMM v2) was with an innovation management consulting firm, specialising in developing, facilitating and managing their clients' innovation process in a collaborative manner, i.e., in conjunction with the client. Specific activities include: critical analyses of business processes, systems and structures; opportunity identification considering both the internal and external environments; solution development; process design including both green-fields and re-design; and programme and project management. The organisation has various value offerings that facilitate the above mentioned including: software for supporting and managing the information and knowledge requirements of the innovation process; frameworks, methodologies and tools describing and enabling the innovation process; and an approach that assimilates these software tools and methodologies (or processes) into a coherent package to manage the innovation process (referred to as roadmapping).

7.1.1 Context

An essential part of an innovation capability evaluation and improvement initiative is to clarify and make explicit the context of the initiative. In this particular case, the context was discussed with the management of the organisation and decided upon as follows:

- Evaluation of innovation capability would be of an internal organisational perspective, i.e., relating to policies, practices, tools and structures for internal innovation and not what is offered to clients.
- Individuals would take a perspective of the organisation as a whole when answering questions (as opposed to a departmental view) and all available employees would complete the questionnaire.

7.1.2 Evaluation procedure

This section will briefly describe the various activities undertaken during the *Evaluate* stage (see Section 6.2.1) of the case study. Being the first case with ICMM v2 and the methodology, this procedure was less refined than it was in the latter cases. With that said, each of the activities performed proved useful, from both a model evaluation perspective and an organisational innovation capability evaluation perspective. Activities are presented in the order in which they were performed, except where it made sense to group certain activities (and which has no influence on the readers' interpretation).

7.1.2.1 Initial exposure

The expertise held within this organisation in the field of innovation management provided an ideal opportunity to evaluate the model from a slightly more detailed point of view than what would normally have been done at another organisation. Thus, the basics of the model's structure and content were presented to the various experts within the organisation with the objective of identify obvious deficiencies therein. The experts included the CEO, Business Engineering Services Manager, Research Manager, Integrated Services and Support Manager and Marketing Manager. The basic conclusion reached was that the fundamental structure was sound. However, while obvious gaps were not apparent then and there, going through the complete exercise (including the evaluation, interpretation of results, prioritising of opportunities for improvement, etc.) would provide improved clarity and highlight less obvious gaps.

7.1.2.2 Management workshop and preliminary results

This session was the first introduction of the model in a format that would become part of the overall innovation capability evaluation and improvement initiative. It was here, with the management of the organisation, that the context (as described in Section 7.1.1) was discussed and decided upon. Further, the evaluate section of the Innovation Capability Improvement Methodology was performed. This included an introduction to the process and the basics of the ICMM v2, an introduction to the questionnaire and assistance with the completion of the first section thereof. Thereafter, the participants completed the remaining 42 questions pertaining to the Innovation Capability Requirements in an uninterrupted manner.

Once all participants had completed the questions, various points were discussed, including:

- Having post-evaluation discussions with each participant to ensure accuracy of the role profiles (due to it having a significant impact on results).
- Whether the model basics and structure should be presented before or after the evaluation and how this may impact the responses.
- Providing the initial context is essential to obtain appropriate and accurate responses.
- The value of understanding the ICMM v2 in context with other organisational improvement models such as EFQM, 6σ, CMMI, etc. (discussed in the Preamble to this dissertation).

The session ended with these discussions. Thereafter, management's responses were processed and the preliminary results (therefore, the perspective of management alone) presented in a second session. Because these results are similar to the overall results and where differences did arise, are highlighted as part of the consolidated summary (see Section 7.1.3); these results are not discussed here. Basically, the conclusion from these results was that the organisation would need to:

- Formalise and make explicit a relevant innovation strategy that is aligned with the overall business strategy.
- This would provide the framework for establishing and/or improving:
    - The testing, screen and prioritising of opportunities and concepts
    - Development and/or acquisition of new competencies and technologies
    - The identification, reduction and mitigation of uncertainty and risk
    - The measurement of innovation-related outputs.

Management confirmed that the summarised results, conclusions and proposed actions were representative and that the initial improvement tasks could be instigated. However, the perspectives of the remaining individuals within the organisation needed to be gauged before the improvement initiative could commence fully, as these perspectives may have presented a different view.

7.1.2.3 Workshop with clinical psychologist

A session was held with the organisation's clinical psychologist that would serve a dual purpose. He was tasked with taking two perspectives during the session that would enable this dual purpose. The two perspectives were:

- As a clinical psychologist with experience in performing questionnaire-based assessments and in understanding peoples reaction to, and interaction with, similar processes. From this perspective, suggestions and critique of the questionnaire (initial questions, structure, "look and feel", wording, etc.) and the associated process, could be obtained.
- As the organisation's clinical psychologist, implying that he take a human resources- and organisational culture-based role. From this, a very specific view could be obtained of the organisation's innovation capability.

The process after explaining the abovementioned was very similar to the one taken with management. This included an introduction to the evaluation and model, an introduction to the questionnaire and assistance with the completion of the first section thereof. Thereafter, the remaining 42 questions were completed in an uninterrupted manner.

Similar discussions (to those with management) took place after having completed the questionnaire, the most important of which were (relating to the first perspective taken as discussed above):

- The importance of the initial context to ensure accurate and appropriate responses.
- The importance of getting the participants' initial response to a question, i.e., avoid over rationalisation which often leads to biased responses. Related to this, participants should not back track and change answers based on other questions and answers.
- Developing an infrequency test to determine whether responses are inconsistently doctored.

Other considerations included having different languages for the questionnaire and various aesthetics-related aspects. In general, the questionnaire (and the associated process) was found to be appropriate, with wording sufficiently simple and generic, the required time and effort suitable, and the questions being suitably independent to stimulate individual answers, but showing sufficient interdependence to give the impression that a background framework exists.

7.1.2.4 Internal sessions

In order to get responses from and accommodate the remaining members of the organisation, 2 sessions were held in which the evaluation was introduced and the questionnaire answered. These sessions did not present the background information on the model, as it was decided during the previously discussed sessions with management and the clinical psychologist, that this may have a biasing effect of the responses. As would be the case for all other evaluation sessions from here on, a brief introduction was presented, highlighting the purpose of the evaluation and the context for answering the questions (discussed in Section 7.1.1). This introduction included the following aspects not presented to management and the clinical psychologist:

- Basic definitions of certain terms used in the questionnaire that have a specific meaning therein.
- A specific request to give "gut responses" to questions.
- The importance of providing a fairly accurate role profile and that each respondent would be met with after the session to clarify this section of the questionnaire.

This session was not followed by discussions as were the other sessions. This was postponed to the presentation and discussion of results.

7.1.3 Summarised results

For the purpose of privacy, very detailed results are not presented in this section. The intention is to highlight a few of the aggregated results that led to the conclusions made and discussed below. Basically, it is the responsibility of the analyst (in this case the author) to consider the discussions of the evaluation sessions and the questionnaire responses, and translate them into a concise but accurate representation of

the organisation's innovation capability maturity. Essentially, this means summarising the *Evaluate* stage of the Innovation Capability Improvement Methodology to provide the primary input for the *Plan* stage thereof.

There were 21 respondents in total. The overall, normalised average innovation capability maturity level was 2.7. The average standard deviation between respondents[11] was 1.0 and between roles[12] was 0.2. A summary of the organisation's innovation capability, based on the 3 Innovation Capability Areas (discussed in Section 6.1.1.1), is presented in Figure 45 from the perspective of the participants and in Figure 46 from the perspective of the roles.

Clearly evident from a comparison between these 2 figures is the reduced variance in the perceived innovation capability maturity from a respondent view, to a roles-based view (the detailed reason for and intention behind this, is discussed in Section 6.1.4.2). Basically, the roles-based perspective intentionally assigns more weight to the responses of individuals that have more exposure to and responsibility for specific Innovation Capability Requirements, thereby reducing the variance in the overall representation of the results (as seen in Figure 46).

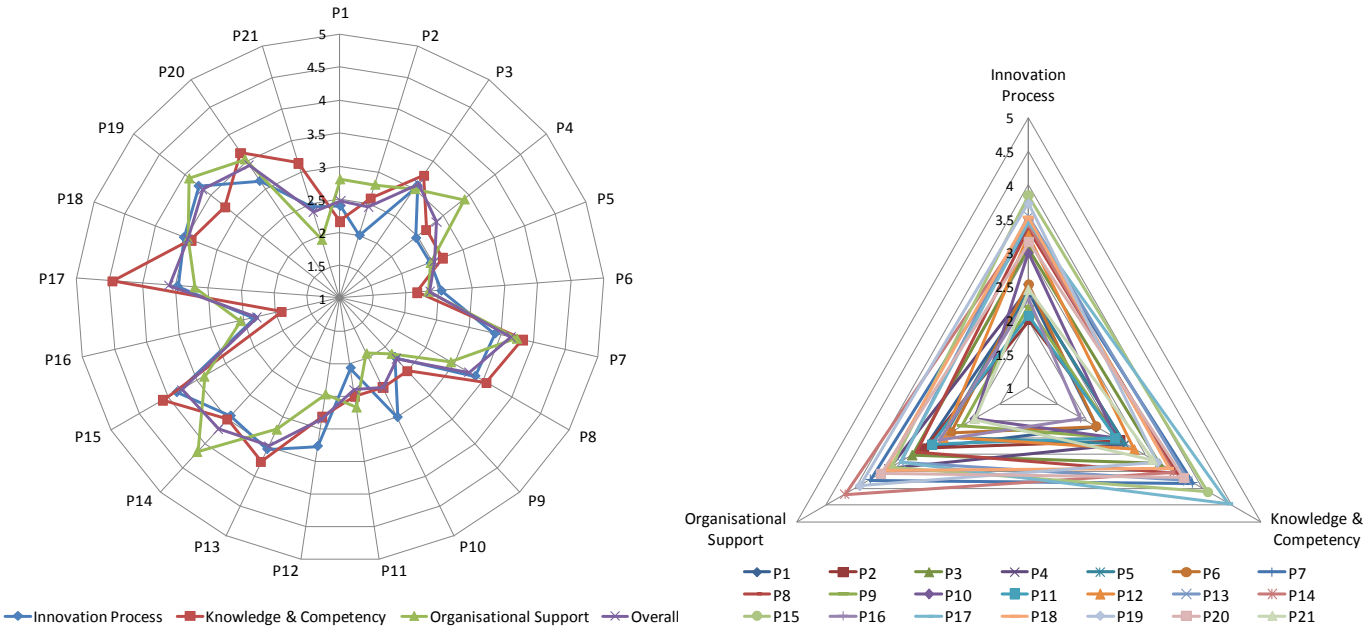

Figure 45 – CS2: respondent perspective of innovation capability

The innovation capability of the organisation appears to be consistent over all three Innovation Capability Areas – Innovation Process, Knowledge & Competency and Organisational Support – when interpreting the roles-based perspective of the results (Figure 46). This presents evidence that the organisation understands (even if unknowingly) that there are process, knowledge and competency, and organisational support requirements necessary to be innovative. In all 3 capability areas, the organisation lies between a maturity

[11] The average of the standard deviations between all respondents for all of the 42 questions.
[12] The average of the standard deviations between all the roles' once the responses have been aggregated into roles for all of the 42 questions.

level of 2.5 and 3. From a roles perspective (left-hand diagram of Figure 46), all 5 roles have a very similar view on the 3 capabilities areas.

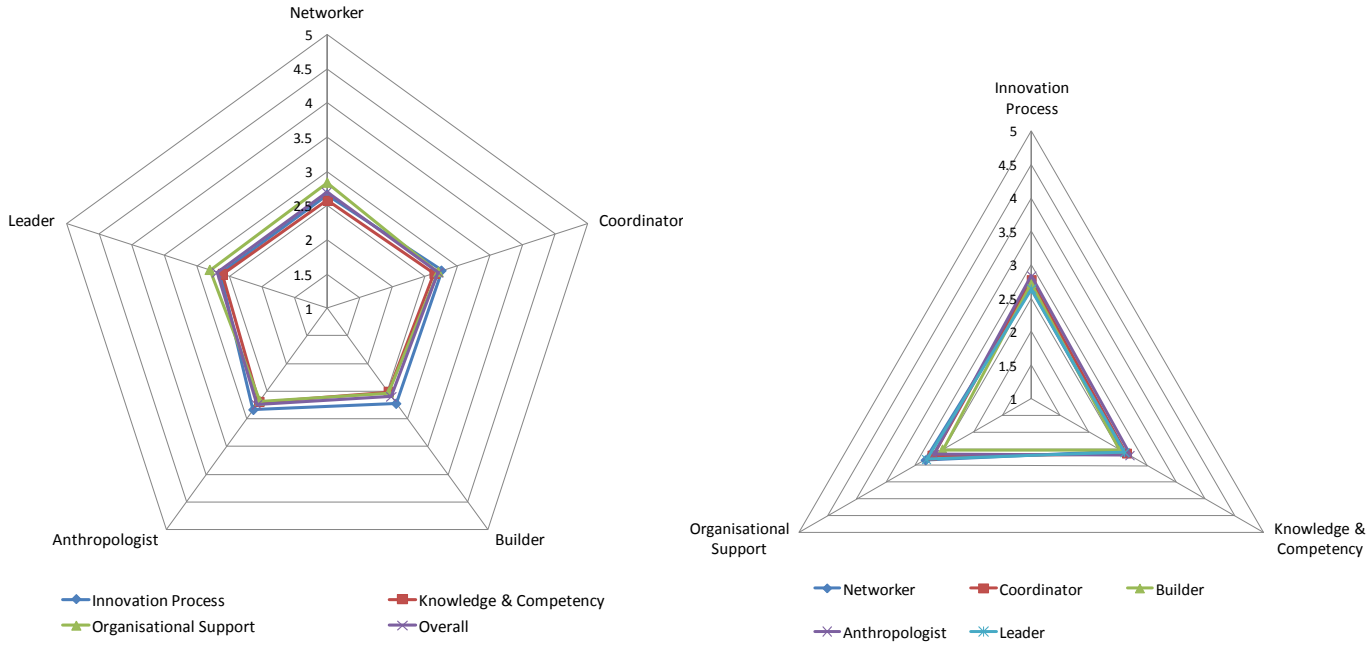

Figure 46 – CS2: role perspective of innovation capability

Figure 47 presented below is intended to provide a rough indication of the strengths and weaknesses of the organisation, from both an innovation capability construct and an organisational construct point of view (referred to as the Innovation Capability Landscape). This diagram should not be overly literally interpreted, as the aggregated results (at an Innovation Capability Construct and Organisation Construct item level) are used to project the values onto the landscape. At each crossing between the vertical and horizontal construct items, the square root of the product of the 2 maturity ratings is calculated and presented. The (MS EXCEL auto-generated) shading highlights the differences by using a colour-scale from red to green where red represents high values and the green low values. Note that the diagram is purely for the purpose of rapidly (and roughly) understanding the organisation's innovation capability. It is **not** a substitute for analysing the detailed results.

From Figure 47, one quickly identifies the high-level strengths and weakness of this organisation from the perspective of the different constructs. As an example, consider the *Internal – Data & Information* organisational construct item. This particular area of the organisation appeared to be strong, supporting the innovation capability construct items (red and orange line running the full vertical length of the diagram). The weaker areas have been outlined by a broad line to highlight them during the results presentation – the most prominent of these being *Customers & Suppliers* [involvement]. It is important to remember however, that these results **must** be considered in conjunction with what is strategically relevant for the organisation (discussed in detail in Sections 6.2.1.4 and 6.2.1.5).

				Strategy & Objectives	Function & Processes	Organisation & Management	Internal - Data & Information	External - Data & Information	Customers & Suppliers
				2.65	2.67	2.67	3.20	2.82	2.26
Innovation Process	2.72	Explore & Converge	2.84	2.74	2.76	2.76	3.02	2.83	2.53
		Portfolio Management	2.65	2.65	2.66	2.66	2.91	2.73	2.45
		Consolidate & Exploit	2.68	2.66	2.68	2.68	2.93	2.75	2.46
		Process Control & Risk Management	2.65	2.65	2.66	2.66	2.91	2.73	2.45
Knowledge & Competency	2.52	Discover & Absorb	2.90	2.77	2.79	2.78	3.05	2.86	2.56
		Consolidate	2.38	2.51	2.52	2.52	2.76	2.59	2.32
		Core Competency & Technology	2.27	2.45	2.46	2.46	2.70	2.53	2.27
Organisational Support	2.75	Innovation Strategy & Leadership	2.60	2.62	2.64	2.64	2.89		
		Structure & Infrastructure	3.24	2.93	2.94	2.94	3.22		
		Environment & Climate	3.06	2.85	2.86	2.86	3.13		
		Resources & Measurement	2.32	2.48	2.49	2.49	2.73		

Figure 47 – CS2: Innovation Capability Landscape

The only detail that will be presented here (for interest sake) is that of the strongest and weakest Innovation Capability Requirements. They are as follows:

- Strongest – *Continuous research (4.11)*
- Weakest – *Measuring Innovation (1.09)*

The strongest requirement correlates with the *Discover & Absorb* innovation capability construct item and the *Internal – Data & Information* organisational construct item, while the weakest with the *Resources & Measurement* innovation capability construct item. This is fairly consistent with overall picture depicted in Figure 47, remembering however that the response-normalisation and aggregation process affects the values projected therein. Thus, the strength from Figure 47 appears to intersect at the *Structure & Infrastructure* and *Internal – Data & Information* construct items.

To conclude, the executive summary[13] presented to all respondents based on the interpreted results and considering the specific needs of the organisation, and what was intended to be a major discussion point (leading to possible further discussions on the detailed results), was:

- Formalise and make explicit a relevant innovation strategy that is aligned with the overall business strategy.
- This would provide the framework to establish, improve and/or clarify:
    - The testing, screen and prioritising of opportunities and concepts
    - Development and/or acquisition of new competencies and technologies
    - The identification, reduction and mitigation of uncertainty and risk
    - The intellectual property policy and the management thereof
    - The measurement of innovation-related outputs.
- Communicate and clarify the differing perspectives pertaining to skills and competency alignment.

Basically, this was the initial plan of action that was recommended to address the most pressing issues (which was similar to the initial summary presented to management in Section 7.1.2.2).

7.1.4 Plan procedure

This section will briefly describe the various activities undertaken during the *Plan* stage of the case study. This includes presenting and discussing the results with participants, prioritising the opportunities for improvement and identifying the necessary actions to be taken.

7.1.4.1 Presentation of summarised results and discussion

As discussed in Section 6.2.2.1.1, the presentation of results is an essential part of the process that will eventually determine the success thereof. It is vital that this session be an interactive one; involving all the evaluation participants. The analyst who interprets the responses and presents the summarised results only knows the organisation from the perspective of the questionnaire. The individuals therein are required to complete the picture using the results presented to them.

The consolidated and summarised results were presented in 3 sessions: first to management, then to the clinical psychologist, and finally to all members of the organisation. In each of the sessions, many points were discussed and debated in an effort to understand, clarify and put into context the results. For the purpose of privacy, details pertaining to these discussions will not be discussed. However, the most

[13] It is not possible to directly relate this summary to the presented results because of the omission of specific detail.

significant conclusions that could impact the ICMM v2 are discussed. These discussions are based on the 3 respondent groups: management, the psychologist and the remaining members of the organisation.

7.1.4.1.1 Management

Management concluded that the results remained consistent and accurate with the inclusion of all organisational members. Further, the added perspective, and differences therein, could highlight potential gaps in communication. This would be true even though it was not made explicit by the group with the communication-related questions. What was concluded was that the majority of organisational members, both management and other, were previously unaware of these communication gaps.

It was mentioned that it would be interesting to note whether other case studies presented similarly accurate results. In particular, the effectiveness of the roles-based normalisation mechanism to reduce overall variance in the results was commended – whether it would prove so successful in other cases studies remained to be seen.

7.1.4.1.2 Clinical psychologist

As mention previously, the clinical psychologist was tasked with taking 2 perspectives: the first, as a psychologist with experience in similar procedures, and the second as an HR-based role within the organisation. The conclusions from the first perspective were discussed in Section 7.1.2.3. The general conclusion, from the second perspective, was that the results were representative of expectations, highlighting specific aspects that were difficult to pinpoint, articulate and motivate without such an exercise.

The most prominent benefit of the approach was the manner in which both the evaluation and presentation of results could stimulate discussion within a team. As mentioned on several occasions, to truly interpret the results and extract value there from, the respondents are required to complete the picture developed by the interpreted responses.

Based on this point, the approach also provides a mechanism of communicating the different individual perspectives without it being brought up by, or directed at, any particular individual. This could avoid potential conflicts, as the responses remain anonymous and the results aggregated and normalised on the basis of the roles. Therefore, the results that emerge are not attached to any particular views, but rather to the aggregated view of the respondents (although specific views, like a "management" perspective, can be determined if requested and approved by respondents).

7.1.4.1.3 Remaining members of organisation

The discussions and conclusions were much the same from the remaining members of the organisation, highlighting the fact that the approach clarified what may have been known subconsciously, but had yet to be made explicit. Furthermore, this clarity was improved by the framework describing the links between the various aspects and their impact on organisational innovation capability.

7.1.4.2 Actions to address opportunities

Having seen and interpreted the results, management approved the recommendations made to improve innovation capability within the organisation (discussed at the end of Section 7.1.3). This would begin with an effort to "Formalise and make explicit a relevant innovation strategy that is aligned with the overall business strategy" – the first recommended action from Section 7.1.3. Only once this had been performed, should the other opportunities be pursued. Management then requested that the following be presented at the next interaction:

- The basic components of an innovation strategy and the most appropriate way of linking it to business strategy.
- A basic plan to address the prioritised opportunities.

In fulfilment of the second request, the management team was introduced to the remaining activities of the improvement methodology as discussed from Section 6.2.2.3 and on, and underlined in Figure 48.

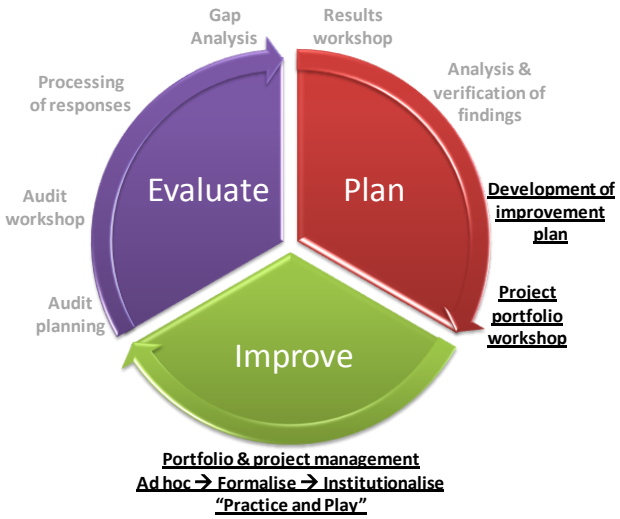

Figure 48 – CS2: remaining improvement activities

In fulfilment of the first request, the author began the process of identifying the specific instantiation necessary to fulfil the requirement *Developing & conveying innovation strategy & objectives* (OS/SO1). This is the point where the scope of the ICMM v2 no longer covers the process on its own and the solution becomes more specific to the organisation and requires support from more dedicated methodologies. However, these activities are assisted by the ICMM v2 and its supplementary components – specifically the Capability Requirement Practices lookup table as discussed in Section 6.1.4.3. The purpose of this lookup table is to provide a starting point for identifying and/or developing organisation-specific practices, tools, techniques, policies, etc. to fulfil the prioritised requirements. Thus, the first activity in fulfilling management's request would be to understand the literature's view of innovation strategy and its link to business strategy, initially from the core corpus (used in the development of the model) and then from the other sources.

Four documents from the core corpus were identified to contain relevant information. Both the manual summaries and the relevant topics as determined by the LDA-based analysis were used to establish this. On the formation of innovation strategy Zairi (1995), Ahmed 1998(1), Martensen and Dahlgaard 1999(1), and Martensen and Dahlgaard 1999(2) were found to be relevant and on the link to business strategy, the latter 2 were relevant (and similar in nature). Three fundamental observations were made from this literature:

- "Innovation as key plank of strategy – ... Innovation was perceived to be part of total organisational transformation, and not a stand alone piece of the strategic jigsaw." (Ahmed 1998(1), p51) "Having innovation activity as an integral part of corporate strategy." (Zairi 1995, p39)

- "Clarity in goals for innovation – A large majority of these firms had explicit goals for innovation... These apparently lofty goals were often used to drive specific actions for innovation." (Ahmed 1998(1), p51) "Having effective communication processes from the corporate level downwards, with clean objectives and a thorough understanding of what the organizational goal is – communication also includes sharing information on results, and action plans." (Zairi 1995, p39-40)

- "An innovation strategy should be closely linked to the company's vision and overall business strategy, and based on comprehensive and relevant information – both from inside the company and from the market and the environment." (Martensen and Dahlgaard 1999(1), p734)

Martensen and Dahlgaard (1999(1) and 1999(2)) provide an action plan for developing and communicating an innovation strategy and linking it to the overall business strategy. This guide is an adaptation of the European Business Excellence Model's PDSA loop (plan, do, study and act – also called the Deming Cycle), Hoshin Kanri[14] and the Balanced Scorecard from Kaplan and Norton. To align with the standing of this case study, the organisation involved and the overall innovation capability improvement methodology, a roadmap has been developed that describes the activities necessary to develop an innovation strategy and deploy that strategy within the organisation – see Figure 49.

An elemental aspect to consider in the development of an innovation strategy is neatly summed up by Tidd et. al (2005). They argue that an 'incrementalist' strategy development approach is more relevant to the complexity and uncertainly associated with the environment in which radical innovation is required. Furthermore, they argue that the utilisation of the 'rationalist' approaches (such as Porter's model) should be used to better inform organisational leadership of the situation and ready them for the changes of the future, but should not be used to established inflexible strategy and objectives. This supports the iterative procedure proposed by Martensen and Dahlgaard (1999(1) and 1999(2)) and Hoshin Kanri.

The roadmap is also based on the framework described in Section 6.2.3.2 (Figure 41) which describes generic improvement paths for the different entities involved in developing organisational innovation capability. In this case, the first row of the framework dealing with *Strategy, Objectives & Policies* was relevant to the development of this roadmap. It is important to note that the roadmap provides a more

[14] A Japanese "direction setting" methodology first used by Hewlett-Packard in 1976 (Kenyon 1997)

detailed extension of the overall Innovation Capability Improvement Methodology, focusing on the planning, design and implementation related activities for, specifically, innovation strategy. The findings of the innovation capability evaluation served as the trigger for the activities of Figure 49. Furthermore, the process assumes that these findings have been verified through a more focused analysis of the situation within the organisation (described in Section 6.2.2.2) relating to the specific capability requirement (in this case *Developing & Conveying Innovation Strategy & Objectives*).

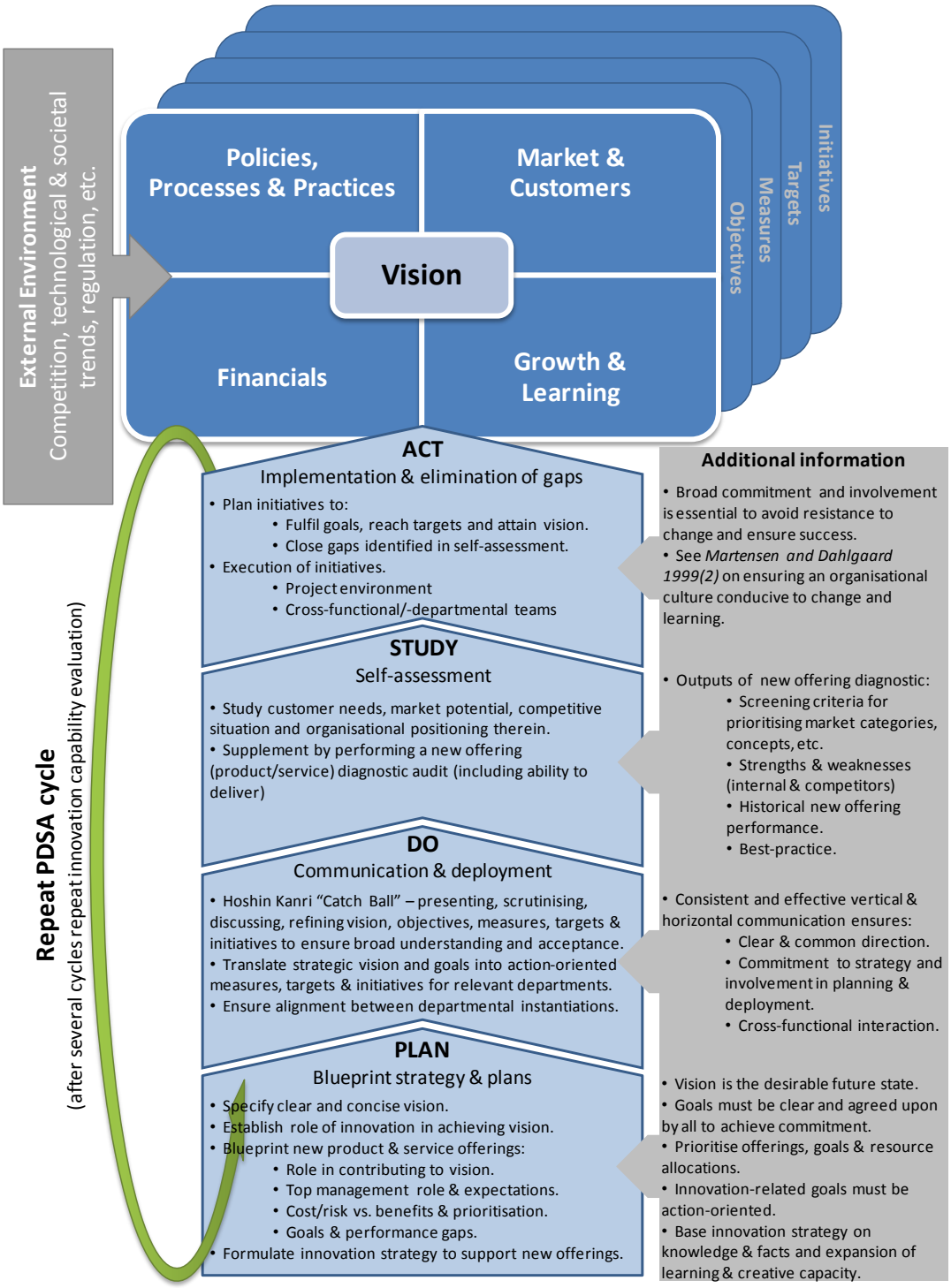

Figure 49 – CS2: Innovation strategy development and deployment roadmap

Note that the author has not provided detailed descriptions of the activities depicted within the roadmap as they are, essentially, outside the scope of this research[15]. The intention of including a visual depiction of the roadmap is, however, to practically demonstrate how the Innovation Capability Improvement Methodology, and specifically the findings of the innovation capability evaluation, would lead onto more detailed improvement methods that deal with specific requirements within the innovation capability domain.

On a final note, while management had agreed upon the execution of this process in principle, detailed plans therefore and the outcomes thereof were not available upon the writing of this document.

7.2 Case Study 3 – innovative insurance products

The organisation with which the process was conducted in this section is a small and agile spin-off of one of South Africa's larger insurers. This larger insurer's retail division was part of the case study presented in Chapter 4.6. The spin-off was initiated to provide basic and convenient insurance products to a severely underinsured mass-market in South Africa, with an opportunity to take these products to similar markets in Africa and abroad. The logic was that the established paradigm of an insurance product, along with the overheads associated with a larger insurer, would not enable the development of products that are appropriate to this segment of the market.

It must be mentioned that this case was the least comprehensive in terms of the tasks completed at the time of documentation and submission. Only the CEO of the organisation had completed the questionnaire, thus providing the perspective of only a single individual. Therefore, the results had to be interpreted accordingly. The reason for including it was to discuss the lessons that were learnt from this short, but important exercise. Because all the case study's lessons are consolidated in Section 7.6, this section will provide a short description of the process, the results and the interpretation thereof.

7.2.1 Evaluation procedure

A one-on-one meeting was held with the CEO in which a basic introduction to the process was presented. The intention was to limit any potential influence that the introduction may have, while giving sufficient information to complete the questionnaire as accurately as possible. This information included the context for completing the questionnaire (to consider the spin-off organisation as a whole) and the definitions of certain words that have a specific meaning in the context of the questionnaire.

Thereafter, the questionnaire was completed with initial guidance though the first sections thereof. After having completed the process, several discussions ensured. They included:

- The importance of and value in being innovative – where incremental innovation maintains competitive positioning and radical innovation enables an organisation to leap ahead of the competition.

[15] Refer to Martensen and Dahlgaard 1999(1) and references listed therein for the details behind these activities.

- The anonymous results of the previous case were presented. The fact that an organisation at maturity level 3 (overall) is fairly strong was discussed – having formalised and become proactive in their approach to innovation. Also discussed was the fact that results were not directed at individuals, but rather at the group as a whole – thereby avoiding any blaming.

- The activities after completion of the evaluation as described by the improvement methodology in Section 6.2.

- The importance of the prioritisation of requirements being an interactive process with all participants, and not based on the results obtained from the evaluation alone.

7.2.2 Summarised results

Due to the results being based on the perspective of a single individual, they will not be shown or discussed in detail. Only a few interesting points will be highlighted. The overall average innovation capability maturity level was 2.3.

The Innovation Capability Landscape, as depicted in Figure 50, clearly highlights the high-level strengths (red) and opportunities for improvement (green) within the organisation.

				Strategy & Objectives	Function & Processes	Organisation & Management	Internal - Data & Information	External - Data & Information	Customers & Suppliers
				2.50	2.08	1.79	2.67	3.00	3.00
Innovation Process	2.52	Explore & Converge	2.63	2.56	2.34	2.17	2.65	2.81	2.81
		Portfolio Management	2.47	2.49	2.27	2.10	2.57	2.72	2.72
		Consolidate & Exploit	2.47	2.48	2.26	2.10	2.56	2.72	2.72
		Process Control & Risk Management	2.47	2.48	2.26	2.10	2.56	2.72	2.72
Knowledge & Competency	1.93	Discover & Absorb	2.13	2.30	2.10	1.95	2.38	2.52	2.52
		Consolidate	2.13	2.30	2.10	1.95	2.38	2.52	2.52
		Core Competency & Technology	1.54	1.96	1.79	1.66	2.03	2.15	2.15
Organisational Support	2.00	Innovation Strategy & Leadership	1.38	1.86	1.70	1.57	1.92		
		Structure & Infrastructure	1.87	2.16	1.97	1.83	2.23		
		Environment & Climate	2.55	2.52	2.30	2.13	2.61		
		Resources & Measurement	2.19	2.34	2.13	1.98	2.42		

Figure 50 – CS3: innovation capability landscape

Note the 2 columns *External – Data & Information* and *Customers & Suppliers*, and in particular, those relating to the Innovation Process. There is a definite perception of strength in this area. In discussions with individuals who play a consultative role within this organisation, the fact that they see themselves as a "middle-man" between their suppliers and customers was attributed to this strength. Their core competence is, therefore, seen to be making essential links between various suppliers to provide basic and convenient insurance products to the market.

Opportunities for improvement lie, in particular, with their organisational- and management-related aspects and, from a *Knowledge & Competency* and *Organisational Support* innovation construct perspective, with their *Function & Processes.* This was again discussed with the individuals playing a consultative role, and found to be representative of a small spin-off in the process of developing and maturing in these aspects.

Upon writing this report, the CEO of this organisation had agreed to perform the questionnaire-based evaluation with the other key individuals within the organisation.

7.3 Case Study 4 – underwriting consultants for financial services

The next case study performed was with a small consulting firm based in the United Kingdom specialising in underwriting and risk appraisal within the financial services industry. The company constitutes a small team of highly specialised individuals servicing a broad range of multinational clients within the industry. The discussions in this section will focus on the key learnings from this particular case, and will therefore not present duplicate points.

7.3.1 Context

The context for this particular case study, although not unique, was important due to the very small number of respondents. Any difference that an individual may have had would be highly influential on the final results, thus, making the common context with which to approach the questionnaire absolutely essential. The context was discussed and agreed upon as follows:

- The assessment of innovation capability would be of the organisation as a whole, and considering the value and services offered to clients.
- Individuals would take a perspective of the organisation as a whole when answering questions (as opposed to an individual-based view).
- All organisational members would complete the questionnaire.

7.3.2 Evaluation procedure

The procedure for this particular case was unique in the sense that the entire process was conducted remotely using voice of IP technology. Sessions were performed by providing the geographically dispersed individuals with a presentation through which they were guided by the facilitator (the author).

Initial exposure constituted an introduction to the basics of the model, the Innovation Capability Improvement Methodology and completion of the questionnaire with a director of the organisation. The unique nature (size and specialisation) of the organisation was a pivotal point of discussion as it would be important to consider when interpreting the results. To stimulate interest, the results from a previous case study (with all aspects linking the organisation removed) were discussed to demonstrate the typical findings of such an exercise.

This team member, satisfied with the process and its relevance to the organisation, agreed to facilitate and guide the remaining members of the organisation through the questionnaire (not presenting the model-related details however). The most important aspect for this team member to convey was the context for answering the questionnaire (as discussed in Section 7.3.1).

Once all respondents had completed their questionnaires, the responses were interpreted in much the same way as the other case studies. What was unique to this particular case, however, was that the roles had been made redundant by the fact that the respondents had agreed that they each performed a similar role within the organisation – from the perspective of the innovation-based roles as described on Section 6.1.2. Thus, given the lack of differentiation in the role profiles, the roles-based normalisation of the responses had no impact on the results. Each respondent would therefore have equal influence on the results. This was an acceptable scenario given the small and specialised nature of the organisation and the likely situation that all individuals were equally aware of, and exposed to, organisational matters.

7.3.3 Summarised results

Due to the respondents having the same role profiles, the roles-based normalisation became redundant (as discussed above). For this reason, the average innovation capability maturity level at 2.7 was used as the overall measure. This is based directly on the participants' responses as opposed to the normalised version used in the other case studies. The average standard deviation between respondents was 0.57. A summary of the organisation's innovation capability, based on the 3 Innovation Capability Areas, is presented in Figure 51.

The most prominent observation from Figure 51 is that the participants (P1, P2 and P3) were almost congruent in their opinions of the organisation's *Innovation Process* and *Organisational Support* capabilities, but differed somewhat in their views of *Knowledge & Competency*.

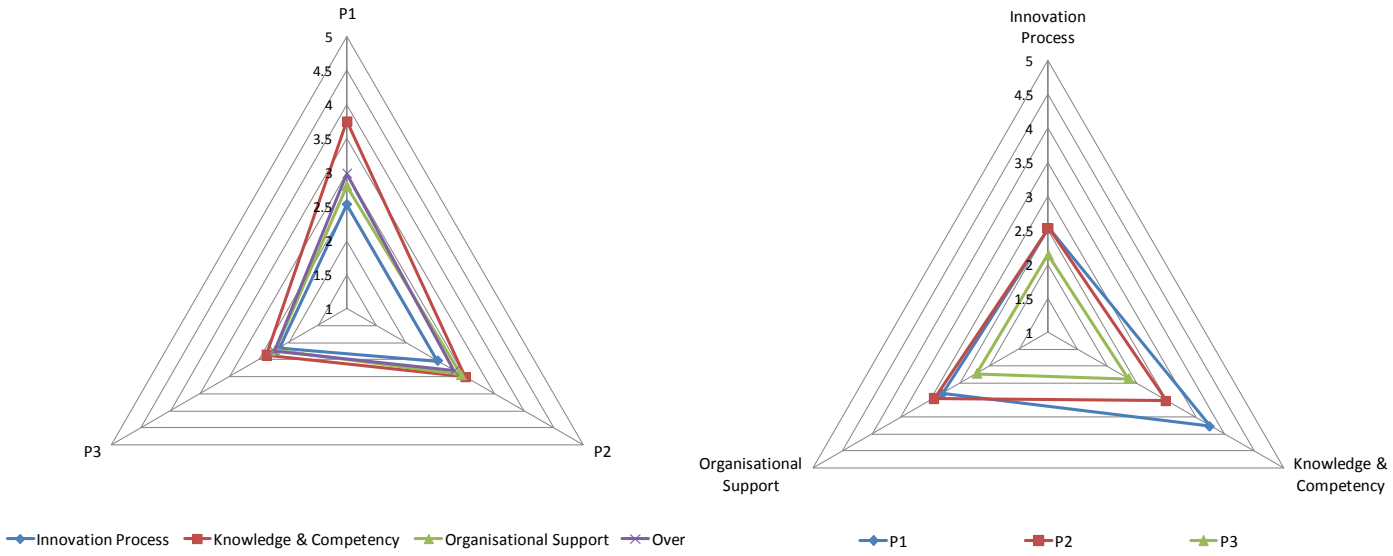

Figure 51 – CS4: respondent perspective of innovation capability

From Figure 52, the organisational construct items *Internal-* and *External – Data & Information* appear to be an area of strength for the organisation, while, from an innovation capability construct perspective, the *Innovation Process* related area (barring those pertaining to *Internal-* and *External – Data & Information*) are a shade of green, highlighting a general weakness therein. Those aspects relating to the *Resources & Measurement* construct item present a particular opportunity for improvement.

The strongest and weakest Innovation Capability Requirements were as follows:

- Strongest – *Communication & the flow of information (4.67).*
- Weakest – *Infrastructure, systems & tools to support process & management requirements (0.67).*

The strongest correlates with the *Internal-* and *External – Data & Information* organisational construct items, seen as the prominent red and orange vertical region in Figure 52. Regarding the internal aspect, this would be expected from a small organisation where communicating with all members is easier. Regarding the external aspect, the nature of their business requires that they communicate regularly and effectively with their clients.

The weakest capability requirement actually does not correlate with the representative *Structure & Infrastructure* innovation capability construct item from Figure 52. The reason for this is that the particular requirement is masked behind several other strong capabilities that include *Creating cross-functional & multidisciplinary teams* (3.7) and *Developing flexible & adaptable organisational structure & infrastructure* (3.3). This demonstrates the importance of considering this landscape-type view in conjunction with the detailed results.

				Strategy & Objectives	Function & Processes	Organisation & Management	Internal - Data & Information	External - Data & Information	Customers & Suppliers
				2.63	2.49	2.36	3.89	4.33	2.56
Innovation Process	2.50	Explore & Converge	2.75	2.69	2.62	2.55	3.27	3.45	2.65
		Portfolio Management	2.32	2.47	2.40	2.34	3.01	3.17	2.44
		Consolidate & Exploit	2.32	2.47	2.40	2.34	3.00	3.17	2.43
		Process Control & Risk Management	2.51	2.57	2.50	2.43	3.13	3.30	2.53
Knowledge & Competency	2.84	Discover & Absorb	3.00	2.81	2.73	2.66	3.42	3.61	2.77
		Consolidate	3.19	2.90	2.82	2.74	3.52	3.72	2.86
		Core Competency & Technology	2.32	2.47	2.40	2.34	3.00	3.17	2.43
Organisational Support	2.60	Innovation Strategy & Leadership	2.41	2.52	2.45	2.38	3.06		
		Structure & Infrastructure	3.07	2.84	2.76	2.69	3.45		
		Environment & Climate	3.21	2.90	2.83	2.75	3.53		
		Resources & Measurement	2.06	2.33	2.27	2.21	2.83		

Figure 52 – CS4: innovation capability landscape

The executive summary presented to the participants that specified the recommended actions to take, was:

- To develop a relevant innovation strategy that relates to the overall business strategy.
- To add context to their opportunities by considering them in relation to future technologies, regulation, society and their existing projects and value offerings (which would assist with prioritisation of opportunities).
- To identify systems and tools to support their specific process and knowledge management requirements (which would assist with managing explicit knowledge).
- To identify a means of managing their core competencies and tacit knowledge – a crucial requirement for a small, knowledge-driven organisation.

7.3.4 Plan procedure

This section will briefly describe the activities of the *Plan* stage of this case study. Basically, this involved presenting and discussing the results, prioritising the opportunities for improvement and identifying the necessary actions to be taken.

7.3.4.1 Presentation of summarised results and discussion

The summarised results were presented in much the same way as the other interactions – using VOIP technologies to connect all the individuals and a common presentation used by the facilitator to guide the individuals through the results and discussions.

All participants basically concluded that the approach proved accurate in it representation of the organisations strengths and weakness, illuminating what (again – as with other cases) was subconsciously known, but not yet explicit. A respondent commented that the approach provided scientific evidence of various aspects needing consideration.

The respondents all agreed that the approach stimulated action, i.e., provided the necessary motivation to instigate an improvement initiative that would address the identified and agreed upon improvement areas. This motivation was also fuelled by the added understanding of the Innovation Capability Landscape and how their organisation mapped onto this landscape (considering the results of Figure 52).

As mentioned, a discussion was had on the small and specialised nature of the organisation and how this would have an impact the results. What was initially discussed, before having processed the responses, was the possibility of significant variance in the ratings between the different requirements for innovation capability. If this were the case, it could be explained by the fact that a specialised organisation may be highly competent in certain areas, and less so in others. This was found to be accurate after having processed and interpreted the results.

Related to this is the fact that a small organisation will have very different instantiations of the capability requirements compared to a larger organisation. Thus, while the requirements themselves are generic, how those requirements are fulfilled would differ substantially between organisations. Therefore, the requirements as specified by the model, remain relevant to the organisation, and only when considering how to address the specific requirements, would an in-depth understanding of the organisation become crucial. This point formed a pivotal part of the discussions around the summarised results.

7.3.4.2 Actions to address opportunities

The procedure used in this case was the same as the one used in Section 7.1.4.2 to support the fulfilment of requirements for Case Study 2 (CS2). The literature identified as applicable "To develop a relevant innovation strategy that relates to the overall business strategy" (the first requirement to be fulfilled for CS2 in Section 7.3.3) was the same for both case studies. For this reason, the findings will not be repeated but to state that the outcomes would be different due to the different environments that the organisations operate within. These findings were presented to the participants with the purpose of initiating the development process. At the time of writing this report, the outcomes had not been finalised.

7.4 Case Study 5 – Client Services of major insurance provider

This case study was performed with a major insurance provider to South Africa and other countries. The specific division with which the process was conducted was Client Services. To remain concise, only the unique aspects of this case study are discussed.

7.4.1 Context

The context for this case study was the first (and only) that would relate to a specific division of an organisation, as opposed the whole. The following aspects conveyed this context:

- The innovation capability of the Client Services department would be evaluated.
- The questionnaire would be completed by individuals from three levels within the department – business leaders, operations managers and team leaders, with the responses of the general manager of the department being included with those of the business leaders.
- As many individuals as were available from each of the levels would complete the questionnaire.

This being the largest case study in terms of organisational size, obtaining responses from all relevant individuals within the department would be difficult to achieve. Therefore, it was decided that so long as a sufficiently representative sample from each of the relevant groups was obtained, the results would be considered relevant.

7.4.2 Evaluation procedure

This case was initiated with a planning meeting attended by the instigator (or champion) thereof. Essentially, this individual plays a consultative role to the group, particularly at the operations managers' level. Within this meeting, the basic context (as discussed in Section 7.4.1), was decided upon.

Two evaluation workshops where held – one to accommodate the business leaders and another for the operations managers and team leaders. Basically, the workshops were much the same as the previous cases, except that this was the first where the questionnaire was paper-based. The most significant impact hereof seemed to be that the respondents worked more quickly though the paper-based version than the computer-based one (this was not timed and verified, but merely an observation).

Few discussions followed these workshops due to time constraints, but it was agreed that the results feedback presentations would be more interactive. Interpretation of the results then commenced, with requests from both the business leaders and operations managers, to show the results from the different perspectives of the 3 levels of individuals having completed the questionnaire.

7.4.3 Summarised results

Mentioned previously is the fact that the completion of these case studies and the representation of results was a progressive and maturing process. Thus, new mechanisms for completing these activities, interpreting the responses and presenting the results were identified and used as the cases were performed, one after the other. This particular case used several new mechanisms for the results interpretation and representation; a few of which will be discussed in this section. Additionally, this was the only case (except for CS3) where a sample of individuals, and not the entire population, completed the questionnaire. To accommodate for this, the confidence interval (CI) statistic was used as an indication of the confidence that may be held in the calculated average.

The overall, normalised average innovation capability maturity level was 2.27. The average standard deviation between respondents was 0.96. The calculated CI at a confidence level of $\alpha = 0.1$ was 0.29. The interpretation of this static implies that 90% of all samples taken (from the population) would give a confidence interval that contains the population average (or mean). In this case, the bounds of the interval are 2.12 and 2.41 (as depicted in Figure 53).

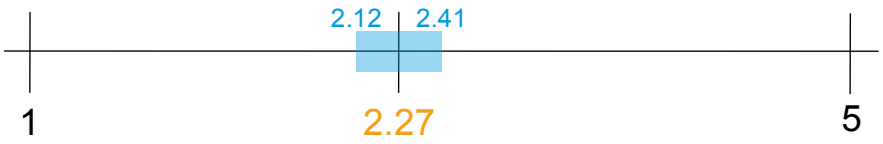

Figure 53 – CS5: overall, normalised average maturity level and confidence interval

In Figure 54, 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 interpretation process, using the logic discussed in Section 6.2.1.4 to make certain (initial) conclusions. Basically, the analyst can rapidly identify potential strengths, opportunities for improvement and areas of non-consensus in terms of the capability requirements.

Discussed in Section 6.2.1.4 are the "rule of thumb" boundaries to define these strengths, opportunities and non-consensus requirements. In this particular case, however, the boundary defining the strength was shifted from maturity level 3 to 2.75. The most significant reason for doing so was to be able to demonstrate to the respondents that they had certain strengths (plural!) and not only one, as would have been the case had the boundary remained at level 3. While this is not necessarily "technically" appropriate, it was clear that in order to minimise the negative impact of presenting the many weak areas of the organisation, certain strengths had to be presented, discussed and recommended as leveraging opportunities. This motivational approach of presenting the results, while not core to this research, will be discussed as an extremely important aspect in the consolidated implications of these case studies (Section 7.6).

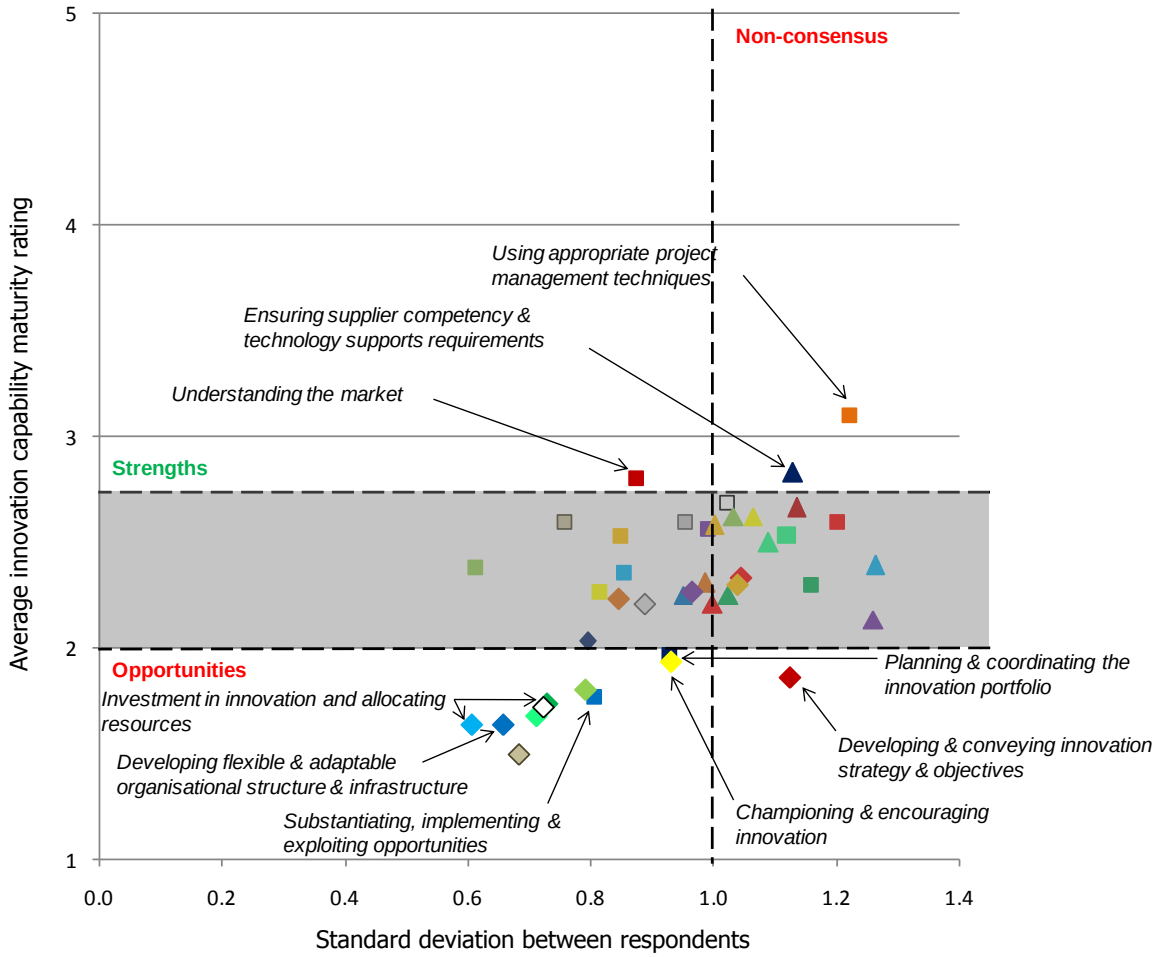

Figure 54 – CS5: Innovation Capability Portfolio

To highlight some of the results, the *Using* [of] *appropriate project management techniques* may be seen as typical of a large, corporate environment that has adopted and internalised such practices. Still lacking, however, is the *Planning & coordinating* [of the projects in] *the innovation portfolio.*

Another aspect that may be seen as typical is the perceived weakness in terms of *Developing flexible & adaptable organisational structure & infrastructure.* Managing operations in large organisations is often supported by a multi-layered organisational hierarchy. While this may be effective for controlling operations, it can be restrictive of communication, collaboration, organisational adaptation and many other requirements for innovation.

Note that the capability requirement that is lowest in the portfolio in terms of rating was not highlighted. This requirement, referred to as *Meta-innovation* (or innovation model adaptation), was not deemed relevant because of the nature of the situation. The organisation had yet to define an innovation model, let alone work towards the improvement thereof. For this reason, this capability requirement was not deemed important in the given situation. This highlights the point that these results **must** be considered in an integrated manner.

Another view on the data that was requested from respondents was that of the different perspectives of the three groups of individuals that completed the questionnaire. Those capability requirements showing the greatest differences[16] between these 3 groups are shown in Figure 55. This figure served as a major discussion point during the presentation of results (see Section 7.4.4.1).

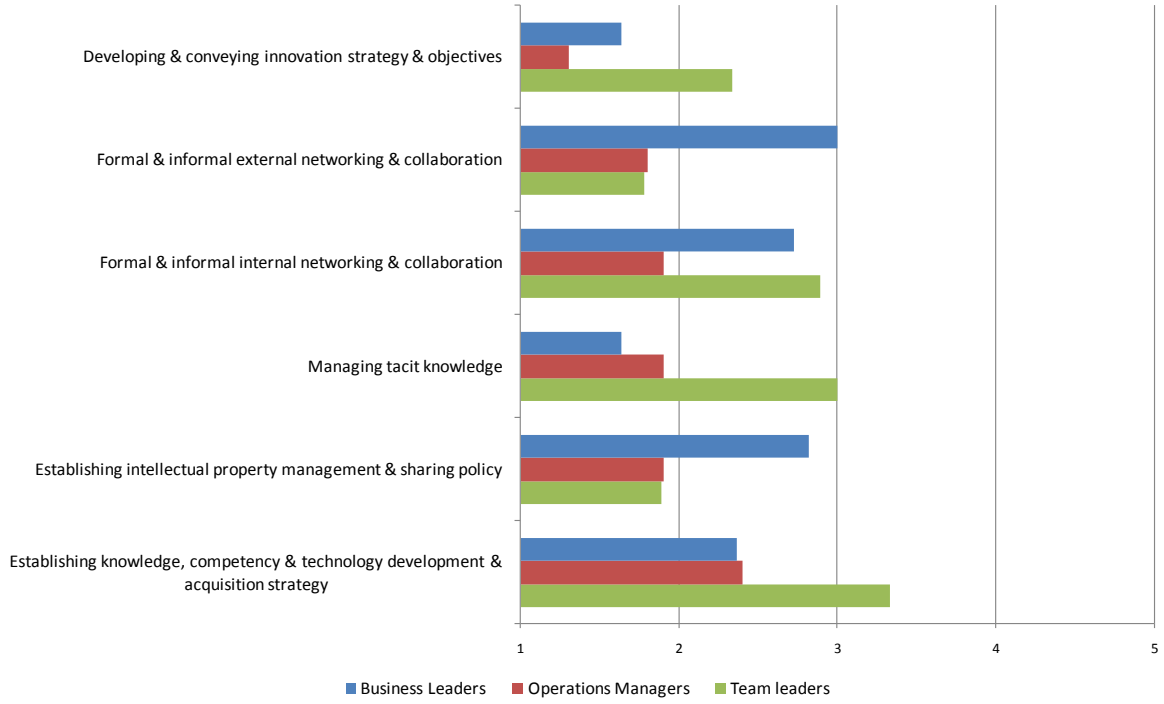

Figure 55 – CS5: differences between organisational groups

Based on the results presented above and other detailed analyses, the following recommendations were made regarding actions to take:

- Formalise and make explicit an innovation strategy, or integrate the need to innovate in existing business strategy.
- Identify and appoint innovation champions at all 3 levels (business leaders, operations managers and team leaders) whose responsibility it is to encourage innovation, provide training, etc.
- Evaluate the existing functional and team structures from a multi-disciplinary and cross-functional perspective and their effectiveness in terms of collaboration.
- Coordinate the projects within the portfolio with the objective of aligning tasks and sharing resources.
- Invest in innovation itself and allocate resources to the improvement and execution thereof.
- Exploit existing project execution capabilities to fulfil the abovementioned recommendations.

[16] Based on the standard deviation between the average, unweighted rating for each group.

- Exploit market research capabilities to continue identifying new opportunities, but to additionally contextualise those opportunities in terms of strategy, future trends, etc.

- Finally, to clarify and discuss the differences in perspective relating to knowledge, competency and technology development or acquisition, and the management of tacit knowledge (mentoring, training, etc.).

7.4.4 Plan procedure

This section describes the activities of the *Plan* stage that were completed for this case study. They included the presentation of results and the discussions that ensued based thereon.

7.4.4.1 Presentation of summarised results and discussion

The summarised results were presented in 2 sessions, similar to the evaluation workshops. The first session was with the business leaders and the second with the operations mangers and team leaders. In addition to the results being conveyed using a MS PowerPoint presentation, a printed handout was provided to the participants. This allowed them to study some of the more detailed results and form their own conclusions there from.

7.4.4.1.1 Business leaders

The overall strengths, weaknesses, detailed results and recommendations were well received and verified by the Business Leaders as accurate and representative of their situation.

One of the perceived strengths, *Using appropriate project management techniques*, was discussed in detail. A participant stated that, while the organisation was familiar with and utilised traditional project management techniques, they were not always effective in ensuring the fruition of intended outcomes and overall project success. The author then discussed the relative nature of this requirement in the light of the other requirements and the fact that it will not always be effective because of certain other requirements being insufficiently addressed. And, even if all aspects are addressed, certain projects will fail due to completely unforeseeable circumstances.

The example used to highlight the abovementioned was the lack of *Planning & coordinating* [of] *the innovation portfolio* (as seen in the recommended improvement opportunities). Without the fulfilment of this requirement, individual projects often result in dissatisfactory results due to poor alignment between the objectives, tasks and resources for the individual projects. To explain this to the group, a metaphor was provided of several vectors with varying lengths (project size and resources) and having different directions (project tasks and objectives), the nett effective of which is zero (combined results of projects in the portfolio).

Another discussion centred on the role profiles of the 3 organisational groups represented by the respondents and presented in Figure 56. While the author is not in the position to divulge any of the details

pertaining to this discussion, what was basically concluded was that at the "OM" or operations managers level (as depicted by the green line in Figure 56) more emphasis should be placed on appropriate recruitment and training of the individuals that fill this position, with special attention to the different roles (and associated skills) required for innovation. Additionally, working more collaboratively with these individuals, from both the Business Leaders' and Team Leaders' perspective, and encouraging innovative behaviour was suggested by the participants.

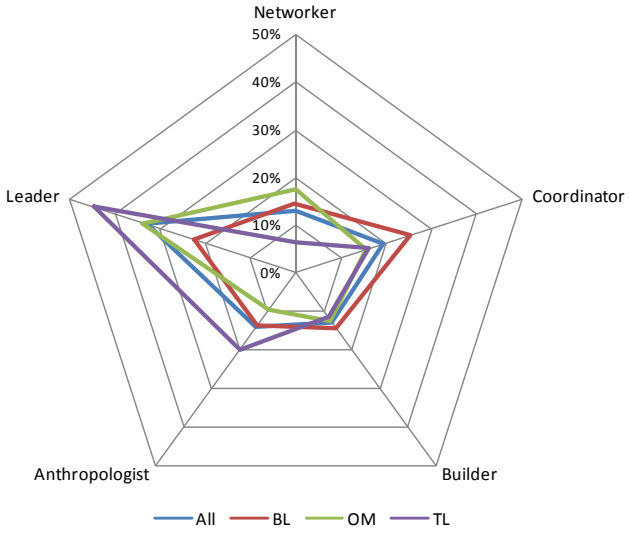

Figure 56 – CS5: role profiles

On completion of this presentation, the business leaders felt is necessary to instigate further action to correct the most pressing issues presented and discussed in the meeting. Before making any decisions however, they thought it necessary to get the operations managers' and team leaders' feedback.

7.4.4.1.2 Operations managers and team leaders

Individuals attending the presentation (including both questionnaire respondents and others) agreed that the results were accurate and representative of the situation. They noted that the identified opportunities for improvement were extremely relevant and confirmed that these aspects should certainly be addressed. This was in response to their confirmation of the fact that being more innovative, from a Client Services perspective, is essential for them to deliver a better service to their clients in the face of an increasingly competitive environment and with ever tightening budgetary allowances.

The subject of the operations managers, and their pessimistic perspective of the business unit's innovation capability (see Figure 55), was again highly topical. Without getting into any specific details, the general conclusion was that these individuals were receiving pressure from the 2 groups above and below them and their mandate to focus on the "operational" restricted their ability to think creatively about their environment. Moreover, the fact that they were extremely busy with these operational aspects further constrained them in terms of their ability to substantiate and implement ideas. These aspects all relate to the effects of a rigorously enforced hierarchical environment in which one only communicates with those

directly above and below one. This causes the pressure that the operations managers are feeling from both ends. What was discussed was that this continuous pressure to deliver (which is of course necessary when appropriately conveyed and balanced in nature) was greatly affecting their ability to be creative and explore.

The fact that the Team Leader's perception was decidedly more optimistic was discussed and related to several aspects. These include: their work being directly at the "coal face", with more tangible results from their ideas; essentially, they are the implementers of strategy and relate more directly to the impact thereof; and the nature of their work requiring that they be more creative and collaborative to solve challenges.

Other positive aspects were also discussed and included their job rotation system (unique to the Client Services department) which allowed individuals who had become mature and proficient in a certain area, to move on to another area. This has several benefits such as: transferring of tacit knowledge, ensuring individuals have a broad knowledge and understanding of their business, and reducing the probability of becoming complacent or bored with a given environment. (It obviously has potential problems that need to be considered and managed as well.)

Upon writing this report, this case study had yet to begin the detailed planning activities. Basically, go-ahead had to be obtained from executive level and the necessary budget and resources allocated, although the need to continue was agreed upon in principle.

7.5 Case Study 6 – Public Relations and communications provider

The sixth and final case study was conducted with a company specialising in public relations (PR) and communications. The South African based company focuses primarily on high-tech organisations that use technology and the internet to enable their business. They provide a broad range of PR strategies, communications services and consultancy in all types of media including print, broadcast, social networks, blogs, forums, etc.

7.5.1 Context

The context for this case was to assess the innovation capability of the organisation as a whole, but due to resource constraints, the entire organisation would not complete the questionnaire. Only the team leaders and key account managers (all on a similar level) would complete the questionnaire. This would include 6 individuals in the evaluation process of the possible 13 within the organisation.

7.5.2 Evaluation procedure

The evaluation process constituted a workshop that was much the same as those described in the previous case studies. Thus, only the post-evaluation discussions that were unique will be discussed.

A lengthy conversation was held on the separation between generic and organisationally-specific innovation capabilities. What was proposed to the participants on this matter is that the 42 questions evaluate **whether** the 42 generic requirements for organisational innovation capability are being fulfilled, and not

how they are being fulfilled. How these requirements are fulfilled is unique to each organisation, and is based on many organisational aspects that include size, industry, value offering, strategy, etc. The questionnaire and all the ICMM-related components do not prescribe any practices, procedures or specific instantiations of innovation capability. The ICMM, therefore, describes the "what" of innovation capability and not the "how". To establish how to fulfil the requirements that may be lacking within a particular organisation is an exercise that requires additional research and the intense involvement of the organisational participants to identifying the best-practice that suite their unique situation. This activity is part of the *Plan* stage of the methodology.

The participants then discussed that an area that may require specific attention is their innovation process (with the associated practices and procedures). This area was described as ad hoc in comparison to the requirements specified in the questionnaire. Participants felt that their existing capability to innovate resided with the organisation's individuals and their natural creative tendency and willingness to collaborate. Whether this was the case remained to be seen.

7.5.3 Summarised results

The overall, normalised average innovation capability maturity level was 2.66 and the average standard deviation between respondents was 0.82.

The Innovation Capability Portfolio for the organisation is shown in Figure 57. Note the greater degree of dispersion between the capability requirement ratings in comparison to those of CS5 in Figure 54 (a much larger, corporate environment). This potential trend is discussed in more detail in Section 7.6.3.

To highlight some of the findings, note the requirement perceived to be the strongest – *Communication & the flow of information*. This is an aspect that relates to the manner in which their teams are structured and collaborate, demonstrated further by the perceived strength in *Creating cross-functional & multidisciplinary teams*.

Typical of a small organisation is the lack of *Investment in innovation & sourcing of capital*, where resources need to be thinly spread over many areas to continue the operations that generate revenues in the short term. However, the fact that *Allocating resources appropriately* is also perceived as a weak area indicates that this process could be done more effectively – according to the respondents. This requirement does not specify the investment of more resources, but rather the manner in which resources are allocated.

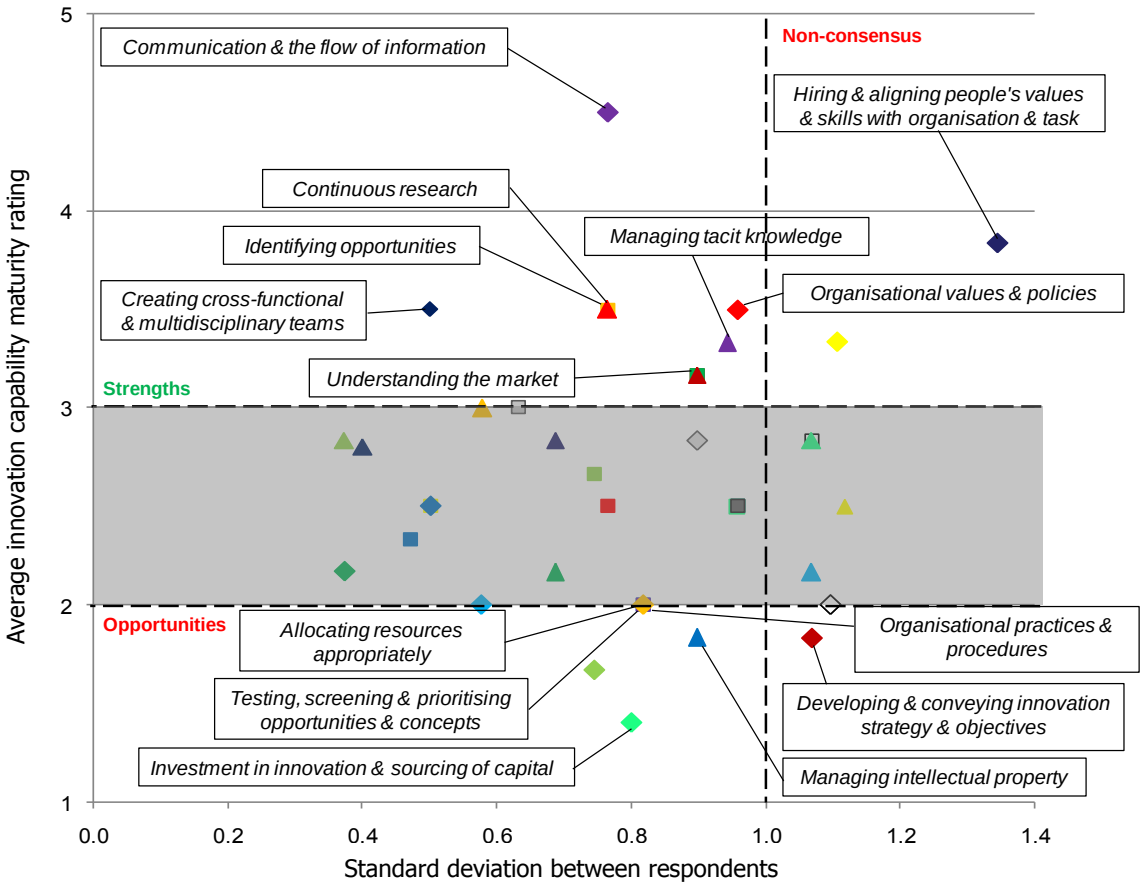

Figure 57 – CS6: Innovation Capability Portfolio

Figure 58 highlights the biggest differences[17] in perspective between three groups based on the tenure of the respondents (years in organisation). It should be noted that the group sizes are small because of the small group of respondents. The groups were defined as: more than 4 years (2 individuals); less than or equal to 4 years, but more than 2 years (1 individual); and less than or equal to 2 years (3 individuals). While the results are not statistically significant (due to the small sample size), they were useful when discussing the different perspectives that an individual may have had.

It is interesting to note that the middle group (while only one individual) differed substantially from the other 2 groups in each of the requirements shown. Even if these are only the perceptions of the individuals that differ, and has nothing to do with the tenure, these aspects should be clarified.

[17] Based on the standard deviation between the average, unweighted rating for each group

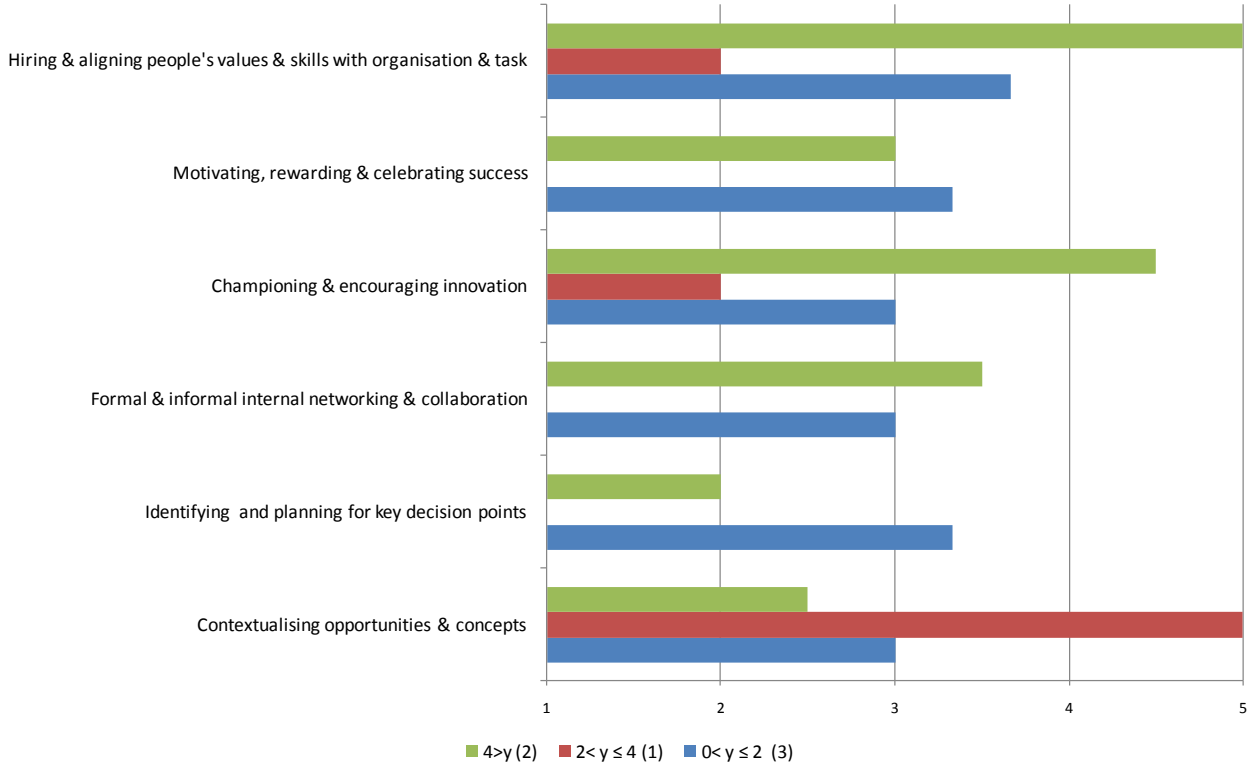

Figure 58 – CS6: differences between tenure groups

Based on the results presented above and other detailed analyses, the following recommendations were made:

- Formalise and make explicit an innovation strategy, or integrate the need to innovate with existing business strategy – provides the guidelines for all innovation activities and decisions.
- Continue to probe and understand the market and identify opportunities, but implement a screening & prioritisation process to pursue only the most promising and relevant opportunities and improve the allocation of resources.
- Continue to place emphasis on their existing values and policies, but translate those into practices and procedures that drive innovation – especially when growing as an organisation.
- Also consider managing intellectual property and investment in innovation (once the previously mentioned have been addressed).
- Ensure that the strengths remain in place while addressing the abovementioned aspects – avoid negatively impacting the existing strengths by "losing touch" with what were core competencies.
- And finally, clarify and discuss the differences in perspective, with attention to hiring and aligning people's values and skills with organisation and task, and the championing and encouraging of innovation within the organisation.

7.5.4 Plan procedure

This section describes the activities of the *Plan* stage that were completed for this case study. They included the presentation of results and the discussions that ensued based thereon.

7.5.4.1 Presentation of summarised results and discussion

As has consistently been the case, the participants responded very positively towards the accuracy and relevance of the presented results and recommendations. Individuals related to the presentation, and the discussions that ensued from each slide were rich with detailed reasons as to why certain aspects were depicted the way they were in the results. To reiterate a regularly mentioned point, this discussion between the participants is the most beneficial result of having executed the process to this point. The fact that the participants walk away with improved understanding of their innovation capability, and the fact that this understanding is now **common**, places them in a position to effectively and rapidly improve their capability.

There was one particular result that a few of the respondents disputed – *Managing tacit knowledge* being one of their strengths. These individuals stated that they certainly did not have specific and explicit practices to manage and transfer tacit knowledge. The author responded with the argument that the explicit documentation of specific practices is not a necessity for an organisation to be strong in the fulfilment of a particular requirement. What is required is common understanding between the individuals and the actual execution of those practices – this may be achieved verbally. In a large organisation, it may be necessary to document such aspects to achieve this commonality, but in an organisation of this nature, the individuals could share a basic practice without it having to be explicit. Basically, managing and transferring tacit knowledge at maturity levels 4 and 5 requires individuals to readily feed off of and learn from others within the organisation.

Also discussed was the fact that organisational values and policies were perceived as conducive to innovation, whereas the specific practices and procedures necessary to drive the innovation process and improve the consistency of its outputs were perceived as ill-defined and/or ad hoc. To avoid unnecessarily stereotyping or over-generalising small organisations of this nature, it must be mentioned that this was found to be consistent with only certain other small organisations having completed the process. Furthermore, there are too few completed cases to claim the existence of such a trend.

7.6 General remarks

This section presents the various lessons learnt during the execution of the case studies discussed in this chapter. Certain lessons are as a direct result of the interactions with the organisations and their representatives (Section 7.6.1) and others are as a result of specific findings that were investigated further (Sections 7.6.2 and 7.6.3).

7.6.1 Combined lessons from case studies

The reader may note the progressive incorporation of various learnings as these case studies were executed (and reported on). In other words, the process and methodology used in the later case studies had included more aspects of the Innovation Capability Improvement Methodology as discussed in Section 6.2. This also implies that the process used in CS2 was less refined than the one presented in Section 6.2. These refinements included, for example, the inclusion of the Innovation Capability Portfolio in CS5 (Figure 54, Section 7.4.3) to improve the visual interpretation and presentation of results. Also included were slightly altered mechanisms of initiating the evaluation workshop to improve clarity in terms of the objectives, while minimising the possibility of influencing the participants' responses. These lessons were, therefore, broad in nature and varying in terms of their impact on the overall process. The most prominent of these lessons include:

- It is essential to provide context for answering the questionnaire – such as a specific department to relate the questions to. This ensures, as much as possible, that the respondents begin the questionnaire with the same frame of mind.

- Provide the respondents with definitions and descriptions of the words that have specific meanings in the context of the questionnaire.

- When presenting the results and their interpretations, be sensitive that what is being discussed may seem to be targeted at certain individuals. Warn against this and reassure the participants that the assessment is of the organisation or business unit as a whole. Further, use the phrase "opportunities for improvement" rather than "weaknesses".

- Before the initial interactions with an organisation, establish a basic understanding of their business (via internet research or visiting their offices). This is useful during the initial meeting to plan the context and essential during the interpretation of results. While this does not negate the need to properly understand the results by involving the respondents, it does assist in the process of identifying those requirements that may be more important than others (whether for strategic or other reasons).

- Having the aforementioned in mind, no Innovation Capability Requirement is irrelevant. Certain requirements may be irrelevant at a specific point in time due to organisational circumstances, but that will change with improved capability. The requirement of *Meta-innovation* surfaced on several occasions to demonstrate this point.

- Emphasise to respondents, after completion of the questionnaire, that the 42 questions establish whether the 42 generic Innovation Capability Requirements of the ICMMv2 are being fulfilled. How they are being fulfilled is not being assessed because this is unique to the organisation and based on many aspects (including size, industry, etc.). The questionnaire, therefore, does **not** prescribe

specific practices. Mention that the process of determining "how" to fulfil the requirements needs the involvement and commitment of participants. This establishes buy-in and ensures relevance.

- Discuss the concept of "appetite" for improving innovation capability as the organisations' willingness to improve therein. This should be related to the competiveness of the organisation and the specific industry in which it operates. While it is important for all organisations to be innovative, it is **not** necessary for all organisations to be at and/or target innovation capability maturity level 5.

- Questionnaires in multiple languages may be necessary. This will ensure that the individuals' whose first language is not English will have a better understanding of descriptions and, therefore, provide more accurate responses. This may also reduce the variation in the time required to complete the questionnaire – witnessed most clearly in CS5 as a result of the large and diverse group of respondents.

- Prepare participants for the fact that they will be completing a questionnaire before the workshop – it places the individuals at ease. Providing no upfront information (with the objective of eliminating any possible response biasing) can cause individuals to feel intimidated – as if their ability is being assessed. Emphasise that the questionnaire is there to understand the individual's perspective of the organisation.

- The "mood" of a certain group within the respondents can have a significant impact on the overall results that would be difficult to normalise for with any of the currently implemented mechanisms (normalisation parameters). However, by capturing the appropriate meta-data (such as the groups to which respondents belong) these differences in perspective can be identified and appropriately dealt with. In fact, the ability to identify these differences in perspective or "moods" allows for the necessary communication and clarification of such aspects that will eventually ensure alignment between the individuals and groups.

7.6.2 Normalisation mechanism sensitivity analysis

In an effort to establish the effect of the roles-based normalisation mechanism on the results, a sensitivity analysis was performed. Basically, the objective was to better understand the impact of the mechanism on the results, particularly the seemingly convergent effect that it has on the high variation in responses obtained from participants. The implications of the various normalisation parameters severely complicated the mathematical determination thereof. The next option was to perform a sensitivity analysis. This analysis could also be performed in various ways by adjusting the different parameters (as described in Section 6.1.4.2) to identify the effect that this have on the results. Eventually, the following conditions and assumptions were applied in the execution of the analysis:

- The results of CS1 would be used as the reference data, because of the substantial amount of time (more so than in the other cases) expended on ensuring that the individual role profiles were accurate.

- The role profiles would be varied to determine the effect thereof on the normalised average maturity rating for the Innovation Process, Knowledge & Competency and Organisational Support capability areas, as well as the overall normalised average innovation capability maturity level.

- Using the original role profiles as the basis, the variations therein would be generated by adding a random integer between -*x* and *x* to each of the original values in the 5 by 21 matrix.

- The value of *x* was assigned the values of 1, 2, 5, 10, 20 and 30 to vary the potential difference between the original and adjusted roles profile matrices. The randomisation of the matrix was performed 5 times for each of the abovementioned values for *x*.

- The measure of the difference between the original roles profile matrix and the randomly generated profile matrix is calculated as follows (referred to as the Frobenius norm – Schatzman and Taylor (2002)):

$$y = \sqrt{\sum_{i=1}^{21}\sum_{j=1}^{5}(Aij - Bij)^2}$$

  Where:
  y = consolidated measure of the difference between the profiles
  Aij = the value in column *i* and row *j* of the original roles profile matrix
  Bij = the value in column *i* and row *j* of the random roles profile matrix

- The resultant dataset totalled 30 entries including the following statics: the difference between the organisational (original) roles profile as provided by the respondents and the adapted roles profile – *y;* the normalised average maturity rating for the Innovation Process, Knowledge & Competency and Organisational Support capability areas; as well as the overall normalised average innovation capability maturity level calculated based on the adapted roles profiles and the original responses of the participants. This data was then plotted on a graph of the ratings versus the differences between the matrices – Figure 59.

The results of this analysis clearly indicate an increase in the dispersion of the normalised innovation capability results with an increase in the difference between the organisational (original) roles profile and the adapted roles profile (solid bars represent each of the original statics). This provides evidence of the fact that the roles-based normalisation mechanism is sensitive to the relative accuracy of the profiles provided by the respondents.

The convergent effect that the mechanism has on the results is based on the respondents providing a representative role profile. Thus, if the profiles provided are not representative, excessive variation (in both relative and absolute terms) may be witnessed in the results. This analysis, therefore, provides evidence that the roles-based normalisation mechanism is performing the intended function. It also highlights the importance of the respondents providing an accurate roles profile.

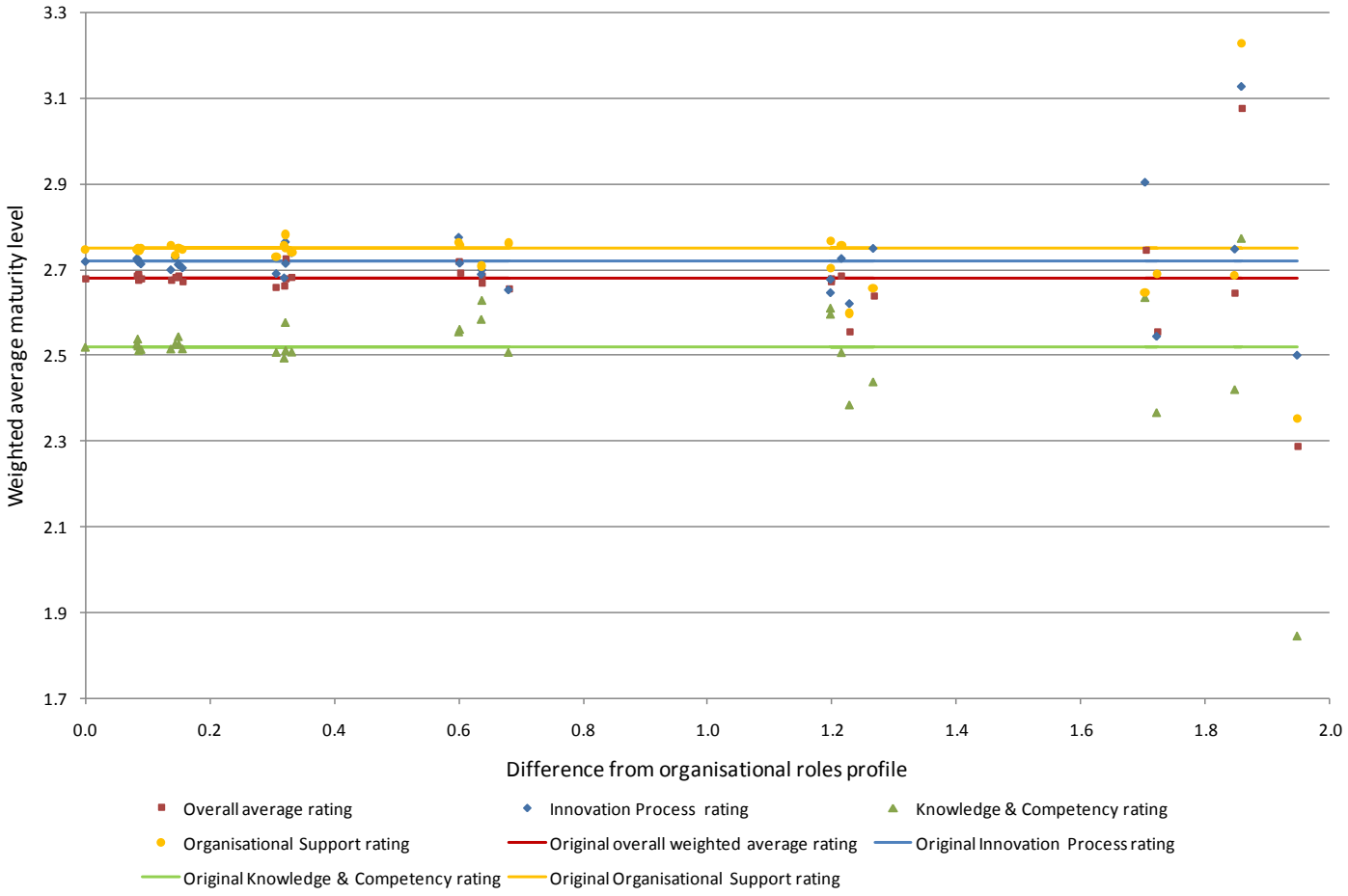

Figure 59 – Sensitivity analysis of normalisation mechanism

It is important to note, however, that these findings are based on a single case study – one that the author had confidence in the fact that the roles profiles were representative. More analyses are required to state, confidently, that the mechanism fulfils its intended purpose consistently.

7.6.3 Once-off ratings, overall ratings and other trends

This section presents certain trends that appeared within the results of the case studies. It should be noted upfront that these trends are based on 5 cases and should, therefore, be interpreted accordingly. For this reason, these trends will be briefly discussed. Table 11 provides the data for these discussions.

	No. of respondents	Organisation/ business unit size (approx.)	Once-off overall rating	Overall average rating	Overall normalised average rating	Average std. dev. between respondents	Std. dev. between requirements ratings (normalised ave.)
CS2	21	25	3.1	2.93	2.68	1.03	0.55
CS3	1	10	3.0	2.30	N/A	N/A	0.91
CS4	3	3	2.0	2.68	N/A	0.57	1.03
CS5	30	160	1.6	2.27	2.22	0.96	0.40
CS6	6	13	2.3	2.66	2.55	0.82	0.69

Table 11 – Summarised case study data

One of the objectives of including a once-off maturity rating of an organisation in the questionnaire (see the 3rd part of the questionnaire in Appendix I) 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 (see Section 6.1.1.3 for these descriptions), thus linking the outputs of innovation to the innovation capability maturity of an organisation. To make the intended comparison, the 2nd and 3rd columns of Table 11 will be plotted against one another – Figure 60. Note that the overall normalised average rating was not used because in 2 of the case studies, this value could not be calculated.

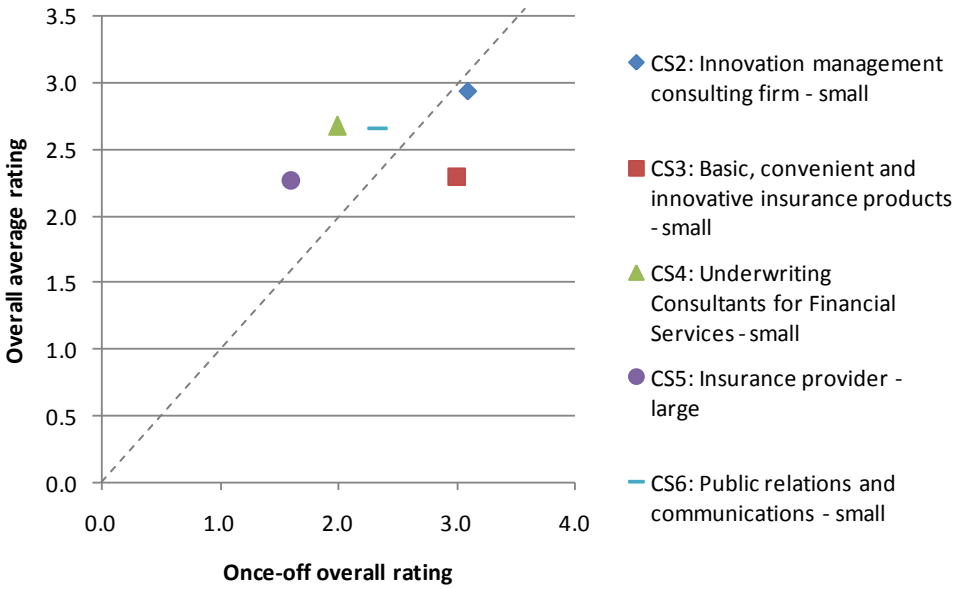

Figure 60 – Once-off overall rating vs. overall average rating

The ideal situation would be to see the points plotted along the grey dotted line depicted in Figure 60. 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:

- The once-off ratings descriptions do not present an accurate and generic global picture of an organisation at each of the maturity levels.
- 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 proposed 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.

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 7, Table 11). These 2 values were plotted against one another for each of the case studies – Figure 61.

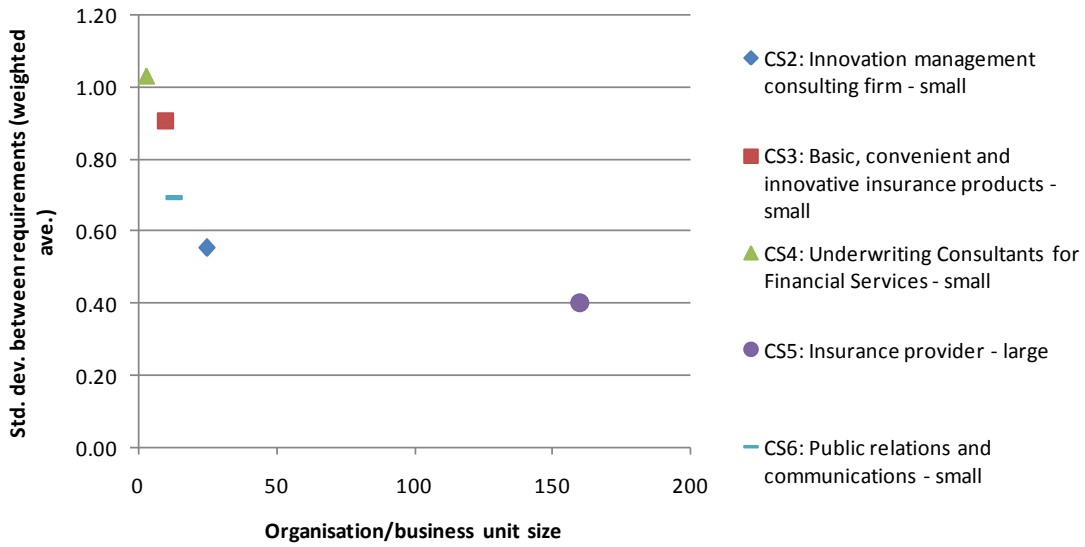

Figure 61 – Dispersion in requirements vs. organisation size

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 is 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. The author's opinion is that 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 and methodology. If this were the case, it would require correlation between an organisation's size and the implementation of structure.

7.7 Conclusion

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 optimistic that should the recommended actions be taken, their innovation capability and essentially, the manner in which they conduct business, should improve.

Having completed the process several times over, certain essential insights were gained to demonstrate the benefit and value in using the model and the associated improvement methodology. These 4 fundamental findings are:

- 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.

- 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.

- 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.

- 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.

8. Conclusion

This research commenced with the challenge of understanding innovation. It was always clear that innovation is the means for organisational prosperity. With the progression of this research, many complex and interrelated innovation requirements were discovered – requirements that need to be understood and addressed to be capable of innovation. Fundamentally through, to innovate is a conscious decision made by those that drive, facilitate and partake in its activities. At the core, it requires organisations to change – relentlessly – while maintaining (and improving) operational efficiency and effectiveness. Innovation is a complex and consuming process with the potential for generating significant and sustained value, shuffling the status quo, overturning entire markets, and creating radically new ones. Its advocates are able to consistently position themselves ahead of the hesitant. It is a way of thinking, a way of believing and a way of doing, and then doing it all over again. It is an organisational way of life!

8.1 The "meaning" of innovation

This research has also led to the identification of several aspects (or issues) pertaining to the "meaning" of innovation. These aspects have become issues because they relate to the misunderstanding of innovation, its constituents and/or role within the organisation. While these discussions do not describe the meaning of innovation, they do highlight misconceived notions thereof in the hope of improving general understanding.

In Sections 1.1.1 and 3.1.1, the definition of innovation was addressed. A resounding aspect was the requirement for newness, uniqueness and/or novelty. Virtually all material that has addressed the matter of innovation supports this. While newness has and always will be an integral part of innovation, the author feels that the pursuit of newness alone is certainly not the core requirement for innovation. Being new for the sake of it is not what creates markets and attracts customers. Often, it is the new aspect (product, process and/or strategy) that better fulfils existing needs or uncovers latent needs. But, newness is not the only "recipe for success". Consider Apple's iPod and iStore and the enormous success thereof – it is a well known fact that Apple did not invent the mp3 player or the music store. However, the convergence of these two existing "products" along with aesthetic appeal, flawless ergonomics and a stable platform (software) ensured a winning recipe. One may argue that the combination was new (which it was), but to consider the newness as the reason for success without a contribution from other aspects would be erroneous.

Another misconception relates to the inappropriate use of the word "innovation" to replace the words "creativity" or "invention". For instance, to have an "innovative idea" is paradoxical because an idea cannot be innovative without it having been implemented and successful in the fulfilment of objectives. Innovation refers to a rigorous process that requires ideas be taken through multiple phases until commercial successes have been realised.

Company mission statements often allude to an "innovative culture". Seldom is this elaborated on, such as to describe how this is achieved and the benefits realised. The findings of this research suggest that an innovative culture is not developed explicitly, but rather that the existence of this culture is implicit in the

instantiation of many organisational attributes. Thus, culture is not a single aspect that can be tweaked and manipulated until it becomes innovative – it is a complex arrangement of multiple attributes that need to be simultaneously considered and adjusted to have a beneficial effect thereon. These attributes may include the values of the individuals hired by the organisation; the values that the organisation is promoting to its employees; the policies, practices and procedures that have been internalised; the physical environment that the employees interact in and with; the way leadership interacts with their employees and the example that they set; the manner in which and for what employees are rewarded; the acceptance of risk, uncertainty and that failing is not failing, but learning; etc. – the list is extensive. While the ICMM v2 does not claim to cover this list thoroughly, it does provide improved understanding of many of these attributes, their relation to one another and their impact on the organisation.

8.2 State of the art – December 2008

This is not a detailed description of the state of the art of innovation evaluation models. Rather, it is a brief summary of the latest developments in the field of innovation assessment – a field that was substantially sparser at initiation of this research. While none of the models listed are the same as the ICMM and their theoretical or empirical foundations are unclear, they provide comparative opportunities that could strengthen the foundation of the ICMM (and vice versa). In fact, collaboration with 2 of the institutions responsible for their development has been initiated, with one particular institute discussing the development of a unified model similar to the SEI's CMMI.

The sheer speed with which this field of research has progressed since the initial research began at the beginning of 2006, has been immense. Some recent and significant developments include:

- Innovation Management Maturity Index from Intelekto in Brazil (see www.intelekto.com.br).
- INPAQT Innovation Capability Maturity Model from INPAQT in The Netherlands (see www.inpaqt.nl).
- Innovation Aptitude™ Audit from The Innovation Practice (see www.theinnovationpractice.com).

While the theoretical basis of these models has not been established, collaboration has been initiated in an attempt to stimulate mutual learning. Intelekto, a spin-off consultancy from the University of Sao Paulo in Brazil, has expressed interest in forming an NGO to develop a unified model combining the research of Intelekto and the work presented in this dissertation. Additionally, discussions have been instigated with INPAQT. In general, the objective of this collaboration would be to improve the robustness of the respective models.

8.3 Future research

The following additional research aspects have been identified from the research described in this dissertation. The intention would be to improve the ICMM v2 and, specifically, the Innovation Capability Improvement Methodology. They include:

- Questionnaire and related aspects – with specific attention to the detailed design thereof and the inclusion of a response 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, it's effectiveness in other situations should be evaluated.

- A framework describing the implicit interdependencies within the Innovation Capability Requirements, i.e., those that are not depicted in the framework in Section 6.1.1. Based on these interdependencies, a mechanism could be developed to understand the impact of prioritising certain requirements during an improvement initiative. The mechanism should be used to refine the prioritisation process in conjunction with the existing mechanisms described in Section 6.2.2.1.2.

- The proposed *Improve* 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.

- 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.).

8.4 Final remarks

This research endeavoured to describe a framework that would capture the "organisational way of life" that is innovation and render it transferable and learnable. An approach, Maturity Modelling, was recognised for its ability to describe organisational progression towards such an ideal. An Innovation Capability Maturity Model, with the intention of describing generic and evolutionary plateaus of innovation capability maturity, was developed from a comprehensive literature study. This model was evaluated with a first case study, which led to a rigorous refinement initiative that included further literature study, a mapping and comparison exercise, and a detailed analysis of innovation capability themes using an LDA-based topic modelling approach. The consolidation of these activities and integration with the initial model resulted in the second version thereof – ICMM v2.

To the author's knowledge, this was the first comprehensive study of the broad and disparate ingredients of organisational innovation capability, particularly, with the use of advanced text analysis techniques (such as LDA) to contextualise and structure the vast amount of literature. The approach taken enabled both detailed analysis and holistic synthesis of the subject matter, providing valuable insight into the "DNA" of innovation capability, while maintaining clear perspective of how the components piece together. This proved vital in developing a model that was sufficiently pragmatic to be used in practice – and deriving actual benefit therefrom – while maintaining the theoretical substance of the content.

The resulting model was utilised in an additional 5 case studies that would serve to evaluate and validate the content and structure thereof, but also make a fundamental contribution to the application of the model – captured in the so called Innovation Capability Improvement Methodology. The case studies provided substantial evidence that the content and structure of the ICMM v2, including the approach used to convey

these aspects, fulfil their intended purpose by appropriately identifying the innovation capability strengths and weaknesses of the representative organisations.

Note that 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 – which the ICMM v2 is intended to eliminate.

Several benefits, apart from the obvious identification of strengths and weakness, were recognised by case study participants. They can be summed up as a radical improvement in their understanding of what being an innovation capable organisation implies, in creating a unified understanding of the organisation's position in relation thereto, and allowing for improvement objectives to be established that are shared by all. These benefits were found to be vital in achieving buy-in – an aspect, without which, any improvement initiative is destined to fail. For an initiative to be successful, the stakeholders who are responsible for its funding, implementation and eventual use must believe in its value. The process of assessing an organisation's innovation capability, based on a questionnaire that was completed by the relevant stakeholders and who were regularly involved in the interpretation thereof, was consistently found to achieve the necessary buy-in to instigate improvement.

The final point relates to this discussion and the concluding remarks of the previous chapter. Innovation is a process that has been found to be extremely reliant on people; in the necessary roles, for generating and nurturing ideas, for implementing and exploiting those ideas, to provide objective opinions, and so on. Certainly, people will always be at the core of innovation, with anything else only providing support. It is therefore that the assessment of organisational innovation capability, based on people's opinions (or perspectives), is sufficient to provide a strong case for improvement. Furthermore, it provides the answer as to why the results of the cases with few respondents (such as Case Study 4), in the absence of advanced statistical techniques to analyse and present those results, still provided the respondents with valuable insight as to where they need to focus their attention. Innovation is a people driven process and, therefore, directly impacted by their perspectives. It is these perspectives that the ICMM v2 endeavours to contextualise within the innovation capability landscape, allowing organisations to rapidly re-organise themselves for innovation.

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A

Appendix A Maturity model impact mapping summary

		Enterprise Lifecycle					Product Lifecycle								Technology Lifecycle					
		Concept	Functional Analysis	Implementation	Operation	Recycle & Disposal	Concept	Definition	Design	Industrialisation	Production	Distribution & Logistics	Product Support & Maintenance	Disposal	Identification/ Needs Assessment	Solution Architecture /Selection	Development/ Acquisition	Implementation	Exploitation	Decommissioning
CMMI	Level 1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Level 2	5.3%	47.4%	89.5%	100.0%	15.8%	15.0%	30.0%	70.0%	75.0%	100.0%	95.0%	65.0%	15.0%	30.0%	50.0%	85.0%	100.0%	80.0%	15.0%
	Level 3	38.5%	87.2%	100.0%	76.9%	30.8%	72.4%	89.7%	96.6%	100.0%	93.1%	72.4%	65.5%	51.7%	63.3%	100.0%	100.0%	100.0%	76.7%	56.7%
	Level 4	0.0%	25.0%	75.0%	100.0%	0.0%	14.3%	14.3%	57.1%	57.1%	100.0%	71.4%	71.4%	14.3%	14.3%	42.9%	57.1%	85.7%	100.0%	14.3%
	Level 5	16.7%	50.0%	100.0%	100.0%	16.7%	60.0%	100.0%	80.0%	80.0%	100.0%	60.0%	40.0%	40.0%	42.9%	57.1%	71.4%	71.4%	100.0%	71.4%
	Total	*13.3%*	*50.8%*	*92.9%*	*100.0%*	*14.0%*	*33.2%*	*47.2%*	*72.7%*	*74.7%*	*100.0%*	*77.2%*	*64.3%*	*26.0%*	*36.6%*	*64.0%*	*82.7%*	*98.0%*	*100.0%*	*37.8%*
P3M3	Level 1	100.0%	100.0%	83.3%	33.3%	0.0%	40.0%	100.0%	40.0%	40.0%	20.0%	20.0%	20.0%	20.0%	80.0%	100.0%	60.0%	20.0%	20.0%	20.0%
	Level 2	27.3%	100.0%	84.1%	45.5%	15.9%	79.4%	100.0%	88.2%	94.1%	61.8%	52.9%	47.1%	44.1%	84.8%	97.0%	100.0%	84.8%	63.6%	36.4%
	Level 3	19.4%	74.2%	100.0%	64.5%	12.9%	65.4%	80.8%	100.0%	100.0%	80.8%	65.4%	57.7%	50.0%	53.8%	76.9%	88.5%	100.0%	84.6%	42.3%
	Level 4	12.5%	75.0%	100.0%	87.5%	0.0%	37.5%	62.5%	100.0%	100.0%	75.0%	50.0%	50.0%	50.0%	66.7%	77.8%	88.9%	100.0%	44.4%	44.4%
	Level 5	44.4%	100.0%	88.9%	66.7%	0.0%	75.0%	100.0%	87.5%	87.5%	62.5%	50.0%	50.0%	37.5%	87.5%	100.0%	100.0%	100.0%	75.0%	62.5%
	Total	*43.3%*	*97.5%*	*100.0%*	*64.8%*	*6.9%*	*66.6%*	*100.0%*	*97.0%*	*98.4%*	*70.3%*	*55.3%*	*52.1%*	*47.4%*	*82.4%*	*100.0%*	*98.1%*	*92.4%*	*63.1%*	*45.6%*
SE-CMM	Level 1	22.9%	97.9%	100.0%	70.8%	22.9%	42.6%	80.9%	100.0%	97.9%	66.0%	42.6%	40.4%	34.0%	60.9%	89.1%	100.0%	87.0%	69.6%	39.1%
	Level 2	22.9%	97.9%	100.0%	70.8%	22.9%	42.6%	80.9%	100.0%	97.9%	66.0%	42.6%	40.4%	34.0%	60.9%	89.1%	100.0%	87.0%	69.6%	39.1%
	Level 3	22.9%	97.9%	100.0%	70.8%	22.9%	42.6%	80.9%	100.0%	97.9%	66.0%	42.6%	40.4%	34.0%	60.9%	89.1%	100.0%	87.0%	69.6%	39.1%
	Level 4	22.9%	97.9%	100.0%	70.8%	22.9%	42.6%	80.9%	100.0%	97.9%	66.0%	42.6%	40.4%	34.0%	60.9%	89.1%	100.0%	87.0%	69.6%	39.1%
	Level 5	22.9%	97.9%	100.0%	70.8%	22.9%	42.6%	80.9%	100.0%	97.9%	66.0%	42.6%	40.4%	34.0%	60.9%	89.1%	100.0%	87.0%	69.6%	39.1%
	Total	*22.9%*	*97.9%*	*100.0%*	*70.8%*	*22.9%*	*42.6%*	*80.9%*	*100.0%*	*97.9%*	*66.0%*	*42.6%*	*40.4%*	*34.0%*	*60.9%*	*89.1%*	*100.0%*	*87.0%*	*69.6%*	*39.1%*

Table 12 – Lifecycle Impact and Support Summary

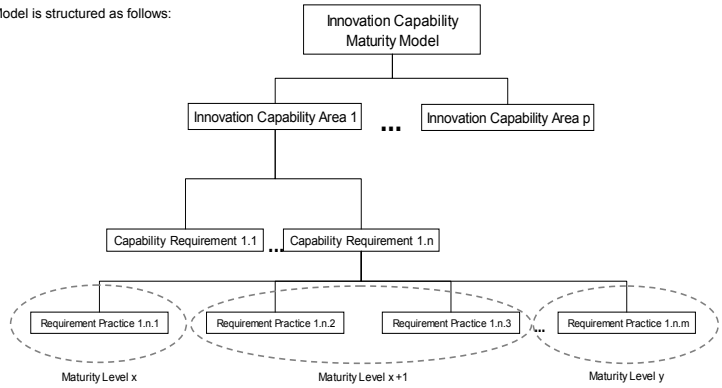
Appendix B ICMM v1 content & interdependencies

ICR INTERDEPENDENCIES

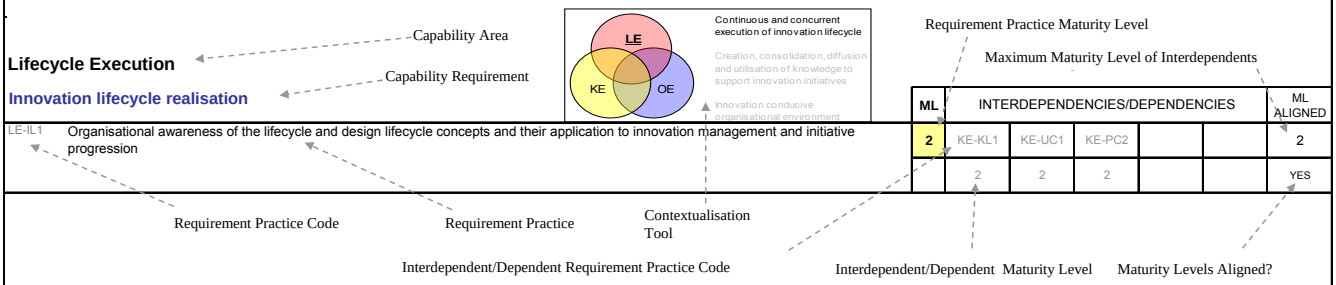
General Comments

The intention of this appendix is to provide a first-cut version of the interdependencies of the requirement practices. It is highly likely that more interdependencies exist and a suggestion for further research is the continued identification of these interdependencies.
The interdependencies as they are listed below played a crucial role in the determination of appropriate maturity levels for specific requirement practices. The assigned maturity level of a specific requirement practice could be compared with the maturity level of those identified to be interdependents thereof. From this comparison it was ensured that the maximum maturity level of all the specific practice's. This process was continued throughout the development of the model.

The Innovation Capability Maturity Model is structured as follows:



The interdependencies are structured as follows:



The maturity levels are described as follows:

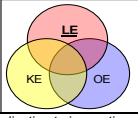
1	Innovation is not a consideration of the organisation. Individual attempts at being creative or "out-of-the-ordinary" are dismissed. Innovative output is virtually zero. The organisation is consumed with day-to-day operations to maximise short term revenues.
2	The organisation has identified the need to innovate. Innovation is clearly defined and innovative activity is encouraged. A basic understanding has been established of the various factors that influence innovation capability. Innovative outputs are not consistent in nature.
3	Tools, techniques, methods and procedures for facilitating innovation activities have been identified and are deployed. Individuals are empowered to innovate. Improved understanding of the concepts of innovation have been institutionalised and utilised to improve innovation initiatives. Innovative outputs are consistent in nature and sustain organisation positioning.
4	Tools, techniques, methods and procedures for integrating innovation initiatives and related activities have been identified and are deployed. Profound understanding of the concepts of innovation and the interdependencies thereof have been institutionalised to create improved interaction between multiple initiatives. Innovative outputs are diverse, consistent and a reliable source of differentiation.
5	Innovation is embedded in individual, team and organisational patterns of behaviour. The interactions between multiple innovation initiatives are optimised to achieve synergy. The entire organisation is aligned in a quest to dominate undiscovered and untapped markets. Innovative outputs consistently position the organisation ahead of competitors or even render the organisation uncontested.

The practices described within a specific level of innovation maturity must all be fulfilled on a consistent basis for the organisation to have attained that level of maturity. Furthermore, the practices described within maturity level x are assumed as institutional in maturity level x + 1. Many practices within maturity level x require the parallel fulfilment of other practices also within maturity level x, and described in maturity level x – 1 are consistently fulfilled. The structured and layered fulfilment of these practices is necessary due to the many interdependencies that are present between the practices.

NOTE: There are occurrences when a listed interdependency has a lower maturity level than the actual Requirement Practice. In this case, the Requirement Practice is dependent on the fulfilment of the listed practice. The listed practice is however not dependent on the original practice (this would present a problem in terms of achieving the listed practice seeing that it relies on another practice in a

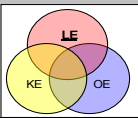
Lifecycle Execution

Innovation lifecycle realisation



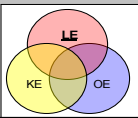
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-IL1	Organisational awareness of the lifecycle and design lifecycle concepts and their application to innovation management and initiative progression	2	KE-KL1	KE-UC1	KE-PC2			2
			2	2	2			YES
LE-IL2	Understanding of the lifecycle phases and their respective inputs, outputs, controls and mechanisms is established	2	KE-KL2	KE-CP3				2
			2	2				YES
LE-IL3	Structures and procedures are implemented to facilitate the management and coordination of innovation initiative lifecycles	3	OE-ST8	KE-CP11	KE-KL3	LE-AS7		3
			3	3	3	3		YES
LE-IL4	Identification and institutionalisation of effective and efficient processes to ensure successful execution of innovation initiative lifecycles	3	LE-RR5	KE-UC3	KE-PC2	KE-CP7	CI-LR2	3
			3	3	2	3	3	YES
LE-IL5	Profound organisational understanding of the lifecycle concept and the implications thereof to ensure successful and repeated execution of innovation initiatives is established	3	KE-UC3	KE-KE3				3
			3	3				YES
LE-IL6	Concurrent and repeated successful execution and management of innovation initiatives and their lifecycles	3	LE-AS7	LE-PI2	KE-PC6			3
			3	3	3			YES
LE-IL7	Identification, implementation and integration of tools, systems and models to facilitate the management, execution and integration of innovation initiative lifecycles	4	CI-UI2	KE-UC7	LE-OI3			4
			4	4	3			YES
LE-IL8	Profound organisational understanding of the interaction between the multiple instances and types of lifecycles playing out within the organisation is established	4	KE-CP15	OE-ST10				4
			4	4				YES
LE-IL9	Managing the interaction and achieving synergy between the enterprise relevant lifecycles and the multiple innovation initiatives in progress within the organisation	5	CI-UI3	KE-CP16	OE-ST12	CI-CF7		5
			5	5	5	5		YES

Agile-to-systematic project ability



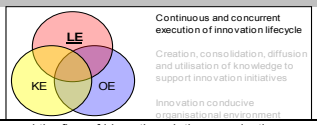
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-AS1	Distinction between radical innovation initiatives and initiatives having many recurring attributes has been made, the implications of each understood, and a basic approach to manage the distinction deployed	2	LE-MF1	OE-SD1	LE-IL2			2
			2	2	2			YES
LE-AS2	Regular project appraisal is an institutionalised activity compelling project and organisational learning	3	CI-UM1					3
			3					YES
LE-AS3	Structure projects for effective communication, integration and adaptability	3	OE-ST8	KE-CP11	CI-CP5	CI-CF5	CI-CP7	3
			3	3	3	3	3	YES
LE-AS4	Planning, design and deployment of initiatives is performed at all levels of organisational detail and directionally effected to be most facilitative of innovation initiatives	3	OE-ST3	OE-SD5	KE-CP7			3
			3	3	3			YES
LE-AS5	Develop understanding of the characteristics of innovation initiatives based on the degree of newness and level of impact of the innovation	3	LE-MF3	LE-OI5	CI-CS3	CI-CP5		3
			3	3	3	3		YES
LE-AS6	A distinction between the fuzzy front end and systematic phases of an innovation initiative is made and the need to manage appropriately identified	3	LE-MF1	LE-IL5				3
			2	3				YES
LE-AS7	Identification and deployment of effective fuzzy front end and systematic phase management and execution techniques	3	KE-KE3	LE-MF2	LE-SE3	LE-OI3		3
			3	3	3	3		YES
LE-AS8	Establish the innovativeness of initiatives and apply and integrate the appropriate combination of management and execution techniques to ensure creativity and flexibility while still adhering to timelines and milestones	4	LE-MF5	LE-OI8	CI-CS5	CI-CF6		4
			4	4	4	4		YES
LE-AS9	Interactive and dynamic representation and visualisation of project and/or programme lifecycles to advance understanding and facilitate execution of innovation initiatives	4	LE-IL8	KE-UC6	CI-UI2			4
			4	4	4			YES
LE-AS10	Transition from the fuzzy front end to the systematic phase is seamlessly integrated and effectively managed to achieve timeous fruitation of innovation initiatives	5	KE-CP16	OE-ST12	CI-CF7	KE-UC9		5
			5	5	5	5		YES

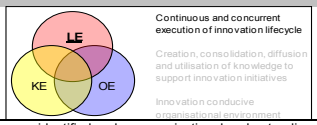
Risk realisation and management

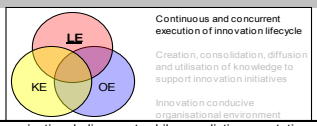


		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-RR1	The organisation distinguishes between programme and project risk in an effort to create the right balance between risk and security that is reflective of the organisation's capability to manage and capacity to absorb risk	3	LE-AS5	KE-UC3				3
			3	3				YES
LE-RR2	The ambiguities, uncertainties and complexities associated with innovation initiatives are related to risk	3	LE-MF1	CI-CF5	LE-OI5			3
			2	3	3			YES
LE-RR3	Efforts to continuously identify and manage risk throughout the lifecycle of an initiative are established	3	LE-IL5	KE-CP7				3
			3	3				YES

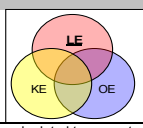
LE-RR4	The early anticipation of high level risks and continued revision and management thereof is an institutionalised activity	3	LE-OI5	KE-UC4	CI-CF5	CI-CP6		3
			3	3	3	3		YES
LE-RR5	Effective tactics are identified and deployed to mitigate the likelihood of anticipated risks becoming realities, resulting in an overall improvement in initiative execution	3	KE-CP7	CI-CF5				3
			3	3				YES
LE-RR6	Risk mitigation tactic successes and failures are embraced as organisational opportunities for growth and learning	4	OE-CI8	KE-UC8	KE-PC6			4
			3	4	3			YES
LE-RR7	Risks are accepted and embraced by the organisation as opportunities to succeed and serve to differentiate the organisation from its competitors	5	OE-CI12	OE-ID9	OE-CC12	CI-CP11		5
			5	4	5	5		YES

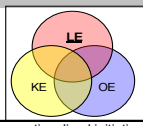
Opportunity identification and solution generation		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-OI1	Establish an understanding of the influx of information, idea and solution generation, and the flow of ideas though the organisation	2	LE-MF1	KE-PC2	CI-CF2			2
			2	2	2			YES
LE-OI2	Identify and deploy techniques to facilitate the influx of information, idea and solution generation, and the flow of ideas through the organisation	3	OE-CC1	OE-ID3	KE-UC3	KE-CP7		3
			2	2	3	3		YES
LE-OI3	Identification and application of effective skills and techniques to facilitate internal (organisational) and external (environmental) scanning and recognition of opportunities	3	KE-PC5	KE-CP7	CI-CF5	CI-LR2	OE-ST5	3
			3	3	3	3	3	YES
LE-OI4	Identification and application of effective skills and techniques to rapidly generate multiple ideas and potential solutions for the recognised opportunities	3	KE-PC5	KE-CP7	CI-CF5			3
			3	3	3			YES
LE-OI5	Develop a profound understanding of the recognised opportunities and relate to organisational strategy and core competency	3	KE-UC3	CI-CS3	OE-SD6	CI-CC3		3
			3	3	3	3		YES
LE-OI6	Ideas spawn from all corners of the organisation and are appreciated as contributions toward the organisational quest to innovate	3	OE-CC6	OE-CI6	OE-ID3	OE-ST5		3
			3	3	2	3		YES
LE-OI7	Comprehensive studies of the opportunities from numerous diverse and fresh perspectives are performed to create a landscape of opportunities that presents a broad scope for organisational differentiation	4	KE-UC7	CI-CF6	CI-UI2	CI-LR3		4
			4	4	4	4		YES
LE-OI8	An advanced understanding of the organisational implications of market and industry trends and the pursuit (or ignorance) of the recognised opportunities is established	4	CI-CS5	CI-LR6	KE-UC8			4
			4	4	4			YES
LE-OI9	Based on new perspective, organisations challenge presumptions, expand boundaries, discover the "white spots" and unearth unrealised and seemingly disparate opportunities	5	KE-UC9	CI-LR7	CI-CF7	OE-CC11		5
			5	5	5	4		YES
LE-OI10	Efforts are strongly aligned and integrated to achieve synergy from the multiple opportunity, idea and solution streams	5	KE-CP16	CI-LR9	CI-UI3	CI-CF7		5
			5	5	5			YES

Fuzzy front end management		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-MF1	The ambiguities, uncertainties and complexities associated with innovation initiatives are identified and an organisational understanding thereof established	2	LE-OI1	CI-CF2	LE-IL2			2
			2	2	2			YES
LE-MF2	Appropriate adaptive and flexible management techniques are effectively utilised to successfully address the requirements of the fuzzy front end of innovation initiatives	3	KE-KE3	KE-CP7	CI-CF5	OE-ST6		3
			3	3	3	3		YES
LE-MF3	Trajectory strategies for the innovation initiatives are established based on the degree of newness and the level of impact thereof	3	CI-CS3	LE-OI5				3
			3	3				YES
LE-MF4	The early anticipation and resolution of barriers to innovation initiatives is a continuous, organisation-wide activity	3	LE-RR3	LE-IL5	CI-CF5	CI-CP6		3
			3	3	3	3		YES
LE-MF5	Effective tactics are developed and deployed to manage the ambiguities, uncertainties and complexities associated with the fuzzy front end and exploit them as opportunities to derive competitive advantage	4	KE-UC8	KE-CP12	CI-CF6	OE-CC11		4
			4	3	4	4		YES
LE-MF6	Interrelationships between the fuzzy front ends of initiatives are identified, understood and exploited to achieve synergy between the efforts and extract maximum value	4	KE-CP14	KE-UC7	CI-CF6	LE-IL8	CI-UI2	4
			4	4	4	4	4	YES
LE-MF7	Embrace and exploit the fuzzy front end as the opportunity to instigate an initiative with enormous potential to create new markets, long term competitive advantage, long term return on investment and ensure the sustained prosperity of the organisation	5	OE-CI12	CI-LR8	CI-CF7			5
			5	5	5			YES

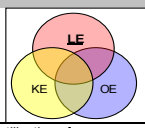
Prioritisation of opportunities and testing and screening of ideas		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-PO1	All ideas are rigorously and rapidly evaluated to ascertain potential and scope for organisational alignment, while a realistic expectation of return is maintained	2	CI-CS1	KE-CP3	KE-UC1	CI-CC2		2
			2	2	2	2		YES

LE-PO2	Ideas are screened allowing through only those with substantial potential, resulting in a manageable cluster of resilient possibilities	2	OE-ST2	CI-CC2				2
			2	2				YES
LE-PO3	Ideas are swiftly abandoned if unsuccessful in order to release crucial resources and continue testing and screening	3	OE-RA6	OE-ST8	LE-AS3			3
			3	3	3			YES
LE-PO4	Highly promising and organisationally aligned opportunities are prioritised and the remainder are stowed for possible future revival and/or to advance organisational learning	3	OE-SD7	KE-PC6	CI-CC3	OE-ST8		3
			3	3	3	3		YES
LE-PO5	Opportunities unaligned with organisational strategy are scrutinised for potential and alternative strategies and competency development options are considered	3	OE-SD7	KE-PC6	OE-ST7			3
			3	3	3			YES
LE-PO6	Unsuccessful ideas are embraced as an opportunity for learning and stowed for later possible utilisation	3	KE-PC6					3
			3					YES
LE-PO7	Resilient ideas and possible solutions are imbedded in as tangible objects as possible to facilitate the testing and screening thereof	3	CI-CS3	CI-CF5	CI-CC6			3
			3	3	3			YES
LE-PO8	Resilient ideas and possible solutions are put through a period of incubation constituting rigorous experimentation and circulation in order to evolve them into stimulating business propositions	4	KE-CP15	OE-RA5	KE-UC7	CI-CC8		4
			4	3	4	4		YES
LE-PO9	The organisation engenders action and rapid idea turnaround to promptly and recurrently exhume those ideas and solutions that are most likely to deeply satisfy the opportunities that are promising to bring about substantial differentiation	5	OE-RA10	OE-CC12	OE-ID10	CI-CC10		5
			5	5	5	5		YES

Substantiation and exploitation of opportunities	 Continuous and concurrent execution of innovation lifecycle Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives Innovation conducive organisational environment	ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-SE1	Consideration of realistic adoption rates, sales and bottom line profitability is made and related to competency, resources and capacity, technology, etc., to ensure the operational success of the innovation initiative	3	CI-CS3	CI-CC3				3
			3	3				YES
LE-SE2	Effective utilisation and institutionalisation of appropriate systematic and comprehensive management techniques and controls to ensure the realisation of opportunities and solutions	3	CI-UM1	LE-IL5	OE-ST7	KE-UC5		3
			3	3	3	3		YES
LE-SE3	The differences between fuzzy front end flexibilities and constrained organisational requirements are effectively bridged	3	LE-AS7	LE-MF1	OE-RA6			3
			3	2	3			YES
LE-SE4	Pursued opportunities and their prospective solutions are rapidly accelerated and become focused initiatives for deriving value	3	OE-RA6	CI-CC6				3
			3	3				YES
LE-SE5	Integrated consideration is made of aspects such as the value chain and partners, enterprise architecture and infrastructure, technology, etc., and the implications thereof when implemented within an innovative environment is understood	3	KE-CP7	CI-CF5	CI-CS3	CI-UI1	CI-LR2	3
			3	3	3	3	3	YES
LE-SE6	There are metrics concerned with the overall contribution to organisational growth and the rapid substantiation of opportunities into operable value generators	3	CI-UM1	OE-SD7				3
			3	3				YES
LE-SE7	An understanding of the networking behaviour of the targeted market, the adoption lifecycle, and the category maturity are established, and appropriate promotion and diffusion techniques developed and deployed	4	CI-CS5	CI-LR3				4
			4	4				YES
LE-SE8	Transition from the fuzzy front end to the accelerated opportunity exploitation and value creation phase is seamless and facilitated by institutionalised, finely tuned procedures to bring about the rapid substantiation and fruition of innovation initiatives	5	CI-UI3	LE-IL9	CI-CC10	KE-CP15		5
			5	5	5	4		YES

Parallel incremental and radical innovation execution	 Continuous and concurrent execution of innovation lifecycle Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives Innovation conducive organisational environment	ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-PI1	Continued and concurrent initialisation and execution of incremental innovation on operationalised initiatives to ensure sustained differentiation of the organisation	3	LE-IL6	CI-CS3	LE-OI4	KE-UC5		3
			3	3	3	3		YES
LE-PI2	Rewards of successfully executed and operationalised innovations are reaped and distributed amongst contributors to show appreciation and stimulate the desire to repeat such successes	3	OE-CC7	OE-ID3				3
			3	2				YES
LE-PI3	Continued and concurrent scanning for new and radical opportunities, revitalising and revising of old opportunities and ideas, and a general continuation of the innovation process	3	LE-OI3	KE-UC3	KE-UC5	KE-PC7		3
			3	3	3	3		YES
LE-PI4	The processes executed to bring about the successful or unsuccessful realisation of initiatives are embraced and exploited as opportunities to stimulate organisational learning	3	KE-PC6	OE-CC1				3
			3	2				YES
LE-PI5	Interrelationships of concurrently executed radical and incremental initiatives and operationalised initiatives are identified and exploited to achieve synergy between, maximise the potential of, and increase the likelihood of multiple successes	4	CI-UI2	CI-CC7	KE-CP15			4
			4	4	4			YES

Timeous disposal of initiatives



Continuous and concurrent execution of innovation lifecycle

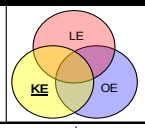
Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives

Innovation conducive organisational environment

		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
LE-KW1	Establish the critical point of diminished returns and ineffective and/or sub-optimal utilisation of scarce capacity and resources and effect the closure of the initiative or endeavour	3	CI-CC6	LE-IL5	OE-RA6			3
			3	3	3			YES
LE-KW2	Rapid redistribution of vital capacity and resources for utilisation and exploitation in operationally feasible endeavours and/or new opportunities	3	OE-ST6	LE-IL5	OE-RA6			3
			3	3	3			YES
LE-KW3	Endeavours and initiatives that are discontinued are revisited, the process retraced and scrutinised in hindsight in an effort to learn from successes, challenges and failures and ensure improved execution of in progress and future initiatives	4	KE-UC8	LE-IL8	KE-PC9			4
			4	4	4			YES
LE-KW4	Establish the critical point where continued execution and operation could damage the internal and/or external perception of the organisation and the attainment of its vision and effect the closure of the endeavour	4	CI-CS4	CI-LR3	KE-UC7			4
			4	4	4			YES

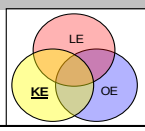
Knowledge Exploitation

Knowledge lifecycle realisation



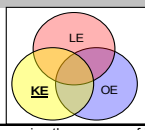
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
KE-KL1	Organisational awareness of the lifecycle concept and its application to knowledge management	2	LE-IL1	KE-UC1	KE-PC2			2
			2	2	2			YES
KE-KL2	Understanding of the lifecycle phases and their respective inputs, outputs, controls and mechanisms is established	2	LE-IL2	KE-CP3	KE-KE2			2
			2	2	2			YES
KE-KL3	Structures and procedures are implemented to facilitate the management and coordination of the lifecycle of knowledge enhancement initiatives	3	OE-ST8	KE-CP11	KE-PC8	KE-UC5	KE-RC4	3
			3	3	3	3	3	YES
KE-KL4	Identification and institutionalisation of effective and efficient processes to ensure the successful execution of knowledge enhancement initiative lifecycles	3	KE-KE2	KE-UC3	KE-PC2	KE-CP7	LE-OI3	3
			2	3	2	3	3	YES
KE-KL5	Organisational understanding of the lifecycle concept and the implications thereof to ensure successful and repeated execution of knowledge enhancement initiatives is established	3	KE-KE3	KE-UC3				3
			3	3				YES
KE-KL6	Concurrent and repeated execution and management of knowledge enhancement initiatives and their lifecycles	3	KE-UC5	LE-IL6	KE-PC7			3
			3	3	3			YES
KE-KL7	Identification, implementation and integration of tools, systems and models to facilitate the management, execution and integration of knowledge enhancement initiatives	4	CI-UI2	KE-UC7	LE-OI3			4
			4	4	3			YES
KE-KL8	Profound understanding of the interaction between the multiple innovation and knowledge enhancement initiatives, and the management of these interactions to achieve synergy between them	5	CI-UI3	KE-CP16	OE-ST12	CI-CF7		5
			5	5	5	5		YES

Knowledge evolution realisation



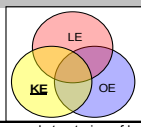
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
KE-KE1	Organisational awareness of the evolution of knowledge and the stages thereof	2	KE-KL2	KE-PC1				2
			2	2				YES
KE-KE2	An understanding of the implications of knowledge evolution in terms of executing knowledge enhancement initiatives is established	2	KE-KL2	KE-CP2				2
			2	2				YES
KE-KE3	An understanding of the implications of knowledge evolution is established in terms of executing innovation initiatives and identification and deployment of techniques to facilitate knowledge evolution and support knowledge enhancement and innovation	3	KE-UC3	KE-CP7	KE-KL5	LE-OI3		3
			3	3	3	3		YES

Proficient creation and absorption of knowledge



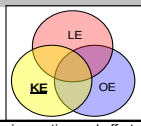
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
KE-PC1	Organisational awareness of the pivotal role of timeous and relevant knowledge in ensuring the success of innovation initiatives	2	OE-SD1	OE-CC1	LE-IL2	KE-KL2		2
			2	2	2	2		YES
KE-PC2	Effective techniques to rapidly analyse data and create useable knowledge are identified and deployed to ensure timeous availability of relevant knowledge	2	KE-KE1	KE-UC1				2
			2	2				YES
KE-PC3	Product and process data are captured, analysed and evolved into useable knowledge to facilitate improvement initiatives	2	KE-KE2	KE-UC1	KE-CP2	CI-CF2		2
			2	2	2	2		YES
KE-PC4	Data is gathered from in progress improvement initiatives and is analysed and evolved into useable knowledge to facilitate improvement initiatives	3	KE-UC4	KE-CP7				3
			3	3				YES
KE-PC5	Critical internal and external sources of data and effective techniques for the analysis thereof are identified and deployed	3	LE-OI3	OE-ST5	KE-CP7			3
			3	3	3			YES
KE-PC6	The failures and successes of innovation initiatives are scrutinised for critical outcomes deciding data which is further analysed to establish the root causes of the successes and failures and transformed into valuable knowledge	3	LE-PI4	OE-CC1				3
			3	2				YES
KE-PC7	The organisation partakes in regular and systematic revision of old knowledge to generate new knowledge based on fresh perspective and contextual understanding	3	KE-KE2	KE-KL5	KE-UC3	KE-CP7		3
			2	3	3	3		YES
KE-PC8	Identification and deployment of systems, tools and techniques to increase the rate of knowledge creation while maintaining data and knowledge integrity	3	LE-OI3	KE-KE3	KE-KL5			3
			3	3	3			YES
KE-PC9	Identification and deployment of effective tools and techniques to mine and analyse data from obscure environments and generate unique and organisationally applicable knowledge	4	LE-OI3	KE-UC6	CI-CF6	CI-CS5		4
			3	4	4	4		YES
KE-PC10	The organisation has a finely tuned capability to sense and absorb faint and seemingly disparate data signals and utilises sophisticated techniques to analyse and extract radically unique and relevant knowledge there from	5	CI-CF7	KE-CP16				5
			5	5				YES

Consolidation and application of knowledge

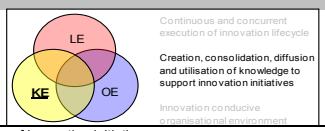


		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
KE-UC1	Identification and deployment of effective tools and techniques to facilitate the storage and structuring of knowledge and enhance the contextual understanding thereof	2	KE-KE2	KE-KL2	KE-CP2			2
			2	2	2			YES
KE-UC2	Clusters of knowledge are identified and integrated to form mappings of related knowledge, furthering understanding of the immediate environment and creating contextually new knowledge	3	KE-PC5	KE-CP7	CI-CF5	CI-CS3		3
			3	3	3	3		YES
KE-UC3	Knowledge mapping is systematised and capable of creating a dynamic representation thereof to facilitate rapid knowledge consolidation, contextualisation and utilisation	3	LE-IL5	KE-KL5	KE-PC8			3
			3	3	3			YES
KE-UC4	Knowledge and understanding are the driving force of individual and organisational learning, facilitating quicker and more effective response to stimuli from the environment	3	LE-IL5	KE-KL5	KE-PC6			3
			3	3	3			YES
KE-UC5	Knowledge mappings are formalised and reusable in the form of a standard to facilitate and accelerate the execution of repeat initiatives	3	KE-PC8	KE-KL6	LE-IL6	LE-PI4		3
			3	3	3	3		YES
KE-UC6	Advanced visualisation techniques are utilised to enhance representation, interpretation and understanding of knowledge mappings	4	KE-KL7	LE-IL8	KE-KE3			4
			4	4	3			YES
KE-UC7	Knowledge mappings are viewed from diverse perspectives relating to the various stakeholders and produce customised representations	4	KE-CP15	CI-CF6	CI-CS5			4
			4	4	4			YES
KE-UC8	Seemingly unrelated clusters of knowledge are integrated, creating fresh perspective, unique understanding of immediate and possibly unidentified environments, and more powerful knowledge	4	CI-UI2	KE-CP14	KE-KL7	KE-PC9	KE-RC5	4
			4	4	4	4	4	YES
KE-UC9	Integration of knowledge maps to create a knowledge landscape from which holistic understanding of markets and trends, client behaviour and the greater environment may be established	5	KE-KL8	KE-PC10	CI-CS6	CI-CF7	KE-CP16	5
			5	5	5	5	5	YES

Proficient collaboration

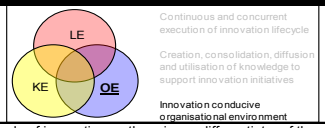


		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
KE-CP1	Abundant and widespread availability of relevant knowledge is identified as crucial to innovation and efforts focused on ensuring this are realised	2	LE-IL2	KE-KL2	KE-KE2	KE-PC2	KE-UC1	2
			2	2	2	2	2	YES
KE-CP2	Two or more individuals interact in an effort to facilitate creative endeavours, share, and contribute to collective knowledge and understanding	2	OE-ID1	OE-CC1	CI-CF1			2
			2	2	2			YES
KE-CP3	Groups engage on both formal and informal basis's to ensure that detailed issues are addressed as well as the occurrence of open and flexible interaction to stimulate creative deliberation and relationship building	2	OE-CI3	OE-ID1	CI-CF1	OE-ST2		2
			2	2	2	2		YES
KE-CP4	Ensure openness and sharing by continuously advocating a respectful and trusting environment and engaging in mutually beneficial idea exchange activities	3	OE-CI3	CI-CF3	OE-CI4	OE-ID4	OE-CI7	3
			2	3	3	3	3	YES
KE-CP5	Engagements are passionate and open to ensure the materialisation of genuine opinions	3	OE-CI4	CI-CF5				3
			3	3				YES
KE-CP6	Ensure diversity in terms of organisational groupings, fields of expertise, and work domains of elements entering into collaborative groups	3	OE-ST6	CI-CF5	OE-CI7	CI-CS3		3
			3	3	3	3		YES
KE-CP7	Effective means of communication and interaction are identified and deployed to facilitate the collaborative efforts of established groups	3	OE-ID4	OE-ST6				3
			3	3				YES
KE-CP8	The opportunity for shared successes within groups is created by establishing and formalising shared themes, plans and objectives	3	OE-CI3	OE-ST6				3
			2	3				YES
KE-CP9	Metrics that facilitate collaborative efforts, creativity and shared relevance of outputs, and diversity are identified and implemented	3	CI-UM1					3
			3					YES
KE-CP10	Shared vocabulary and an effective structure for data and knowledge categorisation and navigation are identified and deployed and an effective and efficient search engine installed to ensure rapid extraction of relevant information and knowledge	3	KE-UC3	KE-PC8	CI-CF5			3
			3	3	3			YES
KE-CP11	Establish and utilise an effective means of facilitating and capturing engagement proceedings and ensuring the continued evolution of the shared knowledge base	3	KE-KL5	KE-KE3	KE-RC4	KE-PC5		3
			3	3	3	3		YES
KE-CP12	Individuals and the groups as a whole exhibit an ability to cope with ambiguity, uncertainty, complexity and seemingly insurmountable obstacles and succeed in spite of them	3	CI-CF5	OE-RA7	OE-ST5			3
			3	3	3			YES
KE-CP13	Isolation from the external environment is avoided by promoting flexibility and having fresh and diverse external perspective play a regular role in collaborative efforts	3	CI-CF2	CI-CS3				3
			2	3				YES
KE-CP14	Internal collaborative groups are surveyed to identify areas of commonality and facilitate interaction and networking that may be mutually beneficial to the interacting groups	4	OE-ST10	OE-RA8	CI-CF6	LE-IL8		4
			4	4	4	4		YES
KE-CP15	Collaborative and networking endeavours between internal teams such as those addressing different phases of an initiative's lifecycle and between and with external role players such as government, academia and other industry networks are established	4	CI-CF6	CI-CS5	OE-ST7			4
			4	4	3			YES

KE-CP16	Holistic efforts collectively address the objectives of multiple networked groups and their members and achieve strategic and operational synergies between their initiatives resulting in mutually beneficial harmony	5	OE-ST12	CI-CF7	CI-CS6	KE-KL8	LE-IL9	5
			5	5	5	5	5	YES
Retention, capture and integration of tacit knowledge		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
KE-RC1	Organisational awareness of the vital role of tacit knowledge in ensuring the success of innovation initiatives	2	KE-PC1	KE-CP1	KE-KE2			2
			2	2	2			YES
KE-RC2	Organisational sources of tacit knowledge and mechanisms for the transfer thereof are identified and understood	2	CI-CC2	CI-CF1				2
			2	2				YES
KE-RC3	Identify and deploy tacit knowledge transfer programs (such as mentorship, job rotation, cross-functional teaming, collaboration, etc.) to prolong the retention of deep seated expertise	3	OE-ST6	CI-CF5	KE-CP7			3
			3	3	3			YES
KE-RC4	Identify and deploy techniques to effectively capture and absorb tacit knowledge and ensure the integration and transformation thereof into explicit knowledge	3	KE-PC5	KE-CP11				3
			3	3				YES
KE-RC5	External sources of tacit knowledge and effective mechanisms for the absorption thereof are identified and deployed	4	CI-CS5	KE-UC8				4
			4	4				YES
KE-RC6	Tacit knowledge is seamlessly integrated with explicit knowledge resulting in the unique consolidation and holistic interpretation thereof	4	CI-UI2	CI-CS5				4
			4	4				YES

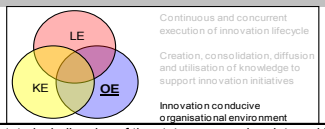
Organisational Efficacy

Strategic drive and emphasis on innovation



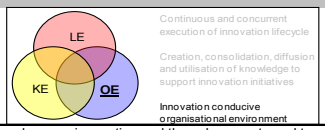
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
OE-SD1	The definition of innovation is organisationally clarified and institutionalised and the role of innovation as the primary differentiator of the organisation is understood	2	KE-KL1	LE-MF1	KE-PC1	OE-CI1	OE-ST1	2
			2	2	2	2	2	YES
OE-SD2	The strategic intent to be innovative is regularly and passionately communicated to all in the organisation and the role of strategy creation in the innovation process clearly and broadly understood	2	KE-CP1	OE-ID1	OE-CC1			2
			2	2	2			YES
OE-SD3	Strategic decision making is directed by the desire to innovate and be more innovation capable	3	CI-CC3	CI-LR1				3
			3	3				YES
OE-SD4	Corporate vision and mission strongly allude to innovation and the organisational intent to mature in terms of innovation capability	3	CI-LR1	OE-ID2				3
			3	2				YES
OE-SD5	Strategic deliberation is the privilege of not only the senior executives, and all are encouraged to think big, radical and long term	3	OE-ID4	OE-CC1	OE-ST5	KE-CP12	CI-CP3	3
			3	2	3	3	2	YES
OE-SD6	Long term organisational and innovation goals are transparent and assumed by all individuals	3	OE-CC3	OE-ID4	OE-ST5			3
			3	3	3			YES
OE-SD7	Alignment with organisational strategy is the duty of all individuals, at all levels, with corporate statements as the motivation for organisational and individual actions	3	OE-RA7	OE-CC1	CI-CC3			3
			3	2	3			YES
OE-SD8	Strategic ambiguity, uncertainty, complexity and risk are considered opportunities to generate long term prosperity	4	OE-RA7	OE-ID9	CI-CF5	LE-RR2	OE-CC11	4
			3	4	3	3	4	YES
OE-SD9	Strategy is seen as inquisitive, expansive, prophetic, inventive, inclusive, and demanding and **not** ritualistic, reductionist, extrapolative, positioning, elitist, and easy	4	OE-CC11	OE-CI8	CI-LR1			4
			4	3	3			YES
OE-SD10	Strategy has become synonymous with innovation, dismissing legacy and orthodoxy, promoting fresh perspective, and premeditated revolutionism	5	OE-CC12	OE-CI12	OE-ST12	CI-CP11		5
			5	5	5	5		YES

Innovation conducive climate



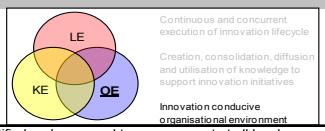
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
OE-CC1	Individuals are encouraged to be proactive, creative and unconventional, team orientated, challenging of the status quo, and undeterred by risk or failure	2	OE-ID2	OE-SD2	OE-RA1			2
			2	2	2			YES
OE-CC2	Factors that influence organisational climate are identified and the role that each may play in an innovation facilitative environment is understood	2	OE-ID3	OE-RA1				2
			2	2				YES
OE-CC3	Short term organisational and innovation goals are realistic and clearly and positively related to long term goals	3	OE-SD6	OE-ST5	LE-SE5	KE-CP7		3
			3	3	3	3		YES
OE-CC4	Regular education is provided of relevant innovation best practices and means of fostering individual traits that are enhancing of innovative capability and outputs	3	OE-RA7	LE-IL5	KE-KL5	LE-OI4	LE-AS7	3
			3	3	3	3	3	YES
OE-CC5	Understanding of the interrelatedness of factors influencing organisational climate and the implications of changes made to these factors is established	3	KE-UC3	KE-CP7	OE-ID5	CI-CF5		3
			3	3	3			YES
OE-CC6	Metrics are designed to encourage innovative activities, promote follow-through of such activities and generate innovative outputs	3	OE-RA7	CI-UM1	OE-SD2	OE-ID1		3
			3	3	2	2		YES
OE-CC7	Motivation and reward systems for individuals and teams are delicately structured to balance the intrinsic and extrinsic aspects thereof, ensure fairness and be facilitative of innovation	3	OE-ID6	OE-RA1				3
			3	2				YES
OE-CC8	Organisational policies, practices and procedures that are likely to foster a climate conducive to innovation are identified and deployed	3	OE-ID5	OE-ST5	KE-CP7	CI-CF5		3
			3	3				YES
OE-CC9	Understanding of the interrelatedness of organisational climate and culture is established and a means developed to mange this interrelatedness from a climate perspective and ensure the result thereof is facilitative of innovation	4	OE-CI6	KE-CP15	CI-CF6	OE-ID9		4
			3	4	4	4		YES
OE-CC10	Autonomous behaviour is delicately balanced to create sufficient freedom to be creative and self-sufficient, while still ensuring the fulfilment of operational necessities	4	OE-ID8	OE-RA8	OE-ST10			4
			4	4	4			YES
OE-CC11	Teams and individuals embrace the ambiguities, uncertainties, complexities and risks associated with innovation as an opportunity to prosper as individuals, as teams, and as an organisation	4	CI-CF5	OE-SD8	LE-MF5			4
			3	4	4			YES
OE-CC12	Innovation is imbedded and distinctly visible in the policies, practices and procedures of the organisation and impels the decisions and actions taken by individuals, teams, and the organisation as a whole	5	OE-CI12	OE-SD10	OE-ST12			5
			5	5	5			YES

Innovation conducive culture



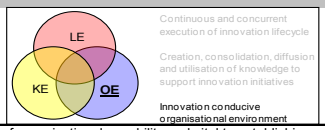
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
OE-CI1	There is awareness of the inhibitive effects that an extremely deep seated culture may have on innovation and the subsequent need to cultivate change accepting norms is established	2	CI-CP1	OE-SD1				2
			2	2				YES
OE-CI2	Factors that influence organisational culture are identified and the role that each may play in an innovation facilitative environment is understood	2	OE-ID3	KE-CP3				2
			2	2				YES
OE-CI3	A sense of openness, trust and mutual respect is promoted to enhance communication and sharing and the rapid emergence of both ideas and issues	2	OE-ID3	OE-ST1	KE-CP3	CI-CF1		2
			2	2	2	2		YES
OE-CI4	Individuals are encouraged to accept and deliver respectful criticism, engage in debate and expect conflict, and show pride for and take ownership of their ideas and initiatives	3	OE-ST5	KE-CP4	CI-CF5			3
			3	3	3			YES
OE-CI5	Understanding of the interrelatedness of factors influencing organisational culture and the implications of changes made to these factors is established	3	KE-UC3	KE-CP7	OE-ID5	CI-CF5		3
			3	3	3	3		YES
OE-CI6	Identification and cultivation of beliefs, norms, values, and patterns of behaviour that are characteristic of an innovation conducive culture	3	OE-ID5	OE-ST5	KE-CP7	CI-CF5		3
			3	3	3	3		YES
OE-CI7	Although authority and rank are present, individuals do not perceive it as such and regard one another as peers, reciprocating respect and trust	3	OE-ID4	OE-ST5	OE-CC1			3
			3	3	2			YES
OE-CI8	The fear of overlooking or ignoring the next radical opportunity is far greater than the fear of attempting and failing	3	OE-CC1	OE-SD4	LE-RR5	OE-RA7		3
			2	3	3	3		YES
OE-CI9	Distinction between implicit and explicit culture is made and an appropriate means to cultivate an innovation conducive culture established based on an understanding of each and the interrelatedness thereof	3	KE-CP7	OE-ID5	CI-CF5	KE-UC3		3
			3	3	3	3		YES
OE-CI10	Understanding of the interrelatedness of organisational climate and culture is established and a means developed to mange this interrelatedness from a culture perspective and ensure the result thereof is facilitative of innovation	4	OE-CC8	KE-CP15	CI-CF6	OE-ID9		4
			3	4	4	4		YES
OE-CI11	The organisation exhibits a culture of rapid learning and unlearning, resulting in improved reactivity to environmental stimuli and adaptability of approach	4	OE-ST10	KE-UC4	CI-CP7	OE-RA7		4
			4	3	3	3		YES
OE-CI12	Innovation is embedded in individual, team and organisational beliefs, norms, values, and patterns of behaviour and the collective aspiration of the entire organisation	5	CI-CF7	OE-RA8	OE-CC12	OE-ID10	OE-ST12	5
			5	4	5	5	5	YES

Innovation driven leadership



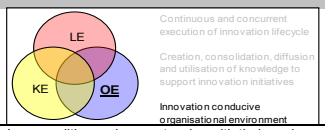
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
OE-ID1	The need to persistently drive, encourage and support innovative behaviour is identified and conveyed to management at all levels	2	OE-SD2	OE-CC1				2
			2	2				YES
OE-ID2	Leaders are committed to being innovative, improving the innovation capability of the organisation and employ a philosophy of "lead by doing"	2	OE-RA2	OE-SD2				2
			2	2				YES
OE-ID3	Leaders are appreciative of the fundamental role of people throughout the innovation process and continuously challenge individuals to be more innovative and give due recognition for doing so	2	OE-RA2	CI-CP3				2
			2	2				YES
OE-ID4	Leaders exude energy, are easily approachable, open to suggestion, and encourage this type of behaviour amongst those around them	3	OE-ST5	OE-SD7	KE-CP4			3
			3	3	3			YES
OE-ID5	Organisational leaders are the convenors of an innovation conducive culture and climate	3	OE-RA2	OE-CI5	OE-CC5	OE-ST6		3
			2	3	3	3		YES
OE-ID6	Leaders are hypersensitive to creative signals from within the organisation and quickly uncover and exploit such creativity	3	OE-RA2	KE-CP5				3
			2	3				YES
OE-ID7	Innovation champions are identified, recruited, developed, trained, empowered, encouraged and acknowledged throughout the organisation	3	OE-RA7	OE-CC4				3
			3	3				YES
OE-ID8	Leaders are the overseers of autonomous behaviour, but also ensure clarity in terms the boundaries for self-driven actions and accountability therefore	4	OE-ST10	OE-RA8				4
			4	4				YES
OE-ID9	Leaders excel in situations of ambiguity, uncertainty, complexity and risk and serve as organisational role models in managing these situations	4	CI-CF6	KE-CP12	OE-CI11	KE-RC6		4
			4	3	4	4		YES
OE-ID10	Effective leadership and management techniques to facilitate and accelerate innovation initiatives by continuously leveraging the innovative behaviour of individuals are established	5	OE-ST12	OE-RA10	CI-CF7			5
			5	5	5			YES

Organic organisational structure



		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
OE-ST1	Organisational structure is identified as the foundation and structural reinforcement of organisational capability and vital to establishing a platform for innovation	2	OE-SD1	OE-CC2	CI-CC1			2
			2	2	2			YES
OE-ST2	Decision making responsibility is held as low as possible to avoid delays associated with tall and narrow organisational structures	2	OE-CC1	OE-SD1	OE-ID3			2
			2	2	2			YES
OE-ST3	The number of levels within the organisational structure are minimised to facilitate the vertical flow of information	3	OE-ID4	OE-CI7				3
			3	3				YES
OE-ST4	Organisational structure and reporting lines are conducive to the execution of projects requiring multidisciplinary and cross functional input	3	LE-AS7	OE-ID4	CI-CF4			3
			3	3	3			YES
OE-ST5	Organisational structure is transparent and encourages open and frequent interaction within and between all organisational levels	3	OE-ID4	OE-CC8	OE-CI5	OE-SD6		3
			3	3	3	3		YES
OE-ST6	Rigid and formal departmental separation and functional specialisation is minimised to facilitate collaboration between organisational initiatives	3	CI-CF4	OE-CI7	KE-CP8			3
			3	3	3			YES
OE-ST7	A fluid definition of organisational boundaries allowing for spin-offs, the creation of new workspace, and/or the acquisition of new competencies to exploit opportunities not aligning with the business model and/or core competencies	3	KE-CP6	OE-RA6	CI-CC5	OE-SD6		3
			3	3	3	3		YES
OE-ST8	Decision making authority and procedures are decentralised and geared toward flexibility and reactivity	3	OE-SD7	CI-CF5	KE-CP12			3
			3	3	3			YES
OE-ST9	A distinction between implicit and explicit adaptation of organisational structure is made and an understanding of each and their interrelatedness established	3	KE-UC4	CI-CF5	CI-CP9			3
			3	3	3			YES
OE-ST10	Adoption of a horizontal management style avoiding unnecessary communication layers, embedding flexibility, and improving the integration and sharing of knowledge	4	OE-CC10	OE-ID8	OE-CI11			4
			4	4	4			YES
OE-ST11	Effective means to facilitate and execute implicit and explicit adaptation of organisational structure are identified, deployed and managed to achieve synergy between efforts	4	CI-CP10	KE-CP12	CI-CF6	CI-LR5		4
			4	3	4	4		YES
OE-ST12	Organisational structure is organic in nature, highly flexible and reactive, transparent, and focused on consolidating and harmonising core competencies	5	OE-ID10	OE-CI12	OE-CC12	OE-SD10	CI-CC10	5
			5	5	5	5	5	YES

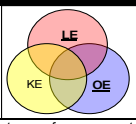
Resource alignment, training and slack



		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
OE-RA1	A need is identified and efforts are established to ensure the alignment of individuals' personalities and competencies with their work descriptions	2	OE-ID3	OE-ID3				2
			2	2				YES
OE-RA2	Hired individuals exhibit strong personality and competency alignment with their proposed activities and social alignment with organisational culture	2	OE-CI2	OE-CC2				2
			2	2				YES
OE-RA3	Training on aspects such as innovation principles, techniques and best practices, and the ability to exploit creativity is frequently provided	3	OE-CC4	LE-IL5	KE-KL5	LE-OI4	LE-AS7	3
			3	3	3	3	3	YES
OE-RA4	Ensure the overall diversity of disciplines of the individuals in terms of vertical and horizontal organisational dimensions	3	OE-ST6	CI-CF5				3
			3	3				YES
OE-RA5	Organisational resourcing for creative and explorative activities, to absorb failure, for testing and screening, and other innovation activities is sufficient to not present a barrier for innovation	3	CI-CC5	OE-ST6	LE-AS6			3
			3	3	3			YES
OE-RA6	The proportion of resources assigned to contextual and core activities is managed to ensure a reflection that is appropriate of the level of innovativeness of the initiative	3	CI-CC6	LE-AS5				3
			3	3				YES
OE-RA7	Identify personal traits and cognitive factors that are strongly correlated with the various roles for innovation and acquire these traits either through hiring individuals exhibiting these characteristics or cultivating them in candidates with potential	3	OE-CI6	KE-UC3	OE-ID7			3
			3	3	3			YES
OE-RA8	Managers develop an acute ability to assess organisational needs and individual traits and harmonise these to achieve mutually beneficial relationships	4	CI-LR4	OE-SD6	OE-CC10	OE-ID6		4
			4	3	4	3		YES
OE-RA9	The revolutionaries within the organisation are identified and their emotional and intellectual energy utilised to leverage innovation initiatives	4	OE-ID8	OE-CI6	CI-CC7			4
			4	3	4			YES
OE-RA10	Organisational resourcing provides sufficient slack to be consistently directed towards freedom for creativity, exploring for and of opportunities, rigorous testing and screening, allowance for failure, creation of spin-offs, and promote these and other such innovation	5	OE-ST12	OE-CI12	OE-CC12	CI-CC10	CI-CF7	5
			5	5	5	5	5	YES

Common Capability Requirements

Realisation of and proficiency in core competencies (LE/OE)



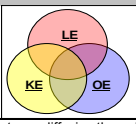
Continuous and concurrent execution of innovation lifecycle

Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives

Innovation conducive organisational environment

		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-CC1	The organisation is aware of the need to conceive, manage and drive its initiatives in terms of core competencies	2	OE-SD1	OE-ST1				2
			2	2				YES
CI-CC2	The organisation has identified and distinguished between contextual activities and the core activities that serve to differentiate the organisation	2	OE-SD2	LE-AS1				2
			2	2				YES
CI-CC3	Understanding of the organisation's core competencies and the means with which they bring about differentiation is established	3	CI-CF5	CI-CS3	CI-LR2	OE-RA5		3
			3	3	3	3		YES
CI-CC4	The organisation is dedicated to persistently building and managing core competencies and widening the competitive gap established by these competencies	3	LE-OI3	CI-LR2	OE-SD2	OE-ID2		3
			3	3	2	2		YES
CI-CC5	The sources of core competencies (people, processes and/or values) are identified and appropriately managed to be facilitative of innovation	3	OE-ST5	LE-IL5	KE-KL5	CI-CF5	KE-RC4	3
			3	3	3	3	3	YES
CI-CC6	Sufficient core competencies are allocated to opportunities where they are most likely to ensure the long term prosperity of the organisation	3	OE-RA6	LE-AS5	KE-UC4			3
			3	3	3			YES
CI-CC7	Organisational understanding and the effective consolidation and utilisation of core competencies is exploited to create competitive advantage and greater market share	4	CI-LR5	OE-RA8	CI-CF6	KE-CP14	OE-ST11	4
			4	4	4	4	4	YES
CI-CC8	Core competencies provide access to diverse and untapped markets, are extremely difficult to imitate, and generate significant customer perceived benefit	4	KE-UC8	CI-CS5	CI-CF6	KE-CP14		4
			4	4	4	4		YES
CI-CC9	Next-generation core competencies are continuously identified and resources amply allocated to developing and/or acquiring, and becoming proficient in these competencies	4	CI-LR5	OE-RA6				4
			4	3				YES
CI-CC10	Core competencies exhibit a dynamism that ensures their long term utility in the pursuit of multiple and diverse opportunities	5	OE-RA10	CI-LR9	CI-CP11	KE-UC9	OE-ST12	5
			5	5	5	5	5	YES

Cross-functional and multidisciplinary teaming (LE/KE/OE)



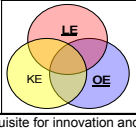
Continuous and concurrent execution of innovation lifecycle

Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives

Innovation conducive organisational environment

		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-CF1	The organisation is aware of the need to ensure effective knowledge and core competency diffusion throughout the organisation and into initiative focused teams	2	LE-IL2	KE-KL2	KE-KE2	CI-CC1		2
			2	2	2	2		YES
CI-CF2	Individuals from different disciplines are introduced into established teams to induce new perspective and create fresh ideas	2	OE-ID3	OE-CI3	OE-CC2			2
			2	2	2			YES
CI-CF3	Individuals and the organisation as a whole exhibit a deep commitment towards functioning across organisational boundaries	3	OE-ST6	OE-ID4	CI-CC5	OE-CI3		3
			3	3	3	2		YES
CI-CF4	Rigid and formal departmental separation and functional specialisation is minimised to facilitate collaboration between initiative focused teams	3	OE-ST6	OE-CI7	KE-CP8			3
			3	3	3			YES
CI-CF5	Cross-functional and multidisciplinary individuals are grouped to assist with the management of innovation associated ambiguities, uncertainties, complexities and risk	3	OE-RA7	LE-MF1	KE-CP12			3
			3	2	3			YES
CI-CF6	Interrelationships and interdependencies between teams and groupings are identified, understood and the sharing of competencies facilitated to collectively benefit the teams, groupings and the organisation as a whole	4	CI-CC7	OE-RA8	OE-ST10	OE-CC11	KE-CP14	4
			4	4	4	4	4	YES
CI-CF7	Flexible teaming of diversely skilled individuals are established to facilitate the recognition of new and obscure opportunities by blending and harmonising functional expertise in unique manners	5	OE-RA10	OE-ST12	OE-CC12	KE-CP16	CI-CP11	5
			5	5	5	5	5	YES

Change proficiency (LE/OE)



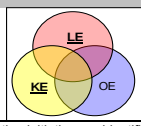
Continuous and concurrent execution of innovation lifecycle

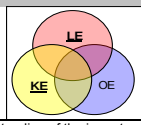
Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives

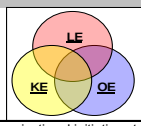
Innovation conducive organisational environment

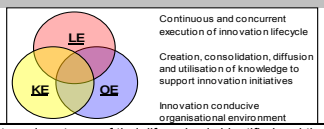
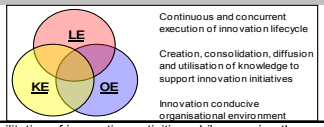
		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-CP1	There is organisational realisation that persistent change and adaptation is a prerequisite for innovation and long term prosperity	2	OE-SD1	OE-CI1				2
			2	2				YES
CI-CP2	Understanding is established of the change process and the need to continuously manage and reinforce the change to be successful	2	LE-IL2	OE-ST1	OE-CI2	OE-CC2		2
			2	2	2	2		YES
CI-CP3	Awareness that people are averse to change primarily because they were not engaged in decisive activities, the change is not transparent and/or their role during and after change is uncertain is established	2	OE-ID3	OE-RA2				2
			2	2				YES
CI-CP4	Entrenched organisational aspects that require transformation to render the organisation more change capable are identified and appropriately addressed	3	KE-UC4	CI-CC4	OE-ST7	CI-CF5	KE-CP12	3
			3	3	3	3	3	YES
CI-CP5	Establish the level of change and adaptation necessary based on an understanding of how innovative the initiative is and determine whether the organisation is capable of such change	3	LE-AS5	LE-IL5	CI-LR2			3
			3	3	3			YES

CI-CP6	The early and continued anticipation of barriers to change, the understanding thereof, and efforts toward resolution are established and institutionalised	3	LE-RR4	KE-UC4	OE-ST5			3
			3	3	3			YES
CI-CP7	Change is viewed as an opportunity to learn and grow, both as individuals and as an organisation, and basically as a means to improve upon the status quo	3	CI-CF5	OE-CI8	KE-UC4	OE-ST5		3
			3	3	3	3		YES
CI-CP8	Core competencies embedded within people, processes and/or values are proportionally managed to be facilitative of the necessary degree of change	3	CI-CC5	LE-AS5	OE-RA6			3
			3	3	3			YES
CI-CP9	A distinction between implicit and explicit adaptation is made, and an understanding of each and their interrelatedness established	3	OE-ST9	CI-CF5	KE-UC4			3
			3	3	3			YES
CI-CP10	Effective means of facilitating and executing implicit and explicit organisational adaptation are identified, deployed and managed to achieve synergy between efforts	4	OE-ST11	KE-CP12	CI-CF6	CI-LR5		4
			4	3	4	4		YES
CI-CP11	The organisation is able to rapidly adapt to the needs of a given situation, whether the changes are of an evolutionary or a revolutionary nature	5	CI-CF7	CI-CC10	OE-ST12	OE-CC12	OE-CC12	5
			5	5	5	5	5	YES

Consumer, supplier and stakeholder assimilation (LE/KE)	 Continuous and concurrent execution of innovation lifecycle Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives Innovation conducive organisational environment	ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-CS1	External entities that are likely to affect or be affected by the outcomes of an innovation initiative are identified and continued efforts to develop and maintain strong links are established	2	LE-IL2	KE-UC1	KE-CP1	KE-PC2		2
			2	2	2	2		YES
CI-CS2	The organisation has a clear understanding of the relationships it holds with external entities and the role or potential role each may have with organisational initiatives	3	KE-UC3	CI-LR2	LE-OI5	LE-PI3		3
			3	3	3	3		YES
CI-CS3	The organisation involves external entities in order to understand their needs, trends, and substantially improve the outcomes of innovation initiatives by ensuring the relevance thereof	3	CI-CF5	KE-CP11	KE-RC4	CI-LR2		3
			3	3	3	3		YES
CI-CS4	The organisation utilises interactions with external entities as an opportunity to create an external perception that is inline with its strategic vision	4	KE-RC6	OE-SD6	CI-CF6			4
			4	3	4			YES
CI-CS5	External entities play a vital role and are well integrated into the complete proceedings of innovation initiatives to profoundly understand their desires and needs and ensure outcomes that are widely adopted	4	KE-RC6	CI-CF6	KE-CP15	CI-UI2	KE-UC7	4
			4	4	4	4	4	YES
CI-CS6	Unique and effective techniques are utilised to tap the ideas and experiences and absorb the tacit knowledge of external entities, facilitating identification and understanding of the intrinsic and often unknown needs of those entities	5	KE-RC6	KE-UC9	CI-CF7	KE-CP16	CI-LR8	5
			4	5	5	5	5	YES

Long range opportunity identification and evaluation (LE/KE)	 Continuous and concurrent execution of innovation lifecycle Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives Innovation conducive organisational environment	ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-LR1	The organisation has replaced the short term drive for returns for a dynamic understanding of the importance of future orientation and sustained prosperity	3	OE-SD6	LE-OI4	OE-SD5			3
			3	3	3			YES
CI-LR2	The organisation regularly scans the environment to identify long term opportunities and then relates these opportunities to time, strategic orientation and initiates further investigation	3	LE-OI3	OE-SD6	CI-CF5	KE-CP12	KE-PC8	3
			3	3	3	3	3	YES
CI-LR3	Environmental scanning is wide, diverse and of seemingly unrelated environments to identify, consolidate and analyse emerging and/or disparate signals and trends that may present opportunities	4	OE-SD8	CI-CF5	KE-PC9	KE-UC8	KE-CP15	4
			4	3	4	4	4	YES
CI-LR4	The organisation performs interactive assessment, development and prioritization of long range business opportunities, and identifies the associated and interrelated grand challenges	4	OE-SD8	CI-CF5	KE-CP15	KE-UC6	CI-UI2	4
			4	3	4	4	4	YES
CI-LR5	The organisation interactively ascertains the required technologies, core competencies, the influence of regulatory aspects, and their time-scales and the necessary convergences to exploit the prioritised opportunities and address the grand challenges	4	CI-CS5	CI-CC9	CI-CF5	KE-CP15		4
			4	4	3	4		YES
CI-LR6	Organisational implications pertaining to resources, processes, products, etc., their necessary convergences and resultant milestones are established to create a long term plan that may be scrutinised and serve as the launch pad for subsequent initiatives to exploit the	4	OE-RA8	KE-UC7	CI-CF5	KE-CP15	LE-IL8	4
			4	4	3	4	4	YES
CI-LR7	The continued execution of future orientated activities, continuous updating of already established plans, and continued identification of new opportunities and their associated grand challenges is an institutional effort	5	LE-IL9	CI-CP11	OE-ST12	CI-CP11	CI-CS6	5
			5	5	5	5	5	YES
CI-LR8	Profound understanding of potentially synergistically related sets of opportunities and grand challenges is established to improve the long term strategic orientation of the organisation	5	KE-CP16	KE-UC9	KE-RC6	CI-CF7		5
			5	5	4	5		YES
CI-LR9	Assimilated future orientated activities result in strongly integrated and increasing synergistic radical innovation initiatives, involving and aligning the entire organisation in a quest to dominate undiscovered future markets	5	CI-UI3	CI-CC10	OE-ST12	LE-IL9		5
			5	5	5	5		YES

Meta-innovation (LE/KE/OE)	 Continuous and concurrent execution of innovation lifecycle Creation, consolidation, diffusion and utilisation of knowledge to support innovation initiatives Innovation conducive organisational environment	ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-MI1	The generic innovation practices and methods of this model are applied to those organisational initiatives tasked with improving innovation capability	4	OE-SD9	OE-ST10	OE-ID2			4
			4	4	2			YES

CI-MI2	The generic innovation capability requirements of this model are applied to the model itself in an effort to be innovation innovative	5	CI-CF7	KE-CP16	OE-ST12	KE-UC9		5
			5	5	5	5		YES
CI-MI3	The organisation exhibits an intrinsic capability for innovative evolution and revolution, continuously and rapidly adapting to the competitive necessities of the environment, and consistently positioning itself ahead of its competition	5	CI-CP11	CI-CC10	OE-ST12	OE-SD10		5
			5	5	5	5		YES
Utilisation of integrative systems (LE/KE/OE)		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-UI1	A need to utilise systems that integrate the efforts of multiple innovation initiatives at varying stages of their lifecycles is identified and the requirements of such systems established	3	LE-IL5	CI-CF5	KE-KL5	KE-KE3		3
			3	3	3	3		YES
CI-UI2	The identification and/or development, deployment and effective utilisation of innovation integrative systems is realised and greater understanding of the collective effect of multiple initiatives achieved	4	LE-IL8	KE-KL7	KE-PC9	LE-IL7	KE-KL7	4
			4	4	4	4	4	YES
CI-UI3	Synergy is achieved between the multiple innovation initiatives of the organisation through the effective and efficient utilisation of flexible and dynamic integrative systems	5	LE-IL9	KE-KL8	CI-CP11	CI-CF7	KE-UC9	5
			5	5	5	5	5	YES
Utilisation of facilitative metrics (LE/KE/OE)		ML	INTERDEPENDENCIES/DEPENDENCIES					ML ALIGNED
CI-UM1	Individual, team and organisational metrics are developed and deployed that are facilitative of innovation activities while ensuring the realisation of operative activities	3	OE-CC5	OE-CI5	KE-CP9	OE-CC6	LE-IL5	3
			3	3	3	3	3	YES
CI-UM2	Metrics are continuously monitored and updated to ensure their continued alignment with strategic intent and relevance in terms of adapting to internal and external environments	4	OE-SD6	CI-CP10	OE-ST10			4
			3	4	4			YES
CI-UM3	Metrics are facilitative of integrated and synergistic innovation activities	5	LE-IL9	OE-ST12	CI-CC10	CI-LR9	CI-MI3	5
			5	5	5	5	5	YES

Appendix C ICMM lifecycle impact mapping

ICMM									
	Applicable Matruity Levels				Generic Lifecycle				
Capability Requirement	**ML2**	**ML3**	**ML4**	**ML5**	**Concept**	**Functional Analysis**	**Implementation**	**Operation**	**Recycle & Disposal**
Lifecycle Execution									
Innovation lifecycle realisation	1	1	1	1	3	3	3	3	3
Agile-to-systematic project ability	1	1	1	1	3	3	3	3	1
Risk realisation and management		1	1	1	3	3	3	3	3
Opportunity identification and solution generation	1	1	1	1	4	4	2	2	2
Fuzzy front end management	1	1	1	1	4	3	1	0	0
Prioritisation of opportunities and testing and screening of ideas	1	1	1	1	2	4	3	2	1
Substantiation and exploitation of opportunities		1	1	1	0	1	4	2	1
Parallel incremental and radical innovation execution		1	1	1	2	2	2	2	2
Timeous disposal of initiatives		1	1		1	2	2	3	4
Knowledge Exploitation									
Knowledge lifecycle realisation	1	1	1	1	2	2	2	2	2
Knowledge evolution realisation	1	1			2	2	3	3	3
Proficient creation and absorption of knowledge	1	1	1	1	3	3	2	2	2
Consolidation and application of knowledge	1	1	1	1	2	2	3	3	1
Proficient collaboration	1	1	1	1	2	3	3	3	1
Retention, capture and integration of tacit knowledge	1	1	1		3	3	3	2	2
Organisational Efficacy									
Strategic drive and emphasis on innovation	1	1	1	1	3	3	2	2	2
Innovation conducive climate	1	1	1	1	3	3	2	2	2
Innovation conducive culture	1	1	1	1	3	3	3	2	2
Innovation driven leadership	1	1	1	1	3	3	3	2	2
Organic organisational structure	1	1	1	1	3	3	3	2	3
Resource alignment, training and slack	1	1	1	1	2	2	2	2	1
Common Capability Requirements									
Realisation of and proficiency in core competencies (LE/OE)	1	1	1	1	2	2	2	2	2
Cross-functional and multidisciplinary teaming (LE/KE/OE)	1	1	1	1	3	3	3	2	2
Change proficiency (LE/OE)	1	1	1	1	1	2	4	3	3
Consumer, supplier and stakeholder assimilation (LE/KE)	1	1	1	1	3	3	2	2	2
Long range opportunity identification and evaluation (LE/KE)		1	1	1	4	4	2	2	1
Meta-innovation (LE/KE/OE)			1	1	2	2	2	2	2
Utilisation of integrative systems (LE/KE/OE)		1	1	1	2	2	2	2	2
Utilisation of facilitative metrics (LE/KE/OE)		1	1	1	2	2	2	2	1
Generic Practices									
Maturity Level 1					0	0	0	0	0
Maturity Level 2					56	59	54	46	39
Maturity Level 3					70	75	71	62	53
Maturity Level 4					70	75	70	61	52
Maturity Level 5					66	70	65	56	46
Maximum					412	412	412	412	412
Impact level as % of highest									
Level 1					0.0%	0.0%	0.0%	0.0%	0.0%
Level 2					94.9%	100.0%	91.5%	78.0%	66.1%
Level 3					93.3%	100.0%	94.7%	82.7%	70.7%
Level 4					93.3%	100.0%	93.3%	81.3%	69.3%
Level 5					94.3%	100.0%	92.9%	80.0%	65.7%
Total					*93.9%*	*100.0%*	*93.2%*	*80.6%*	*68.1%*
Impacted					**YES**	**YES**	**YES**	**YES**	
Non-impacted									

Figure 62 – ICMM lifecycle impact mapping

Appendix D Innovation Capability Corpus

Article name	Author(s)	Keywords	Themes of innovation capability	5 Topic LDA	5 Topic <---> 5 Topic	10 Topic LDA	10 Topic <---> 10 Topic	20 Topic LDA	20 Topic <---> 20 Topic	5 Topic <---> 10 Topic	10 Topic <---> 20 Topic
A benchmark study of strategic commitment to innovation.pdf	Cottam et al. 2001	Innovation, Investment, Personnel, Strategic planning	Strategic commitment, Innovation teams	Topic 3 (0.999) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.959) - Idea Management, Culture and Strategy for Innovation		Topic 20 (0.901) - Project Knowledge, Planning and Control, and Innovation Teams		5_Topic 3 <--> 10_Topic 1 = 0.60	10_Topic 1 <--> 20_Topic 20 = 0.160
A Framework Approach to Measure Innovation Maturity.pdf	Narayana 2005	Innovation, Key Processes, Strategy, Implementation	Strategic intent, Strategic management, Internal organisation and processes, Innovation process management, Understanding customers, Core competencies, Parrallel innovation processes	Topic 3 (0.971) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.23) - Organisational Innovation Strategy and Learning Topic 3 (0.541) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities	10_Topic 2 <--> 10_Topic 3 = 0.256	Topic 8 (0.915) - Innovation Process Management		5_Topic 3 <--> 10_Topic 2 = 0.66 5_Topic 3 <--> 10_Topic 3 = 0.46	10_Topic 2 <--> 20_Topic 8 = 0.524 10_Topic 3 <--> 20_Topic 8 = 0.244
A framework for analysing business performance, firm innovation and related contextual factors.pdf	Neely et al. 2001	Innovation, Italy, United Kingdom, Performance	Culture, Internal processes, Understand environment and Industry foresight	Topic 5 (1) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 5 (0.999) - Innovation Process and Idea Management		Topic 11 (0.999) - Future Trends Roadmapping		5_Topic 4 <--> 10_Topic 5 = 0.38	10_Topic 5 <--> 20_Topic 11 = 0.300
A Framework for Strategic Innovation.pdf	Palmer and Kaplan 2007		Industry foresight, Consumer/customer insight, Organisational readiness, Strategic alignment, Long-term/exploratory opportunity identification, Innovation process, Core technologies and competencies, Organisational climate, Divergent and convergent thinking (processes), Stakeholder assimilation, Disciplined implementation,Innovation process stage-gates, Innovation process management	Topic 3 (0.833) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 5 (0.855) - Innovation Process and Idea Management		Topic 9 (0.998) - Idea Management and Opportunity Identification		5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 5 <--> 20_Topic 9 = 0.496
A multi level theory of innovation implementation.pdf	McAdam 2005	Conflict, Innovation	Innovation implementation, Innovation process, Innovation lifecycle	Topic 2 (0.639) - Organisational Environment (work), Metrics and Measurement		Topic 3 (0.998) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 7 (0.998) - Innovation Process Management, Learning and Change Management		5_Topic 2 <--> 10_Topic 3 = 0.10	10_Topic 3 <--> 20_Topic 7 = 0.412
A multidimensional approach to the adoption of innovation.pdf	Cooper 1998		Radical and incremental innovation, Product and process innovation, Administrative and technological innovation	Topic 1 (0.412) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources) Topic 3 (0.504) - Innovation Process, Project and Change Management, Project Knowledge and Learning	5_Topic 1 <--> 5_Topic 3 = -0.02	Topic 1 (0.562) - Idea Management, Culture and Strategy for Innovation Topic 9 (0.423) - Organisational Stucture and suitability for Change and Innovation	10_Topic 1 <--> 10_Topic 9 = 0.256	Topic 3 (0.999) - Quality and Control of the Innovation Process		5_Topic 1 <--> 10_Topic 1 = 0.32 5_Topic 1 <--> 10_Topic 9 = 0.21 5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 9 = 0.32	10_Topic 1 <--> 20_Topic 3 = 0.468 10_Topic 9 <--> 20_Topic 3 = 0.524
A roadmapping and conceptual framework based approach for efficient knowledge and innovation management.doc	Du Preez et al. 2006	Innovation, Knowledge Management, Roadmapping, Innovation Management, Conceptual Framework	Knowledge lifecycle, Knowledge evolution (data-intelligence), Innovation lifecycle, Integrative/collaborative systems, collaborative tools, roadmap	Topic 3 (0.999) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.993) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 20 (0.993) - Project Knowledge, Planning and Control, and Innovation Teams		5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 20 = 0.720
A roadmapping methodology for managing innovation projects.doc	Le Bihan 2006		Innovation project, roadmaps, roadmapping, project execution	Topic 3 (0.417) - Innovation Process, Project and Change Management, Project Knowledge and Learning Topic 4 (0.583) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property	5_Topic 3 <--> 5_Topic 4 = 0.011	Topic 8 (0.995) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 17 (0.992) - Roadmaps and Innovation Projects Management		5_Topic 3 <--> 10_Topic 8 = 0.46 5_Topic 4 <--> 10_Topic 8 = 0.13	10_Topic 8 <--> 20_Topic 17 = 0.328
Auditing best practice for effective product innovation management.pdf	Cormican and O'Sullivan 2004	Product innovation management; Best practice model; Self-assessment scorecard; Case study analysis	Strategy and leadership, Culture and climate, Project planning and management, Prioritisation and selection, Organisational structuring, Communication and collaboration	Topic 3 (0.998) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.655) - Idea Management, Culture and Strategy for Innovation Topic 2 (0.319) - Organisational Innovation Strategy and Learning	10_Topic 1 <--> 10_Topic 2 = 0.411	Topic 3 (0.922) - Quality and Control of the Innovation Process		5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 1 <--> 20_Topic 3 = 0.468 10_Topic 2 <--> 20_Topic 3 = 0.412
Barriers to Innovation Management in Service Companies.pdf	Oke 2004	Innovation, service sector, barriers and innovation performance	Motivation, Idea generation, Prototyping or concept testing, Lack of legacy, management support, IP protection, Appropriate measures, Innovation process	Topic 3 (0.984) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.957) - Idea Management, Culture and Strategy for Innovation		Topic 4 (0.94) - Organisational Learning and Change		5_Topic 3 <--> 10_Topic 1 = 0.60	10_Topic 1 <--> 20_Topic 4 = 0.496
Benchmarking innovation best practice.pdf	Ahmed 1998(1)		Innovation strategy, Strategic commitment, Innovation objectives, Values, Culture, Cross-functional teams, Resource slack (freedom), Organisational structure, Innovation process, Customer involvement, Collaboration, Celebrate victory, Long-term focus/management, Knowledge management, Idea generation and management, Rewards	Topic 3 (0.901) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.719) - Idea Management, Culture and Strategy for Innovation Topic 2 (0.257) - Organisational Innovation Strategy and Learning	10_Topic 1 <--> 10_Topic 2 = 0.411	Topic 8 (0.952) - Innovation Process Management		5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 1 <--> 20_Topic 8 = 0.384 10_Topic 2 <--> 20_Topic 8 = 0.524
Benchmarking Innovation for Best Practice.pdf	Zairi 1995		Leadership, Strategic commitment, Innovation Strategy, Climate, Culture, Communication, Innovation process, Project structure, Multi-disciplinary/cross-functional teams, Innovation metrics, Core competencies, Systems and tools,	Topic 3 (0.845) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.556) - Idea Management, Culture and Strategy for Innovation Topic 2 (0.418) - Organisational Innovation Strategy and Learning	10_Topic 1 <--> 10_Topic 2 = 0.411	Topic 9 (0.951) - Idea Management and Opportunity Identification		5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 1 <--> 20_Topic 9 = 0.356 10_Topic 2 <--> 20_Topic 9 = 0.412
Building a radical innovation competency.pdf	O'Connor and Ayers 2005	Organisation structures, innovation cultures, radical innovation hubs, radical innovation competencies	Infrastructure, Idea generation, Idea incubation, R&D management systems, Innovation Process, Idea acceleration, Organisational structure, Leadership, Innovation model evolution, Tools, Skills, Rewards, Metrics	Topic 1 (0.995) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 1 (0.998) - Idea Management, Culture and Strategy for Innovation		Topic 9 (0.999) - Idea Management and Opportunity Identification		5_Topic 1 <--> 10_Topic 1 = 0.32	10_Topic 1 <--> 20_Topic 9 = 0.356
Building an Innovation factory.pdf	Hargadon and Sutton 2000		Knowledge brokering cycle, Idea generation and management, Idea incubation, Reusing ideas, Prototyping	Topic 4 (0.998) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 1 (0.961) - Idea Management, Culture and Strategy for Innovation		Topic 12 (0.997) - Idea/Opportunity Indentification and Prioritisation Process		5_Topic 4 <--> 10_Topic 1 = 0.24	10_Topic 1 <--> 20_Topic 12 = 0.356
Business Week's 5 Themes of Innovation - Coordinate & Collaborate .doc	McGregor, Hagel and John Seely Brown, Ehrlich , Rae, Martin (businessweek.com [20/07/2007])		Cross-boundary collaboration, Organisational structuring and alignment, Synchronisation from the core	Topic 1 (0.71) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 1 (0.992) - Idea Management, Culture and Strategy for Innovation		Topic 12 (0.985) - Idea/Opportunity Indentification and Prioritisation Process		5_Topic 1 <--> 10_Topic 1 = 0.32	10_Topic 1 <--> 20_Topic 12 = 0.356
Business Week's 5 Themes of Innovation - Customer Insight .doc	Zaccai, Carney, Kharif, Kiley (businessweek.com [20/07/2007])		Customer involvement and integration, Customer-centric design	Topic 4 (0.997) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 9 (0.999) - Organisational Stucture and suitability for Change and Innovation		Topic 11 (0.999) - Future Trends Roadmapping		5_Topic 4 <--> 10_Topic 9 = 0.18	10_Topic 9 <--> 20_Topic 11 = 0.132
Business Week's 5 Themes of Innovation - Innovator's-In-Chief .doc	Tiplady, Martin, O'Connell (businessweek.com [20/07/2007])		Leadership driven innovation, Leadership support, Top-level drive	Topic 5 (0.558) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 5 (0.203) - Innovation Process and Idea Management Topic 6 (0.648) - Disruptive Innovation and Innovation Strategy	10_Topic 5 <--> 10_Topic 6 = 0.318	Topic 11 (0.995) - Future Trends Roadmapping		5_Topic 4 <--> 10_Topic 5 = 0.38 5_Topic 4 <--> 10_Topic 6 = 0.58	10_Topic 5 <--> 20_Topic 11 = 0.300 10_Topic 6 <--> 20_Topic 11 = 0.300
Business Week's 5 Themes of Innovation - Measure What Matters .doc	Tiplady (businessweek.com [20/07/2007])		Innovation measurement, Innovation metrics, Monitoring	Topic 4 (0.86) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 9 (0.953) - Organisational Stucture and suitability for Change and Innovation		Topic 12 (0.988) - Idea/Opportunity Indentification and Prioritisation Process		5_Topic 4 <--> 10_Topic 9 = 0.18	10_Topic 9 <--> 20_Topic 12 = 0.636
Business Week's 5 Themes of Innovation - Open Innovation .doc	Byrnes, Lacy (businessweek.com [20/07/2007])		Open innovation, Open R&D, Collaboration, Customer and supplier involvement, Networking	Topic 4 (0.989) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 9 (0.995) - Organisational Stucture and suitability for Change and Innovation		Topic 5 (0.988) - Knowledge Networks and Research		5_Topic 4 <--> 10_Topic 9 = 0.18	10_Topic 9 <--> 20_Topic 5 = 0.020
CIDEM Guides for managing innovation Part I - Diagnosis.pdf	Ohme 2002		Innovation process, Resource allocation, Creating concepts, Knowledge and technology management, Culture, Developing new products/processes/marketing approaches (projects), Innovation measurement	Topic 3 (0.999) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 5 (0.976) - Innovation Process and Idea Management		Topic 8 (0.999) - Innovation Process Management		5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 5 <--> 20_Topic 8 = 0.552
CIMS Innovation Management Framework.pdf	Mugge 2006		Idea management, Market management, Portfolio management, Platform management, Project management, Dimensions (Strategy, Organisation & Culture, Processes, Tools & Techniques, Metrics), Level (Macro, Industry, Firm)	Topic 3 (0.951) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.998) - Organisational Innovation Strategy and Learning		Topic 8 (0.995) - Innovation Process Management		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 8 = 0.524
CONNECT and DEVELOP - Inside Procter & Gamble's new model for innovation.pdf	Huston and Sakkab 2006		Open innovation, Collaboration (across organisational borders), Global networking, Senior accountability/leadership, "Posting" problems to network, Culture	Topic 4 (0.87) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 5 (0.856) - Innovation Process and Idea Management		Topic 5 (0.151) - Knowledge Networks and Research Topic 9 (0.834) - Idea Management and Opportunity Identification	20_Topic 5 <--> 20_Topic 9 = -0.0	5_Topic 4 <--> 10_Topic 5 = 0.41	10_Topic 5 <--> 20_Topic 5 = 0.020 10_Topic 5 <--> 20_Topic 9 = 0.496
Culture and climate for innovation.pdf	Ahmed 1998(2)		Culture, Climate, Organic organisational structure, Resource freedom, Future orientation, Leadership involvement, Strategic intent, Rewards, Cross-functional interaction, Trust & openness, Clear risk tolerance, Balanced autonomy	Topic 3 (0.837) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.994) - Idea Management, Culture and Strategy for Innovation		Topic 1 (0.49) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources) Topic 14 (0.172) - Organisational Culture and Orientation towards Innovativeness Topic 15 (0.305) - Innovative Climate and Behaviour, and Innovation Measurement	20_Topic 1 <--> 20_Topic 14 = 0.10 20_Topic 1 <--> 20_Topic 15 = -0.0 20_Topic 14 <--> 20_Topic 15 = 0.01	5_Topic 3 <--> 10_Topic 1 = 0.60	10_Topic 1 <--> 20_Topic 1 = 0.188 10_Topic 1 <--> 20_Topic 14 = 0.440 10_Topic 1 <--> 20_Topic 15 = 0.076
Dealing with Darwin - Geoffery Moore.pdf	Moore 2005		Innovation Process, Market Maturity, Resourcing innovation, Core competencies	Topic 1 (0.999) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 6 (0.996) - Disruptive Innovation and Innovation Strategy		Topic 1 (0.997) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		5_Topic 1 <--> 10_Topic 6 = 0.74	10_Topic 6 <--> 20_Topic 1 = 0.636
Determinants of firm innovation in Singapore.pdf	Wan et al. 2003	Firm innovation; Determinants of firm innovation; Innovation management	Communication, Decentralized structure, Resource slack, Belief that innovation is important, Willingness to take risks, Willingness to exchange ideas	Topic 3 (0.793) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 9 (0.972) - Organisational Stucture and suitability for Change and Innovation		Topic 3 (0.996) - Quality and Control of the Innovation Process		5_Topic 3 <--> 10_Topic 9 = 0.32	10_Topic 9 <--> 20_Topic 3 = 0.524
Disruptive technology roadmaps.pdf	Kostoff 2004	Text mining; Literature-based discovery; Innovation; Workshops; Roadmaps; Disruptive technologies; Interdisciplinary; Multidisciplinary; Clustering	Integrative systems and tools, Future orientation, long-term opportunity identification, Environment scanning	Topic 4 (0.901) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 4 (0.772) - Open Innovation and Intellectual Property Management Topic 8 (0.216) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management	10_Topic 4 <--> 10_Topic 8 = 0.039	Topic 17 (1) - Roadmaps and Innovation Projects Management		5_Topic 4 <--> 10_Topic 4 = 0.72 5_Topic 4 <--> 10_Topic 8 = 0.13	10_Topic 4 <--> 20_Topic 17 = 0.300 10_Topic 8 <--> 20_Topic 17 = 0.328

Table 13 – Innovation Capability Corpus

Drivers and obstacles to Innovation.pdf	Baker 2002		Distinguish innovation types, Knowledge creation and absorption, Environmental scanning, Strategic commitment, Fluid organisation structure, Risk management, Culture, Resource slack, Rewards and incentives, Fuzzy-front end management, Individuals(employee empowerment and engagement, trust, training, job rotation, and the extent and range of individual networks), Project(diverse teams, openness to ideas, distinguish fuzzy front-end and systematic), Deconstruct existing mental models, Idea management, Project management, Innovation lifecycle (initiation, exploitation, deployment and commercialisation), Change management, Environmental (competition, Communities of practice, partners, alliances, regulations, stakeholder engagement)	Topic 3 (0.837) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.989) - Organisational Innovation Strategy and Learning		Topic 7 (0.974) - Innovation Process Management, Learning and Change Management		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 7 = 0.384
Dynamic capabilities and strategic management.pdf	Teece et al. 1997	competences; capabilities; innovation; strategy; path dependency; knowledge assets	Core competencies, dynamic (adaptive) capabilities, Coordination/integration, Learning, Reconfiguration and transformation	Topic 5 (0.977) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 3 (1) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 4 (0.999) - Organisational Learning and Change		5_Topic 4 <--> 10_Topic 3 = 0.27	10_Topic 3 <--> 20_Topic 4 = 0.440
Engendering an innovative culture and maintaining operational balance.pdf	Hyland and Beckett 2005	Innovation, Partnership, Organizational culture, Organizational development, Leadership, Australia	Innovation process management, Customer/supplier engagement, Environmental positioning, Strategic commitment, Leadership, Portfolio Management, Collaboration	Topic 3 (0.933) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.996) - Organisational Innovation Strategy and Learning		Topic 14 (0.998) - Organisational Culture and Orientation towards Innovativeness		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 14 = 0.328
Enhancing innovation capability through relationship management and implications for performance.pdf	Panayides 2006	Innovation, Channel relationships, Distribution management, Business performance, Quality, Hong Kong	Relationship orientation (Bonding, Communication, Shared values, Empathy)	Topic 3 (0.885) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.357) - Organisational Innovation Strategy and Learning Topic 10 (0.608) - Organisational (work) Environment, Metrics and Measurement	10_Topic 2 <--> 10_Topic 10 = -0.02	Topic 14 (0.999) - Organisational Culture and Orientation towards Innovativeness		5_Topic 3 <--> 10_Topic 2 = 0.66 5_Topic 3 <--> 10_Topic 10 = 0.04	10_Topic 2 <--> 20_Topic 14 = 0.328 10_Topic 10 <--> 20_Topic 14 = -0.03
European Commission Green Paper on Innovation.doc	European Commission 1995		Innovation management	Topic 2 (0.672) - Organisational Environment (work), Metrics and Measurement		Topic 7 (0.999) - Knowledge Networks and Communities of Practice		Topic 19 (0.999) - Involvement of Innovation stakeholders		5_Topic 2 <--> 10_Topic 7 = 0.07	10_Topic 7 <--> 20_Topic 19 = 0.440
Formal knowledge networks.pdf	Clark 1998		Knowledge networks, Knowledge creation and dissemination, Communication strategy, Network structuring, Multidisciplinary, multisectoral and multi-national, Network culture, Collaboration	Topic 5 (0.889) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 7 (0.999) - Knowledge Networks and Communities of Practice		Topic 5 (0.999) - Knowledge Networks and Research		5_Topic 4 <--> 10_Topic 7 = 0.32	10_Topic 7 <--> 20_Topic 5 = 0.524
From Invention to Innovation.pdf	US Department of Energy 1999		Innovation process								
From product innovation to solutions innovation - a new paradigm for competitive advantage.pdf	Shepherd and Ahmed 2000	Product innovation, Computers, Electronics, Competitiveness, Paradigms	Solution innovation, Innovation process, Technical competence, Integration competence, Market/business knowledge competence, Customer partnering competence	Topic 3 (0.616) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.981) - Organisational Innovation Strategy and Learning		Topic 2 (0.955) - Innovation Process Measurement, and Idea and IP Management		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 2 = 0.328
Handbook of organizational measurement.pdf	Price 1997		Measurement, Metrics	Topic 2 (1) - Organisational Environment (work), Metrics and Measurement		Topic 10 (1) - Organisational (work) Environment, Metrics and Measurement		Topic 13 (0.987) - Organisational and Individual Measures, Incentives and Job satisfaction		5_Topic 2 <--> 10_Topic 10 = 0.91	10_Topic 10 <--> 20_Topic 13 = 0.832
How do you best organise for radical innovation.pdf	Simon et al. 2003		Leadership, Innovation objectives and strategy, Environment (climate and culture), Dedicated resources, Risk sharing and management, Skills, knowledge and competencies, Opportunity identification and idea generation	Topic 2 (0.999) - Organisational Environment (work), Metrics and Measurement		Topic 2 (0.999) - Organisational Innovation Strategy and Learning		Topic 2 (0.996) - Innovation Process Measurement, and Idea and IP Management		5_Topic 2 <--> 10_Topic 2 = 0.07	10_Topic 2 <--> 20_Topic 2 = 0.328
Index of Corporate Innovation_Brochure.pdf	The Conference Board of Canada		Corporate culture, Leadership, Workforce capacity, Organizational processes and structure, Collaboration and partnerships, Investment in innovation, Innovation metrics and measurement	Topic 3 (0.636) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.344) - Idea Management, Culture and Strategy for Innovation Topic 2 (0.29) - Organisational Innovation Strategy and Learning	10_Topic 1 <--> 10_Topic 2 = 0.411	Topic 8 (0.96) - Innovation Process Management		5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 1 <--> 20_Topic 8 = 0.384 10_Topic 2 <--> 20_Topic 8 = 0.524
Information Accelerated Radical Innovation - Dismuke.pdf	Dismukes 2005	Accelerated Radical Innovation, Paradigm, Challenges, Hurdles, Information Technology	Innovation process, New knowledge generation, Information assessment, Pattern recognition, Innovation management, Stakeholder engagement (internal and external), Long range business opportunities (roadmapping)	Topic 3 (0.993) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.895) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 7 (0.959) - Innovation Process Management, Learning and Change Management		5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 7 = 0.412
Inhibitors of disruptive innovation capability-a conceptual model.pdf	Assink 2006	Innovation, Corporate strategy, Large enterprises	Innovation process, Resources, Competencies, Strategy, Structure, Team, Culture, Inhibitors - Dominant design/path dependency, Organisational dualism (conflict of status quo and change), Excessive beauracracy, Inability to unlearn, Lack of distinctive competencies, Obsolete mental models/theories in use, Learning trap (not invented here/groupthink), Unrealistic ROI expectation, Risk aversion, Unwilling to cannibalise (investments/markets), Lack of creativity, Lack of foresight/market sensing, Senior management turnover, Innovation process mismanagement, Lack of infrastructure, Lack of follow-through,	Topic 1 (0.528) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources) Topic 3 (0.467) - Innovation Process, Project and Change Management, Project Knowledge and Learning	5_Topic 1 <--> 5_Topic 3 = -0.02	Topic 1 (0.98) - Idea Management, Culture and Strategy for Innovation		Topic 4 (0.989) - Organisational Learning and Change		5_Topic 1 <--> 10_Topic 1 = 0.32 5_Topic 3 <--> 10_Topic 1 = 0.60	10_Topic 1 <--> 20_Topic 4 = 0.496
Innovating Innovation.pdf	Brown 2003		Innovating innovation (Meta-innovation), Open innovation, Collaboration	Topic 4 (0.632) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 4 (0.777) - Open Innovation and Intellectual Property Management		Topic 18 (0.848) - Sourcing Ideas, Managing Intellectual Property and Sourcing Captial (Open Innovation)		5_Topic 4 <--> 10_Topic 4 = 0.72	10_Topic 4 <--> 20_Topic 18 = 0.860
Innovation and Transformation - A Life Cycle Model.pdf	Coffman and Kaufman		Innovation lifecycle management, Innovation and market timing, Timing of parallel initiatives, Life cycle stage's impact on procedures, policy and environment	Topic 1 (0.976) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 6 (0.416) - Disruptive Innovation and Innovation Strategy Topic 10 (0.201) - Organisational (work) Environment, Metrics and Measurement	10_Topic 6 <--> 10_Topic 10 = -0.11	Topic 9 (0.997) - Idea Management and Opportunity Identification		5_Topic 1 <--> 10_Topic 6 = 0.74 5_Topic 1 <--> 10_Topic 10 = -0.0	10_Topic 6 <--> 20_Topic 9 = 0.300 10_Topic 10 <--> 20_Topic 9 = 0.020
Innovation as newness - what is new, how new, and new to whom.pdf	Johannessen et al. 2001	Innovation, Measurement, Entrepreneurialism, Norway	Innovation measurement, Innovation metrics	Topic 3 (0.79) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 9 (0.963) - Organisational Stucture and suitability for Change and Innovation		Topic 3 (0.25) - Quality and Control of the Innovation Process Topic 6 (0.669) - Communities of Practice and Knowledge Networks	20_Topic 3 <--> 20_Topic 6 = 0.13	5_Topic 3 <--> 10_Topic 9 = 0.32	10_Topic 9 <--> 20_Topic 3 = 0.524 10_Topic 9 <--> 20_Topic 6 = 0.300
Innovation Capability and the Maturity Model.pdf	Man, no date		Strategy (Vision, Technical Alliance, Merger & Acquisition, Technology adoption), Organisational (Resource Allocation & Planning, People/Champions, Intangible Resources and Assets, Financial Performance, Culture), Management (Knowledge and Learning, Customer Relationship, Supplier and Distributor Relationship), Business Functions (R&D, Marketing, Manufacturing)	Topic 1 (0.507) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources) Topic 3 (0.427) - Innovation Process, Project and Change Management, Project Knowledge and Learning	5_Topic 1 <--> 5_Topic 3 = -0.02	Topic 2 (0.381) - Organisational Innovation Strategy and Learning Topic 6 (0.239) - Disruptive Innovation and Innovation Strategy Topic 7 (0.287) - Knowledge Networks and Communities of Practice	10_Topic 2 <--> 10_Topic 6 = 0.132 10_Topic 2 <--> 10_Topic 7 = -0.02 10_Topic 6 <--> 10_Topic 7 = 0.008	Topic 7 (0.896) - Innovation Process Management, Learning and Change Management		5_Topic 1 <--> 10_Topic 2 = 0.27 5_Topic 1 <--> 10_Topic 6 = 0.74 5_Topic 1 <--> 10_Topic 7 = -0.0 5_Topic 3 <--> 10_Topic 2 = 0.66 5_Topic 3 <--> 10_Topic 6 = 0.18 5_Topic 3 <--> 10_Topic 7 = 0.13	10_Topic 2 <--> 20_Topic 7 = 0.384 10_Topic 6 <--> 20_Topic 7 = 0.188 10_Topic 7 <--> 20_Topic 7 = 0.216
Innovation Competitive Advantage and Rents.pdf	McGrath et al. 1996	Innovation, Competitive Advantage, LISREL Analysis, Competence, Capabilities	Innovation process, Causal understanding (reduce uncertainty through understanding of relations among inputs, combinations and results of operational deployment), Team proficiency, New competencies, From competence to competitive advantage	Topic 4 (0.978) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 9 (0.948) - Organisational Stucture and suitability for Change and Innovation		Topic 15 (0.585) - Innovative Climate and Behaviour, and Innovation Measurement		5_Topic 4 <--> 10_Topic 9 = 0.18	10_Topic 9 <--> 20_Topic 15 = 0.076
Innovation Metrics - Measurement to Insight.pdf	Vonortas, no date		Innovation metrics, indicators (Knowledge, Networks, Conditions for innovation)	Topic 3 (0.992) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.614) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 7 (0.323) - Innovation Process Management, Learning and Change Management Topic 16 (0.464) - Innovation Metrics, Measurement and Maturity Development	20_Topic 7 <--> 20_Topic 16 = 0.32	5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 7 = 0.412 10_Topic 8 <--> 20_Topic 16 = 0.272
Innovation Metrics.pdf	InnovationPoint 2008		Innovation Metrics, Innovation Measurements, Return on Investment Metrics, Organisational Capability Metrics, Leadership Metrics	Topic 3 (0.933) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.658) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 9 (0.208) - Idea Management and Opportunity Identification Topic 16 (0.757) - Innovation Metrics, Measurement and Maturity Development	20_Topic 9 <--> 20_Topic 16 = 0.29	5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 9 = 0.188 10_Topic 8 <--> 20_Topic 16 = 0.272
Innovation Roles - The people you need for successful innovation.pdf	Hering and Phillips 2005		Resource alignment, Innovation roles, Innovation process, Managing the fuzzy front-end, Culture, Tools and methods	Topic 1 (0.604) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 5 (0.487) - Innovation Process and Idea Management Topic 9 (0.435) - Organisational Stucture and suitability for Change and Innovation	10_Topic 5 <--> 10_Topic 9 = 0.101	Topic 6 (0.931) - Communities of Practice and Knowledge Networks		5_Topic 1 <--> 10_Topic 5 = 0.35 5_Topic 1 <--> 10_Topic 9 = 0.21	10_Topic 5 <--> 20_Topic 6 = 0.244 10_Topic 9 <--> 20_Topic 6 = 0.300
Introduction to IM2 - Innovation Maturity Model.pdf	Williams 2007		Culture, Leadership, People, Processes, Tools & Techniques, Training, Facilities, Idea Capture, Idea Management, Strategic Planning and Metrics	Topic 3 (0.974) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 3 (0.974) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 16 (0.996) - Innovation Metrics, Measurement and Maturity Development		5_Topic 3 <--> 10_Topic 3 = 0.46	10_Topic 3 <--> 20_Topic 16 = 0.384
Learning Innovation Policy - A Design of a Dynamic Approach Based on Scientific Knowledge.pdf	Schwerin and Werker 2000	Innovation Policy, Innovation, Technological Change, Growth, Market Evolution, Stylised Facts, Economic History	Innovation policy, Market maturity (understanding and the impact on innovation policy)	Topic 3 (0.985) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.998) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 7 (0.999) - Innovation Process Management, Learning and Change Management		5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 7 = 0.412
Making Innovation Happen - The Telecon Innovation Life Cycle.pdf			Innovation process, Innovation lifecycle, Opportunity identification, Detailing and impact analysis, Prototyping, Implementation, Operation								
Managing organisation innovation in the knowledge economy.pdf	Johannessen et al 1999	Innovation, Vision, Process management, Knowledge workers	Change and adaptability, Management level: Focus (Willingness to take risk, Pro-activeness, Goals formulation), Mastery (Creating commitment, Initiating change, Managing time), Intensity (Confidence in mission, Discipline, Detachment), Integrity (Ability to create trust, Personal values, Ethical rules)	Topic 3 (0.997) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 3 (0.998) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 6 (0.996) - Communities of Practice and Knowledge Networks		5_Topic 3 <--> 10_Topic 3 = 0.46	10_Topic 3 <--> 20_Topic 6 = 0.132
Managing uncertainty in the front end of radical innovation development.pdf	Paasi et al. 2007	Uncertainty Management, Fuzzy Front End, Conceptualization, New Concept Development, Radical Innovation, Open Innovation	Uncertainty reduction/management, Risk management, Opportunity identification, Opportunity analysis, Idea generation and enrichment, Idea selection, and Concept definition, Strategy, Corporate culture, Networking, Innovation process, Open innovation, Foresight,	Topic 3 (0.686) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.995) - Organisational Innovation Strategy and Learning		Topic 16 (0.995) - Innovation Metrics, Measurement and Maturity Development		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 16 = 0.356

Table 13 – Innovation Capability Corpus (Continued)

Measuring police innovation - issues and measurement.pdf	King 2000	Police, Innovation, USA	Innovation measurement, Innovation metrics	Topic 1 (0.681) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 9 (0.998) - Organisational Stucture and suitability for Change and Innovation		Topic 12 (0.992) - Idea/Opportunity Indentification and Prioritisation Process		5_Topic 1 <--> 10_Topic 9 = 0.21	10_Topic 9 <--> 20_Topic 12 = 0.636
Measuring your return on innovation.pdf	Kuczmarski and Shapiro		Innovation measurement, Portfolio measurement	Topic 3 (0.59) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.982) - Organisational Innovation Strategy and Learning		Topic 7 (0.912) - Innovation Process Management, Learning and Change Management		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 7 = 0.384
Meeting the Challenge of Disruptive Change.pdf	Christensen and Overdorf 2000		Core capabilities (within resources, processes and values), Creating/adapting capabilities to follow change (through spin-off, acquisition or internally)	Topic 5 (0.993) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 6 (0.996) - Disruptive Innovation and Innovation Strategy		Topic 10 (0.992) - Disruptive vs. Sustaining (degree of) Innovation		5_Topic 4 <--> 10_Topic 6 = 0.58	10_Topic 6 <--> 20_Topic 10 = 0.552
Open Innovation - The New Imperative for Creating and Profiting from Technology.pdf	Chesbrough 2003		Open innovation, Understanding, managing and leveraging the knowledge landscape, Knowledge diffusion, Internal knowledge creation & external knowledge application, Innovation of the innovation process/strategy, Creative assimilation of internal and external knowledge, A "Venture Capital" type mechanism for finance, Managing IP (buying & selling), Modular architecture of solutions (allowing plug 'n play), Business model innovation	Topic 4 (0.998) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 4 (0.999) - Open Innovation and Intellectual Property Management		Topic 18 (0.998) - Sourcing Ideas, Managing Intellectual Property and Sourcing Captial (Open Innovation)		5_Topic 4 <--> 10_Topic 4 = 0.72	10_Topic 4 <--> 20_Topic 18 = 0.860
Organizational innovation - a meta-analysis of effects of determinants moderators.pdf	Damanpour 1991		Specialization, Functional differentiation, Professionalism, Managerial attitude toward change, Managerial tenure, Technical knowledge resources, Administrative intensity, Slack resources, External communication, Internal communication	Topic 5 (0.481) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 9 (0.999) - Organisational Stucture and suitability for Change and Innovation		Topic 12 (0.993) - Idea/Opportunity Indentification and Prioritisation Process		5_Topic 4 <--> 10_Topic 9 = 0.27	10_Topic 9 <--> 20_Topic 12 = 0.636
Organizational Models for Innovation.pdf	Kaplan and Winby 2007		Ambidextrous Organizations (separation between innovation & current line-of-business), Venture Boards (advisory boards focused on bringing external perspectives inside), Innovation Councils (cross-functional governance body enabling cross-business decision making and coordination), Cross Group Solutions Teams, Thought Leader Resource Networks, Open Innovation Network, Innovation Communities of Practice	Topic 3 (0.579) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.336) - Organisational Innovation Strategy and Learning Topic 5 (0.382) - Innovation Process and Idea Management	10_Topic 2 <--> 10_Topic 5 = 0.380	Topic 9 (0.822) - Idea Management and Opportunity Identification		5_Topic 3 <--> 10_Topic 2 = 0.66 5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 2 <--> 20_Topic 9 = 0.412 10_Topic 5 <--> 20_Topic 9 = 0.496
Roadmapping Continuous Innovation.pdf	Stopper 2002		Innovation management, Management/leadership, Roadmapping (futures): knowledge management, strategy focus, core competencies and vision, capacity for innovation, decision making and accountability	Topic 3 (0.838) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 1 (0.391) - Idea Management, Culture and Strategy for Innovation Topic 2 (0.322) - Organisational Innovation Strategy and Learning Topic 8 (0.22) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management	10_Topic 1 <--> 10_Topic 2 = 0.411 10_Topic 1 <--> 10_Topic 8 = 0.194 10_Topic 2 <--> 10_Topic 8 = 0.163	Topic 9 (0.964) - Idea Management and Opportunity Identification		5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 2 = 0.66 5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 1 <--> 20_Topic 9 = 0.356 10_Topic 2 <--> 20_Topic 9 = 0.412 10_Topic 8 <--> 20_Topic 9 = 0.188
Roadmapping Convergence.pdf	Albright 2003		Roadmaps and Roadmapping (futures), Long-term planning/scanning, Scenarios	Topic 1 (0.686) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 4 (0.851) - Open Innovation and Intellectual Property Management		Topic 11 (0.995) - Future Trends Roadmapping		5_Topic 1 <--> 10_Topic 4 = 0.21	10_Topic 4 <--> 20_Topic 11 = 0.272
Roadmapping.pdf	Muller 2005		Roadmaps and Roadmapping (futures), Long-term planning/scanning, Futures visualisation, Uncertainty management	Topic 3 (0.414) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 5 (0.825) - Innovation Process and Idea Management		Topic 11 (0.987) - Future Trends Roadmapping		5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 5 <--> 20_Topic 11 = 0.300
SAP's Product Innovation Lifecycle.pdf	SAP AG 2005		Innovation Lifecycle/Process, Portfolio management, Project-oriented approach, Key decision points/filters & prioritisation/go & no-go points, Identify opportunities, Exploit opportunities, deploy opportunities, Optimisation	Topic 4 (0.974) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 10 (0.769) - Organisational (work) Environment, Metrics and Measurement		Topic 11 (0.997) - Future Trends Roadmapping		5_Topic 4 <--> 10_Topic 10 = -0.0	10_Topic 10 <--> 20_Topic 11 = -0.00
Situations for Innovation Management - towards a contingency model.pdf	Drejer 2002	Innovation, Competitive advantage	Innovation management, Innovation process, Technological integration, Strategic technology planning, Organisational change, Business development, Situational innovation management (meta-innovation)	Topic 4 (1) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 4 (0.999) - Open Innovation and Intellectual Property Management		Topic 16 (0.999) - Innovation Metrics, Measurement and Maturity Development		5_Topic 4 <--> 10_Topic 4 = 0.72	10_Topic 4 <--> 20_Topic 16 = 0.300
State of Art Report on Knowledge Networks.doc	Le Bihan 2006		Knowledge management, Knowledge networks, Communities of practice, Knowledge creation, structuring and dissemination, Multi-disciplinary teams, Collaboration, Integrating and collaborating systems	Topic 4 (0.786) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 7 (0.993) - Knowledge Networks and Communities of Practice		Topic 6 (0.99) - Communities of Practice and Knowledge Networks		5_Topic 4 <--> 10_Topic 7 = 0.18	10_Topic 7 <--> 20_Topic 6 = 0.300
STEPS - A knowledge management maturity roadmap for corporate sustainability.pdf	Robinson et al. 2006	Construction industry, Corporate strategy, Sustainable development, Knowledge management, United Kingdom	Motivation and awareness, KM strategy, KM resources, KM tools, Reward schemes	Topic 3 (0.999) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 3 (0.958) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 16 (0.986) - Innovation Metrics, Measurement and Maturity Development		5_Topic 3 <--> 10_Topic 3 = 0.46	10_Topic 3 <--> 20_Topic 16 = 0.384
Strategic Innovation - the engine that propels business.pdf	Hammer 2006		Innovation lifecycle/process, Idea generation, Concept development, Evaluation/prioritisation, Commercialisation, Improvement, Innovation leadership, Innovation/cross-functional teams, Innovation tools	Topic 1 (0.414) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources) Topic 3 (0.567) - Innovation Process, Project and Change Management, Project Knowledge and Learning	5_Topic 1 <--> 5_Topic 3 = -0.02	Topic 1 (0.446) - Idea Management, Culture and Strategy for Innovation Topic 5 (0.367) - Innovation Process and Idea Management	10_Topic 1 <--> 10_Topic 5 = 0.287	Topic 9 (0.987) - Idea Management and Opportunity Identification		5_Topic 1 <--> 10_Topic 1 = 0.32 5_Topic 1 <--> 10_Topic 5 = 0.35 5_Topic 3 <--> 10_Topic 1 = 0.60 5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 1 <--> 20_Topic 9 = 0.356 10_Topic 5 <--> 20_Topic 9 = 0.496
Strategic issues in managing innovation's fuzzy front-end.pdf	Kim and Wilemon 2002	Fuzzy logics, New product development, Teams, Project management, Innovation	Fuzzy front-end management, Stakeholder involvement, Senior management role, Cross-functional/multi-disciplinary teams, Innovation process	Topic 3 (0.999) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.929) - Organisational Innovation Strategy and Learning		Topic 17 (0.994) - Roadmaps and Innovation Projects Management		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 17 = 0.356
Strategy and planning for Innovation Management - a business excellence approach.pdf	Martensen and Dahlgaard 1999	Innovation, Quality, Strategy, Planning, Model, Electronics industry	Strategic intent (link between innovation strategy and business strategy), Evaluation and prioritisation, Communication and policy deployment, Self-assessment (innovation metrics), Implementation	Topic 3 (0.998) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.999) - Organisational Innovation Strategy and Learning		Topic 4 (0.99) - Organisational Learning and Change		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 4 = 0.524
Strategy and planning for innovation management - supported by creative and learning organisations.pdf	Martensen and Dahlgaard 1999	Innovation, Creativity, Learning organisations, Planning	Strategic intent (link between innovation strategy and business strategy), Culture, Learning organisation: dynamic change and corporate learning, Creativity, Training and education, Innovation process	Topic 3 (0.999) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 2 (0.994) - Organisational Innovation Strategy and Learning		Topic 4 (0.988) - Organisational Learning and Change		5_Topic 3 <--> 10_Topic 2 = 0.66	10_Topic 2 <--> 20_Topic 4 = 0.524
Strategy as Revolution.pdf	Hamel 1996		Strategic planning, Strategy development, Inclusive process, Combined top-down/bottom-up process, Core competencies, Diverse/varied perspectives, Change and then engagement, Innovation champions/roles,	Topic 5 (0.998) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 5 (0.999) - Innovation Process and Idea Management		Topic 19 (0.996) - Involvement of Innovation stakeholders		5_Topic 4 <--> 10_Topic 5 = 0.38	10_Topic 5 <--> 20_Topic 19 = 0.216
Structured Innovation Empowered by TRIZ.pdf	Pretium Consulting Services 2005		Innovation process, Decision points/stage-gates, Fuzzy front-end management, Idea generation, evaluation and priortisation, Roadmapping	Topic 3 (0.643) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 5 (0.908) - Innovation Process and Idea Management		Topic 3 (0.758) - Quality and Control of the Innovation Process		5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 5 <--> 20_Topic 3 = 0.244
Success and Failure of 50 Innovation Projects in Dutch companies.pdf	Cozijnsen et al. 2000	The Netherlands, Innovation, Project management, Success, Business failures	Innovation process, Implementation (time/cost/information management & decision making), Leadership, Climate and culture, Organisational alignment, Resource slack, Portfolio Management	Topic 3 (0.903) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.96) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 8 (0.986) - Innovation Process Management		5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 8 = 0.300
Supporting Collaborative Innovation - Ralf's Thesis.doc	Frombach 2003		Collaboration, Innovation lifecycle/process, Supporting systems/tools, Stakeholder involvement, Knowledge management, Project Management	Topic 3 (0.998) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 5 (0.891) - Innovation Process and Idea Management		Topic 7 (0.99) - Innovation Process Management, Learning and Change Management		5_Topic 3 <--> 10_Topic 5 = 0.35	10_Topic 5 <--> 20_Topic 7 = 0.356
Targeting innovation and implications for capability development.pdf	Francis and Bessant 2005	Innovation; Targeting; Innovation capability; Discontinuous innovation	Strategic intent, Targeting/focusing innovation efforts (Product, Processes, Positioning and/or Paradigm), Radical/Incremental Innovation, Resource balancing (prioritisation)	Topic 1 (0.624) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 1 (0.983) - Idea Management, Culture and Strategy for Innovation		Topic 16 (0.998) - Innovation Metrics, Measurement and Maturity Development		5_Topic 1 <--> 10_Topic 1 = 0.32	10_Topic 1 <--> 20_Topic 16 = 0.496
Technological innovation and complexity theory.pdf	Frenken 2005	Innovation, complexity, fitness landscape, NK-model, percolation, complex networks	Innovation systems/tools (simulation, complexity theory)	Topic 5 (0.969) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 1 (0.999) - Idea Management, Culture and Strategy for Innovation		Topic 6 (0.999) - Communities of Practice and Knowledge Networks		5_Topic 4 <--> 10_Topic 1 = 0.41	10_Topic 1 <--> 20_Topic 6 = 0.272
The Innovator's Dilemma - CHRISTENSEN.pdf	Christensen 1997		Managing Disruptive Technological Change, Core-capabilities (appraisal and exploitation), Resource allocation, 5 Success factors: Develop and commercialize disruptive technologies, Develop disruptive technologies in organisations small enough to get excited, Fail early and inexpensively, Utilise the resources of the mainstream organisation, but not the processes and values, Find or develop new markets that value the attributes of the disruptive products.	Topic 5 (0.998) - Disruptive Technology and Innovation, and Knowledge Networks		Topic 6 (0.999) - Disruptive Innovation and Innovation Strategy		Topic 10 (0.999) - Disruptive vs. Sustaining (degree of) Innovation		5_Topic 4 <--> 10_Topic 6 = 0.58	10_Topic 6 <--> 20_Topic 10 = 0.552
The Integration of Project Management Processes with a Methodology to Manage a Radical Innovation Project_Bernard Thesis .doc	Katz 2006		Fuzzy front-end management and Project Management Integration, Portfolio Management & Integration, Knowledge Transfer, Governance Principles, Design Objectives, Roadmaps, Knowledge Management, Management Commitment, Mock-ups & Prototypes, Measure and Learn, Risk Management, Change Management	Topic 3 (0.989) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 8 (0.999) - Innovation Project Management and Teams, Roadmapping and Innovation Implementation Management		Topic 20 (0.999) - Project Knowledge, Planning and Control, and Innovation Teams		5_Topic 3 <--> 10_Topic 8 = 0.46	10_Topic 8 <--> 20_Topic 20 = 0.720
The Process of Innovation.pdf	Pavitt 2003		Innovation process, Production of knowledge, Transformation and exploitation of knowledge, (into products, systems, processes and services), Continuous matching of the latter to market needs and demands								
The relationship between TQM practices, quality performance, and innovation performance.pdf	Prajogo and Sohal 2003	Total quality management, Innovation, Modelling	Total quality management, Leadership, Strategic planning, Customer focus, Information & Analysis, People management, Process management	Topic 3 (0.924) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 3 (0.976) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 3 (0.998) - Quality and Control of the Innovation Process		5_Topic 3 <--> 10_Topic 3 = 0.46	10_Topic 3 <--> 20_Topic 3 = 0.384
Toward a multi-dimensional measure of individual innovative behaviour.pdf	Kleysen and Street 2001	Individual behaviour, Innovation, Measurement, Model	Alignment of individual behaviour (Opportunity exploration, Generativity, Formative Investigation, Championing, Application)	Topic 1 (0.459) - Strategic Core Alignment (products and services, markets and customers, systems and processes, and people and resources)		Topic 10 (0.83) - Organisational (work) Environment, Metrics and Measurement		Topic 15 (0.999) - Innovative Climate and Behaviour, and Innovation Measurement		5_Topic 1 <--> 10_Topic 10 = -0.0	10_Topic 10 <--> 20_Topic 15 = 0.076
Transitioning Towards Creativity and Innovation Measurement in SMEs.pdf	McAdam and Keogh 2004		Innovation and creativity process, Creativity and innovation measurement, Knowledge creation, Idea generation, Idea screening, Innovation structure (organisational), TQM/CI, Business process innovation, Benchmarking, Knowledge management	Topic 3 (0.992) - Innovation Process, Project and Change Management, Project Knowledge and Learning		Topic 3 (0.996) - Quality and Measurement of Innovation Process, and Organisational Knowledge, Learning and Capabilities		Topic 2 (0.989) - Innovation Process Measurement, and Idea and IP Management		5_Topic 3 <--> 10_Topic 3 = 0.46	10_Topic 3 <--> 20_Topic 2 = 0.356
What innovation is-How companies develop operating systems for innovation.pdf	Smith 2005		Innovation process, Idea generation, Creativity, Collaboration, Opportunity identification, Idea Management, IP Protection, Mock-ups, prototypes & simulation, Solutions development (TRIZ), Integrative tools, Innovation renovation (Meta-innovation)	Topic 4 (0.644) - Knowledge Management, Open Innovation, and Managing Ideas and Intellectual Property		Topic 5 (0.998) - Innovation Process and Idea Management		Topic 2 (0.962) - Innovation Process Measurement, and Idea and IP Management		5_Topic 4 <--> 10_Topic 5 = 0.41	10_Topic 5 <--> 20_Topic 2 = 0.552

Table 13 – Innovation Capability Corpus (Continued)

Appendix E Innovativeness Constructs & ICMM v1 mapping

Mapping Notes

These relations are identified only at a high-level in relation to the ICMM. More relations are therefore possible (and likely) at a level of detail lower than is currently depicted herein. For the purpose of this analysis however, the level of detail used is suffcient to serve the purpose of identifying potentially core and non-core ICMM components.

(R) Reverse coded
** These construct indicators represent measures of innovative output more than innovativeness or innovation capability
?? Uncertain of validity of indicator
Potential core Capability Requirement (based on initial "gut-feel")
Check - potential gap
Out of scope

Author(s)	Constuct Name	Construct Items	Indicators	Relation to ICMM						Notes
Wang and Ahmed 2004	Organisational Innovativeness Construct	Behavioural Innovativeness	We get a lot of support from managers if we want to try new ways of doing things	OE-ID	OE-RA	OE-CI				
			In our company, we tolerate individuals who do things in a different way	OE-CI	OE-ID	OE-CC				
			We are willing to try new ways of doing things and seek unusual, novel solutions	LE-OI	OE-CI	OE-CC				
			We encourage people to think and behave in original and novel ways	OE-SD	OE-ID					
		Market Innovativeness	Our recent new products and services are only minor changes from our previous products and services (R)	CI-LR	LE-OI	LE-PI				**
			New products and services in our company often take us up against new competitors	CI-LR	LE-OI	LE-PI				**
			In comparison with our competitors, our products' most recent marketing programme is revolutionary in the market	CI-LR	LE-OI	LE-PI				**
			In new product and service introductions, our company is often at the cutting edge of technology	CI-LR	LE-OI	LE-PI				**
		Process Innovativeness	We are constantly improving our business processes	LE-IL	LE-OI	CI-MI	LE-SE	CI-CP		
			Our company changes production methods at a great speed in comparison with our competitors	CI-CP						**
			During the past five years, our company has developed many new management approaches	CI-MI	CI-CP					??
			When we cannot solve a problem using conventional methods, we improvise on new methods	OE-CC	LE-IL					
		Product Innovativeness	In new product and service introductions, our company is often first-to-market	CI-LR	LE-OI	LE-SE				**
			Our new products and services are often perceived as very novel by customers	CI-LR	LE-PI					**
			In comparison with our competitors, our company has introduced more innovative products and services during the past five years	LE-IL	LE-PI					**
			In comparison with our competitors, our company has a lower success rate in new products and services launch (R)	LE-PO	LE-SE	LE-IL				**
		Strategic Innovativeness	Our firm's R&D or product development resources are not adequate to handle the development need of new products and services (R)	OE-RA						
			Key executives of the firm are willing to take risks to seize and explore "chancy" growth opportunities	OE-SD	OE-ID	OE-CI	LE-FF			
			Senior executives constantly seek unusual, novel solutions to problems via the use of "idea men"	OE-SD	OE-ID	OE-RA	LE-OI			
			When we see new ways of doing things, we are last at adopting them (R)	CI-CP						
Hult et al. 2004	Market Orientation (Narver and Slater 1990)	Customer Orientation	Customer commitment	CI-CS						
			Create customer value	CI-CS	CI-CF					
			Understand customer needs	CI-CS	KE-PC	KE-CP	CI-CF			
			Customer satisfaction objectives	CI-CS						
			Measure customer satisfaction	CI-CS	KE-CP	CI-UM				
			After-sales service	*CI-CS*						?? By itself, not an innovation capability (reactive to situation)
		Competitor Orientation	Salespeople share competitor information	*KE-CP*						?? Only effective extends further than only salespersons
			Respond rapidly to competitors' actions	CI-CP	LE-OI					
			Top managers discuss competitors' strategies	KE-UC						
			Target opportunities for competitive advantage	LE-OI	KE-PC	KE-UC				
		Interfunctional Coordination	Interfunctional customer calls	CI-CF	KE-CP	KE-CP				
			Information shared among functions	KE-CP	CI-CF	OE-ST	CI-UI			
			Functional integration in strategy	CI-CF	OE-SD	OE-ST				
			All functions contribute to customer value	OE-ST	CI-CF	OE-RA	KE-CP	OE-SD		
			Share resources with other business units	OE-ST	CI-CF	OE-RA	KE-CP	CI-UI		
	Learning Orientation (Sinkula, Baker and Noordewier 1997)	Commitment to learning	Managers basically agree that our organization's ability to learn is the key to our competitive advantage	OE-ID	KE-KL	KE-CP	KE-UC	KE-PC		
			The basic values of this organization include learning as key to improvement	KE-KL	OE-CI	KE-CP	KE-UC	CI-CP		
			The sense around here is that employee learning is an investment, not an expense	KE-CP	KE-UC	OE-CI	KE-RC	OE-CC		
			Learning in my organization is seen as a key commodity necessary to guarantee organizational survival	KE-RC	OE-SD	OE-CC	KE-PC			
		Shared vision	There is a commonality of purpose in my organization	OE-SD	OE-ID	OE-RA				
			There is total agreement on our organizational vision across all levels, functions, and divisions	OE-SD	OE-ID	OE-ST	OE-RA			
			All employees are committed to the goals of this organization	CI-CP	OE-RA	OE-ID				
			Employees view themselves as partners in charting the direction of this organization	OE-CC	OE-CI	LE-OI	LE-PO			
		Open-mindedness	We are not afraid to reflect critically on the shared assumptions we have made about our customers	OE-CC	OE-CI	OE-ID	CI-CP	KE-PC		
			Personnel in this enterprise realize that the very way they perceive the marketplace must be continually questioned	LE-OI	OE-CC	OE-CI	OE-ID			
			We rarely collectively question our own bias about the way we interpret customer information (R)	LE-OI	OE-CC	OE-CI	OE-ID	KE-PC		
	Entrepreneurial Orientation (Covin and Slevin 1989)	Environmental Hostility	The external environment in which my firm operates is very safe, little threat to the survival and well-being of my firm							?? Being overly "safe" could allow complacency
			The external environment in which my firm operates is rich in investment and marketing opportunity	LE-OI	CI-LR					
			The external environment in which my firm operates is an environment that my firm can control and manipulate to its own advantage							?? "Control" and "manipulation"?
		Organization Structure	The operating management philosophy in my firm favors open channels of communication with important financial and operating information flowing quite freely throughout the organisation	KE-CP	OE-ST					
			The operating management philosophy in my firm favors managers' operating styles allowed to range freely from the very formal to the very informal	OE-ID	OE-CC	OE-CI				
			The operating management philosophy in my firm favors a strong tendency to let the expert in a given situation have the most say in decision-making, even if this means temporary bypassing of formal line authority	OE-CC	OE-CI					
			The operating management philosophy in my firm favors a strong emphasis on holding fast to changing circumstances without too much concern for past practices	CI-CP	LE-OI					
			The operating management philosophy in my firm favors a strong emphasis on getting things done even if this means disregarding formal procedures	LE-SE	LE-AS	LE-RR	LE-FF			
			The operating management philosophy in my firm favors loose, informal control; heavy dependence on informal relationships and norm of cooperation for getting work done	KE-CP	OE-CC	OE-CI				
			The operating management philosophy in my firm favors a strong tendency to let the requirements of the situation and the individual's personality define proper on-job behaviour	OE-RA	OE-ID	OE-CC	OE-CI			
		Stategic Posture	In general, the top managers of my firm favour a strong emphasis on R&D, technological leadership, and innovation	OE-SD	OE-ID					
			My firm has marketed very many new lines of products and services in the past 5 years							?? Outcome of innovation strategy
			Changes in my firm's products and services have usually been quite dramatic	*CI-CP*						??
			In dealing with its competitors, my firm typically initiates actions which competitors then respond to							??
			In dealing with its competitors, my firm is very often the first business to introduce new products/services, adminstrative techniques, operation technologies, etc.							?? Outcome of innovation strategy
			In dealing with its competitors, my firm typically adopts a very competitive, "undo-the-competitors" posture							??
			In general, the top managers of my firm have a strong proclivity for high-risk projects (with chances of very high returns)	LE-RR	LE-FF					
			In general, the top managers of my firm believe that owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm's objectives	OE-SD	CI-LR					
			When confronted with decision making situations involving uncertainty, my firm typically adopts a bold, aggressive posture in order to maximise the probability of exploiting potential opportunities	*LE-RR*	*LE-FF*					
Baker and Sinkula 1999	Market Orientation (Adapted from Kohli et al. 1993)	Intelligence Generation	In this business unit, we meet with customers at least twice per year to find out what products or services they will need in the future	CI-CS						
			In this business unit, we do a lot of in-house market research	*LE-OI*	*CI-LR*					?? Market reseach can also be bought/collaborated (old paradigm)
			We are slow to detect changes in our customers' product preferences (R)	CI-CS	LE-IL	LE-PI				
			We poll users at least twice per year to assess the quality of our products and services	CI-CS						
			We are slow to detect fundamental shifts in our industry (e.g. competition, technology, regulation) (R)	LE-IL	LE-OI	CI-LR				
			We frequently review the likely effect of changes in our business environment (e.g., regulation) on customers	LE-IL	LE-PI					
		Intelligence Dissemination	We have interdepartmental meetings at least once a quarter to discuss market trends and developments	CI-CF	KE-UC	KE-CP	CI-UI			
			Marketing personnel in our business unit regularly schedule meetings to discuss customers' future needs with other functional departments	CI-CS	CI-CF	KE-CP	KE-UC			
			When something important happens to a major customer or market, the whole business unit is informed about it within a short period	CI-CF	KE-CP	OE-ST				
			Data on customer satisfaction are disseminated at all levels in this business unit on a regular basis	CI-CF	KE-CP	OE-ST	KE-UC	CI-CS		
			When one department finds out something important about competitors, it is slow to alert other departments (R)	CI-CF	KE-CP	OE-ST				
		Responsiveness	We are slow to decide how to respond to our competitors' price changes (R)	CI-CP	CI-CS	LE-OI				
			For one reason or another, we tend to react slowly to changes in our customers' product or service needs (R)	CI-CP	CI-CS	LE-OI	CI-LR			
			We constantly review our product development efforts to ensure that they are in line with what customers want	CI-CP	CI-CS	LE-OI	LE-IL	OE-ST		
			Several departments get together periodically to plan a response to changes taking place in our business environment	CI-CF	KE-CP	OE-ST				
			If any competitor were to launch an intense campaign targeted at our customers, we would implement a response immediately	CI-CP						
			The activities of the different departments in this business unit are well coordinated	OE-RA	OE-ST	CI-CF				
			The positive resolution of all customer complaints is not a top priority in this business unit (R)	CI-CS	OE-CI	OE-CC				
			Even if we came up with a great marketing plan, we would probably not implement it in a timely fashion (R)	CI-CP	OE-CI	OE-CC				
			When we find that customers would like us to modify a product or service, the departments involved make concerted efforts to do so	CI-CS	OE-CI	OE-CC				
	Learning Orientation (Adapted from Sinkula, Baker and Noordewier 1997)	Commitment to learning	Managers basically agree that our organization's ability to learn is the key to our competitive advantage.	OE-ID	KE-KL		KE-CP	KE-UC	KE-CP	
			The basic values of this organization include learning as key to improvement	KE-KL	OE-CI	KE-CP	KE-UC	CI-CP		
			The sense around here is that employee learning is an investment, not an expense	KE-CP	KE-UC	OE-CI	KE-RC	OE-CC		
			Learning in my organization is seen as a key commodity necessary to guarantee organizational survival	KE-RC	OE-SD	OE-CC	KE-PC			
			Our culture is one that does not make employee learning a top priority (R)	OE-CI	KE-KL					
			The collective wisdom in this enterprise is that once we quit learning, we endanger our future	KE-KE	OE-CC					
		Shared vision	There is a commonality of purpose in my organization	OE-SD	OE-ID	OE-RA				
			There is total agreement on our organizational vision across all levels, functions, and divisions	OE-SD	OE-ID	OE-ST	OE-RA			
			All employees are committed to the goals of this organization	CI-CP	OE-RA	OE-ID				
			Employees view themselves as partners in charting the direction of this organization	OE-CC	OE-CI	LE-OI	LE-PO			
			Top leadership believes in sharing its vision for the business unit with the lower levels	OE-SD	OE-ID					
			We do not have a well-defined vision for the entire business unit (R)	OE-SD						
		Open-mindedness	We are not afraid to reflect critically on the shared assumptions we have about the way we do business	OE-CC	OE-CI	OE-ID	CI-CP	KE-PC		
			Managers in this business unit do not want their "view of the world" to be questioned (R)	LE-OI	OE-CC	OE-CI	OE-ID			
			Our business unit places a high value on open-mindedness	OE-CC	OE-CI	OE-ID				
			Managers encourage employees to "think out of the box"	OE-ID						
			An emphasis on constant innovation is not a part of our corporate culture (R)	OE-CI	OE-SD	OE-ID				
			Original ideas are highly valued in this organisation	OE-CC	OE-CI	KE-PC	LE-OI			

Table 14 – Innovativeness Construct & ICMM v1 mapping

Kohli et al. 1993	Market Orientation	Intelligence Generation	In this business unit, we meet with customers at least twice per year to find out what products or services they will need in the future	CI-CS							
			In this business unit, we do a lot of in-house market research	*LE-OI*	*CI-LR*					??	Market reseach can also be bought/collaborated (old paradigm)
			We are slow to detect changes in our customers' product preferences (R)	CI-CS	LE-IL	LE-PI					
			We poll users at least twice per year to assess the quality of our products and services	CI-CS							
			We are slow to detect fundamental shifts in our industry (e.g. competition, technology, regulation, etc.) (R)	LE-IL	LE-OI	CI-LR					
			We frequently review the likely effect of changes in our business environment (e.g., regulation) on customers	LE-IL	LE-PI						
		Intelligence Dissemination	We have interdepartmental meetings at least once a quarter to discuss market trends and developments	CI-CF	KE-UC	KE-CP	CI-UI				
			Marketing personnel in our business unit regularly schedule meetings to discuss customers' future needs with other functional departments	CI-CS	CI-CF	KE-CP	KE-UC				
			When something important happens to a major customer or market, the whole business unit is informed about it within a short period	CI-CF	KE-CP	OE-ST					
			Data on customer satisfaction are disseminated at all levels in this business unit on a regular basis	CI-CF	KE-CP	OE-ST	KE-UC	CI-CS			
			When one department finds out something important about competitors, it is slow to alert other departments (R)	CI-CF	KE-CP	OE-ST					
		Responsiveness	We are slow to decide how to respond to our competitors' price changes (R)	CI-CP	CI-CS	LE-OI					
			For one reason or another, we tend to react slowly to changes in our customers' product or service needs (R)	CI-CP	CI-CS	LE-OI	CI-LR				
			We constantly review our product development efforts to ensure that they are in line with what customers want	CI-CP	CI-CS	LE-OI	LE-IL	OE-ST			
			Several departments get together periodically to plan a response to changes taking place in our business environment	CI-CF	KE-CP	OE-ST					
			If any competitor were to launch an intense campaign targeted at our customers, we would implement a response immediately	CI-CP							
			The activities of the different departments in this business unit are well coordinated	OE-RA	OE-ST	CI-CF					
			The positive resolution of all customer complaints is not a top priority in this business unit (R)	CI-CS	OE-CI	OE-CC					
			Even if we came up with a great marketing plan, we would probably not implement it in a timely fashion (R)	CI-CP	OE-CI	OE-CC					
			When we find that customers would like us to modify a product or service, the departments involved make concerted efforts to do so	CI-CS	OE-CI	OE-CC					
Calantone et al. 2002	Learning Orientation (Adapted from Sinkula, Baker and Noordewier 1997)	Commitment to learning	Managers basically agree that our organization's ability to learn is the key to our competitive advantage	OE-ID	KE-KL	KE-KE	KE-CP	KE-UC	KE-CP		
			The basic values of this organization include learning as key to improvement	KE-KL	OE-CI	KE-CP	KE-UC	CI-CP			
			The sense around here is that employee learning is an investment, not an expense	KE-CP	KE-UC	OE-CI	KE-RC	OE-CC			
			Learning in my organization is seen as a key commodity necessary to guarantee organizational survival	KE-RC	OE-SD	OE-CC	KE-PC				
		Shared vision	There is a commonality of purpose in my organization	OE-SD	OE-ID	OE-RA					
			There is total agreement on our organizational vision across all levels, functions, and divisions	OE-SD	OE-ID	OE-ST	OE-RA				
			All employees are committed to the goals of this organization	CI-CP	OE-RA	OE-ID					
			Employees view themselves as partners in charting the direction of this organization	OE-CC	OE-CI	LE-OI	LE-PO				
		Open-mindedness	We are not afraid to reflect critically on the shared assumptions we have made about our customers	OE-CC	OE-CI	OE-ID	CI-CP	KE-PC			
			Personnel in this enterprise realize that the very way they perceive the marketplace must be continually questioned	LE-OI	OE-CC	OE-CI	OE-ID				
			We rarely collectively question our own bias about the way we interpret customer information (R)	LE-OI	OE-CC	OE-CI	OE-ID	KE-PC			
			We continually judge the quality of our decisions and activities taken over time	OE-CC	OE-CI	OE-ID					
		Intraorganizational knowledge sharing	There is a good deal of organizational conversation that keeps alive the lessons learned from history	KE-CP	OE-ST	CI-CF	KE-RC	KE-PC			
			We always analyze unsuccessful organizational endeavors and communicate the lessons learned widely	KE-KL	KE-KE	KE-PC	KE-UC	KE-CP			
			We have specific mechanisms for sharing lessons learned in organizational activities from department to department (unit to unit, team to team)	CI-UI	CI-CF	KE-CP	KE-UC				
			Top management repeatedly emphasizes the importance of knowledge sharing in our company	OE-CC	OE-ID						
			We put little effort in sharing lessons and experiences (R)	KE-CP	OE-ST	CI-CF	KE-RC	KE-PC			
Terziovski, not dated	Continuous Improvement and Innovation Management	Innovation System & Structure	The vision/mission includes a reference to innovation	OE-SD							
			Formally monitors developments in new technologies	CI-UI	LE-OI						
			Considers the use of technology as a driver of business growth	*OE-CC*	*CI-LR*					??	Only if utilised effectively
			Allocates resources to sharing technology across the organisation	CI-UI	OE-RA						
			Allocates resources to the use of cross-functional teams	CI-CF	OE-RA						
			Organisation's culture encourages formal meetings and interactions	OE-CI	KE-CP						
			Employees search for information, new ideas and technologies as part of continuous improvement and innovation management	CI-UI	LE-OI	LE-IL	KE-PC				
			Employees search for and incorporate diverse points of view as part of continuous improvement and innovation management	CI-CF							
			Employees facilitate and encourage informal relationships as part of continuous improvement and innovation management	KE-CP	CI-CS						
			Employees take reasonable risks by continuously experimenting with new ways of doing things	LE-FF	LE-RR	LE-PO					
			Employees challenge the status quo, thereby encouraging constructive conflict as part of continuous improvement and innovation	LE-OI							
			Employees use failures as opportunities to learn as part of continuous improvement and innovation management	KE-UC	OE-CC						
			Employees work towards specific technological goals/objectives as part of continuos improvement and innovation management	*OE-CC*	*LE-IL*	*CI-UM*				??	Technology is not the goal, but rather the enabler of the goal
			Employees let core technologies/organisational objectives guide the evaluation of new ideas and information as part of continuous improvement and innovation management	*LE-PO*	*OE-SD*	*LE-PO*				??	
			Employees actively monitor progress by using action plans/timetables to ensure that goals are met as part of the continuous improvement and innovation management process	CI-UM	CI-UI	LE-AS					
			Innovation strategy has helped the organization to achieve its strategic goals and objectives	OE-SD							
		Continuous Improvement & Innovation Management Strategy	Relative importance of innovation strategy in increasing production volume	OE-SD	LE-SE	LE-PI	LE-OI	LE-PO			
			Relative importance of innovation strategy in increasing employee skills	OE-SD	KE-RC	OE-RA	LE-PO				
			Relative importance of innovation strategy in contributing to customer satisfaction	OE-SD	CI-CS	LE-PO					
			Relative importance of innovation strategy in improving product/service quality	OE-SD	LE-SE	LE-PI	CI-CS	LE-PO			
			Relative importance of innovation strategy in improving employee commitment/morale	OE-SD	OE-RA	OE-CI	OE-ID	LE-PO			
			Relative importance of innovation strategy in improving administrative routines	OE-SD	LE-SE	LE-PI	LE-OI	LE-PO			
			Relative importance of innovation strategy in improving internal communication/cooperation	OE-SD	KE-CP	OE-CC					
		Customer & Supplier Relationships	Degree to which the firm's reputation is important to the firm's competitive advantage							??	Link to innovativeness?
			Degree to which product/service supply is important to the firm's competitive advantage							??	
			Degree to which customer satisfaction is important to the firm's competitive advantage	CI-CS	OE-SD						
		Organisational Culture	The organisation's culture encourages employees to hold knowledge closely (R)	OE-CI	KE-CP						
			The organisation's culture reinforces behaviours that uphold traditions (R)	OE-CI	LE-OI	LE-PI					
			The organisation's culture encourages managers to closely monitor work time (R)	OE-CC							
			The organisation's culture focuses on short term performance (R)	OE-CC	CI-UM						
			The organisation's culture encourages employees to interact with insiders only (R)	CI-CS	OE-CC	KE-CP					
		Technological Capabilities	The extent to which customers have the same or similar technologies to the organization's	*CI-UI*	*CI-CS*					??	Link to innovativeness?
			The extent to which suppliers have the same or similar technologies to the organisation's	*CI-UI*	*CI-CS*					??	
			The extent to which competitors have the same or similar technologies to the organisation's							??	
Lin 2007	Individual Factors	Enjoyment in helping others	I enjoy sharing my knowledge with colleagues	KE-CP	CI-CF	KE-RC	KE-PC	OE-CI			
			I enjoy helping colleagues by sharing my knowledge								
			It feels good to help someone by sharing my knowledge								
			Sharing my knowledge with colleagues is pleasurable								
		Knowledge self-efficacy	I am confident in my ability to provide knowledge that others in my company consider valuable	OE-RA	KE-CP	CI-CF					
			I have the expertise required to provide valuable knowledge for my company								
			It does not really make any difference whether I share my knowledge with colleagues (R)								
			Most other employees can provide more valuable knowledge than I can (R)								
	Organizational Factors	Top management support	Top managers think that encouraging knowledge sharing with colleagues is beneficial	OE-ID	KE-CP	CI-CF					
			Top managers always support and encourage employees to share their knowledge with colleagues								
			Top managers provide most of the necessary help and resources to enable employees to share knowledge								
			Top managers are keen to see that the employees are happy to share their knowledge with colleagues								
		Organizational rewards	Sharing my knowledge with colleagues should be rewarded with a higher salary	OE-CC							Rewards addressed in OE-CC & LE-PI on a Requirement Practice level, but limited
			Sharing my knowledge with colleagues should be rewarded with a higher bonus								
			Sharing my knowledge with colleagues should be rewarded with a promotion								
			Sharing my knowledge with colleagues should be rewarded with an increased job security								
	Technology Factor	ICT use	Employees make extensive use of electronic storage (such as online databases and data warehousing) to access knowledge	CI-UI	KE-CP	CI-CF					
			Employees use knowledge networks (such as groupware, intranet, virtual communities, etc.) to communicate with colleagues								
			My company uses technology that allows employees to share knowledge with other persons inside the organization								
			My company uses technology that allows employees to share knowledge with other persons outside the organization								

Table 14 – Innovativeness Construct & ICMM v1 mapping (Continued)

Ohme 2002	CIDEM	A culture of innovation	What is the role of innovation in long-term bussiness planning?	CI-LR	OE-SD						
			How does management share the opion that innovation should be managed and not left to improvisation?	OE-CC	OE-ID	OE-RA					
			How does management introduce innovation into the company's internal and external communications?	OE-ID	KE-CP	CI-CS					
			How does management develop the know-how of the company on the basis of people skills?	OE-RA	OE-ID						
			How does management deal with the risk that is inherent to innovation?	OE-ID	LE-RR	LE-FF	LE-AS				Risk management poorly addressed
		Creating new concepts	When creating new products, to what degree does the company identify the present and future needs of its cunstomers and examine its competitors' activities?	CI-LR	LE-IL	LE-OI					
			How does the company promote the contribution of ideas, innovative thinking and creativity among its employees?	LE-OI	LE-PO	LE-IL					
			How does the company plan the creation of new concepts?	LE-IL	LE-AS	LE-FF					
			How does the company select the ideas and concepts to be developed?	LE-IL	LE-PO	LE-RR					
			Are the tools for creating new concepts used in a discernable and sustainable manner? (For example: value analysis, TRIZ, brainstorming, product portfolio, project mapping and project funnelling, etc.)	LE-IL	LE-OI	LE-FF	CI-UI				
		Developing products	What information is used by the company to initiative the development of a new product?	KE-PC	LE-OI	CI-LR					
			To what extent do the departments, customers and suppliers take part in the development process from the start of the project?	KE-CP	CI-CF	CI-CS					
			Does the company have a time schedule which includes the objectives to be met, the forecast costs and an ongoing monitoring of the project?	LE-AS	LE-IL						
			To what extent are design and new technologies introduced into the development of a new product?	*LE-OI*	*CI-LR*	*LE-SE*					?? More technological does NOT imply more innovative
			Are product development tools used on a lareg-scale and ongoing basis? (For example: CAD/CAM/CAE, QFD, value engineering, virtual prototype, service provision map, etc.)	CI-UI	LE-SE						
		Redesigning production processes	Does the company monitor the manufacturing technolgies and the models used for managing the production processes?	LE-PI	CI-UM						
			Does the company have plans to devote resources to the development of new production processes?	OE-RA							
			Does the company have an outsourcing strategy?	LE-SE	CI-CS	CI-CC					
			Does the company plan to innovate by integrating logisitic activities?	LE-SE	CI-CS	CI-UI	CI-CC				
			Are the most appropriate tools for defining and controlling the production process used to a significant degree and on an ongoing basis? (For example: FMEA, process simulation, TPM, controlled pilot experiments)	LE-IL	LE-SE	CI-UI					
		Redesigning marketing processes	Does the company implement other commercial practices to create new ideas for improving or modifying marketing processes?	OE-CC	LE-OI	LE-SE					
			How does the company market a new product?	CI-CS	LE-SE						
			Does the company redesing marketing processes and to what extent does this help the company increase product value?	OE-CC	LE-OI	LE-SE					
			Does the company maintain contact with its customers after the sale?	CI-CS							
			Is the company aware of the marketing potential offered by the new information technologies?	LE-OI	CI-LR						
		Managing knowledge and technology	Does the company identify the key technologies for its business and how does it assess the impact of these technologies on future products?	CI-LR	LE-OI	LE-PO					
			Does the company have a stratigic plan to introduce new technologies into the development of new products and is this based on a budget allocation and an estimate of expected profitiability?	OE-SD	LE-PO	OE-RA					
			Is there procedure in place for deciding what should be dealt with internally and what should be outsourced?	OE-CC	CI-CC						
			Does the company manage knowledge appropriately?	KE-KL	KE-PC	KE-UC	KE-CP	KE-RC			
			Does the company manage its intellectual property assets (patents, copyright, trademarks, industrial secrets and know-how)?	KE-RC	KE-UC	KE-PC					IP management poorly addressed
Cormican and O'Sullivan 2004	Product Innovation Management Scorecard	Strategy and leadership	The product strategic plan is effective and used	*OE-SD*	*LE-PO*						?? Outcome of successful innovation strategy
			Product strategy is clearly defined and communicated to all employees	OE-SD	OE-ID						
			The product innovation programme has a long term thrust and focus	CI-LR	LE-IL						
			Product strategy is used to align priorities with other functions	LE-PO	LE-AS						
			Strategies are flexible enough to respond to changes in the environment	CI-CP	OE-SD						
			Senior management is accountable for new product results	OE-ID							
			Leaders visibly drive innovation	OE-ID	OE-SD	OE-ST					
			Leaders adopt a consensus and shared approach to decision making	OE-ID	OE-ST	OE-SD					
			Leaders adopt a participative decision making style	OE-ID	OE-ST						
			Senior management actively encourages the submission of new product ideas	OE-ID	LE-OI						
		Culture and climate	The organisation permits the emergence of intrapreneurs or product champions	OE-ID	OE-CC						
			The organisation provides support in terms of autonomy, time and rewards	OE-ID	OE-CC	OE-RA					
			Money is made available for internal projects	OE-RA							
			Adequate resources are available and committed to achieve project goals	OE-RA							
			All employees participate in generating ideas	OE-ID	LE-OI						
			Senior management is committed to risk taking in product innovation	LE-RR	OE-ID						
			Failures and mistakes are tolerated and not punished	OE-RA	OE-CI	OE-CC					
			Knowledge sharing is encouraged and rewarded	OE-CC	KE-CP						
			All operations are driven by customer needs	CI-CS							
			There is a formal idea generation process in place	LE-OI	CI-LR						
		Planning and selection	An effective product innovation process is consistently implemented	LE-IL	LE-PI	LE-AS					
			A formal process is used to determine and update project priorities	LE-PO							
			Concepts are selected using pre-defined, multiple and explicit criteria	LE-PO	LE-SE	LE-AS					
			Pre-development market and feasibility studies are rigorously undertaken	LE-SE	LE-AS						
			Projects are terminated if and when necessary	LE-KW							
			Project proposals are tested for alignment with organisational goals	LE-PO	OE-SD						
			The project and the spending breakdown mirrors the organisations goals and measures	OE-RA	CI-UM						
			There is a good balance of projects which maximises the value of the portfolio	LE-PI	LE-PO						
			The product portfolio is matched to the firm's competencies and capabilities	CI-CC	LE-PO						
			The voice of the customer is built into all product innovations	CI-CS							
		Structure and performance	Projects are developed using effective cross-functional teams	CI-CF							
			Project teams are organic, flexible and agile	CI-CF	OE-ST	CI-CP					
			All team operations are driven by customer needs	CI-CS							
			Team leaders are involved in setting the product performance objectives	OE-ID	OE-RA						
			All team members are mutually accountable	CI-CF							
			Team members are empowered to make decisions	OE-ID	OE-CC						
			Virtual team members are equipped with effective ICT tools	KE-CP							
			Team members' rewards are equitable	OE-CC	CI-CF						
			Performance indicators are aligned with the organisations goals	CI-UM							
			Performance indicators encourage desired behaviour	CI-UM	OE-CC						
		Communication and collaboration	Gatekeepers are in place to continuously span the external environment	CI-LR	KE-PC	LE-OI					
			Customers and suppliers are involved in the product innovation process	CI-CS							
			Alliances are often formed with other organisations for mutual benefit	KE-PC							
			Communications among team members is efficient and effective	CI-CF							
			Communications between project teams is efficient and effective	KE-CP	CI-CF						
			Information on ideas generated, problems raised and project status is accessible	KE-UC							
			User needs analyses are undertaken and communicated to all	KE-CP	CI-CS						
			Product strategy and performance measures are clearly communicated to all	KE-CP	OE-ID	CI-UM					
			Individual skills are effectively leveraged within and between project teams	OE-RA	CI-CF						
			Virtual team members seamlessly communicate with each other	KE-CP	CI-CF						
Tang 1998	Integrative model of innovation in organisations	Information and Communication	Flow of information and technology	*KE-CP*	*OE-ST*						?? Flow of technology and not technology itself
			Use of information technology	KE-UC	KE-CP	KE-PC					
			Information as source of knowledge and stimulus for innovation	KE-UC	KE-CP						
		Behavior and Integration	Behavior traits	OE-RA	OE-CI						
			Creative behaviors	OE-CI	LE-OI						
			Motivation to innovate	OE-SD	OE-CC	OE-ID					
			Team roles	CI-CF	OE-ST						
			Cross-functional integration	OE-ST	CI-CF						
		Knowledge and Skills	Creativity, intelligence, insights, bisociation, domain- related knowledge and skills	KE-KL	KE-PC	KE-RC					
			Tacit and explicit knowledge	KE-RC	KE-UC						
			Knowledge creation	KE-PC							
			Learning and training	KE-UC	OE-RA						
		Project Raising and Doing	Opportunity and problem finding	LE-OI							
			Problem solving	LE-OI							
			Product and process development stages	LE-IL	LE-AS	LE-FF					
			Uncertainty reduction	LE-FF	LE-RR						
		Guidance and Support	Organization's mission, task, structure, strategy, resources, operation systems	OE-SD	OE-ST	OE-RA	LE-IL				
			Shared values	OE-CI							
			Leadership style	OE-ID							
		External Environment	Economic rules and innovation								Not within scope of ICMM
			National innovation system								Not the ability of the organisation
			Industry structure								to improve the innovation
			Culture								capability of the external environment

Table 14 – Innovativeness Construct & ICMM v1 mapping (Continued)

Appendix F Innovativeness Constructs coverage of ICMM v1

		Core Cap Req ?? / Periferal Cap Req
Lifecycle Execution	Ensuring the complete innovation lifecycle is efficiently and effectively managed and executed to continuously and concurrently realise successful innovative outputs	
LE-IL	**Innovation lifecycle realisation**	
25	Ensuring the organisation progresses in terms of innovation lifecycle understanding, identifies and deploys tools, techniques and methods to repeatedly and concurrently execute successful innovation initiatives, and integrates these with the lifecycles of the enterprise	2
LE-AS	**Agile-to-systematic project ability**	
10	Ensuring the organisation distinguishes between the fuzzy front-end and the more consistent phases of an innovation initiative, identify and deploy effective techniques to manage each, and ensure effective bridging between the two	1
LE-RR	**Risk realisation and management**	
8	Ensuring that the ambiguities, uncertainties and complexities associated with innovation initiatives are related to risk as early as possible, and effective techniques are identified and deployed to mitigate and manage these risks	1
LE-OI	**Opportunity identification and solution generation**	
53	Ensuring that effective processes for opportunity identification and idea/solution generation are employed and that the processes are managed and maximised to ensure that the opportunities and ideas that surface present significant potential	3
LE-FF	**Fuzzy front-end management**	
10	Ensuring that the ambiguities, uncertainties and complexities associated with innovation initiatives are understood and exploited to maximise the potential of pursued opportunities and ideas	1
LE-PO	**Prioritisation of opportunities and testing and screening of ideas**	
24	Ensuring that the number of opportunities and ideas is rapidly reduced to a manageable and resilient cluster that exhibits strong organisational alignment and potential for long term return	2
LE-SE	**Substantiation and exploitation of opportunities**	
17	Ensuring that the fuzzy front-end is rapidly bridged, that the prioritised opportunities and ideas are accelerated to become focused initiatives for deriving value, and that consideration of operational intricacies is made	1
LE-PI	**Parallel incremental and radical innovation execution**	
17	Ensuring the continuous and concurrent execution of innovation initiatives in terms of operationalised efforts and new initiatives, spanning the entire degree-of-newness scale from incremental to radical	1
LE-KW	**Timeous disposal of initiatives**	
1	Ensuring that both non-operationalised initiatives and operational endeavours are discontinued once they are no longer feasible	1
Knowledge Exploitation	Ensuring the creation, consolidation, diffusion and utilisation of relevant knowledge to support the activities of innovation initiatives	
KE-KL	**Knowledge lifecycle realisation**	
10	Ensuring the organisation progresses in terms of knowledge lifecycle understanding, identifies and deploys tools, techniques and methods to repeatedly and concurrently execute successful knowledge enhancement initiatives, and relates and integrates these activities to the innovation lifecycle	1
KE-KE	**Knowledge evolution realisation**	
3	Ensuring an organisational understanding of the knowledge evolution process and the implications thereof in terms of the innovation and knowledge lifecycles	1
KE-PC	**Proficient creation and absorption of knowledge**	
25	Ensuring the identification of data sources, and the identification and deployment of tools, techniques and methods to effectively and efficiently analyse data, create and capture knowledge	2
KE-UC	**Consolidation and application of knowledge**	
27	Ensuring knowledge is clustered and utilised in unique and effective ways so as to create new perspective and understanding of internal and external environments	2
KE-CP	**Proficient collaboration**	
58	Ensuring the effective exchange of knowledge, sharing of ideas, perspectives and objectives, interaction, and deliberation between internal and external networked groups of individuals and networked groups of groups	3
KE-RC	**Retention, capture and integration of tacit knowledge**	
14	Ensuring an organisational understanding of tacit knowledge, and the identification and deployment of effective methods to retain, transfer, capture and integrate tacit knowledge	1
Organisational Efficacy	Ensuring an innovation conducive organisational environment with consideration of strategy, climate, culture, leadership, structure, and resourcing	
OE-SD	**Strategic drive and emphasis on innovation**	
40	Ensuring that strategy is innovation focused and facilitative of long term innovative capability, and that organisational vision and mission is collectively embraced by all individuals	2
OE-CC	**Innovation conducive climate**	
55	Ensuring an understanding of the role of organisational climate in innovation and that policies, practices and procedures create an environment that is facilitative of innovation activities	3
OE-CI	**Innovation conducive culture**	
45	Ensuring an understanding of the role of organisational culture in innovation and that the beliefs, norms, values, and patterns of behaviour of individuals and the organisation as a whole are conducive to an organisation-wide innovation mindset	3
OE-ID	**Innovation driven leadership**	
55	Ensuring that leadership drive and encourage innovative behaviour, that they serve as organisational role models for such behaviour, and exuberate energy and openness	3
OE-ST	**Organic organisational structure**	
30	Ensuring that organisational structure is supportive of and conducive to the execution of innovation activities, and exhibits sufficient flexibility, adaptability and transparency to continuously achieve this	2
OE-RA	**Resource alignment, training and slack**	
36	Ensuring the resourcing of innovation initiatives is sufficient to allow freedom for creativity and room for failure, the alignment of individual capabilities and interests with work description, and the training of individuals in innovation related principles and practices	2
Common Capability Requirements	Provision for those Capability Requirements overlapping in their contribution to Innovation Capability Areas	
CI-CC	**Realisation of and proficiency in core competencies (LE/OE)**	
4	Ensuring that the organisation develops an understanding of its core competencies, effectively manages them to maximise appropriate outputs, identifies necessary new competencies, and develops both (feasible) old and new competencies	1
CI-CF	**Cross-functional and multidisciplinary teaming (LE/KE/OE)**	
41	Ensuring that all teams and groupings within the organisation are diversely populated to bring varied perspective, new understanding and improve the relevance of outputs	3
CI-CP	**Change proficiency (LE/OE)**	
28	Ensuring that the organisation understands the dynamics of change and exhibits an ability to rapidly adapt to changes in the environment	2
CI-CS	**Consumer, supplier and stakeholder assimilation (LE/KE)**	
44	Ensuring the organisation effectively involves various external entities throughout the lifecycle of innovation initiatives and establishes a profound understanding of their needs	3
CI-LR	**Long range opportunity identification and evaluation (LE/KE)**	
26	Ensuring the organisation develops a future orientation and is capable of scanning environments, identifying opportunities and transforming those opportunities into workable business propositions that serve as a launch pad for subsequent innovative activity	2
CI-MI	**Meta-innovation (LE/KE/OE)**	
2	Ensuring the organisation develops an ability to innovate in terms of innovation and its capability to innovate, thereby ensuring the renewal of its approach to innovation	1
CI-UI	**Utilisation of integrative systems (LE/KE/OE)**	
14	Ensuring the organisation identifies and/or develops, deploys and exploits systems that are capable of integrating innovation initiatives, their lifecycles, and the lifecycles of the enterprise	1
CI-UM	**Utilisation of facilitative metrics (LE/KE/OE)**	
9	Ensuring the organisation develops and deploys individual, team and organisational metrics that are facilitative of innovation, but simultaneously ensure the realisation of operational objectives	1

Table 15 – Innovativeness Constructs coverage of ICMM v1

Appendix G ICMM v2 reference

Code	Capability Requirement	Primary Role-players	Secondary Role-players	Limited Role-players	Question	Maturity Scenarios Maturity Level 1 Ad hoc & Limited -->	Maturity Level 3 <-- Formalisation & Predictability -->	Maturity Level 5 <-- Integration, Synergy & Autonomy
IP/CS1	**Understanding the market** (Existing & latent needs, maturity, size, competition, regulation, etc.)	Networker Anthropologist Leader	Builder	Coordinator	What is done to understand the market (existing and latent needs, maturity and size, competition, regulation, etc.)?	Market perspective is based on past experience.	Initiatives to probe the market are periodically undertaken. Procedures have been developed and implemented, and the required outputs defined.	Initiatives are regular and results effectively utilised for planned and in-progress projects and strategy development. Procedures are institutional.
IP/CS2	**Involving customers & suppliers in the innovation process**	Networker Anthropologist	Builder Coordinator Leader		How effectively are customers, suppliers and other stakeholders involved?	Customers play a small role early in the innovation process. Suppliers are considered and consulted in the later phases.	Customers and suppliers are consulted at various stages throughout the innovation process.	Customers and suppliers play an intrinsic role throughout the innovation process - consistent involvement in activities and at key decision points.
IP/FP1	**Identifying opportunities**	Leader Builder Anthropologist Networker Coordinator			How do opportunities and ideas surface?	Opportunities and ideas are seldom discussed or brought forward.	Individuals are encouraged to bring ideas forward and have guidelines on how to substantiate and present those ideas.	Identifying opportunities and bringing them forward is natural behaviour. Ideas are also sourced from external stakeholders. Procedures to manage and substantiate ideas are institutional.
IP/FP2	**Developing concepts**	Leader Builder Anthropologist Networker Coordinator			How are opportunities and ideas transformed into concepts?	Ideas are seldom elaborated on or put into action.	Ideas are conceptualised and basic characteristics elaborated on. Procedures have been developed and implemented, and the required outputs defined.	Concepts developed are modular and flexible, enabling multiple opportunities to be addressed. Conceptualising opportunities and ideas is institutional.
IP/SO1	**Scanning & exploring for latent opportunities**	Networker Leader	Anthropologist Builder Coordinator		How are latent, future opportunities identified?	"Opportunities" of the future are based on extrapolation of the past.	Initiatives to find latent opportunities are undertaken. Procedures have been developed and implemented, and the required outputs defined.	Future-orientated scanning and exploring activities provide consistent strategic input. Procedures to indentify latent opportunities are institutional.
IP/OM1	**Contextualising opportunities & concepts** (Future roadmapping, scenario planning, etc.)	Networker Leader	Coordinator	Anthropologist Builder	How are opportunities and concepts put into context?	Opportunities, ideas and concepts are viewed as isolated potential projects.	Opportunities and concepts are coordinated and viewed in context with required technology, competencies, processes, systems, etc.	Latent opportunities, opportunities and concepts are viewed in relation to one another considering timelines of future technologies, changing regulation and society, etc. Future scenarios are identified and used during strategic planning and portfolio planning.
IP/FP3	**Testing, screening & prioritising opportunities & concepts** (Strategic alignment, market timing, prototyping)	Leader Coordinator	Networker Builder	Anthropologist	How are opportunities and concepts tested, screened and prioritised?	Testing of concepts is superficial and ad hoc. Prioritisation is a once-off activity based on limited understanding of the opportunities and concepts.	Concepts are tested and screened using various formal techniques. Prioritisation is based on testing and screening results and other factors like strategic alignment, market timing, etc.	Concepts are quickly made tangible in the form of prototypes. Prioritisation also considers interrelations between opportunities, concepts, future scenarios, etc.
IP/FP4	**Substantiating, implementing & exploiting opportunities**	Coordinator Builder	Anthropologist Networker Leader		How effectively are concepts developed, deployed and exploited?	Concepts are slow to get taken forward, lacking both direction and focus.	Focused practices and procedures for developing and implementing concepts have been defined and implemented.	Development and implementation of modular concepts and sub-components enables concurrent exploitation of opportunities. Practices and procedures are institutional.
IP/OM2	**Planning & coordinating the innovation portfolio**	Coordinator Leader	Builder	Anthropologist Networker	How are innovation projects planned and coordinated?	Projects are planned and executed in isolation.	Project tasks and schedules are planned and coordinated as a portfolio of projects based on prioritisation.	Projects are integrated by aligning and overlapping tasks that share objectives, concurrently completing multiple project requirements.
IP/OM3	**Allocating resources appropriately**	Coordinator Leader	Builder	Anthropologist Networker	Are resources appropriately allocated?	Resources are assigned in an ad hoc.	Resources are allocated to the portfolio based on project prioritisation.	Resources are pooled through the alignment and integration of project tasks.
IP/SO2	**Balancing the innovation portfolio** (Radical vs. incremental value-add & disruptive vs. sustaining market influence)	Leader	Networker Coordinator	Builder Anthropologist	Are the effects of innovation projects understood and balanced (radical vs. incremental value-add and disruptive vs. sustaining market impact)?	The effect of pursing an opportunity is seldom understood.	Considering and balancing the potential impact (internal and external) of projects is a standard procedure.	The potential impact of latent opportunities and future scenarios is considered in combination with possible projects. The project portfolio is balanced to align with strategic objectives.
IP/OM4	**Using appropriate project management techniques**	Coordinator	Builder Anthropologist Networker Leader		Are appropriate project management techniques utilised?	Project control and management techniques are used inconsistently.	Appropriate techniques and procedures for managing schedule, cost and quality at the different stages of innovation have been defined and deployed.	Projects' schedule, cost and quality are managed as an integrated whole within the innovation portfolio. Techniques and procedures are institutional.
IP/FP5	**Identifying and planning for key decision points** (Go, no-go - fail quick, smart & cheap)	Leader	Coordinator	Builder Anthropologist Networker	Are key decision points identified within the innovation process?	Decisions regarding project direction are made primarily in times of crisis.	Key decision points are identified for each project. Planning and information needs have been defined and implemented.	Key decision points are identified, planned and executed with consideration for other projects. Procedures are institutional.
IP/SO3	**Using fundamental principles to guide process & make decisions** (Governance principles)	Leader Coordinator	Builder Anthropologist Networker		How are decisions made?	Decisions are made based on past experience and with limited understanding of progress.	Governance principles derived from strategy, objectives and values are used to guide decision making.	Fundamental principles are institutionalised, with individuals using them to guide and focus activities and make decisions autonomously.
IP/OM5	**Reducing uncertainty & mitigating risk** (Policies, causal understanding)	Coordinator Leader	Anthropologist	Builder Networker	How are uncertainties and risks managed and reduced?	Project uncertainties are seldom addressed and the risks not identified or fully understood.	Procedures to reduce project uncertainty and identify, manage and mitigate risk have been defined and implemented.	Project uncertainties and risks are identified, managed, balanced and reduced as an integrated whole within the innovation portfolio.
KC/SO1	**Establishing knowledge, competency & technology development & acquisition strategy**	Leader *(Strategic Management)*	Networker	Builder Anthropologist Coordinator	Has a knowledge, competency and technology development/ acquisition strategy been established?	Strategy is not explicit or focuses on maintaining the status quo.	Development and/or acquisition strategy to meet future requirements has been established and deployed.	Strategy provides clear objectives to align organisational learning and differentiate their ability to deliver value.
KC/FP1	**Continuous research**	Leader Builder Anthropologist Networker Coordinator			How is research conducted?	Research is limited to known fields and focused on building on existing knowledge.	The practice of exploring existing and new fields of research has been established. Sources and tools for research are readily available.	Individuals and teams explore and expand knowledge related to organisational learning objectives. Research efforts are co-ordinated and traceable and practices institutional.
KC/FP2	**Identifying & extracting relevant information**	Leader Builder Anthropologist Networker Coordinator			Is the essence of new information identified and extracted?	Information is seldom summarised or the relevant inserts highlighted.	The practice of summarising, highlighting and/or extracting relevant information is established.	Grasping and extracting the core, most relevant information is an institutional behaviour.
IP.KC/DI1	**Capturing, storing & retrieving data & information** (Opportunities, ideas, concepts, project & other information & documentation, standard procedures, relevant literature, etc.)	Leader Builder Anthropologist Networker Coordinator			How is data and information captured, stored and retrieved?	Information is "dumped" into unstructured storage. Search and retrieval is predominantly manual.	Procedures and frameworks for contextualising, categorising and capturing, and tools for storing and retrieving, data and information have been identified, defined and deployed.	Individuals and teams have adopted and exploit the deployed procedures, frameworks and tools.
KC/OM3	**Managing core competency & technology**	Leader	Coordinator	Builder Anthropologist Networker	Are competencies and technologies effectively managed?	Competencies and technologies are application specific and used in isolation.	Core competencies and technologies are identified, managed and maintained to ensure that project and operational needs are continuously fulfilled.	Core competencies and technologies are aligned and synchronised for both innovation and operational requirements.
KC/FP3	**Developing & acquiring the required competencies & technologies**	Builder Leader Networker	Coordinator	Anthropologist	How are competencies and technologies developed or acquired?	Development and acquisition occur on an "as-and-when-needed" basis.	Procedures for proactively identifying, developing and/or acquiring required competencies and technologies have been defined and deployed.	Development and acquisition focuses on adaptable and flexible core competencies and technologies to meet multiple requirements.
KC/SO2	**Establishing intellectual property management & sharing policy**	Leader *(Strategic Management)*	Networker	Builder Anthropologist Coordinator	What is the policy regarding intellectual property?	Their is no specific policy or the policy is to guard IP at all cost.	Policy prescribes appropriate protection of IP, while enabling collaboration with external parties.	Policy facilitates collaboration and mutual sharing of IP, while protecting the interests of all involved.
KC/OM2	**Managing intellectual property**	Leader Networker	Builder Anthropologist Coordinator		How is intellectual property policy deployed and managed?	IP is not protected or it is heavily protected with strict regulation limiting accessibility and exposure.	Procedures and techniques for protecting IP and managing infringement are understood and employed.	Procedures and techniques that balance protection and sharing, while minimising resource consumption, are institutional.
KC/CS3	**Ensuring supplier competency & technology supports requirements**	Coordinator Networker	Leader	Builder Anthropologist	Are supplier competencies and technologies evaluated for their ability to support requirements?	Supplier competencies are seldom considered or evaluated.	Procedures to evaluate suppliers' ability to support requirements have been defined and deployed.	The practice of supporting suppliers in competency and technology development is institutional.

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KC/OM1	**Managing tacit knowledge** (Teaching and mentoring)	Leader	Builder Anthropologist Networker Coordinator		How is tacit knowledge managed?	Little effort is made to "pass-on" knowledge between individuals.	Teaching and mentorship programs have been established. Identifying, documenting and implementing best-practices is standard procedure.	Individuals readily teach and mentor others. Best-practice management and improvement is institutional.
IP.KC/DI2	**Formal & informal internal networking & collaboration** (Communities of practices, cross-project & department collaboration, social interaction)	Coordinator Networker	Builder Anthropologist Leader		What is the state of collaboration and networking internally?	Networking and collaboration within the organisation is informal and ad hoc.	Practices to network and facilitate collaboration between internal teams have been defined and deployed. Informal networking is encouraged and facilitated.	Teams and individuals naturally involve the knowledge and skills of others. Teams with complementary objectives are aligned. The nature of interaction is open and trusting. Practices have been institutionalised.
IP.KC/DI2	**Formal & informal external networking & collaboration** (Knowledge networks, NoN, Open Innovation, cross-organisation collaboration - government, academia, research institutions, conferences etc.)	Coordinator Networker	Builder Anthropologist Leader		What is the state of collaboration and networking with external parties?	There is little or no networking and collaboration with external parties.	Practices to network and facilitate collaboration with external parties have been defined and deployed. Informal networking is encouraged and facilitated.	Teams and individuals naturally involve the knowledge and skills of external parties. Groups with complementary objectives, or where mutual benefit exists, are identified and involved. Practices have been institutionalised.
OS/SO1	**Developing & conveying innovation strategy & objectives** (Linking to business strategy, objectives, focus & clarity)	Leader *(Strategic Management)*	Builder Anthropologist Networker Coordinator		Has an innovation strategy been established and communicated?	Innovation strategy and objectives are not explicit.	Innovation strategy and objectives are developed to support business objectives and clearly communicated. Aligning project objectives with innovation and business objectives is standard practice.	Strategy and objectives are developed from a holistic view of latent opportunities, future scenarios and business objectives. Strategy and objectives are regularly communicated and "owned" by all individuals.
OS/SO2	**Organisational values & policies** (Resource slack, positively influence individual behaviour, transparency & openness, relationship orientation)	Leader Anthropologist	Builder Networker Coordinator		How do values and policies contribute to the organisational environment?	Values and policies focus strongly on tradition, conformance and maintaining the status quo. Individual opinion is seldom accommodated.	Values and policies create an environment that encourages individuals to communicate openly and bring ideas forward. Time is allocated for learning, exploring, and building relationships.	People and relationships are considered fundamental drivers of innovation. Appropriate freedom fosters continuous learning, improvement and autonomy. Change and mistakes are seen as opportunities to learn.
OS/FP3	**Organisational practices & procedures** (Best-practices, change management)	Leader Anthropologist	Builder Networker Coordinator		How do organisational practices and procedures support innovation?	Innovation-specific practices and procedures are limited. General practices and procedures are seldom reviewed.	Best-practices and procedures are identified and standardised. Change management procedures have been defined and deployed.	Best-practices and procedures are continuously monitored and improved. Change management procedures are institutional.
OS/FP1	**Championing & encouraging innovation** (Consistent input & feedback, positively influence individual behaviour)	Leader Anthropologist	Builder Networker Coordinator		How is innovative behaviour encouraged and supported?	Little encouragement or support is provided for innovative behaviour.	Innovation champions are identified and tasked with leading, supporting and encouraging innovative behaviour. Leaders support and guide individuals through change initiatives.	Autonomous behaviour is encouraged. Leaders support, coordinate and ensure alignment between individuals' activities.
OS/SO3	**Investment in innovation & sourcing of capital**	Leader Networker		Builder Anthropologist Coordinator	How does capital investment support innovation?	Investment in innovation is limited and the required return structures restrict project activities.	Direct investment in innovation is consistent, ensuring that business and innovation objectives are achievable.	Investment quantity and structures, and the required returns, provide sufficient "slack" and freedom for activities to deviate when required.
OS/FP4	**Providing the necessary resources** (Resource slack, focussed resources)	Leader Coordinator	Builder Anthropologist Networker		How are resources made available to support innovation?	Resources assigned to innovation are limited or activities have low priority.	Innovation activities are appropriately prioritised and assigned the necessary resources to meet targets and objectives.	Resources dedicated to innovation are provided ensuring sufficient "slack" for activities. Needs are continuously monitored and gaps filled.
OS/FP2	**Infrastructure, systems & tools to support process & management requirements**	Leader Coordinator Builder	Anthropologist Networker		How effectively does infrastructure, systems and tools support innovation?	Infrastructure, systems and tools are insufficient to support innovation activities.	Infrastructure, systems and tools to support innovation activities and management requirements are available.	Dedicated infrastructure, systems and tools to facilitate innovation activities are available. Modularity enables multi-functionality. Needs are continuously monitored, gaps filled and improvements made.
OS/OM3	**Developing flexible & adaptable organisational structure & infrastructure** (Hierarchy, functional & project structures, decision structures, facility layout)	Leader	Builder Anthropologist Networker Coordinator		How does organisational structuring and infrastructure installation support innovation?	Structure and layout lacks flexibility to adapt to changing business requirements. Authorisation channels are complex.	Functional and project structures are designed to be as flexible as possible to meet changing business requirements.	Functional and project structures are modular and adaptable in nature. Installation and layout of infrastructure is flexible and adaptable.
OS/OM2	**Creating cross-functional & multidisciplinary teams**	Leader Networker Anthropologist	Coordinator Builder		How are teams constructed?	Teams are predominantly skills based, with limited depth of training, competency or perspective.	Innovation teams are made up of individuals from various functional divisions with diverse skills.	Teams constitute core, multidisciplinary individuals that involve the skills base across functional and organisational boundaries.
OS/DI1	**Communication & the flow of information** (Company communication, project feedback, performance feedback, etc.)	Leader Coordinator	Builder Anthropologist Networker		What is the state of communication?	Communication is poor and the vertical flow of information limited. Individuals provide and receive limited feedback.	Vertical and horizontal communication is adequate. Mechanisms and tools to facilitate the flow of information have been identified and implemented.	Communication is regular, transparent and open.
OS/OM4	**Motivating, rewarding & celebrating success**	Leader Anthropologist	Builder Networker Coordinator		How are individuals and teams motivated and rewarded?	Initiatives to motivate do not exist or lack in ability to mobilise individuals and teams.	Standardised initiatives to motivate individuals have been developed and implemented. Successes are communicated and celebrated in a consistent manner.	Motivation is linked to business and innovation targets. Individuals motivate each other. Initiatives are monitored and refined based on their impact.
OS/OM5	**Hiring & aligning people's values & skills with organisation & task**	Leader Anthropologist	Networker	Builder Coordinator	How are new people hired and roles assigned?	Hiring procedures seek to fill vacant positions. Individuals perform the tasks they were hired to do from the start.	Procedures to hire the "right" people with needed skills and align existing personnel's' skills with their role have been defined and implemented.	Initiatives to find and attract individuals with the "right" values and skills are performed. Existing personnel's' roles are adapted and/or changed to meet their skills and preferences (as much as possible).
OS/FP5	**Measuring innovation** (ROII, process throughput, individuals & teams, etc.)	Leader Coordinator Anthropologist	Networker Builder		How is innovation measured and monitored? (ROI, patents, process throughput, individuals & teams, etc.)	Innovation measurement is ad hoc with limited definition of metrics and associated inputs.	Innovation metrics have been identified, defined and implemented. Targets are aligned with innovation objectives. Metrics are monitored to identify process and management improvements.	The impact of utilised metrics on innovation performance is determined. Metrics and targets are continuously refined. Monitoring and improving processes and management practices is continuous.
OS/OM1	**Meta-Innovation** (Innovation model adaptation)	Leader	Coordinator	Builder Anthropologist Networker	How is the innovation model adapted and improved?	The innovation model is undefined and poorly understood.	The innovation model, with associated processes, practices, tools, etc., is defined. Improvement initiatives are practice, procedure or tool specific.	Improvement initiatives are holistic and integrated, considering process inputs, outputs and relations between practices, procedures, and tools. Initiatives balance incremental and radical improvement requirements.
OS/OM6	**Benchmarking innovation** (Metrics, processes, management practices, outputs, etc)	Leader Networker	Anthropologist Coordinator	Builder	How are innovation processes and management practices benchmarked?	Innovation processes and management practices are not compared to those of external entities.	Benchmarking compares innovation processes, management practices and standardised metrics with those of other organisations. Internal improvements are identified and deployed.	Benchmarking is a collaborative effort to collectively identify and define best-practice processes, management practices, metrics, etc.

Table 16 – ICMM v2 reference (Continued)

Appendix H Innovation Roles distillation

Hering and Phillips 2005	Kelly and Littman 2006	IBM 2004	Taylor 2005	Initial Role Consolidation	Description	Final Role Consolidation	Description
Scout	The Cross-Pollinator	Explorer	Strategy / Strategist	Explorer	Scan market, industry, technology, regulatory, societal, etc. trends to understand potential futures and identify latent opportunities	**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.
Connectors	The Collaborator	Connector		Connector	Create connections between internal and external individuals, teams, customers, suppliers, etc. who can assist at version stages in the innovation process.		
	The Hurdler	Advocate Scrounger	Opportunity Generator	Advocate	Overcome or outsmart the roadblocks in the innovation process. Interpret, contextualise, explain, protect, position and promote opportunities and concepts.	**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.
		Coordinator Planner		Coordinator	Put into scope, prioritise, plan, allocate, assign, coordinate, schedule, and assure completion of projects. Balance business & innovation objectives, resources, uncertainties, milestones, deliverables, etc.		
Prototyper	The Experimenter	Inventor		Prototyper	Make tangible concepts of ideas, demonstrate concepts and obtain feedback from colleagues, customers, etc., and then refine those concepts.	**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.
	The Experience Architect	Builder	Value Creator	Builder	Build, test and refine working "products" and ensure "production" readiness. Deliver on the initial vision of the concept without compromising for production and delivery.		
Storyteller	The Storyteller The Set Designer		Change Agent	Enticer	Create the environment in which individuals can do their best work - transform the physical environment into a powerful tool to influence behaviour and attitude. Build both internal morale and external awareness.	**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.
	The Anthropologist The Caregiver	Analyst	Customer Satisfier	Anthropologist	Develop deep understanding of how people interact physically and emotionally with products, services, one another, and the environment as a whole. Anticipate and service the needs of colleagues, customers, suppliers and other stakeholders.		
Judge		Judge Interpreter		Realist	Evaluate opportunities and ideas against a standard framework, ensuring all business functions are considered. Provide continuous input to ensure ideas progress realistically without being a barrier to innovation.	**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.
Framer Librarian Metric Monitor				Framer	Define and deploy the frameworks by which opportunities, ideas and concepts are evaluated and prioritised; meta-data to facilitate capture, storage and retrieval of ideas and information; and innovation metrics to measure innovation.		
	The Director	Leader Financier	Leader Wealth Creator	Leader	Continuously align business and innovation strategy and objectives. Build and involve teams of the "right" individuals at the "right" time. Validate the relevance of and prioritise innovation activities. Take ownership and responsibility. Guide progress, monitor metrics and instigate corrective action. Build synergy into the innovation portfolio.		

Figure 63 – Innovation roles distillation

I

Appendix I ICMM v2 questionnaire (1st page)

INNOVATION CAPABILITY QUESTIONNAIRE

The completion of this questionnaire is the first activity of an Innovation Capability Audit. The purpose of the audit is to determine your organisation's capability to innovate. To start, we need to know a few things about you and your role within the organisation.

Name and surname:	
Date:	Office hours contact (tel. and/or email):
Your title/position:	Business unit:
No. of years in company:	No. of years in business unit:
Describe your day-to-day activities in a few words:	

ROLE DESCRIPTION

Below are descriptions of 5 organisational roles. A person does not necessarily play only one role and the roles do not cover all organisational roles. If any of these roles describe, in part, some of the activities that you perform, what percentage of your day do they consume? (E.g. Networker 20%, Coordinator 40% and Anthropologist 5% - totalling 65% of daily activities.)

		%
Net-worker	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.	
Coordi-nator	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.	
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.	
Anthro-pologist	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.	
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.	

INNOVATION STATUS DESCRIPTION

Below are 5 high-level descriptions of innovation status within organisations. Read through them and mark the one that most accurately describes the overall status of innovation within your organisation.

		X
1	The organisation is wholly consumed with day-to-day operations - maximising short-term revenue and reducing cost. Individual attempts at being creative or "out-of-the-ordinary" are often dismissed. Innovative outputs are inconsistent and unpredictable.	
2	The organisation has identified the need to innovate. Innovation is clearly defined. A basic understanding has been established of the various factors that influence innovation. Innovative outputs are inconsistent, but traceable.	
3	Innovation is supported and managed with appropriate practices, procedures and tools. Individuals are encouraged to be innovative. Innovative outputs are consistent in nature and ensure sustained market share and positioning.	
4	Practices, procedures and tools for integrating innovation activities are used. A deep understanding has been established of the internal innovation model and its relation to business requirements. Innovative outputs are consistent, diverse and a source of differentiation.	
5	Innovation practices, procedures and tools are institutional. Individuals are empowered to innovate. Synergy is achieved through the alignment of business and innovation strategy and the synchronisation of activities. Innovative outputs provide sustained competitive advantage in existing and new markets.	
Not applicable	I do not think that this classification is applicable or relevant to my organisation.	
Not sure	I am not sure whether my organisation falls into any of the categories described above.	

The remainder of the questionnaire asks that you position your organisation on a scale of 1 to 5 for each of 42 Innovation Capability Requirements. Each requirement is described with 3 scenarios for each of the maturity levels 1, 3 and 5. Level 2 is represented as a mixture between levels 1 and 3, as is the case for level 4. The 42 requirements are divided into 3 Innovation Capability Areas, namely: Innovation Process, Knowledge and Competency, and Organisational Support. Make a **X** in the appropriate block.

INNOVATION PROCESS QUESTIONS

		Level 1	Level 2	Level 3	Level 4	Level 5
1	**What is done to understand the market (existing and latent needs, maturity and size, competition, regulation, etc.)?**	Market perspective is based on past experience.		Initiatives to probe the market are periodically undertaken. Procedures have been developed and implemented, and the required outputs defined.		Initiatives are regular and results effectively utilised for planned and in-progress projects and strategy development. Procedures are institutional.
	Not sure ☐ *Not applicable* ☐	☐	☐	☐	☐	☐
2	**How effectively are customers, suppliers and other stakeholders involved?**	Customers play a small role early in the innovation process. Suppliers are considered and consulted in the later phases.		Customers and suppliers are consulted at various stages throughout the innovation process.		Customers and suppliers play an intrinsic role throughout the innovation process - consistent involvement in activities and at key decision points.
	Not sure ☐ *Not applicable* ☐	☐	☐	☐	☐	☐

Table 17 – ICMM v2 questionnaire (1st page)