

An Innovation Capability Maturity Model – Development and initial application

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

Keywords—Capability Maturity, Innovation, Innovation Capability

I. INTRODUCTION

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

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

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

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

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

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

II. MODEL DEVELOPMENT

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

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

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

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

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

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

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

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

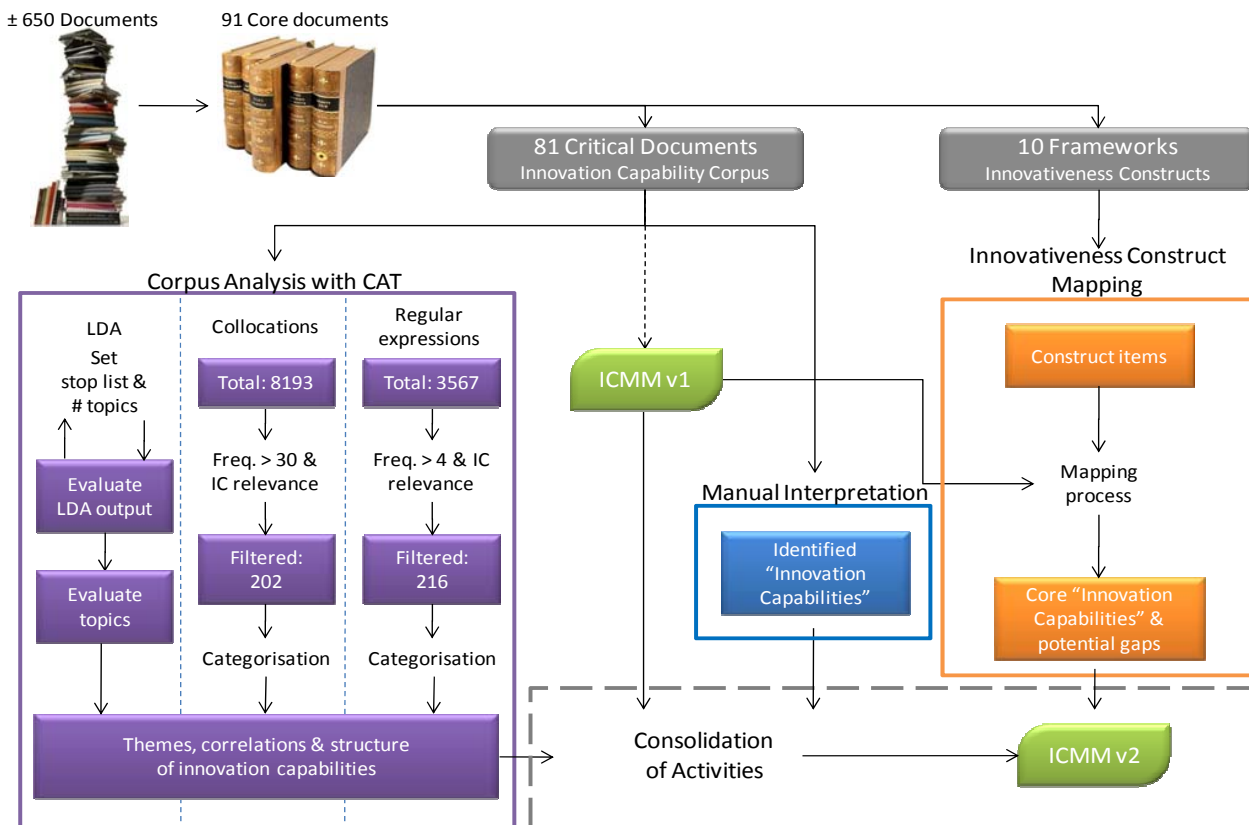


Fig. 1 Refinement process

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

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

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

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

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

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

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

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

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

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

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

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

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

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

III. ICM v2

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

A. Framework

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

The first dimension of the framework, the so called

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

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

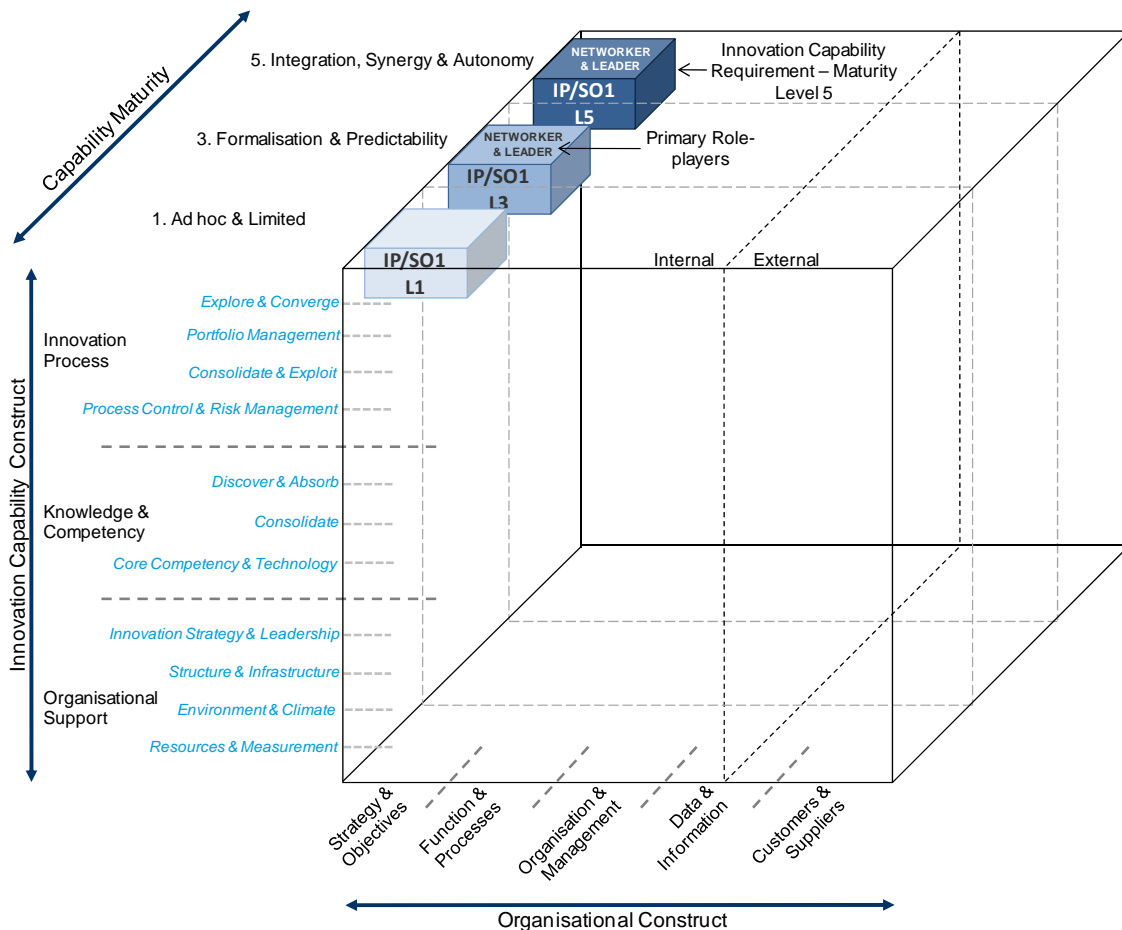


Fig. 2 ICM v2 framework, example capability requirement and primary role-players

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

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

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

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

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

B. Innovation Capability Requirements

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

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

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

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

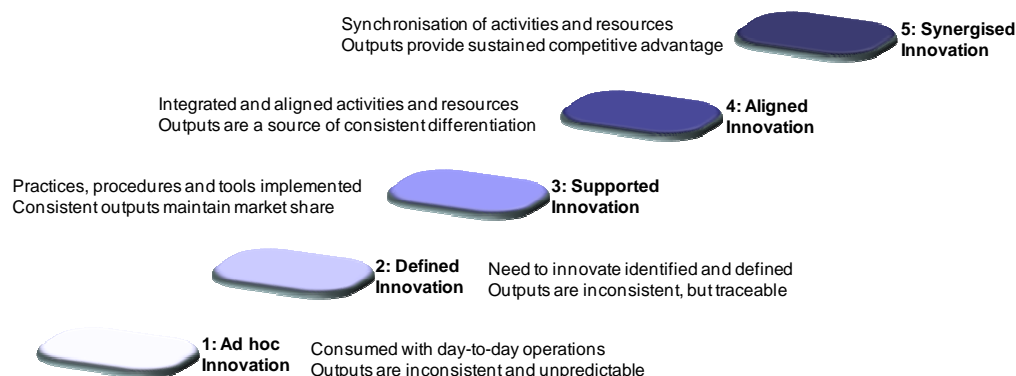


Fig. 3 ICMM v2 Maturity Levels

Organisational Construct		Internal				External	
		Strategy & Objectives	Function & Processes	Organisation & Management	Data & Information	Customers & Suppliers	
Innovation Capability Construct	Explore & Converge	IP/SO1 - Scanning & exploring for latent opportunities	IP/FP1 - Identifying opportunities IP/FP2 - Developing concepts	IP/OM1 - Contextualising opportunities & concepts IP/OM2 - Planning & coordinating the innovation portfolio	IP/KC/D11 - Capturing, storing & retrieving data & information IP/KC/D12 - Formal & informal external networking & collaboration	IP/CS1 - Understanding the market	
	Portfolio Management	IP/SO2 - Balancing the innovation portfolio	IP/FP3 - Testing, screening & prioritising opportunities & concepts IP/FP4 - Substantiating, implementing & exploiting opportunities IP/FP5 - Identifying and planning for key decision points	IP/OM3 - Allocating resources appropriately IP/OM4 - Using appropriate project management techniques IP/OM5 - Reducing uncertainty & mitigating risk		IP/CS2 - Involving customers & suppliers in the innovation process	
	Consolidate & Exploit	IP/SO3 - Using fundamental principles to guide process & make decisions					
	Process Control & Risk Management						
Knowledge & Competency	Discover	KC/SO1 - Establishing knowledge, competency & technology development & acquisition strategy	KC/FP1 - Continuous research	KC/OM1 - Managing tacit knowledge	IP/KC/D12 - Formal & informal external networking & collaboration	KC/CS3 - Ensuring supplier competency & technology supports requirements	
	Absorb & Consolidate		KC/FP2 - Identifying & extracting relevant information	KC/OM2 - Managing intellectual property			
	Core Competency & Technology	KC/SO2 - Establishing intellectual property management & sharing policy	KC/FP3 - Developing & acquiring the required competencies & technologies	KC/OM3 - Managing core competency & technology			
Organisational Support	Innovation Strategy & Leadership	OS/SO1 - Developing & conveying innovation strategy & objectives	OS/FP1 - Championing & encouraging innovation	OS/OM1 - Meta-Innovation	OS/D11 - 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 OS/OM4 - Motivating, rewarding & celebrating success			
	Environment & Climate		OS/FP4 - Providing the necessary resources (<i>Resource Slack, focussed resources</i>)	OS/OM5 - Hiring & aligning people's values & skills with organisation & task			
	Resources & Measurement	OS/SO3 - Investment in innovation & sourcing of capital	OS/FP5 - Measuring innovation	OS/OM6 - Benchmarking innovation			

Fig. 4 Innovation Capability Requirements categorised into construct

C. Innovation Roles

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

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

IV. CASE STUDIES

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

A. Questionnaire

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

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

TABLE I
SUMMARIZED CASE STUDY DATA

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

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

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

B. Sample Results

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

basic statistics valuable.

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

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

C. General Findings

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

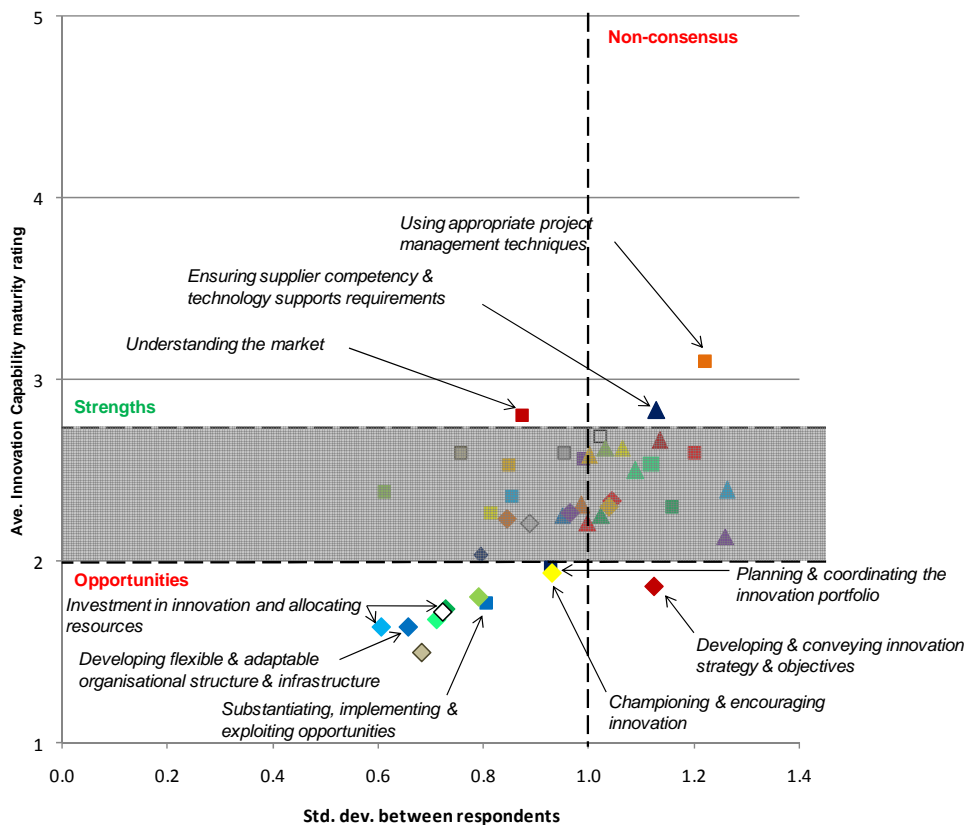


Fig. 5 Case Study 4 – Innovation Capability Portfolio

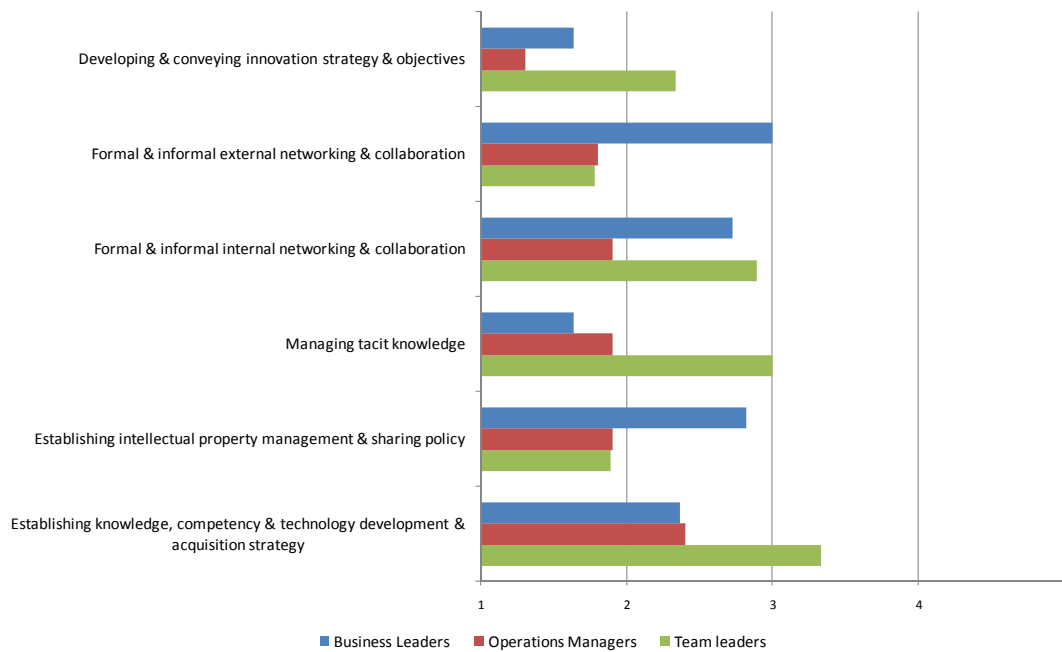


Fig. 6 Case Study 4 – differences between organisational groups

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

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

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

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

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

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

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

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

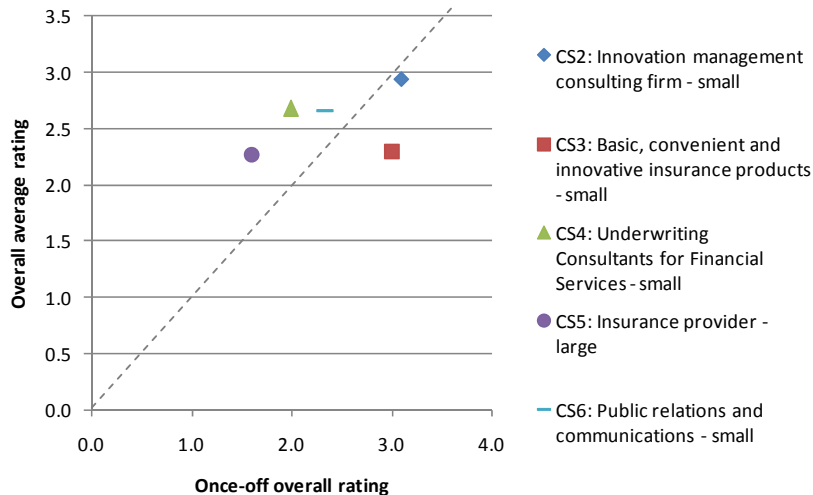


Fig. 7 Once-off overall rating vs. overall average rating

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

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

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

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

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

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

V. CONCLUSION

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

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

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

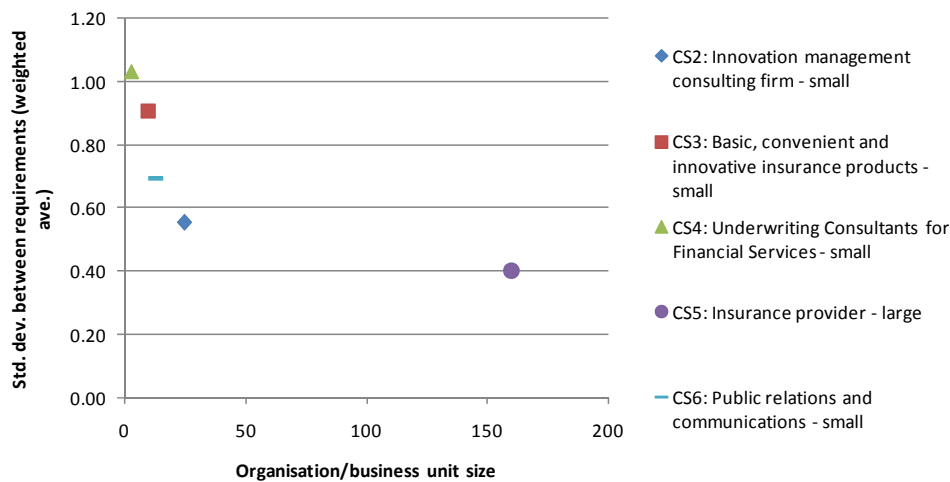


Fig. 8 Dispersion in requirements vs. organisation size

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

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

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

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