

A Knowledge-Based View of Process Improvement:
A Mixed Methods Study into the Role of Social Networks
and Knowledge Acquisition

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ABSTRACT

The goal of this dissertation is to motivate a Knowledge-Based View of Process Improvement. In doing so, it advocates that acquiring and exploiting knowledge is the key to achieving and sustaining competitive advantage. The heightened competitive landscape firms now operate in, is not only driving the need for process improvement in order for firms to stay competitive, but also the need to acquire knowledge from external sources as firms may no longer have the luxury of developing solely from internally generated ideas. With the understanding that knowledge resides in and is created by individuals, and in line with broader trends towards more micro-views of the firm, the research looks at process improvement and knowledge acquisition at the individual level.

Based on a mixed methods design, founded on a comprehensive review of the knowledge-based view, process improvement, and social network literatures, eight case interviews were first employed. This qualitative work identified Absorptive Capacity, and notably Zahra and George's (2002) interpretation, as the key underlying theory to this investigation. Furthermore, it identified three major dyads that govern the acquisition of knowledge: affective vs. competence-based trust; costs of searching vs. motivations for sharing; and individual attributes vs. firm culture. This conceptual framework was then empirically tested with a sample of 200 respondents. To analyse the quantitative data, the variance-based structural equation modelling approach of Partial Least Squares (PLS) was used in conjunction with three advanced techniques: higher-order formative measurement analysis, interaction analysis, and multigroup analysis.

The resulting contributions to knowledge are five-fold. Firstly and arguably the largest contribution, the research identifies and empirically verifies the "social integration mechanisms", the factors that convert potential absorptive capacity (PAC) to realised absorptive capacity (RAC) in Zahra and George's (2002) conceptualisation of Absorptive Capacity. To the best of the author's knowledge, this is one of the first empirical studies to do this and thus makes a significant contribution to this theory. Secondly, it empirically demonstrates the existence of three dimensions to our knowledge stocks: individually-held knowledge, network-based knowledge from strong ties, and network-based knowledge from weak ties. In doing so, it empirically illustrates the *strength of weak ties* hypothesis by Granovetter (1973) in addition to providing insight into the antecedents of Absorptive Capacity. Thirdly, following the trend towards the more micro-

foundation view, this research contributes to the discourse on the individual-level view of Absorptive Capacity (iCAP). Fourthly, it extends the knowledge-based view of process improvement by beginning to fill the dearth of literature on the exploratory and socially embedded aspects of knowledge acquisition. In addition, it endorses Absorptive Capacity as a useful theoretical lens by which to view this perspective. Finally, the outcomes of process improvement, and thus the outcomes of knowledge acquisition, are contextualised as cognitive and behavioural changes, which are in high contrast to the more traditional tangible outcomes such as number of new products, or physical improvements in products such as quality or cost.

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List of Abbreviations

ACAP	Absorptive capacity
EO	Entrepreneurial Orientation
MCAR	Missing Completely at Random
MGA	Multigroup Analysis
MM	Mixed Method
MMR	Mixed Method Research
MVN	Multivariate
PAC	Potential Absorptive capacity
PLS	Partial Least Squares
RAC	Realised Absorptive capacity
SEM	Structural Equation Modelling
SPC	Statistical Process Control
TOC	Theory of Constraints
VIF	Variance Inflation Factor

Chapter 1: Introduction

Knowledge has become the key economic resource and the dominant—and perhaps even the only—source of comparative advantage

- Peter Drucker (1995), *Managing in a Time of Great Change*

1.1 Background

In the wake of the global financial crisis, we are seeing a severe restriction in the ability to access capital. The fall out of this is wide spread; from limiting cash for raw material or daily operations; to halting expansion and investment projects; to preventing simple machine upgrades. This in turn has driven a necessity to do more with existing resources in order to stay competitive, foster growth and meet performance expectations- in other words, a need for process improvement. Furthermore, in light of the “Knowledge Economy”, the servitisation of western economies, and the growth of knowledge intense industries, we are seeing a growing realisation that knowledge is a key resource to firm success. This notion is reflected in the literature as the “knowledge-based view of the firm”, which asserts that the key to achieving and sustaining competitive advantage stems from the ability to acquire and exploit new knowledge (Grant, 1996). This research consequently draws these two perspectives together by purporting to, and formally coining, the term Knowledge-Based View of Process Improvement¹.

To date, knowledge-based research in process improvement has primarily focused at firm-level knowledge sharing, transfer and dissemination (Ferdows, 2006, Fugate et al., 2009), within-firm knowledge creation (Anand et al., 2010, Linderman et al., 2004) and organisational learning (Skerlavaj et al., 2007, Terwiesch and Bohn, 2001). This has lead to two distinct gaps in the literature. Firstly, there is the understanding that knowledge is fundamentally created, inherent and shared at the individual level (Nonaka, 1994, Mors, 2010, Alavi and Leidner, 2001), yet the majority of the focus to date has been at the firm

¹ This term was first used in my 2011 EurOMA conference paper- see Section 1.8 on publications below. In addition, it was warming to read a similarly titled paper in this year’s 2013 EurOMA conference. Initial discussions on formally collaborating and developing this topic are already underway.

level. In the broader management literature, we are seeing a trend that is moving from the firm-level view towards the individual-level, microfoundation view (Abell et al., 2008, Felin and Foss, 2005). Furthermore, the systematic literature review by Foss et al.(2010) on knowledge processes concludes that the literature is "preoccupied with constructs, processes, and phenomena defined at a macro (collective, organizational) level and pay comparatively little attention to micro (individual) level constructs" (p455). Given this, it would seem timely to conduct research that focuses its attention at the individual level.

Secondly, little attention has been given to Grant's (1996) "acquisition" perspective, instead viewing it primarily as a benchmarking routine within the context of process improvement (Chiles and Choi, 2000, Naylor et al., 2001). This issue is made particularly poignant given the suggestion that firms may no longer have the luxury of developing solely from internally generated knowledge due to heightened competitive pressures such as shortening product life cycles and rapid advances in technology (Matusik and Heeley, 2005, Lee et al., 2011). An exception to this is the study by Gowen III et al. (2008) which explored the role of knowledge acquisition in Six Sigma initiatives. Their study found that knowledge acquisition had little impact on competitive advantage and quality program performance. However, their limited attention to the social interaction aspects of knowledge acquisition may help explain these results. There is a widely appreciated understanding that tacit knowledge is the most valuable form of knowledge (Polanyi, 1966), and to acquire such knowledge requires social interaction (Nonaka, 1994, Ferdows, 2006). In other words, the acquisition of knowledge is predominantly a social process (Kogut and Zander, 1992, Yli-Renko et al., 2001). Thus, Gowen III et al.'s (2008) insufficient acknowledgment to the more social aspects meant that valuable knowledge may not have been acquired and hence the limited results of their study. This subsequently suggests the central role of social aspects, such as embeddedness and networks in knowledge acquisition. Extant literature highlights that social networks provide access to a range of knowledge, resources and technologies that can be leveraged to create value (Inkpen and Tsang, 2005). Mors (2010) subsequently suggests that "in homogeneous contexts, for example inside the firm, the biggest challenge to innovation that managers face is access to diverse information and knowledge" (p843) with the caveat that "innovation in the manufacturing sector generally focuses on process improvements" (Terziovski, 2010; p893). Hence, external social networks may not only

facilitate the acquisition of new knowledge, but also in the development of innovative, creative and novel approaches that could lead to sustained advantage. On a more personal note, from my 5+ years in process improvement roles, I have found that one of my key assets was the people I could access and the relationships I had formed. Hence this research is also motivated by my personal interest in both process improvement, and social networks.

The discussion above highlights the limited research to date on a knowledge-based view of process improvement and particularly in individually centred network-based knowledge acquisition. More importantly though, it demonstrates the value of such activities and thus the timeliness of this enquiry. The following sections provide a brief account of the research questions, the research design employed to address them, and the contributions that this research provides.

1.2 Research Questions

In order to contribute the two research gaps identified above, three research questions are identified:

- RQ1: What role, if any, does social networking and knowledge acquisition play in process improvements?
- RQ2: How can social networks be fostered to enhance the acquisition of knowledge in process improvements?
- RQ3: Can the acquisition of knowledge through social networks ultimately lead to enhanced process improvement?

1.3 Research Objectives

This research aimed to explore the knowledge-based view of process improvement. To achieve this and to address the research questions above, five research objectives are employed:

- To provide an empirical study into the Knowledge-based view (KBV) of process improvement from a knowledge acquisition perspective

-
- To identify the key variables and theories in the Knowledge-based view of process improvement
 - To conceptualise and refine a theoretical framework for knowledge acquisition in process improvement
 - To validate and test mechanisms that enhance the conversion of potential knowledge to realised knowledge from the theoretical framework
 - To suggest potential guidelines for improving knowledge acquisition in process improvement

1.4 Scope of the Study

In detailing the scope of this research, the three core areas of social networks, knowledge and process improvement are used to guide the discussion, in addition to the research's unit of analysis. Firstly, whilst there has been excellent work on exploring social networks within the firm (i.e. Borgatti and Cross, 2003, Tsai and Ghoshal, 1998), the research lends itself to the view that social networks external to the firm are more likely to lead to new, more valuable knowledge (McDonald et al., 2008) and so limits itself accordingly.

Secondly, on the knowledge aspect, the research explicitly centres on knowledge acquisition. In doing so, it does not concern itself with internalising or exploitation routines such as knowledge integration (Grant, 1996, Guinery, 2006), knowledge assimilation (Tu et al., 2006, Nemanich et al., 2010), knowledge transformation (Weber and Weber, 2009, Hotho et al., 2011) or knowledge sharing/transfer (Inkpen and Tsang, 2005, Ferdows, 2006, Siemens et al., 2008). Furthermore, it appreciates yet limits its attention away from the domains of organizational learning² (Huber, 1991, Garvin, 1993) and learning as a dynamic capability (Kale and Singh, 2007, Teece et al., 1997). In reference to the theory underpinning the research, it focuses on the first of the four-stages

² For a discourse on the complementarities of these activities, see MARZEC, P. E. & MATTHEWS, R. L. 2012. Refining the Internal-External Learning Model via Knowledge Acquisition and Organizational Learning. *Academy of Management Conference*. Boston MA.

of absorptive capacity (acquisition) rather than the later (assimilation, transformation and exploitation; Zahra and George, 2002).

Thirdly with regards to process improvement, it does not attempt to limit itself to any particular form of process improvement, be it radical (i.e. Business Process Reengineering) or incremental (i.e. Kaizen). Furthermore, it does not attempt to converge on a particular process improvement methodology but rather view it holistically as problem solving³, which is consistent with both the nature of process improvement and aligned to aspects of the knowledge-based view.

Finally, the research is scoped by way of its Unit of Analysis. Consistent with previous knowledge-network research, this research adopts the individual as its unit of analysis (i.e. Nebus, 2006, Carpenter and Westphal, 2001, Houghton et al., 2009, McDonald et al., 2008), rather than the team (i.e. Choo, 2010, Hansen, 1999, Chandler and Lyon, 2009), firm (i.e. Benner and Tushman, 2002, Haas and Hansen, 2007) or interfirm (i.e. Arian, 2009, Bell, 2005)

1.5 Research Design

Given the infancy of the Knowledge-Based View of Process Improvement as a research domain, the research began by first gaining a solid understanding of knowledge, process improvement, and social network literatures as outlined in figure 1.1 below. The intent here was to identify key perspectives, theories, and variables that may be important to this domain. Following this, eight exploratory case interviews were undertaken in order to understand more practically, the cross-over of knowledge, social networks and process improvement. This empirical work was subsequently used to obtain the key theory and variables from those short-listed by the literature review. In doing so, this initial exploratory phase was able to address RQ1 and RQ2, as well as providing the foundation for developing the conceptual framework (Figure 4.1).

³ As a Green belt Lean Six Sigma professional, having lectured on Lean Manufacturing and worked in the Industry for 6 years, from a practitioner aspect this also seems fitting.

The second phase provided generalisability to the study by statistically testing the conceptual framework developed in the exploratory qualitative phase on a larger sample of process improvement practitioners. To do so, a web-based questionnaire was developed and administered via the social network platform LinkedIn. LinkedIn was used as it provided a means to specifically target process improvement practitioners, as well as being regarded as a highly professional networking platform, thus provided a suitable proxy for finding “networking” individuals. The resulting data was analysed using structural equation modelling (via Partial Least Squares- PLS) to address RQ2 and RQ3.

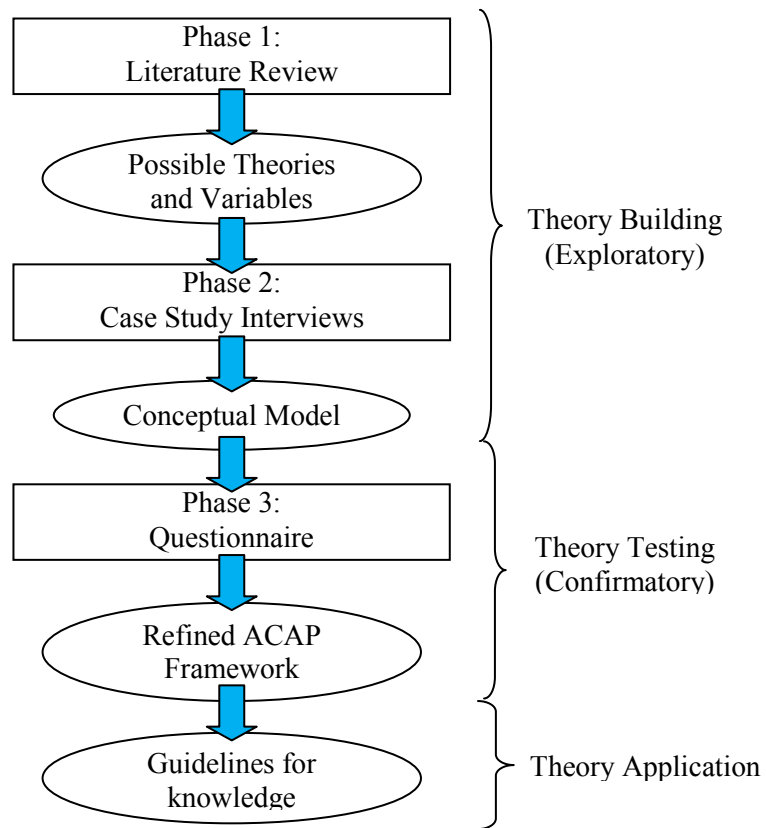


Figure 1.1: Outline of research design

1.6 Contributions

Following the suggestion that knowledge is the key to sustained competitive advantage (Grant, 1996), Zahra and George (2002) on Absorptive Capacity state that the key to understanding variations in firm performance can be explained by the variation in the ability to convert available knowledge (termed *Potential* Absorptive Capacity, PAC), to useable knowledge, or *Realised* Absorptive Capacity (RAC). Thus, Zahra and George (2002) imply that superior performance can be achieved by maximising the conversion of Potential knowledge to Realised knowledge. However, investigation into this theory revealed a distinct lack of detail and empirical evidence on exactly how this can be done or what these “social integration mechanisms” are - the factors that convert potential absorptive capacity (PAC) to realised absorptive capacity (RAC). This research therefore makes a significant contribution by proposing and empirically verifying three dyadic relationships which act as these social integration mechanisms.

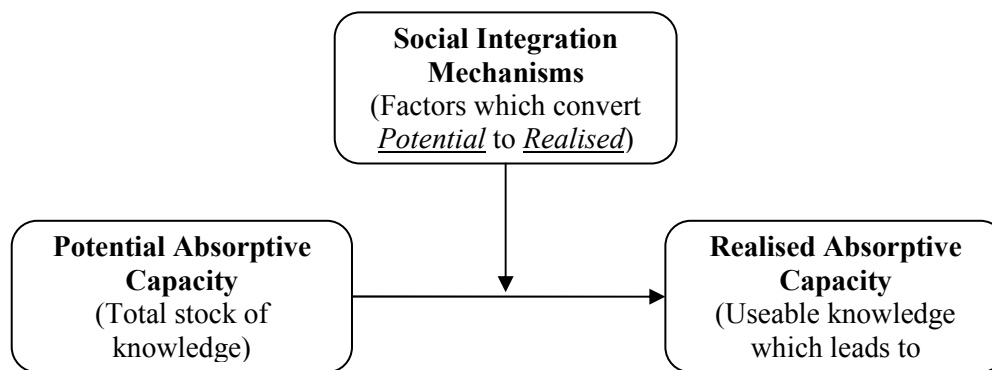


Figure 1.2: Zahra and George's (2002) conceptualisation of Absorptive Capacity

Secondly, an additional contribution to the ACAP theory is made by drawing together the two distinct fields of social networks and ACAP. The research theorises and empirically validates the existence of three dimensions to our knowledge stocks- individual-held knowledge, network-held knowledge from strong ties, and network-held knowledge from weak ties. To date, ACAP incorporates only two dimensions: individually-held and network-held knowledge. By distinguishing between the two distinct types of network-held knowledge based on Granovetter's (1973) *Strength of Weak Ties* argument in the social network literature, this research provides a finer-grained understanding of our sources of knowledge.

A third and final contribution to ACAP theory is made by way of the research's unit of analysis- the individual. Cohen and Levinthal's (1990) original work on the theory highlighted the interrelationship between the individual and the firm in creating Absorptive Capacity. However, with more recent interpretations of the theory (i.e. Zahra and George, 2002), the role of the individual is sadly lacking. Thus through the conceptualisation of the three dyads, the explicit role of the individual in ACAP was examined.

In sum, these three contributions address explicit calls from the most recent theorising on Absorptive Capacity by Volberda et al. (2010), that:

- Research on ACAP should explain the impact of individuals on the ACAP process (p944)
- Research on ACAP should draw on social network research to clarify how channels of communication implied by networks impact ACAP (p946)
- Research on ACAP should aim to determine which organizational antecedents have the greatest impact (p947)

Finally, there are two minor methodological points of interest. For the statistical analysis, variance-based structural equation modelling (Partial Least Squared, PLS) rather than the more common covariance-based modelling via LISREL is used. This is due to the use of a formative measure, and the failure of the key assumption of covariance-based SEM/LISREL⁴, multivariate normality of the data- an aspect that is vital yet rarely

⁴ Technical note: PLS is commonly cited to address "small sample size" issues. Although technically true**, editors and readers should be wary of such justifications. This argument is only applicable in instances when the *population size* is small, and thus leading to a small sample size. If this is not the case, then justifying the use of PLS via this small samples argument reflects fundamental deficiencies in the research design that have resulted in a small sample size.

**For details on the small sample size proof, see the following for a Monte Carlo simulation study on PLS with small samples- CHIN, W. W. & NEWSTED, P. R. 1999. *Structural equation modelling analysis with small samples using partial least squares*. In: HOYLE, R. H. (ed.) *Statistical strategies for small sample research*. Sage.: Thousand Oaks, CA.

reported in many of the SEM based studies. In doing so, it promotes insight into the use of an alternate statistical tool. Furthermore, the conceptual model required the use of three advanced statistical techniques in order for it to be analysed: the *two-stage approach* for analysing formative measures, *interaction analysis* to analyse the social integration mechanisms, and *multigroup analysis* to analyse the complementarities between social integration mechanisms (aka the three dyads of trust, search costs/motivation, and firm-culture/individual-attributes).

1.7 Structure of Thesis

This thesis is divided into seven chapters, described as follows:

- Chapter 1 provides an overview and introduction of the research. Research background, motivation, questions, and objectives are described.
 - Chapter 2 reviews the literature on the knowledge based-view, process improvement, knowledge acquisition, and social networks. It provides theoretical background to the research, identifies the research gaps, and elicits the key theories and variables in the Knowledge-Based View of Process Improvement.
 - Chapter 3 describes the research design, explains and justifies the chosen research approach, including the method of data collection, selection of subject, and the analysis methods.
 - Chapter 4 reports the findings from the exploratory empirical study. In consequence, the research theory and key variables were identified, and hypothesis and conceptual model developed.
 - Chapter 5 tests and validates the conceptual model. As a result, key insights into knowledge sources, constraining and motivating mechanisms to knowledge flows, and resulting outcomes of the process are verified.
 - Chapter 6 converges the two empirical stages and discusses the findings with respect to extant literature. An abridged version of the Chapter is developed into guidelines and recommendations for practitioners.
 - Chapter 7 discusses the outcomes of the research and the contributions to knowledge. The limitations and future work recommendations are also provided.
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1.8 Paper Publications

Marzec, P. E. & Matthews, R. L. 2012. Refining the Internal-External Learning Model via Knowledge Acquisition and Organizational Learning. *Academy of Management Conference*. Boston MA.

This paper was a direct response to feedback made in my first year annual review. The comments made were in relation to the overlap between R. L. Matthew's work and my own. The acceptance of this paper in such a distinguished conference demonstrated the distinct yet complementary nature of our work.

Matthews, R. L. and P. E. Marzec (2012). "Social capital, a theory for operations management: A systematic review of the evidence." *International Journal of Production Research* 50(24): 1-19.

This paper shaped much of the approach taken in the Literature Review chapter. The structured methodology helped identify key literature as well as aiding in bounding its scope.

Marzec, P. E. & Tan, K. H. 2011. A knowledge-based view of process improvement: Examining the role of networks and knowledge acquisition, *Accepted to 18th EurOMA Conference*. Cambridge UK

This paper was the major output from the qualitative phase of the research. Conference and reviewer feedback helped shape the work in two key areas. Firstly, the paper originally argued heavily on theoretical aspects, consistent with approaches found in wider management journals. This was subsequently made more pragmatic to accommodate the more applied/practitioner field of OM. Secondly, reviewer comments helped shape the presentation of findings and in turn, the development of the conceptual model.

Marzec, P. E. and K. H. Tan (2010). Incorporating Virtual Learning in Operations Management via Second Life. *SAGSET 40th Annual Conference. Guildford, UK.*

This paper started as an independent research project for my supervisor. Inadvertently, the learning theories identified in this study were later speculated in this thesis as theories that may provide fruitful avenues for future research into the knowledge-based view.

Marzec, P. E. & Matthews, R. L. Exploring Operational Improvement Terms: Process, Continuous, and Quality Improvement, a tautology? *Under development, to be submitted to IJPR.*

This paper was also in response to feedback from an annual review, namely the confusion surrounding quality improvements, continuous improvement/kaizen/TQM, and process improvement. This paper explores the nuances of three areas, and based on this, developed a conceptual model illustrating the interrelationship between these areas in addition to a number of suggested antecedents.

Chapter 2: Literature Review

Chapter 1 introduced the emerging field of the Knowledge-Based View (KBV) of Process Improvement (PI) and its relative infantile state of research. Aligned with this, the following Chapter is an account of the literature to provide a solid background to the three key areas of research- knowledge acquisition, social networks, and process improvement. In addition, it identifies key theories and variables to inform the subsequent empirical work. Figure 2.1 below illustrates the structure of the Chapter. The first section provides background to the broad domain of the knowledge-based view, its importance, and the key theories. Section 2 describes the nature and definition of process improvement as well as the theoretical evolutions of the research field. Section 3 converges these two sections by detailing the Knowledge-Based View of Process Improvement, its definition, motivations, and gaps in existent research. Following this, Section 4 refines the discussion on the KBV of PI by documenting the nature and motivations for Knowledge Acquisition. Section 5 then documents the justification for the inclusion of Social Networks. The Chapter concludes with the derivation of the Research Questions.

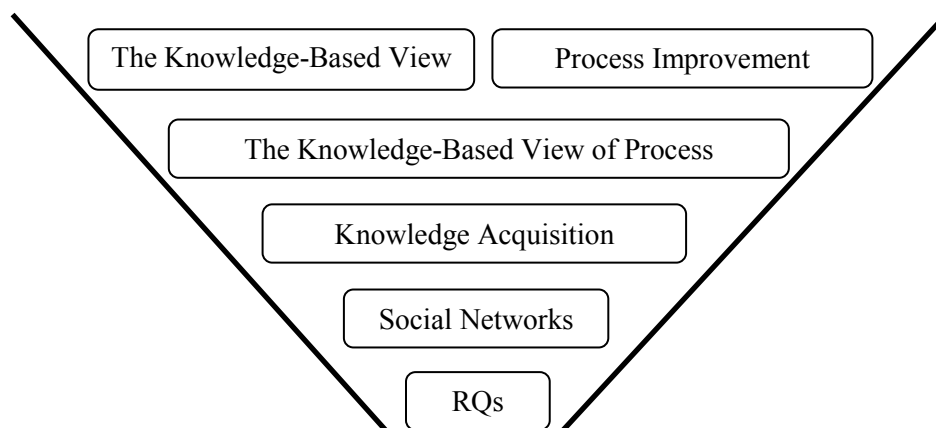


Figure 2.1: Literature review "Funnel"

2.1 The Knowledge-Based View

2.1.1 What is Knowledge? The Knowledge Hierarchy

In addressing the question of *what is knowledge*, the following discussion mirrors Grant's (1996) sentiment of establishing “*those characteristics of knowledge which have critical implications for managers*” (Grant, 1996; p110). The review of the literature has generated a plethora of definitions and perspectives in answering this question. However, the concept of a Knowledge Hierarchy provides a systematic and logical lens to interpret and categorize these definitions. The origins of the Knowledge Hierarchy stems from Ackoff (1989) who suggested the DIKW hierarchy model- Data, Information, Knowledge, and finally Wisdom. Carayannis (1999) refined this work by replacing the Wisdom stages and with "Expertise" and "Capabilities". This research concurs with Carayannis' adaptation for two reasons. Firstly, Frické's (2009) key critique of Ackoff's model suggests that wisdom is “*a matter of using that practical know-how to achieve appropriate ends*” (p141). From this, it is reasonable to suggest that “expertise” suitably mirrors this sentiment. Secondly, Carayannis' (1999) inclusion of "Capabilities" also suitably introduces the wider discussion of knowledge that can reside at the social/collective/firm level. The following details the Knowledge Hierarchy in addition to exploring the sub-dimensions to these five levels of knowledge as summarised in Appendix 1.

Level 1: Data

The lowest level of the typology suggests Data as the simplest form of knowledge. Ackoff (1989) defines it as “*symbols that represent properties of objects, events and their environment*” (p3). Somewhat more pragmatically, Carayannis (1999) describes it as text or facts such as those generated through MRP reports. Given its simplicity, data itself does not represent knowledge.

Level 2: Information

The second level is *information*- organized, structured, interpreted and summarized data (Carayannis, 1999). It is reinforced by two perspectives- knowledge as *explicit* and knowledge as an *object*. In examining the first perspectives, Alavi and Leidner (2001) define this as *explicit* knowledge, reflecting the well adopted typology of knowledge as

explicit, versus *tacit* as theorised by Polanyi (1966) and later famed by Nonaka (1994). In this perspective, explicit refers to “*codified knowledge ...that is transmittable in formal, systematic language*” (Nonaka, 1994; p16). The second perspective sees information as an *object* that can be stored, accessed and manipulated (Alavi and Leidner, 2001). In this perspective, the focus is on building and managing knowledge stocks and is the perspective that is most supports the knowledge management focus on information technologies (c.f. Gunasekaran and Ngai, 2007). Given its ease of transfer and storage, this form of knowledge has limited value as it is neither rare, inimitable nor non-substitutable (c.f. Barney, 1991).

Level 3: Knowledge

The third hierarchical level is *knowledge*, a fundamental shift from the previous two levels in that it is inherently more personalized and cannot be readily codified and communicated, making it more difficult to transfer and hence more valuable (Nonaka, 1994). This perspective is consistent with Nonaka’s *tacit* knowledge. This form of knowledge provides competitive advantage as it is rooted in actions and experience which is difficult to imitate (Alavi and Leidner, 2001, Anand et al., 2010). A progression of this perspective is what Alavi and Leidner (2001) call a *state of mind* where knowledge is a state of clarity, knowing and understanding. The third and final perspective of this level of knowledge is as a *process* of creation, sharing, and distribution (Alavi and Leidner, 2001). Section 2.1.3 below details this process further. As this form of knowledge provides competitive advantage, it is a level of the knowledge hierarchy that is of particular interest to this research.

Level 4: Expertise

The fourth level of knowledge is the concept of *expertise*, for example fast and accurate advice, reasoning, and the justification of result (Carayannis, 1999). The first perspective of this form observed in the literature is colloquially summarised as *that which is known* (Grant, 1996; p110) and includes being *antiquated with*, *familiar with*, and *aware of certain expertise*. The second perspective are those prefixed with ‘know’ such as *know-how*, *know-why*, and *know-what* and stem from reasoning and explanation capabilities. Alavi and Leidner (2001) summarises such views as being declarative (*know-what*), procedural (*know-how*), causal (*know-why*), conditional (*know-when*), and relational (*know-with*). Ferdows (2006), for example, discusses the transfer of production *know-how*

and utilizes the Absorptive Capacity framework by Cohen and Levinthal (1990). In this work, Ferdows defines *know-how* as “*a recipe for action, often referred to as procedural knowledge*” (p2). Jensen et al. (2007) describes the implications of this type of knowledge by suggesting that:

- “*Know-what* and *know-why* may be obtained through reading books, attending lectures and accessing data bases, the two other categories [*know-how*, *know-who*] are more rooted in practical experience” (p682).
- “*Know-how* will typically be learnt in apprenticeship relations” (p682); and
- *know-who* is “learnt in social practice and ...specialized education environments” (p682)

The final perspective is knowledge as a *justified true belief* where “*knowledge is a dynamic human process of justifying personal beliefs as part of an aspiration for the truth*” (Nonaka, 1994; p15). Adding to such a definition, Van der Spek and Spijkervet (1997) state that “*knowledge is the whole set of insights, experiences, and procedures which are considered correct and true and which therefore guide the thoughts, behaviours, and communication of people*” (cited in Carayannis, 1999, p221). Given the inherently action orientated and personalised nature of this form of knowledge, it is consistent with this research’s focus on the individual (as justified in Section 2.1.5 below), and on the pragmatic context of process improvement, thus of interest in this study.

Level 5: Capabilities

The fifth and final level of the knowledge hierarchy is *capabilities*, which resides at the organizational level as expertise, repositories of knowledge, and organisational memory (Levitt and March, 1988, Huber, 1991, Carayannis, 1999). This perspective best illustrates the emerging trend from core competencies and the resource based view (Penrose, 1995, Barney, 1991) to the knowledge-based view of the firm where knowledge is viewed as the most strategic resource to build competitive advantage (i.e. Grant, 1996, Choo et al., 2007b). At this level, there are two underlying themes. Firstly, Alavi and Leidner’s (2001) *pragmatic* knowledge focuses on the nature of knowledge being useful to organizations, captured by systems, processes, and culture (Carayannis, 1999). This type of knowledge is consistent with organisational learning (ie Huber, 1991) and information and communication technology (ICT)-based knowledge management

systems (ie Gunasekaran and Ngai, 2007). The second theme is knowledge as the “*potential to influence action*” (Alavi and Leidner, 2001, p111). Carayannis (1999) expands on this and suggests that this form of knowledge is embedded in routines and processes which actively guide task execution, problem-solving, and decision making in order to perform. Given this research’s focus at the individual level, this form of knowledge is not of direct interest to this research.

In summary, this research focuses on the acquisition of knowledge as defined in level 3 and level 4 of the knowledge hierarchy.

2.1.2 What is the Knowledge-Based View?

The knowledge-based view (KBV) colloquially builds on Sir Francis Bacon's "knowledge is power". Grant (1996) goes as far as saying that "if we were to resurrect a single-factor theory of value... then the only defensible approach would be a knowledge-based theory of value, on the grounds that all human productivity is knowledge dependent, and machines are simply embodiments of knowledge" (p112). The knowledge-based view purports that knowledge is the key resource to sustained competitive advantage (Grant, 1996). Successful firms are then those with the ability to consistently create new knowledge, disseminate it throughout the organization, and quickly embody it in new technologies and products (Nonaka, 1991). In this manner, Nonaka (1991) first draws attention to Polanyi's (1966) explicit and tacit knowledge-equivalent to level 2 and level 3 knowledge respectively in the Knowledge Hierarchy above. In "the Knowledge Creating Company", Nonaka (1991) makes the distinction between two views of the firm: the antiquated view of the organization as a machine for “information processing” where the only useful knowledge is seen as formal, systematic, codified procedures and universal principles, i.e. explicit knowledge; and the "new" Japanese approach which focuses on the creation of knowledge by "tapping the tacit and often highly subjective insights, intuitions, and hunches of individual employees and making those insights available for testing and use by the company as a whole" (p164). Kogut and Zander (1992) refine this view by clarifying three central competitive dimensions of the firm: it's ability to create knowledge; transfer knowledge efficiently within the organization; and transform individual and social expertise into economically useful products and services. In doing so, they highlight the need to synthesize and apply current and acquired knowledge, and introduce the notion of internal and external

learning. Internal knowledge is knowledge created by the firm by reorganising knowledge and through experiments; and external learning is knowledge created from acquisitions and joint ventures. This aspect of internal and external learning was similarly explored in Marzec and Matthews (2012). Following Kogut and Zander's refinement, Nonaka's second key work converges his original thinking on tacit/explicit knowledge, with Kogut and Zander's (1992) internal/external learning by proposing the famous SECI model- the four modes of knowledge creation (Nonaka, 1994). *Socialisation* is the process of converting newly acquired tacit knowledge from outside the firm, to firm-contextualised tacit knowledge through shared experiences. *Externalisation* is the articulation of firm-contextualised, internal tacit knowledge into explicit knowledge that can be disseminated throughout the firm, or externalised. *Combination* is the process of combining, editing or processing explicit knowledge collected from inside or outside the organisation, to new firm-specific explicit knowledge and thus an internal learning activity. Finally, *Internalisation* is the dissemination of explicit knowledge throughout the organisation and its subsequent conversion to tacit knowledge by individuals.

These key works provided the foundations to Grant's (1996) profound convergence and formal introduction of the Knowledge-Base View (KBV). As Grant (1996) notes, the success of the KBV can be attributed to the fact that it "extends beyond the traditional concerns of strategic management [to] address other fundamental concerns of the theory of the firm, notably the nature of coordination, organizational structure, the role of management and the allocation of decision-making rights, determinants of firm boundaries, and the theory of innovation" (p110). Grant goes on to state that the KBV is "an outgrowth of the resource-based view" (p110). With Barney (1991) suggesting that sustained competitive advantage stems from resources that are Valuable, Rare, Imitable and Non-substitutable (VRIN), the idiosyncratic ability for a firm to create, transfer and transform knowledge as proposed by Kogut and Zander (1992) becomes such a VRIN capability thus leading to sustained competitive advantage. An additional argument can be found in associating VRIN resources with knowledge. Grant (1996) adds that the broad scope of the knowledge within a capability leads to greater complexity and causal ambiguity and thus creating barriers to replication or imitation. By highlighting that the codification of knowledge increases the likelihood of imitation, Kogut and Zander (1992) demonstrate not only the imitable nature of tacit knowledge, but also that value can only be derived from this form of knowledge. Thus, the proclivity for research on Information

and Communication Technologies (ICT) for knowledge management is fundamentally flawed as these systems only deal with explicit codified knowledge that cannot provide sustained competitive advantage. Other authors are in agreement against this ICT focus:

- "there is growing recognition that whilst technology and its supporting infrastructure is an important enabler of information sharing, it is not in itself sufficient and ignores the behavioural and people issues related to information" (Barratt and Oke, 2007; p1221);
- "no amount of IT can– at least not yet – crack the problem of how to speed knowledge acquisition" (Prusak, 2006; p19); and
- "while having considerable potential, the availability of electronic knowledge exchange does not automatically induce a willingness to share information and build new intellectual capital" (Nahapiet and Ghoshal, 1998; p249).

Zollo and Winter (2002) and Kale and Singh (2007) finalise the transition of the RBV to the KBV by suggesting that the development of capabilities originates in knowledge and learning activities. These works suggest that deliberate learning efforts form a basis for improving a firm's skills to manage complex tasks and "reflect a higher-order dynamic capability through which a firm systematically generates and modifies its operating routines or skills" (Kale and Singh, 2007; p984). Ali et al., (2010) take this a step further in suggesting antecedents to this process. Based on the development of substantive capabilities, those that provide competitive advantage, from the evolution of dynamic capabilities from learning, the author proposes that learning is a function of two orientations- *market* orientation which provides reactive or "adaptive learning"; and *learning* orientation which lends itself to proactive learning.

With an appreciation of the origins and merits of the knowledge-based view, the following section explores the nature of the KBV in practice through the knowledge process.

2.1.3 The Knowledge Processes

With the understanding of knowledge as the key resource for sustained competitive advantage, built from an idiosyncratic capability of knowledge creation, transfer, and

transformation, the following section explores the aspects of this knowledge process in greater detail. In doing so, an approach based on the introduction of the special issue on "Knowledge Management and Organizational Learning" in Omega by King et al. (2008) is used to guide the discussions. This introduction utilised a "Life Cycle" Model to organise the thinking on knowledge management into stages of the knowledge process as shown in figure 2.2 below. From this, table 2.1 summarises the definitions developed from literature.

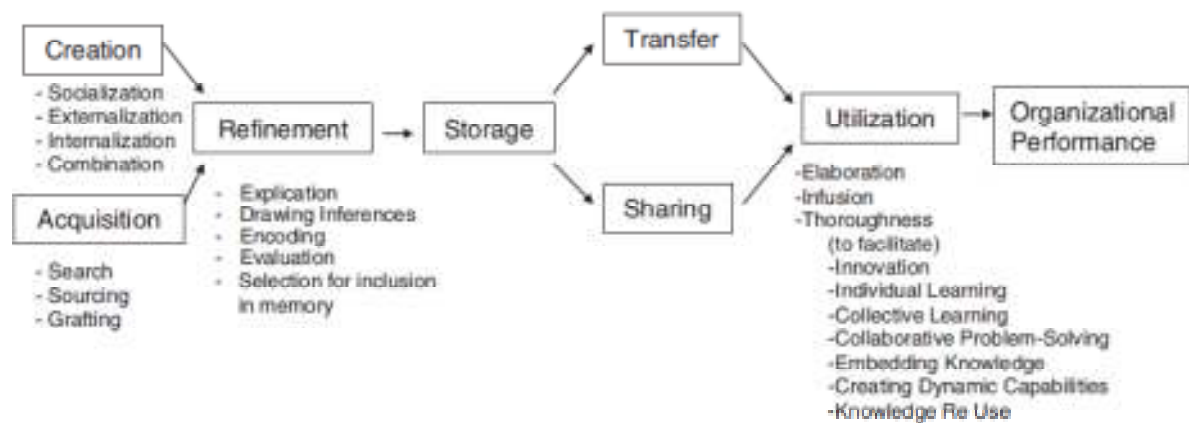


Figure 2.2: The Knowledge Process (from King et al., 2008)

Knowledge Process	Definition
Knowledge Creation	Developing new knowledge or replacing existing knowledge with new content
Knowledge Acquisition	The search, identification and capture of knowledge from outside the firm
Knowledge Refinement	The assimilation, interpretation and understanding of new knowledge and subsequent transformation, refinement and combination with existing knowledge
Knowledge Storage	Knowledge becoming part organizational memory
Knowledge Transfer	The focused and purposeful transmission and receipt of knowledge from a sender to a known receiver
Knowledge Sharing	The focused and purposeful transmission and receipt of knowledge to a receiver unknown to the contributor
Knowledge Utilisation	The exploitation and application of knowledge for formal benefit

Table 2.1: Definitions of Knowledge Processes

2.1.3.1 Knowledge Creation

King et al. (2008) define knowledge creation as "developing new knowledge or replacing existing knowledge with new content" (p167). Kodama (2005) concurs in part in defining it as new knowledge based on developing new technologies and practices, whilst Smith et al. (2005) sees it as dependent on the ability to exchange and combine existing information. McAdam (2004) further suggest that knowledge creation is chaotic, unstructured and unsystematic, a sentiment in particular contrast to Nonaka's structured SECI Model already mentioned. The SECI model does however form the bases of many studies, from reviews in ICT (Alavi and Leidner, 2001), to new product development (Richtnér and Åhlström, 2010), to the role of leadership (von Krogh et al., 2011). Furthermore, Smith et al. (2005) and Arikan (2009) propose the existence of a capability for knowledge creation. For example Smith et al. (2005) suggests that a knowledge creation capability is the ability to access others, to combine information and knowledge, and perceiving value from the exchange and combination process. Of particular relevance to process improvement, Choo (2010) hypothesised that knowledge creation in six sigma projects stems from motivating a sense of challenge and makes the distinction between quality improvements based on performance-driven gaps (e.g. targets) and problem-driven gaps. Their empirical results showed that a problem-driven gap was more likely to create a sense of challenge and thus the creation of knowledge, an aspect well aligned to this research (See Section 2.3.2 on Problem Solving)

2.1.3.2 Knowledge Acquisition

Huber (1991) defines knowledge acquisition as the "process by which knowledge is obtained" (p90). Most other definitions are in agreement with knowledge acquisition involving the search, identification and capture of knowledge from outside the firm (c.f. Yli-Renko et al., 2001, Sullivan and Marvel, 2011). Yli-Renko et al. (2001) also makes an explicit distinction between knowledge acquisition, knowledge assimilation, and knowledge exploitation. This is consistent with Zahra and George's (2002) four stage absorptive capacity framework in which *acquisition*, defined as the activity of identifying and acquiring externally generated knowledge, proceeds and is distinct from *assimilation* and *transformation*. Conversely, several authors combine knowledge acquisition with later knowledge processes. King et al. (2008) define knowledge acquisition as the search, recognition, and *assimilation* of potentially valuable knowledge; and for Holsapple and Joshi (2002) and Carayannis (1999), acquisition includes capturing, distilling, refining,

interpreting, and/or *transforming* knowledge, i.e. aspects of assimilation and transformation. For clarity and given the *refinement* stage of King et al. (2008) that follows, knowledge acquisition is seen as distinct from the assimilation and transformation processes and purely the search, identification and capture of external knowledge.

2.1.3.3 Knowledge Refinement

King et al. (2008) define knowledge refinement as the processes of entering knowledge into an organization's memory by selecting, filtering, purifying and optimizing knowledge. Several authors refer to this process as *internalising*: Holsapple and Joshi (2002) and Carayannis (1999) suggest internalising as incorporating or making knowledge a part of the organization by assessing and valuing the knowledge, structuring it and delivering knowledge. Kale and Singh (2007) term internalising as the absorption and retention of knowledge but take a more social view by suggesting it more through training programs and 'on-the-job' training. Lechner and Floyd (2007) concur to the more social aspects by suggesting the *processing* of knowledge as assimilating information through analysis, discussion of issues, consideration of alternatives and reaching decisions. Finally, Zahra and George (2002) distinguish between two sub-stages of refinement: an initial *assimilation* process where routines and processes are used to analyse, process, interpret and understand the new knowledge found from acquisition; and a subsequent, *transformation* process where knowledge is refined and combined with existing knowledge ready for application.

2.1.3.4 Knowledge Storage

In concurring with Kale and Singh (2007) and Lechner and Floyd's (2007) more social aspects, King et al. (2008) defined knowledge storage as becoming part of organizational memory in the form of electronic repositories of knowledge, as well as knowledge embedded in the minds of organizational members. Alavi and Leidner (2001) refer to organizational memory as the storage, organising, and retrieval of organizational knowledge though electronic bulletin boards, knowledge repositories and databases. The interest in this area, as Hansen et al. (1999) point out, is derived from the rise of networked computers which has made it possible to codify, store and share certain kinds of knowledge more easily and cheaply than ever before. Boh (2008) commenting on knowledge repositories and the reuse of knowledge assets, suggest eight types of

knowledge assess that reside in electronic repositories: designs and codes, analyses and interpretations, work product examples, test strategy and cases, project plans, lessons learned, presentations and research, and client information. Levitt and March (1988) however note the mixed blessing with which automation of knowledge storage and retrieval brings. On the one hand, it makes it more reliable and reduces the costs of finding and using what is stored in memory. However, by standardising the complexity of knowledge, it becomes difficult to capture the unpredictable richness and reduces or eliminates the fortuitous experimentation of unreliable retrieval, making learning more difficult (Levitt and March, 1988).

2.1.3.5 Knowledge Transfer

Grant (1996) in his manuscript on the knowledge-based view, defines knowledge transfer as the transmission and receipt of knowledge. King et al. (2008) add a little more detail in suggesting it as the focused and purposeful communication of knowledge from a sender to a known receiver (vs. knowledge *sharing* where the receiver is unknown). Other authors are far less specific on what knowledge transfer entails yet discuss the topic at length (c.f. Ferdows, 2006, Easterby-Smith et al., 2008b, Levin and Cross, 2004). Others still complicate it further by blurring the line between knowledge process elements. For example, Van Wijk et al. (2008) suggest it as the movement of knowledge between actors and include knowledge sharing and knowledge acquisition into its conceptualisation. Grant (1996) criticises the focus on knowledge transfer by arguing that the key is to achieve effective *integration* while minimizing knowledge transfer through cross-learning, a view shared by Guinery (2006). Grant uses the following vignette to explain.

"If Grant and Spender wish to write a joint paper together, efficiency is maximized not by Grant learning everything that Spender knows (and vice versa; i.e. knowledge transfer), but by establishing a mode of interaction such that Grant's knowledge of economics is integrated with Spender's knowledge of philosophy, psychology and technology, while minimizing the time spent transferring knowledge between them." (Grant, 1996; p144)

Despite this, there is a substantial body of literature exploring this process. Levin and Cross (2004) identify three perspectives by which this has been viewed- social networks, trust, and organizational learning/knowledge. In taking a social network approach,

Easterby-Smith et al. (2008b) suggest that dyadic knowledge transfer comprises four factors: the resources and capabilities of the donor, the resources/capabilities of the recipient firm, the nature of knowledge that is being exchanged, and inter-organizational dynamics. Although jumping ahead in the flow of this Thesis somewhat, this contrast in behaviour between the donor/knowledge giver, and the recipient/knowledge seeker is observed in the exploratory case interviews and later captured in the conceptual model- details of which are developed in Dyad 2 in the model and hypothesis development, Chapter 4. Finally, in taking a leaning/knowledge approach, Ferdows (2006) seminal work on the transfer of production know-how suggests that knowledge transfer mechanisms are subject to two factors- how codified the know-how is, and how fast it is changing. When the know-how is tacit and slow, it is proposed that knowledge transfer is best achieved by moving people; when it is codified and slow, the use of manuals and systems is recommended; when tacit and fast, via projects; and when codified and fast, through joint development.

2.1.3.6 Knowledge Sharing

Aside from the definition by King et al. (2008) of knowledge sharing as the dissemination of knowledge to people who are unknown to the contributor, a clear distinction and definition of this process was difficult to find. In the work by Hansen (1999, 2005) and Siemsen et al. (2008), they readily intertwine transfer and sharing and do not explicitly define knowledge sharing; and Renzl (2008) defines knowledge sharing as the reciprocal process of knowledge exchange. However, three more insightful definitions were found: "the provision or receipt of task information, know-how, and feedback regarding a product or procedure" (Cummings, 2004; p352); the capability to communicate, capture, organise and disseminate knowledge in order to improve decision-making, process efficiency, quality, and cost reduction (Huang et al., 2010); and exchanging and disseminating individually and organizationally held knowledge (Kale and Singh, 2007). In doing so, they mirror the sentiment of *knowledge transfer* as including both the transmission as well as receipt of knowledge.

2.1.3.7 Knowledge Utilisation

As Alavi and Leidner (2001) note, "the processes of knowledge creation, storage/retrieval, and transfer do not necessarily lead to enhanced organizational performance; effective knowledge application does" (p129). In this way, knowledge

application refers to the exploitation and application of knowledge for formal benefit (Zahra and George, 2002); the externalization of knowledge (Carayannis, 1999, Holsapple and Joshi, 2002); and the process that facilitates innovation, collective learning, collaborative problem solving, and the development of dynamic capabilities (King et al., 2008). In providing guidance on plausible sub-routines of knowledge application, King et al. (2008) suggest the process of elaboration through the development of different interpretations and the identification of underlying issues. Alavi and Leidner (2001) also suggest the mechanisms of directives, organizational routines, and the creation of self-contained task teams. *Directives* refer to the set of standards, procedures, and instructions developed from the conversion of specialist tacit knowledge to explicit and integrated knowledge for efficient communication. *Organizational routines* refer to application mechanisms that do require the articulation and communication of what is already known, such as process specifications, interaction protocols, and coordination patterns. Finally, when task complexity and uncertainty limit the use of directives or organisational routines, teams of individuals with specialised knowledge and expertise can be formed.

2.1.4 Why a Knowledge-Based View?

The transition to the knowledge-based view and associated knowledge economy can be attributed to three key changes. Firstly, as Kyläheiko et al. (2011) remark, it is clear that fundamental changes in the economy have shifted the sources of competitive advantage from external sources like monopoly power, entry barriers and tangible assets, to intangible assets like knowledge and intellectual property rights. Secondly, scholars are moving from a focus on competition towards dynamic interdependencies amongst firms and the idea of communities of knowledge (Tallman et al., 2004). Finally, the foundation of industrialised economies has shifted from natural resources to intellectual assets, thus spurring the compulsion to examine the knowledge underlying businesses and how this knowledge is used (Hansen et al., 1999). Kyläheiko et al. (2011) expands on this by suggesting a number of contributing factors to the rise in importance of knowledge and knowledge assets: (i) the globalisation and liberalisation in markets resulting in the limitation of opportunities to raise entry barriers; (ii) information processing, handling and transfer costs have fallen; (iv) the strengthening of intellectual property rights; and (v) rapidly growing knowledge intense industries like materials science, biotechnology, nanotechnology and ICT.

In addition to the motivations stemming from shifts in market forces, the knowledge-based view is also changing the way we view, interpret, and relate business practices. Koskinen and Vanharanta (2002), for example, suggest that economic performance is not simply associated with technology but also dependent on disembodied, intangible assets and working practices such as tacit knowledge; and Smith et al. (2005) suggest that new product introduction is a function of a firm's ability to manage, maintain, and create knowledge. The notion of innovation is on the rise given the unprecedented competition in world markets urging the need to move beyond quality assurance to rapid and proactively responding to global opportunities for new products and services (Tu et al., 2006). In light of this, Tu et al. (2006) emphasise the need to assimilate new technologies and practices whilst Van Wijk et al. (2008) suggest that for firms to develop new applications and survive, there is an onus on knowledge transfer and acquisition. Lechner and Floyd (2007) mirror this sentiment in suggesting that the high failure rate of new products was attributed to the difficulty associated with learning new technologies. They go on to suggest that exploratory initiatives in large firms are faced with significant rigidities that impede the accumulation of new knowledge. Lichtenthaler (2009) adds that in order to foster innovation and to enhance performance, firms are now becoming more reliant on external knowledge to drive these exploratory initiatives. Other authors have also commented on the role of knowledge in the development of dynamic capabilities (King et al., 2008). As Huang et al. (2008) note, "KBV theory provides a useful theoretical lens enabling OM researchers to search for answers to their questions regarding the development of operations competence" (p715). Particularly, they argue that internal learning and external learning lead to effective process implementation, which in turn, improves a manufacturer's mass customisation capability. More seminal papers on the development of dynamic capabilities such as Zollo and Winter (2002) and Kale and Singh (2007), suggest that capabilities are developed from the routines of: (i) knowledge articulation (efforts to externalizing individually held knowledge); (ii) codification (creating and using knowledge objects or resources), sharing (exchanging and disseminating knowledge); and (iii) internalization (efforts to facilitate absorption of accumulated organizational level knowhow by individuals).

Other authors suggest more salient factors driving the knowledge-based view. Paiva et al. (2008), following on from the "unprecedented competition" remarks by Tu et al. (2006), add that increased organizational knowledge reduces risks and uncertainties in dealing with change. They go on to suggest that this is achieved through: a) internal knowledge development to continuously fit capabilities to environmental changes; and b) external knowledge acquisition to identify relevant information in order to anticipate and adequately respond to environmental changes. Consequently, Levin and Cross (2004) conclude that organizations that make better use of their knowledge and collective expertise are more likely to be more innovative, efficient, and effective in the marketplace. And along similar lines, Ferdows' (2006) remarks that "ultimately, all knowledge management efforts in business organizations are supposed to help the organization produce and deliver better products and services" (p1), which in this case was in reference to enabling production and operations management to do a better job.

2.1.5 Unit of Analysis: Why individuals?

This research identifies three key arguments in justifying the Individual as its Unit of Analysis. Aside from its wider adoption in previous knowledge-network research (i.e. Nebus, 2006, Carpenter and Westphal, 2001, Houghton et al., 2009, McDonald et al., 2008), knowledge resides in, and is created by, individuals (Nonaka, 1994). Given the pragmatic nature of the operations management, it would seem logical to address barriers and constraints to knowledge flows at their root cause, i.e. the individual. Nonaka (1994) goes on to suggest that firm-level capabilities should be understood as processes that 'organizationally amplify' the knowledge of their individuals. Thus, greater firm-level benefit would be achieved through the amplification effect of improving individuals then by addressing aspects solely at the firm-level. A second argument is that research on knowledge processes has paid insufficient attention at the micro/individual level and more to organisations and role of governing knowledge processes (Foss et al., 2010). In this way, awareness is growing on the value of a microfoundations view, those monomer factors "that need to be understood and specified in order to explain any collective phenomenon" (Felin et al., 2009; p559). The argument for this is succinct and straight forward- "organizations are made up of individuals, and there is no organization without individuals [yet] this elementary truth seems to have been lost in the increasing focus on structure, routines, capabilities, culture, institutions and various other collective

conceptualizations" (Felin and Foss, 2005; p441). Subsequently, a microfoundations view provides a more complete picture of the knowledge economy (Felin et al., 2009).

A third and final argument is based on the underlying theory of this research, Absorptive Capacity (ACAP)⁵. In their founding work on the theory, Cohen and Levinthal (1990) explicitly note that an "organization's absorptive capacity will depend on the absorptive capacities of its individual members" and "the development of an organization's absorptive capacity will build on prior investment in the development of its constituent, individual absorptive capacities" (p131). This clearly demonstrates the fundamental role of the individual in this theory. Furthermore, as recent works on "iCAP" (individual Absorptive Capacity) note, excess attention has been paid at the firm level, dynamic capabilities aspect of ACAP (da Mota Pedrosa and Jasmand, 2011b, Da Silva and Davis, 2011, ter Wal et al., 2011). Finally, in one of the more recent advances of the theory, Volberda et al. (2010) systematises the research gaps in ACAP and urges "research on AC should explain the impact of individuals on the AC process" (p943).

2.1.6 Theories

With a clear understanding of the motivations for the KBV, the following two sections outline the key theories and variables in the KBV. The intent of these sections is to outline the key attributes that may play an important role in a Knowledge Acquisition perspective of the Knowledge-Based View of Process Improvement. In doing so, it develops a solid theoretical foundation from which the subsequent exploratory interviews can draw from. Table 2.2 below summarises the key theories observed in the literature.

⁵ As this research is an exploratory study into the knowledge-based view of process improvement, the justification for the adoption of this theory comes from its emergence in the exploratory empirical work, rather than as an theoretical argument that would be justified in a literature review.

Theory	Description	Authors
SECI Model	Four modes to knowledge creation: socialisation (tacit→tacit), Externalisation (tacit→explicit), Combination (explicit→explicit), Internalisation (explicit→tacit)	Nonaka (1994)
Creation of Entrepreneurial Knowledge	Three epistemological positions to knowledge creation: Pragmatism (action-oriented view), Subjectivism (what is already known), and Empiricism (verification/refutable observations)	Floyd and Wooldridge (1999)
Advice seeking behaviour	<i>Knowing</i> someone with advice, <i>valuing</i> their advice, gaining <i>access</i> to their advice, the <i>motivation</i> for them to share their advice, and the <i>cost</i> for obtaining this advice	(Nebus, 2006, Borgatti and Cross, 2003, Nahapiet and Ghoshal, 1998)
Single- and double- loop learning	Learning to complete a task (single); and learning by questioning (double)	Argyris (1977)
Explore/Exploit	Two modes of learning- exploratory (searching, discovery, play); and Exploit (refinement, execution, processing)	March (1991a)
4I model of Organisational learning	A 4 stage, multi-level Organisation learning process from the individual (intuition- observing patterns/opportunities) to the individual/group boarder (interpretation- shared sense making) to the Group (integration- sharing of knowledge) and finally organisational level (institutionalisation)	Crossan et al. (1999)
Internal- External Learning	Organisational learning as learning within the firm, and external to the firm.	Schroeder et al. (2002)
Organisational Ambidexterity	The deliberate and simultaneous balancing of exploratory and exploitative actions	(Birkinshaw and Gibson, 2004, He and Wong, 2004)
Absorptive capacity	1) the ability to recognise, acquire and assimilate knowledge with a focus on activates outside/external to the firm; and 2) the ability to transform, apply and exploit knowledge by processes within/internal to the firm	Cohen and Levinthal (1990). Zahra and George's (2002)
Objectivist learning	Learning is the absorption of objective knowledge	(Leidner and Jarvenpaa, 1995)
Constructivist learning	Learning is the construction of knowledge by the individual	(Leidner and Jarvenpaa, 1995)
Collaborative learning	Learning emerges through shared understanding	(Leidner and Jarvenpaa, 1995)
Experiential learning	Learning though doing	Kolb (1984)
Uncertainty reduction theory	Uncertainty is unpleasant and so actions are done to reduce it	Schulz (2001)

Table 2.2: Summary of Knowledge-Based Theories

2.1.6.1 Knowledge Creation Models

The most seminal knowledge creation framework is Nonaka's (1994) four modes of knowledge creation, the SECI model. The study by Anand et al. (2010) helps contextualise this model to this research by applying it to Six Sigma projects. Socialisation (tacit→tacit) is the time-consuming, information rich sharing of tacit knowledge (Anand et al., 2010). This mode focuses on combining individuals' tacit knowledge and creating common understanding, such as through brainstorming and the "five whys", which allows individuals to express ideas, experiences and perspectives to enable other team members to incorporate them into their thinking (Anand et al., 2010). Table 2.3 below summarises the SECI model and its application to Six Sigma as proposed by Anand et al. (2010). Externalisation (tacit→explicit) is the conversion of tacit knowledge to explicit knowledge through the explicit expression of tacit ideas in the form of language (i.e. written descriptions, objective numbers) and visual schemata (i.e. pictures and diagrams) (Anand et al., 2010). In doing so, it enables individuals to express, summarise, and view explicitly jointly created knowledge (Anand et al., 2010). Six Sigma practices such as cause-effect/ fishbone diagrams and value stream mapping (VSM) provide both visual schemata and serve as a convenient language for facilitating communication and analysis (Anand et al., 2010). Combination (explicit→explicit) is the sharing and combination of explicit knowledge from different sources. The focus here is on making explicit knowledge more easily accessible and in understanding explicit relationships, such as through multiple regression or experimentation via the design of experiments (DoE) (Anand et al., 2010). Internalisation (explicit→tacit) is the capturing and translation of explicit knowledge into tacit knowledge. In these cases, explicit knowledge is used as a trigger for the application of tacit knowledge, for example a change identified on control charts may indicate a need for tacit on-the-job corrections or small adjustments to a manufacturing process; conversely, it may generate the need for a team meeting to exchange tacit knowledge in order to solve the issue (Anand et al., 2010).

	To Tacit Knowledge	To Explicit Knowledge
From Tacit Knowledge	Socialisation - Brainstorming - "five Whys"	Externalisation - Fishbone diagrams - VSM
From Explicit Knowledge	Internalisation - Error proofing - Control Charts	Combination - DoE - Multiple regression

Table 2.3: The SECI model and the application of Six Sigma Practices

An alternate knowledge creation model is Floyd and Wooldridge's (1999) epistemological view of knowledge creation which suggests three paradigms of knowledge creation. First, the *Pragmatist* view which takes an action-orientated view of knowledge, akin to Ferdows' (2006) view that "production know-how is a recipe for action" (p2). Second, *Subjectivism* sees creation of knowledge based on the premise that accepting new knowledge is a function of its consistency with what is already known. In this way, knowledge is not constrained in its orientation (i.e. action orientated) so long as it is well confirmed and consistent. Finally, *Empiricism* is the acceptance of knowledge based on measureable observations that can verify or refute. In this way, empirical reproducibility and rationality play a central role as they seek to go beyond isolated empirical observations towards universal principals and theories. Based on these perspectives, Floyd and Wooldridge (1999) derive a three stage process for the development of capabilities. First, opportunities are identified and ideas produced *subjectively*; then *empirical* knowledge is gained in the pursuit of these opportunities, which stimulates further development efforts through their verification or dismissal. Finally, through these actions, *pragmatic* knowledge is developed leading to an organizational-level capability.

2.1.6.2 Advice Seeking Behaviour

Advice seeking behaviour reflects the five factors that influence the selection of whom to turn to for advice. First is the condition for *knowing* the skills, knowledge or expertise of an individual of whom one might turn to (Cross et al., 2001, Borgatti and Cross, 2003). In general, this suggests a basic requirement for knowing where information is stored or who the "experts" are (Cross et al., 2001). Second, is an understanding of the perceived

value of the advice, or the expectation/anticipation of value through the exchanging (Nebus, 2006, Borgatti and Cross, 2003, Cross et al., 2001, Nahapiet and Ghoshal, 1998). Third is the ability to gain *access* to the relevant advice, as knowing and valuing advice is only helpful if it can be accessed in a timely fashion and with relative ease (Nebus, 2006, Borgatti and Cross, 2003, Cross et al., 2001, Nahapiet and Ghoshal, 1998). Fourth is the *motivation* for the knowledge source to share their advice as those engaged must have a sense that the exchange is worth their while (Nahapiet and Ghoshal, 1998, Nebus, 2006). Finally is the perceived *cost* of obtaining the advice, such as monetary compensation, future favours, or the embarrassment in asking for help (Nebus, 2006, Borgatti and Cross, 2003, Cross et al., 2001). Given these, Nebus (2006) proposed two key trade-offs when seeking advice: a) when an individual has an awareness of the task and whom the experts are, the decision is based on the trade-off between the perceived value of the advice, and the cost of obtaining it; conversely b) when an individual has a poor understanding of the task and the experts, the decision is weighed up between the accessibility of a potential contact, and their perceived willingness to share.

2.1.6.3 Organizational Learning

The vast literature on Organisational Learning is consolidated here by reviewing, in brief, four of the most seminal frameworks. In one of its more nascent interpretations, Argyris (1977) proposed the concept of single- and double-loop learning. Single-loop learning is the most commonly found form of learning and refers to the identification and correction of errors to ‘get the job done’. This mode of learning does not question the motives or origins of ‘the job’, but focuses explicitly on learning how to suffice at it. Double-loop learning conversely focuses on understanding and questioning the policies that drive ‘the job’ and so motivated the use of challenging extant practices and the status quo. The next evolution of organisational learning comes from March’s (1991a) consolidation of exploratory and exploitative learning. March makes the distinction here between two forms of learning: exploration, which incorporates practices such as search, risk taking, experimentation, play and discovery; and exploitation, such as refinement, efficiency, implementation, and execution. The third framework, the 4I model by Crossan et al. (1999), is an important framework due to the richness of its interpretation. The model juxtaposes a process view of learning with the hierarchical levels of the firm, thereby capturing the evolution of knowledge from the individual through to an organisational level capability. At the individual level, Crossan et al. (1999) suggest the process of

intuition, the recognition of patterns and/or possibilities stemming from personal experience. At the group level, *integration* is the process of developing shared understanding amongst members and subsequently taking coordinated action. Bridging the individual and group level is the process of *interpretation* where insight and ideas are explained through words and/or actions, an aspect similar to Nonaka's (1994) externalisation. Finally, at the organisational level, *institutionalising* is the process of embedding learning into the organization through systems, structures, procedures, and strategy to ensure that learnt actions occur.

The final model is the internal-external learning model by Schroeder et al. (2002) for which the following discussions are adapted from Marzec and Matthews (2012). Schroeder et al. (2002) define internal learning as learning within the plant/organisation through practices such as employee training and the adoption of employee suggestions. In addition to this, is the need to change and development mental models (i.e. Argyris, 1977 single loop learning). Huber (1991) supports this view by suggesting that proof that organizational learning has taken place when the range of potential behaviours and cognitions of an individual are altered. In this way, internal learning also reflects cognitive and behavioural changes as summarised in table 2.4 below. Schroeder et al. (2002) then define external learning as “inter-organisational learning through problem solving with customers and suppliers” (p108). However, there is a need to extend this view in two key areas. Firstly, the original work is limited by only considering two sources of external knowledge. Extant literature has suggested far greater opportunities for sources of external knowledge- for example, Naylor et al. (2001) proposed 4 sources, Fosfuri and Tribó (2008) 7 sources, and Smith et al. (2005) 8 sources. The second limitation is in the lack of detailed discussion on what external learning entails, thus the field of knowledge acquisition is drawn upon. In doing so, external learning resembles knowledge search routines such as March's (1991) exploration perspective, and other similar processes like extracting, interpreting and transferring knowledge (Carayannis, 1999, Hughes et al., 2007a).

Learning mode	Theory	Factors
Internal Learning	Organizational Learning	1. Training 2. Employee suggestions 3. Cognitive and behavioural changes
External Learning	Knowledge Acquisition	1. External knowledge sources 2. Knowledge search routines

Table 2.4: Extended perspective on Internal and External Learning

2.1.6.4 Organizational Ambidexterity

Organisational ambidexterity builds on March's (1991) explore-exploit perspective of Organisational Learning by theorising a balance between these two perspectives, a subject covered in detail in Matthews, Tan and Marzec (2012). Two definitions of this theory can be identified- first, consistent with March's original notion, He and Wong (2004) define ambidexterity in terms of exploration and exploitation. Conversely, Birkinshaw and Gibson view it in terms of *alignment* and *adaptability*- the simultaneous capacity to achieve alignment and efficiency in managing current business demands, while also being adaptive to changes in environment (Birkinshaw and Gibson, 2004, Gibson and Birkinshaw, 2004). In either definition, what is consistent is the notion of achieving ambidexterity between the two dichotomies, which Gibson and Birkinshaw (2004) conceptualise as two forms. *Structural* Ambidexterity reflects the phenomenon of "dual structures" where one structure focuses on exploration/adaption (i.e. research and development) whilst another focuses on exploitation/alignment (i.e. Production). *Contextual* Ambidexterity argues against the creation of dual structures by focusing on the simultaneous demonstration of alignment and adaptability. In short, processes and systems are developed to: a) encourage individuals to make their own judgments about how to divide their time; and b) support individuals such that both alignment and adaption are equally rewarded, so for example, so the dilemma of continuing to focus on existing customers to meet quota verses nurturing new customers does not arise (Gibson and Birkinshaw, 2004).

2.1.6.5 Absorptive Capacity

Absorptive Capacity (ACAP) is "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990; p128). As one of the more prevalent theories in the Knowledge-based view, in addition to Organisational learning and Ambidexterity, it too is a multifaceted theory. First are the hierarchical perspectives; as Cohen and Levinthal (1990) mention in the founding work on the subject, that Absorptive Capacity (ACAP) is predominately a firm level theory, however, it depends largely on the absorptive capacities of its individuals and the investment in developing individual's absorptive capacities. Thus organisational level ACAP is not simply the sum of individual's ACAP, but governed by the firm's ability to transfer knowledge, which may limit or enhance such capabilities. It should be noted that several authors have called for further work in this area given the limited attention that the individual's role in ACAP has been given (c.f. da Mota Pedrosa and Jasmand, 2011b, Hotho et al., 2011, Da Silva and Davis, 2011, ter Wal et al., 2011, Deng et al., 2008).

The second perspective is in the interpretation of the theory itself; Cohen and Levinthal's (1990) original work implies two holistic views of ACAP- a Cognitive view and a Process view. The cognitive view suggests that prior related knowledge affects the ability to assimilate new knowledge, or more simply, the more that *is* known the more that *can* be known. Studies such as Matusik and Heeley (2005), Tsai (2001) and Tu et al. (2006) incorporate such a loose perspective of ACAP. The process view on the other hand, looks to disentangle the individual stages by which knowledge is *recognised*, *assimilated* and *applied* (Todorova and Durisin, 2007). The most seminal work on this perspective is Zahra and George's (2002) "reconceptualisation and extension" of ACAP. In proposing a dynamic capabilities perspective of ACAP, this work suggests a four stage process of ACAP: *acquisition*, the identification and acquisition of externally generated knowledge; *assimilation*, interpreting and understanding of the externally generated knowledge; *transformation*, combining existing and the newly acquired and assimilated knowledge; and *exploitation*, the application of knowledge. Lichtenthaler (2009) later expands upon this by suggesting two additional processes- the *maintaining* of knowledge stocks, and the *reactivation* of maintained knowledge.

The third and final perspective builds on the process view in suggesting two modes to ACAP. As observed in Cohen and Levinthal's (1990) definition above, it makes a clear distinction between external knowledge, and the internal processes to capture it. Zahra and George (2002) extend this view in distinguishing between *Potential* ACAP, "the capability to value and acquire external knowledge" (p190); and *Realised* ACAP, "the firm's capacity to leverage the knowledge that has been absorbed" (p190). Lichtenthaler (2009) later redefined these capabilities as explorative learning (aka Potential) and exploitative learning (aka Realised). In doing so, ACAP is distinguished by the ability to recognise, acquire and assimilate knowledge with a focus on activities outside/external to the firm; and the ability to transform, apply and exploit knowledge by processes within/internal to the firm.

2.1.6.6 Learning Perspectives

The following perspectives are drawn from more pedagogical aspects of learning and knowledge. The discussion follows on from work published by Marzec and Tan (2010) and are summarised in Table 2.5 below.

Model	Basic Premise	Goals	Major Assumptions	Learning Environment
Objectivist	Learning is the absorption of objective knowledge	Transfer of knowledge from instructor to student	Instructor houses all necessary knowledge	Lecture
Constructivist	Learning is the construction of knowledge by the individual	Formation of concepts to represent reality	Learning is best when individuals discover things themselves	Research
Collaborative	Learning emerges through shared understanding	Promote group skills and socialising-communication, listening, participating	Involvement is central to learning	Group work
Experiential	Learning through doing	Provide first hand learning experiences	Learning occurs best when actively involved in a real world task	Field work

Table 2.5: Summary of learning styles adapted from Leidner and Jarvenpaa (1995)

2.1.6.6.1 Objectivist learning

The objectivist model views learning as the transfer of knowledge from the expert to the novice, typified by the traditional classroom (Hornik et al., 2007, Leidner and Jarvenpaa, 1995). It thereby assumes: 1) there exists a reality; 2) reality can be represented and transferred; 3) the mind acts as a mirror to reality rather than an interpreter; and 4) all learning is essentially the same (Leidner and Jarvenpaa, 1995). Consequently, the goal of learning is to efficiently transmit knowledge from the expert to the novice, with an emphasis on the presentation of information and mechanisms to enhance this (Leidner and Jarvenpaa, 1995). Consequently, interfaces that promote the flow of explicit knowledge such as online presentations, manuals, guidelines and so forth fall into this aspect of learning (Hornik et al., 2007). In this way, many of the studies that focus on knowledge transfer and explicit knowledge could be interpreted as objectivist style learning.

2.1.6.6.2 Constructivist Learning

The primary competing model to the Objectivist model is the Constructivist Model which denies the existence of an external independent reality and instead focuses on interpreting reality (Leidner and Jarvenpaa, 1995). The Constructivist model takes the view that knowledge is created rather than transmitted as the Objectivist model suggests (Leidner and Jarvenpaa, 1995). In doing so, it shifts the focus to a individual-centred approach where learning best occurs with the individual actively pursuing new knowledge rather than the instructor transmitting it (Hornik et al., 2007, Leidner and Jarvenpaa, 1995). Consequently, learning is assumed to be best when individuals are forced to discover things themselves through hypothesising, predicting, posing questions and researching answers rather than being told or instructed (Leidner and Jarvenpaa, 1995). With extant literature primarily focused on more social aspects (i.e. teamwork), the consideration of this form of knowledge may provide interesting new insights to the KBV.

2.1.6.6.3 Collaborative (Sociocultural) learning

Collaborative learning is an extension of the constructivist model and uses interactions in group settings to facilitate learning (Yazici, 2004, Leidner and Jarvenpaa, 1995, Hornik et al., 2007). Learning is achieved via cognitive conflicts through discussion, opinion exchange and the sharing of knowledge that force reflection and cognitive change (González and Blanco, 2008, Hornik et al., 2007). Consequently, there are several key

assumptions of this model. Firstly, that individuals have prior knowledge to share (Leidner and Jarvenpaa, 1995). Secondly, that participation and interaction with peers is expected to lead to learning and is subsequently critical to the process (Leidner and Jarvenpaa, 1995, Umble et al., 2008). Finally, learners will participate if given optimal conditions such as small group sizes or other cultural conditions (Leidner and Jarvenpaa, 1995). Consequently, studies into the relationship between this learning style and performance has suggested that team learning increases involvement, improves problem solving and communication skills and enhances student achievement (Yazici, 2004); discussions and information sharing helps to verify, solidify and improve mental processes (Leidner and Jarvenpaa, 1995); and that this method has been shown to motivate learning and create positive changes in social attitudes (Leidner and Jarvenpaa, 1995). Thus, this model of learning would be well suited to studies on knowledge-based activities in team settings.

2.1.6.6.4 *Experiential learning*

Experiential learning is the process where knowledge is created through the transformation of experience (Polito et al., 2004, Wood et al., 2008). It reflects the notion of “learning by doing” and the importance of first-hand experience. This learning style was founded on the work by Kolb (1984) and particularly his four stage learning cycle: *concrete experience*, where a learning experience has occurred; *reflective observation*, whereby the experience is reviewed and reflected upon; *abstract conceptualisation*, where conclusions are drawn from the experience; and *active experimentation*, where the conclusions and learning is tried out which leads back into *concrete experience*. However, Garris et al. (2002) emphasises that learning through experiential activities must be adequately combined with an appropriate level of background learning for effective learning to occur. This model of learning could thus support more established theories such as ACAP for which experience plays a central role.

2.1.6.7 *Uncertainty Reduction Theory*

Uncertainty reduction theory is based on the premise that uncertainty is unpleasant and so it motivates action to reduce it (University of Twente, 2013). The founding work on this theory by Berger and Calabrese (1975) takes the view of reducing uncertainty through communication, which in light of the KBV, can better be interpreted as the flow of knowledge. Of relevance to the knowledge-based view is its conceptual application to

"newness" of knowledge through which Schulz's (2001) work on the uncertainty of newness can be viewed. Schulz (2001) highlights the self-motivating relationship between knowledge renewal and knowledge acquisition by suggesting that the exposure to new knowledge through knowledge acquisition affects the relevance of current knowledge and thus its level of uncertainty. The reduced confidence in extant knowledge leads to a demand for more information (i.e. knowledge renewal) to re-stabilize the knowledge environment, thus the need for further knowledge acquisition.

2.1.7 Variables

The following section outlines the key variables present in extant empirical work in the KBV. In doing so, they represent variables that may similarly play an important roles in the Knowledge-Based View of Process Improvement. This section thus provides a foundation from which the subsequent exploratory interviews can draw on.

2.1.7.1 Trust

Klein (2007) and Renzl (2008) both refer to trust in their works on knowledge sharing. Klein (2007) contrasts buyers and suppliers trust in the outsourcing of supply chains and utilise three dimensions to trust- *ability*, the level of trust in ability and expertise; *benevolence*, trust that others will act in a positive manner; and *integrity*, the perceived level of devotion to a set of generally accepted principles. Renzl (2008) take a more unilateral view of trust in knowledge sharing by conceptualising benevolence-based trust in management as an antecedent to knowledge sharing. Similar to Klein (2007), Levin and Cross (2004) appreciated the multidimensional nature of trust and found that benevolence and competence-based trust mediated the relationship between the strength of network ties and knowledge transfer. In a second example of trust in knowledge transfer, Easterby-Smith et al. (2008b) argues that trust creates a sense of security and so facilitates knowledge transfer though an underlying notion that the knowledge produced will not be exploited beyond what is intended. Finally, from a knowledge creation perspective, von Krogh et al. (2011) and Choo et al. (2007b) make mention of the development of trust through the knowledge creation process. Trust can be fostered through leadership and management but they cautions against the managing or 'engineering' of such a culture; and in a similar vein to Easterby-Smith et al. (2008b), trust to create a psychologically safe environment for risk-taking, learning and knowledge creation.

2.1.7.2 Leadership

The extensive review by Von Krogh et al. (2011) on leadership in knowledge creation identifies several aspects to leadership that impact the flow of knowledge. They mention that in the majority of studies, leadership is often mentioned only in passing, and when it is discussed, it is viewed as an activity exercised by a privileged few in the upper echelons of the firm. In rebuttal to this, they introduce the nature of centralised and distributed leadership- *centralised leadership*, mirroring the normative sentiments regarding positions and activities controlled by a central authority; and *decentralised leadership*, where leadership is distributed among individuals. In this way, decentralised leadership becomes an "outcome of cooperation between individuals that manifests itself in their shared direction, the alignment of their behaviour, and their mutual commitment to a particular practice" (p253), and thus conceptually aligned to knowledge creation. Von Krogh et al. (2011) further introduce several perspectives of leadership and in brief: style theories, which focus on what leaders do and the roles they take; contingency theories, which take a more dynamic view to leadership by addressing the interactions between situations, followers, and leaders; and strategic leadership, the focus on how leaders impact organizational effectiveness. Again in knowledge creation but in the context of Six Sigma projects, Choo et al. (2007b) emphasise that the role of top management is to not only provide financial and strategic support, but more so to champion initiatives and ensure continuity of effort. Richtnér and Åhlström (2010) reflect this notion in their account of knowledge creation in new product development. They distinguish between formal control mechanisms such as written directives, procedural framework, and reports, which reflect the financial and strategic support of Choo et al.; and informal control mechanisms, such as the level of personal involvement, facilitation, and actively changing and redirecting projects, reflecting the champion aspect of leadership.

2.1.7.3 Motivation

Siemens et al. (2008) suggest that knowledge sharing can only occur when there is the *motivation* or willingness to do so, the *opportunity* or contextual mechanisms that enable action, and the *ability* or skills to undertake the action. Their use of the motivation-opportunity-ability model highlights the importance of motivation in knowledge flows; however, their work lacks a clear definition of motivation and its underlying dimensions. In this regard, Osterloh and Frey's (2000) work on the types of motivations needed for

knowledge transfer provides insight. The work juxtaposes two types of motivation with the level of tacitness of knowledge. Motivation here is seen as either intrinsic- i.e. indirect motivations such as monetary compensation; or intrinsic, where actions are valued for their own sake such as obtaining personal goals. In greater detail, Füller (2010) not only proposes an additional type of motivation, *internalised extrinsic*, but also a continuum of motivations as summarised in the table below. This work explored the motivations of customers for engraining in the co-creation of new products and the inherent transfer of tacit knowledge that is associated with it. Lastly, Szulanski (1996) incorporates the notion of motivation in knowledge transfer by separating the underlying characteristic of the knowledge source, and the knowledge receiver. On the part of the knowledge source, they may be hesitant to share for fear of losing ownership, privilege, or superiority; or they may simply be unwilling to devote time or resources. On the part of the receiver, Szulanski refers to the “not-invented-here” syndrome, or the reluctance to accept knowledge from outside the firm.

	Motivation	Description
Intrinsic	Intrinsic Playful	Contribute as they consider it as playful and enjoyable activity
	Curiosity (CU)	Engage just because they are curious
Internalized Extrinsic	Altruism	To support producers in innovating new products
	Make Friends	Getting in touch with like-minded people
	Self Efficacy	Derived from a sense of accomplishment due to their contributions
	Information Seeking	Looking for information relevant to them or pertinent to their hobby
	Skill Development	Improve their skill and gain knowledge
	Recognition	Participate for ego gratification or the desire for peer recognition
Extrinsic	Dissatisfaction	Engage because they are dissatisfied with existing products
	Compensation	Expectation of payment for efforts given

Table 2.6: Continuum of Motivation

(Adapted from Füller, 2010)

2.1.7.4 Nature of knowledge

As mentioned before, the most widely adopted typology of knowledge is Polanyi's (1966) tacit-explicit dimensions made famous in Nonaka's (1994, 2000) work. In the majority of cases, tacitness of knowledge is used as a moderating or control type variable (c.f. Hansen et al., 2005, Arikian, 2009, Osterloh and Frey, 2000, Bierly III et al., 2009, Levin and Cross, 2004). In addition to tacitness, Easterby-Smith et al. (2008b) refers to the nature of knowledge as also including knowledge complexity and ambiguity, however, relatively sparse details are provided on these. Van Wijk et al. (2008) in their meta-analysis of knowledge transfer, refers to knowledge ambiguity as the inherent uncertainty as to what the underlying knowledge components are and how they interact. Such attributes were said to protect knowledge from being imitated by rivals and hinder knowledge transfer. Regarding knowledge complexity, Pérez-Luño et al. (2011) define it as the number of unique and interacting elements. They add that "elements are distinct when an individual cannot use the same knowledge to understand them, such that increasing the number of unique elements increases the amount of information that must be processed to understand the system's behaviour" (p1371). Consequently, a more rounded notion of knowledge aside from tacitness is also prevalent in the literature.

2.1.7.5 Organisational climate

Liao et al. (2011) and Tu et al. (2006) both refer to the importance of communication climate, the accepted communication behaviour within an organisation which may facilitate or hinder the communication processes. In both studies, communication climate was seen as an antecedent to either knowledge transfer (Liao et al., 2011) or knowledge assimilation (Tu et al., 2006). In the work by Smith et al. (2005) on knowledge creation, an organisational climate of risk taking and teamwork was found to be antecedents to a knowledge creation capability. In a similar field, Nonaka (1994) posits that a "prime mover" for knowledge creation is individual commitment, and of note, the degree of autonomy. Nonaka argues that fostering autonomy increases the probability that individuals will motivate themselves to form new knowledge, and increase the possibility of introducing unexpected opportunities. These notions of risk taking and autonomy appear as sub-dimensions to a broader measure of organisational climate known as *entrepreneurial orientation*, a firm's propensity to act entrepreneurial (Lumpkin and Dess, 1996). Entrepreneurial orientation consists of five sub dimensions: autonomy; risk taking; innovativeness, the tendency to engage and support new ideas, creativity, and

experimentation; proactiveness, a forward-looking perspective that looks to anticipation of future problems, needs, or changes; and competitive aggression, propensity to directly and intensely challenge competitors. Consequently, a number of studies have utilised this measure to explain knowledge flows (i.e. Li et al., 2010b, Li et al., 2011, Hughes et al., 2007a). Importantly, Wang (2008) identified an entrepreneurial orientation of proactiveness, innovativeness, risk taking and aggressiveness as key antecedents to an organisation's learning orientation. In doing so, it highlights that such an orientation is distinctly related to organisational knowledge flows.

2.1.7.6 Individual's traits

As highlighted by the trend towards the micro-foundations of capabilities, absorptive capacity theory, and the 4I model of Organisational learning, the individual and their traits play a key role in knowledge flows. In so doing, the literature suggests three key characteristics. Firstly, *experience*, as it leads to greater expertise and more relevant knowledge which can be incorporated into knowledge flows (Smith et al., 2005). Secondly, *education* not only improves the understanding of what is known, but more so, it motivates and changes to one's knowledge base that can greatly influence cognitive reasoning skills (Smith et al., 2005), akin to uncertainty reduction theory. Finally, functional heterogeneity refers to the variation in an individual's work experience which can induce cognitive conflict and thus knowledge renewal (Smith et al., 2005), and/or connect different loci of knowledge to generate novel and new knowledge (Schulz, 2001). McDonald and Westphal (2003) categorizes functional background into three categories: functions based on a *throughput*, for example operations and engineering; functions based on an orientation of *output* such as sales and marketing; and peripheral functions such as finance and law.

2.1.8 Summary and Gaps

The intent with this section was to first outline the motivations for adopting the knowledge-based view and to clarify its constituent definitions and processes. It highlighted the research's focus on the tacit forms of knowledge (Level 3 & 4 in the knowledge hierarchy) and its association with competitive advantage. As Section 2.5 will show, this form of knowledge is only transferred through social interaction, thus the need for social networks.

Secondly, it introduces the Knowledge Process in order to detail the stages in knowledge intense activities and relate extant KBV thinking. In doing so, it helps relate the research's focus on knowledge acquisition within the broader topic of the KBV as Section 2.4 below details further.

Finally, it scoured the literature for feasible theories and variables that might be attributed to a knowledge-based view of process improvement. This exercise was done to feed into the subsequent exploratory case interviews and help shape the interview protocol. The key here was to mitigate against “re-inventing the wheel” which grounded-theory approaches can be liable to, whilst avoiding fixating on a relatively few factors and “squeezing” results to fit which confirmatory approaches can be criticised for.

Equipped with an understanding of the theoretical underpinnings of this research, the following section explores its context, process improvement.

2.2 Process Improvement

2.2.1 What is Process Improvement?

Prior to reviewing the research in this field, it would be timely to juxtapose the terms Continuous Improvement (CI) and Process Improvement (PI) to provide clarity in their definitions and relationship. Continuous improvement has been defined as “the bundle of routines which can help an organisation improve what it currently does” (Bessant et al., 2001; p68); “the planned, organized and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance” (Jørgensen et al., 2003; p1260); and the “continuous identification and elimination of waste [and] a series of small, strategic improvements” (Chen et al., 2010; p1070-71). Conversely, Process improvement has been defined as “the extent that work related processes in a business have been thoroughly identified, defined, and analyzed with the aim of detecting and resolving process-related problems” (Bhatt and Stump, 2001; p32); “to make business processes- interrelated activities, procedures, and behaviours- efficient, effective, and flexible” (Bhatt, 2000; p1334); and “process improvement corresponds to an increased value of processing capability” (Terwiesch and Bohn, 2001; p10). From these definitions, continuous improvement can be viewed as small, incremental, ongoing, and strategically orientated improvement activities; whilst process improvement, as the name implies, focuses on process elements such as efficiency, effectiveness, and capability.

However, these distinctions are blurred with the intertwining of these definitions. For example in referring to process improvement, Mellat-Parast and Digman (2008) state “both practitioners and scholars recognize continuous improvement as one of the major principles of QM” (p824). Others refer to *continuous process improvement* as a means “to improve the non-value-added or low efficient processes step-by-step...so that the business processes can be improved steadily and continuously” (Lee and Chuah, 2001; p702) which “advocates firms to invest continuously to improve their production processes” (Li and Rajagopalan, 2008; p61). Lastly, Aurich et al. (2009) uses the term *continuous improvement process* as “a well-established method to improve manufacturing processes” (p5297). What is ascertained from these statements is the close relationship between continuous improvement and process improvement. In disentangling

these terms, Bateman (2005) suggest that “continuous improvement is regarded as the extension of process improvement” (p274). This view is similarly shared by Anand et al. (2009) who defines CI as “a systematic effort to seek out and apply new ways of doing work i.e. actively and repeatedly making process improvements” (p444); and Lagrosen et al. (2011) make reference to “the on-going or continuous improvement by means of process improvement” (p26). Lastly, Rich and Bateman’s (2003) work suggests that “the difference in the two approaches [PI and CI] concerns the length of time over which the improvement activity is focused, with continuous improvement taking place over a comparatively longer duration whilst process improvement interventions happen in the short term.” (p186). In this manner, continuous improvement is the accumulation of multiple process improvement initiatives. Thus, focusing on the more monomer-level of process improvement, it is both more pragmatic by focusing attention at the most simplistic level, as well as providing greater value by 'organizationally amplifying' benefits when moving from the simplistic to the complex (c.f. Nonaka, 1994 in reference to individuals above).

2.2.2 Why Process Improvement?

The context of process improvement is motivated from a number of angles. Firstly, process improvement is vital within the context of operations management given the claim that “process improvement is central to Operations Management” (Anand et al., 2010; p304). Secondly, in addition to the central nature of process improvement, research into this topic is timely given suggestions such as “organisations no longer compete on processes but the ability to continually improve processes” (Anand et al., 2009; p444). This timeliness point is mirrored in industry by: a) Deloitte Consultancy who suggest that “63% of respondents [to their Global Shared Services Survey] said that process improvement, a key driver of cost reduction, would be one of their top three priorities over the next two years” (Deloitte, 2009; p3); and b) Topconsulting.com, the industry leader in Management Consulting News in the UK, in a recent recruitment report stress that “for the second year running, Business Process Improvement specialists are likely to be in greatest demand” (Top-Consultant.com, 2011; p12). Thirdly, at a more pragmatic level, process improvement is considered necessary for firms to continually adapt to operating environments (Anand et al., 2009, Lee et al., 2011). Furthermore, it provides a means for creating new knowledge about processes which can subsequently increase their productivity and the competitive positions of organizations (Anand et al., 2010). In

extending this, the work of Bessant et al. (2001) on the evolution of a continuous improvement capability suggests that at its most developed level, a continuous improvement capability is equivalent to the learning organisation. In doing so, it provides an explicit linking between knowledge and improvements thus reinforcing the intent of this research. Fourthly, McKinsey & Co's report *on The Productivity Imperative* emphasises the need for productivity-based activities for two key reasons: first, in an economic argument regarding lasting national employment gains, that "In the United States, for example, every point of productivity-led GDP growth has historically generated an incremental 750,000 follow-on jobs" (Bisson et al., 2010; p2). Second, that for developed nations to sustain wealth creation, they must find ways to boost productivity, with product and process innovation as key (Bisson et al., 2010), noting that "innovation in the manufacturing sector generally focuses on process improvements" (Terziovski, 2010; p893). These aspects highlight that a focus on process improvement can go beyond mere firm-level benefits to influence national wealth creation. Finally, and on a more personal note, I have an intrinsic interest in the topic having worked professionally in the area for 5+ years as well as being Lean Six Sigma Green belt trained.

2.2.3 Theoretical views: an Evolution of Process Improvement Thinking

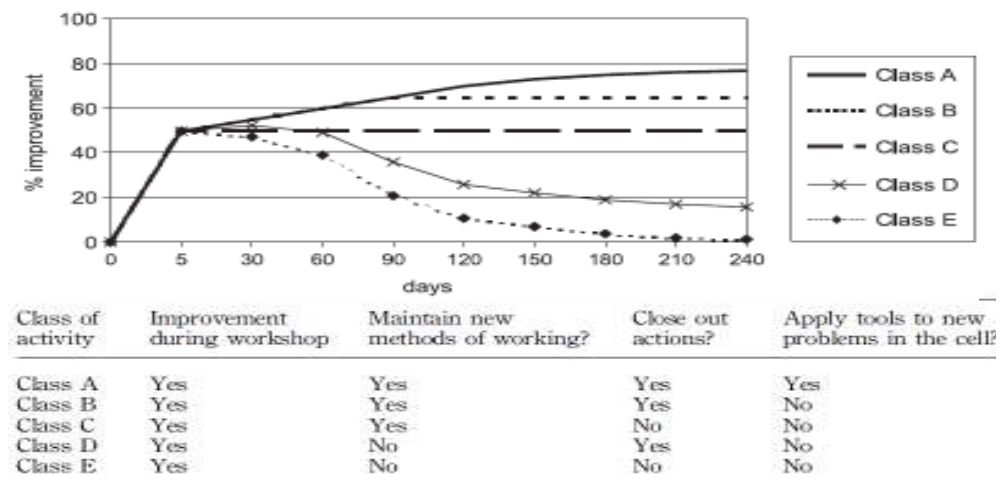
In critiquing the work of Bessant et al. (2001), Wu and Chen (2006) introduce the notion of a behavioural perspective of improvement activities. Extending this notion, the literature on continuous/process improvement can be seen as having a number of distinct perspectives. To do this justice, a similar approach to previous sections was used to review this literature, namely via a systematic search of the domain, the results of which are shown in Appendix 2.

2.2.3.1 The Structuralist view

This perspective is concerned with process improvement as a methodology, attributes, or a selection process. Most notable are the structured tools that have become famous within OM and process improvement such as the PDCA and DMAIC cycles, Six Sigma, and Theory of Constraints (Choo et al., 2007a, Schroeder et al., 2008). Furthering this for example, Herron and Braiden (2006) develop a three step model for sustaining processes starting with a Productivity Needs Analysis (PNA) to identify the current state and problems; then the Manufacturing Needs Analysis (MNA) which provides a plan of

action; and finally a Training Needs Analysis (TNA) to embed the improvements. Similarly, Wu and Chen (2006) develop a five stage evolution of CI activities with problems, models and tools, and promotion, at its core.

In regards to the attribute dimension of the structuralist view, these studies explore the factors of process improvement activities that may lead to sustainable improvements. For example, the self-assessment process by Jørgensen et al. (2003) to identify barriers to CI implementation or Bateman's assessment (Bateman and David, 2002, Bateman, 2005) which provides a longitudinal study on the effects of lean training and kaizen events within a manufacturing cell. Based on whether groups maintained the new working methods, whether all kaizen actions were closed out and if the tools were applied to other issues, they identified five classes of responses as shown in figure 2.3 below.



*Figure 2.3: Longitudinal performance of lean training
(from Bateman, 2005)*

The third and final type of study are those that concern themselves with the selection of process improvement tools. Tan and Platts (2003) develop a model based on weighted criteria and the analytic hierarchy process (AHP), a pair wise exchange algorithm, to identify and subsequently select appropriate action tools given a particular strategy. Thawesaengskulthai and Tannock (2008) similarly use a multiple criteria decision-making (MCDM) method to identify improvement initiatives.

2.2.3.2 The Behavioural view

Bessant et al. (2001) argue against the structuralist view on three accounts. Firstly, they suggest it is often too prescriptive and fails to consider implementation issues. Secondly, when it does consider implementation, it assumes a direct correlation between the exposure to improvement tools and improvement itself, thus neglecting other behavioural elements. Finally, it assumes a split between having and not having CI, rather than its emergence over time and evolution of new behaviour. Later, Delbridge and Barton (2002) reinforce these sentiments by remarking that “much of the emphasis in recent research on continuous improvement has been on patterns of behaviour” (p682). Consequently, the behavioural view stems primarily from Bessant and the related work on the CIRCA (Continuous Improvement Research for Competitive Advantage) project (c.f. Bessant et al., 2001, Bessant and Francis, 1999, Caffyn, 1997, Kerrin, 1999). This view sees continuous improvement as involving the acquisition and embedding of key behaviours such as formal problem-solving, teamwork, training, idea management, recognition and rewards, and responsibility/accountability (Bessant and Francis, 1999). The CIRCA project developed a five-level evolution of a continuous improvement capability, starting from reactively identifying the need for process improvement, through to process improvement as a strategic concern, with the final evolution to becoming a learning organization. Other authors have taken the behavioural view slightly differently. Kaynak (2003) investigated the link between TQM and firm performance by focusing on “TQM practices” such as leadership, training and employee relations, which by definition are behavioural aspects. Treville and Antonakis (2006) explored the nature of lean production practices from three areas of motivation: (a) the role of contextual factors, (b) the effects of work practices, and (c) the implications of the levels of analysis (i.e. individual and organizational levels). They conclude that lean production job design may intrinsically motivate but may be limited by excessive leanness and contingent on production configurations. Finally, Brah et al. (2000) summarise this perspective well in suggesting that “the key to the success of TQM lies in its intangible and behavioural features such as top management support, employee empowerment and employee involvement” (p1309).

2.2.3.3 The Capabilities view

The penultimate evolution of process improvement thinking is consistent with the wider acceptance of the Resource-Based View (RBV) with its focus on capabilities. Anand et al.'s (2009) views continuous improvement initiatives as a dynamic capability based on Zollo and Winter's (2002) definition of dynamic capabilities as “a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness.” (p340). In defining manufacturing strategy as a sequence of improvements, Paiva et al. (2008) argues that the RBV provides a more fine-grained understanding of how competitive advantage is achieved through the generation of valuable, rare and imperfectly imitable resources by operations. Thus they proposed that manufacturing strategies are formulated from different inputs composed from these resources. Peng et al. (2008) on operational capabilities, identify *improvement* as a key operational capability. The premise of this work was a framework for linking resources to firm-level capabilities based on the RBV. Resources were seen as the stocks of human capital, physical assets, and other tangible and intangible factors owned by the firm. Routines are then formed by clustering resources to create patterns of activities, behaviours, and practices. Then at the capabilities level, Peng et al. (2008) suggest that static capabilities are derived from operational routines that focus on current revenue and profit making; and dynamic capabilities from search routines that look to change existing routines or develop new ones.

2.2.4 Summary and Gaps

Process improvement was shown to be a critical area for research given its central role in operations management, and timely due to global competitive pressures. Past research has provided practitioners with considerable insights to organisational improvements; however, the field has been slow to adopting more modern thinking as the following section details.

2.3 The Knowledge-based View of Process Improvement

Just as the early 20th century saw the development of management theory for improving the productivity of factory workers, the 21st century will see the evolution of a myriad of better techniques for managing people who think for a living.

- McKinsey & Co, (Bisson et al., 2010)

2.3.1 What is the Knowledge-based View of Process Improvement?

The latest evolution of process improvement thinking follows the wider trend that is moving from the resource-based view to the understanding that knowledge is the key resource for sustained competitive advantage (Grant, 1996). Mukherjee and Lapré (1998) provide an early account for such a view in their work on knowledge-driven quality improvements. In this study, knowledge was encapsulated as experience and the understanding of new technologies and change. Within the context of quality improvements, notably TQM, it provides a context for ad hoc experimentation to better understand the world. In doing so, “operational learning” was found to facilitate the achievement of short-term quality goals. Lapré and Van Wassenhove (2001) follow on from this with their study on knowledge creation and transfer in manufacturing-based productivity improvements. The study proposed two learning dimensions to quality improvements, conceptual and operational learning. Conceptual learning concerns the acquisition of know-why, i.e. a better understanding of cause-and-effect relationships; and operational learning is the acquisition of know-how, i.e. obtaining validation of action-outcome links. The major criticism of this work is its focus on the learning curve and in deriving a mathematical algorithm to explain this. Such a positivist view of knowledge with its search for universal truth is epistemologically inconsistent to the more accepted socially constructed perspective of knowledge creation and flows (c.f. Karamanos, 2003, McAdam, 2004).

The KBV of process improvement did not receive an appropriate level of traction till 2006, a decade after Grant’s (1996) seminal work on the KBV, with Ferdow’s (2006) account of knowledge transfer and production know-how, as mentioned previously. This work highlighted two key points- firstly that knowledge provides “a recipe for action”. In this way, the identification of opportunities is better viewed as a function of knowledge

flows rather than abstract identification through structural methodologies. Secondly, that "ultimately, all knowledge management efforts in business organizations are supposed to help the organization produce and deliver better products and services- i.e., enable us in the production and operations management function do a better job. " (Ferdows, 2006; p1). Given such a comment, the alignment between a knowledge-based view and operational improvements is well justified.

Following this work, Choo et al. (2007a, 2007b) proposed two works on the role of knowledge creation in quality improvements. In these works, knowledge is demonstrated as the key resource in quality improvements in its definition as "new ideas, improved understanding, and the capability of a team doing a quality project" (Choo et al., 2007a; p437), and explicitly that "quality improvement is inherently a learning and knowledge-based activity that emphasizes learning and knowledge creation" (Choo et al., 2007b; p918). The works go on to propose three drivers to knowledge creation: *methodological* drivers centred on structured problem solving processes such as the PDCA and DMAIC cycles; *psychological* effects based on psychological safety or the belief that the team is safe from interpersonal risk taking such that new ideas or processes can be tried out; and lastly, *contextual* elements such as leadership support, resource availability and the setting of challenging work by management. In this way, methodological elements were empirically found to foster exploitative learning and the creation of explicit knowledge; contextual element supported exploratory learning and the creation of tacit knowledge. Whilst psychological elements were not found to support methodological elements nor learning behaviours (i.e. team interaction), but did support knowledge creation in the form of solution uniqueness, improved understanding and improved capabilities. In a subsequent work, Choo (2010) expands upon the contextual aspects by investigating the link between the sense of challenging work and knowledge creation. He conceptualised two forms of challenging work- a performance gap based on targets and goals, and problem-driven gaps based on the intensity of problem solving. The findings suggest that problem-driven gaps are far superior at creating a sense of challenge than performance-based targets, which subsequently lead to the creation of knowledge. Finally, Anand et al. (2010) argue that process improvements contribute to an organisation's competitive position by creating new knowledge about processes, thereby increasing their productivity. Thus they argue that knowledge creation provides an appropriate lens through which process improvement projects can be studied as it provides the means to

look beyond reactive corrections to root causes and the proactive identification of opportunities for enhancements.

In further support for these arguments and to objectively examine the extent of the knowledge-based view of process improvement, systematic literature searches of process improvement (Appendix 2) and knowledge processes (Appendix 3) and were created and subsequently searched with their respective terms. Namely, the process improvement database was searched for the single term *knowledge*; and the knowledge database was search for the terms *improvement*, *lean*, *six sigma*, *TQM*, *quality*, *Business Process Reengineering*, *TOC (Theory of Constraints)*, *problem solving*, *Toyota* and *JIT*. The result of this search provides the structure for the following six subsections.

2.3.1.1 Knowledge and Six Sigma

Gowen III et al. (2008) found that the application of knowledge management in conjunction with Six Sigma enhanced quality program results. The scope of this study not only supports the notion of a knowledge-based view of process improvement, its conceptualization of knowledge management as knowledge acquisition, knowledge dissemination, and knowledge responsiveness, it also supports the focus on knowledge acquisition as a key area of concern within process improvement. Anand et al. (2010) provide a foundation for viewing process improvement as activities that create and capture both explicit and tacit forms of knowledge. Using Nonaka's (1994) SECI model in reference to a number of six sigma practices, they explore the stages of transforming of external, explicit knowledge to internalized tacit knowledge and its effect on project success. Project success in this case was measured in terms of: (1) the level of process improvement that was realized as a result of the project; (2) whether the project provided immediate benefits; and (3), whether the project provided long-term benefits. The study suggests that a technical orientation that captures explicit knowledge through internalisation (i.e. error proofing, control charts) and combination (i.e. Design of Experiments, QFD) is significant and positively related to project success. In regards to the social orientation that captures valuable tacit knowledge through socialisation (i.e. brainstorming, 5-why's) and externalisation (i.e. VSM, FMEA), this was also found to be significant and positively related to project success. These two studies clearly illustrate the feasibility of a knowledge-based view of process improvement.

2.3.1.2 Knowledge and Lean/JIT/TPS

By utilising the absorptive capacity framework, Tu et al. (2006) investigate knowledge assimilation, sharing and learning in manufacturing. This work studied the impact of absorptive capacity (i.e. prior knowledge, communication network, communication climate, knowledge scanning) on customer value (i.e. quality, loyalty). In this case, several time-based manufacturing practices were suggested to mediate this relationship. Of interest in this section was the cellular manufacturing and pull production practices, which were both found to be significantly related to absorptive capacity and customer value. It was also noted that in both cases, the knowledge scanning dimension of absorptive capacity, activities that “monitor the environment and identify external concepts and ideas that may be useful to the firm” (Tu et al., 2006; p693), was the strongest antecedent to time-based manufacturing practices. This provides evidence to suggest that knowledge acquisition, as defined in this research, plays a fundamental role in the success of process improvement practices. In a second example, Li et al. (2005) investigated six supply chain management practices, of which information sharing and lean practices were two. It was found that both these two factors were significant and positively related to delivery dependability and time to market, again supporting the knowledge-based view.

2.3.1.3 Knowledge and TQM

Chiles and Choi (2000) remark that “knowledge is a construct of great practical importance to TQM” (p199). They suggest four fundamental orientations of TQM-systems, customers, learning and change, of which learning orientation is of interest to this study. In this dimension, they view continuous improvement as the unending cycle of Plan-Do-Check-Act, which results in continuous learning. They subsequently suggest that at the foundation of this unending cycle, and hence continuous improvement, is benchmarking where “organisations acquire knowledge about best industry practices, and learn to develop more efficient work processes and improve products and services” (p189). This definition closely matches Zahra and George’s (2002) definition of knowledge acquisition as the activity of identifying and acquiring externally generated knowledge (see section 2.1.3.2). From this perspective then, knowledge acquisition (aka benchmarking) forms the cornerstone of process improvement.

2.3.1.4 Knowledge and Quality Management

This section documents the use of knowledge in regards to quality and quality management in a broader context thereby separating itself from the quality management as TQM. Adrian Choo and Kevin Linderman are standout authors in this area having produced three key works on this topic. Firstly, the conceptual paper by Linderman et al. (2004) integrates quality management practices with knowledge creation processes in a similar way as later done by Anand et al. (2010). In this study, Nonaka's SECI process was again incorporated and theoretically proposed as a mediating variable between the quality management practices (customer satisfaction, continuous improvement, a systems view) and knowledge creation. In a second conceptual paper, Choo et al. (2007b) link methodological and contextual elements of a quality program to explorative and exploitative learning. They suggest that methodological elements such as structured problem-solving, metrics and analysis, result in a higher exploitative learning and facilitate the creation of explicit knowledge. On the other hand, contextual elements such as leadership support, trust, and resource availability result in higher exploratory learning and tacit knowledge creation. In a third and final study, Choo (2010) empirically explored the effect of problem-based verses performance/target-based gaps on knowledge creating 1500 quality improvement projects. In this work, knowledge creation was seen as the enhancement of team ability, the development of unique solutions, and the volume of ideas created. The results indicate that a problem-driven gap has significantly larger effect on knowledge creation than a performance-driven gap.

2.3.1.5 Knowledge and PI Outcomes

The final section in examining the support for a knowledge-based view of process improvement is to provide an account of the studies that link knowledge-based activities with outcomes that would be suggestive of planned process improvement activities; however, this process improvement is not formally mentioned in the study. Morris et al. (2006) provide the first of such studies where the use of learning networks were used to aid in benchmarking activities leading to the improvement of operations in terms of cost, quality, lead-time, flexibility, capacity to change and innovation. Secondly, Fugate et al. (2009) link the improvement in knowledge management to operational performance in terms of efficiency (i.e. DIFOT, inventory turns) and effectiveness (transportation, warehouse and inventory costs). Finally, Kotabe et al. (2003) investigated two forms of knowledge exchange (technical exchanges, or the exchange of engineering knowledge;

and technology transfer, where partners access or replicate complete technological capabilities of the other partner) and its effect on operational performance improvement (product design, process design, quality, lead-time). These three studies intrinsically reflect the relationship between knowledge and process improvement as suggested in this work.

2.3.2 Problem Solving: the Intersection of Knowledge & Process Improvement

In explaining the central role of problem solving in process improvement, Upton and Kim (1998) refer to factory floor process improvement as in-line problem solving. Others have mirrored this sentiment, i.e. kaizen has been referred to as continual problem solving (Terziovski and Sohal, 2000); continuous improvement abilities include problem-solving skills (Bessant et al., 2001); and for continuous improvement, employees require training in the use of structured problem solving (Anand et al., 2009). Choo et al. (2007b) and Choo (2010) therefore suggest that structured problem solving is a key methodological element of process improvement. Hence, it is no surprise to find that widespread process improvement methodologies such as DMAIC and the PDCA cycle are inherently problem-solving methods (Terziovski and Sohal, 2000, Herron and Braiden, 2006, Linderman et al., 2003), thus highlighting the intimate relationship between process improvement and problem solving.

On relating knowledge and problem solving, Von Hippel (1994) state that “to solve a problem, needed information and problem-solving capabilities must be brought together” (p429). Koskinen and Vanharanta (2002) add that “when people attempt to solve their problems, they are guided by the knowledge they have gained from similar problems earlier” (p58). In light of previous discussions which refer to the development of capabilities as knowledge and learning based activities (Kogut and Zander, 1992, Zollo and Winter, 2002), these statements demonstrate a three-fold role of knowledge in problem solving, and hence its centrality. Cohen and Levinthal (1990) viewed problem solving as the capacity to create new knowledge and more poignantly, suggested that problem solving and learning are so similar that there is little reason to differentiate them. Zahra and George (2002) follow on from this in suggesting that the ability to solve problems comes from modifying, contextualising and transforming new knowledge.

Finally, in relating structured problem-solving to knowledge acquisition, Naylor et al. (2001) suggest that opinions gained through discussions with experts is the only relevant source of knowledge during the ‘fuzzy’ front end of the problem solving (Reid and Brentani, 2004), namely problem identification, problem definition and idea generation.

Given these points, problem solving would appear to be an elegant solution for marrying process improvement with knowledge. Such a view is shared by Ni and Sun (2009) who suggest that when continuous improvement teams learn, it is for the purpose of solving a problem. Delbridge and Barton (2002) also emphasise that a key attribute in contemporary manufacturing is the role of knowledge sharing and application to solve problems and continuously improve.

2.3.3 Summary and Gaps

In documenting the evolution of process improvement thinking, this section highlights that a knowledge-based view (KBV) is timely and yet under research. Furthermore, process improvement (PI) was also shown to be a vital element of operations management and a timely aspect to investigate given current market environments. Thus, the KBV of PI provides an appropriate area for research. Perhaps more so though, given that a PhD as an *academic apprenticeship*, it is a suitably large and important area in which to establish and grow a career.

2.4 Knowledge Acquisition

2.4.1 What is Knowledge Acquisition?

Huber (1991) defines knowledge acquisition as the “process by which knowledge is obtained” (p90). Given such a broad definition, he also remarks that the literature on it is voluminous and multi-faceted and so suggests knowledge acquisition has five sub-processes. *Congenital* learning is the stock of knowledge possessed at a particular time (Huber, 1991, Chandler and Lyon, 2009). *Experimental* learning is learning from the outcomes of past experiences (Huber, 1991, Chandler and Lyon, 2009). *Vicarious* learning by observing and imitating others (Huber, 1991). *Search-and-notice* learning occurs through scanning the environment and actively seeking information to solve specific problems (Huber, 1991, Chandler and Lyon, 2009). Finally, *Grafting* is the formal purchase/acquisition, collaboration, or joint venturing with other firms such that their competencies are grafted on to the central firm (Huber, 1991, Chandler and Lyon, 2009).

To provide a richer consideration of the characteristics of knowledge acquisition given Huber’s remark above, several parallel topics are also drawn upon to elicit three perspectives of knowledge acquisition- a process view, knowledge mining view, and advice seeking behaviour as summarised in Table 2.7 below. The process perspective looks to disentangle the micro processes involved in knowledge acquisition, reflecting comments made by Huber (1991) and by King et al. (2008) in defining the Knowledge Process (Section 2.1.3), i.e. the search, recognition, and assimilation of potentially valuable knowledge. Other process-based definitions have seen knowledge acquisition as “the transfer and transformation of potential problem-solving expertise from some knowledge source to a program” (Hopp et al., 2007; p79, citing Buchanan and Shortliffe 1984); and the activity of identifying and acquiring externally generated knowledge (Zahra and George, 2002). Several authors also make the distinction between knowledge acquisition and the subsequent stage of knowledge refinement or assimilation (Zahra and George, 2002, Lechner and Floyd, 2007, King et al., 2008). Consistent with Zahra and George’s (2002), Peng et al. (2008) reinforced the role of organisational boundaries by suggesting two generic ways firms acquire new knowledge: internal development and acquisition from outside. Thus, they define two knowledge acquisition routines-

developing processes and equipment internally; and search for new technologies externally, an aspect that fits well with the second perspective of knowledge acquisition detailed below. In summary then, the process view of knowledge acquisition is bounded to the sub-routines of search, identification/recognition, and capture of external knowledge, and made distinct from later processes of assimilation/understanding, transfer, and transformation. Within this view, Agarwal and Tanniru (1990) and Vokurka et al. (1996) in exploring the acquisition of knowledge for expert systems, hint to two variables that may influence these processes. Firstly, the difficulties for individuals to articulate their problem-solving strategies and knowledge, which reflects the notion of tacit knowledge and thus the need of social interaction in acquiring, sharing and transferring valuable tacit knowledge (c.f. Nonaka, 1994). Secondly, the role of *experience* in order to recognise valuable knowledge with which to acquire.

Perspective	Authors	Attributes	Variables
Process	(Zahra and George, 2002, Lechner and Floyd, 2007, King et al., 2008, Peng et al., 2008)	KA as the process of search, identification/recognition and capture of external knowledge	– Tacitness of knowledge – Experience
Exploration	(Carayannis, 1999) (Hughes et al., 2007a)	– Extracting, interpreting and transferring knowledge – Identify, acquire, gather – Assimilate, analyse, process, interpret, understand – Play, discovery and experimentation – Searching, processing	
Advice seeking behaviour	(Cross et al., 2001) (Borgatti and Cross, 2003, Nahapiet and Ghoshal, 1998) (Hansen et al., 2005)	– Knowing the skills and knowledge of contacts – Valuing a contact's expertise – Being able to access a contact – The time/monitory/psychological cost for searching – Accessing knowledge sources – Valuing knowledge sources – Motivation for exchanging/combining knowledge	– Trust – Shared vision – Motivation – Tie strength – Tacitness of knowledge – Network density, – Network size

Table 2.7: Attributes and Variables of Knowledge Acquisition

The second perspective of knowledge acquisition is termed *exploration*. This view builds on the explore-exploit distinction proposed by March (1991a) who describes exploration as practices such as search, experimentation, play, and discovery. Other authors use terms such as extracting, interpreting and transferring knowledge (Carayannis, 1999); play, discovery and experimentation (Hughes et al., 2007a) and search, discovery, novelty, and innovation (Choo et al., 2007b) to describe such routines. Sidhu et al. (2004) support such a view by emphasising the centrality of information acquisition in exploration; and Lechner and Floyd (2007) proposed four key learning activities (searching, processing, codifying and practicing) for which “searching activity represents efforts to acquire new information from both within and outside the group” (p11).

Regarding the operation of this perspective, Gold et al. (2001) refer to two main practices: *benchmarking*, to assess the current state of a particular process to identify gaps and problems; and *collaboration*, where interaction promotes learning. But it is Rosenkopf and Nerkar (2001) who provide the most relevant argument for this research. They conceptualise four types of search routines based on organisational and technological boundaries as per table 2.8. *Local search* is a rather limited search routine which expands either organisational or technology boundaries. At the other extreme, *radical search* refers to venturing into the extreme unknown where the knowledge acquired is both technologically distinct and sourced from outside the firm. In-between these lay two stretch strategies. The stretching of technologies in *local search* draws together distinct technology capabilities from within the firm. Conversely, *external search* looks to enhance existing technological capabilities by stretching the boundaries of the organisation by looking for technologically similar knowledge outside of the firm.

	Internal	External
Similar Technology	Local search	External search
Distinct Technology	Internal search	Radical search

Table 2.8: Four types of search routines (from Rosenkopf and Nerkar, 2001)

The third and final perspective of knowledge acquisition relates to the factors that influence the decision of whom to turn to for knowledge or advice, i.e. advice seeking behaviour. Consequently, five factors have been identified from the literature. Firstly, is a baseline condition for knowing the skills, knowledge or expertise of an individual of whom one might turn to (Cross et al., 2001, Borgatti and Cross, 2003). In general, this suggests a basic requirement for knowing where information is stored (Cross et al., 2001). Secondly, is an understanding of the value of the expertise of the individual, or at least, an anticipation of value through the exchange even if it is uncertain what will be produced or how (Nebus, 2006, Borgatti and Cross, 2003, Cross et al., 2001, Nahapiet and Ghoshal, 1998). Thirdly is being able to gain access to an actor with the relevant expertise (Nebus, 2006, Borgatti and Cross, 2003, Cross et al., 2001, Nahapiet and Ghoshal, 1998). Knowing and valuing someone's expertise is important, but only helpful if it is accessible from two perspective- timeliness and ease for locating (Cross et al., 2001). Fourthly, as suggested in the social exchange theory section, is the motivation for the knowledge source to exchange or share their knowledge and thus an expectation for obtaining value for example through trust and obligation (Nahapiet and Ghoshal, 1998, Nebus, 2006). Although expertise may be known, valued and accessible, those engaged must have a sense that it is worth their while (Nahapiet and Ghoshal, 1998). Finally, if all of the previous factors are met, then there is a question on the perceived cost of contacting the individual, albeit monetary costs for asking, social costs such as future favours or obligations, or psychological costs such as the embarrassment in asking for help (Nebus, 2006, Borgatti and Cross, 2003, Cross et al., 2001). Hansen et al. (2005), in their study on the decision of new-product development teams to seek knowledge (aka Advice seeking behaviour) distinguished between two costs- search cost, reflecting the time spend on looking for, identifying, and evaluating knowledge; and transfer costs, the time taken to modifying, editing, and incorporating the identified knowledge. Particularly, they note that these factors are a function of certain network characteristics. For example, search costs were related to relationship strength, transfer cost was related to relationship strength and the tacitness of knowledge, and the decision to seek knowledge was effected by network density, network size and the frequency of interaction

2.4.2 Why Knowledge Acquisition?

The survey of the literature identified four key drivers for knowledge acquisition. First, the desire to increase knowledge stocks (Yang, 2010) or to combat the competence trap related to the over exploitation of core competencies and capabilities (Volberda et al., 2010). Lechner and Floyd (2007) refer to this as the “narrowing of perspectives” whereby searching helps overcome the tendency to use a relatively few, well-known sources of information. Sidhu et al. (Sidhu et al., 2004) suggest that the quest for new routines or practices yields fresh information which aids in improving present and future returns, and increases survival odds. Schulz (2001) also highlights the self-motivating relationship between knowledge renewal and knowledge acquisition by suggesting that the exposure of new knowledge affects the relevance of a unit's knowledge and thus its level of uncertainty. This results in a demand for more information to re-stabilize this knowledge environment, thus leading to more knowledge acquisition. Secondly, knowledge acquisition may increase the probability of serendipitous interactions and thus new sources of value. Knowledge acquisition by definition, connects loci of knowledge but also exposes new knowledge to a large array of diverse prior knowledge (Schulz, 2001). As the relevance of this new knowledge is uncertain, it opens the possibility for serendipitous interactions (Schulz, 2001).

Thirdly, bounded rationality and finite information processing capability (Simon, 1991) coupled with the rapid pace of technology change means that firms may not have the luxury of developing solely from internally generated ideas and knowledge (Matusik and Heeley, 2005). This then necessitates the need to accumulate externally generated knowledge, the starting point being knowledge acquisition (Zahra and George, 2002). Zacharia et al. (2011) agree by observing that firms are “increasingly dependent on the knowledge and expertise in external organizations to innovate, problem-solve, and improve” albeit in regards supply chain performance (p591). Lechner and Floyd (2007) similarly suggest searching as a possible solution to these cognitive limitations as it creates multiple alternatives. This perspective is also illustrated by the growing field of Open Innovation and co-creation, paradigms which emphasise the use of external ideas and knowledge sources to advance products and technologies (Open Innovation- c.f. Chesbrough, 2003, Gassmann and Enkel, 2004, Chesbrough, 2006, Chesbrough and Appleyard, 2007, Chesbrough and Garman, 2009, Mortara et al., 2009, Almirall and Casadesus-Masanell, 2010, Co-Creation- c.f. Prahalad and Ramaswamy, 2004, Payne et

al., 2008, Ramaswamy, 2008, Spohrer and Maglio, 2008, Zhang and Chen, 2008, Füller et al., 2009, Nambisan and Baron, 2009, Füller, 2010). For example, Phillips Electrical now gathers 30% of their ideas from external sources (Mortara et al., 2009) and Proctor & Gamble's Open Innovation strategy now results in over 35% of the company's innovation (Huston and Sakkab, 2006). The final point is best described in Lechner and Floyd's words that "searching not only increases the likelihood that novel ideas are generated, but also increases the awareness and involvement of other actors in the initiative, potentially strengthening the momentum for change and level of support for an exploratory initiative" (p11).

Lastly, the adoption of a knowledge acquisition perspective comes from an explicit search of the literature. The systematic literature review methodology employed in Matthews and Marzec (2012) was used to rigorously identify the relevant KBV literature in OM research from 1981 to 2011. The first stage of the process is to identify the key Journals and databases from which to undertake the search. In order to ensure a high quality of research from which to draw from, only three- and four-star journals from the Association of Business Schools journal ranking guide (www.the-abs.org.uk) were selected. This meant that more specialised "Two-star" Journals such as "Total Quality Management and Business Excellence" and "Journal of Knowledge Management", which although fall solidly in the remit of this thesis, were not included. The second step was to identify the search term(s) and search the previously identified Journals. Consistent with the approaches of Tranfield et al. (2003) and Macpherson and Holt (2007), the titles, abstracts and keywords were searched for the terms outlined in Table 2.9 below. These terms were selected from initial readings of the KBV in general management journals as discussed above. The third stage and final stage was to filter out any irrelevant references such as biographies, editorial notes, or where the terms used were yet unrelated to the core argument of the paper.

As table 2.9 demonstrates, knowledge management in the OM literature has extensively focused on knowledge sharing, knowledge transfer, and a hybrid of these two processes, knowledge exchange. Furthermore, acquisition has received substantially less attention, thus explicitly supports this research's respective focus. Also noting the considerable lack of research into knowledge/information seeking. On further inspection of these findings, the first observation is that the search terms were explicitly searched in the titles,

abstracts and keywords in order to ensure that the topic was central to the paper. Widening the search to the full text revealed considerably more citations- for example Cao and Zhang (2011) make a passing comment on “knowledge seeking” in their hypothesis development by referring to the fact that “cooperation among competitors can foster knowledge seeking” (p167). However, as this point demonstrates, knowledge seeking was not central to the paper and thus not a valid paper in the systematic literature review. The second observation stemmed from simplifying the search term to “seeking” (again only in the title, keywords, and abstract) in order to establish the context by which the term may be used. As expected, this produced a considerable amount of citations, however, the vast majority of citation were in terms of the verb (i.e. “Seeking to...”), *seeking* optimal solutions, rent *seeking*, profit *seeking*, risk *seeking*, or goal *seeking*. Thus they had little association with knowledge/information, suggesting either knowledge/information seeking is an infantile state of research, or that it is of little interest to OM researchers.

Journal	knowledge/ information sharing	knowledge/ information transfer	knowledge/ information exchange	knowledge acquisition	knowledge creation	knowledge/ information seeking
IJOPM	10	3	3	3	2	0
IJPE	35	3	5	1	4	0
IJPR	50	8	10	15	2	0
JOM	14	5	6	1	2	0
Omega	10	3	4	4	0	0
POMS	9	0	3		0	0
Technovation	10	21	9	2	13	0
IEEE on EM	15	16	8	1	3	4
TOTAL	138	43	40	26	23	4

Table 2.9: Systematic Literature Review of Knowledge-based Research in OM)

2.4.3 Summary and Gaps

The discussions above point to a dearth in literature directed toward the more exploratory knowledge activities of search and acquisition whilst also pointing towards its value. In doing so, three perspectives of knowledge acquisition were identified which form the base of this research- process, exploration, and advice seeking behaviour.

2.5 Social Networks

This section outlines the nature of social networks and its development in management research. It shows how empirical works in OM, predominately in buyer-supplier studies, provide support for the use of this perspective.

2.5.1 What are Social Networks?

Firms and individuals are embedded in a network of social, professional and exchange relationships with a growing interest in understanding how these influence behaviour and performance (Gulati et al., 2000). Brass et al. (1998) define a social network as a set of actors and ties that represent some relationship between actors which provide constraints and opportunities. Borgatti and Cross mirror this sentiment in suggesting that a social network is concerned with cliques and relational characteristics (Borgatti and Cross, 2003). The interest in social networks stems from Roethlisberger and Dickson's work in the 1930's which described the importance of informal relations in organisations (Nohria, 1992). By the 1950s, network based research had become an established approach in the fields of anthropology, psychology, and sociology (Nohria, 1992). The 1970s saw the beginnings of the mathematical modelling of social structures (Nohria, 1992). The most recent developments of the field had stemmed from the solidifying of social capital as a key theory in management research (Matthews and Marzec, 2012, Nahapiet and Ghoshal, 1998, Tsai and Ghoshal, 1998, Lin, 1999).

In exploring the scope of social networks, the management literature describes three ways in which to classify social networks: based on their unit of analysis, reference to organisational boundaries, and level of formality as the table below summarises. The first network types are those concerned with the specific unit of analysis. Such studies have focused on the individual or ego-centric networks (Cross and Cummings, 2004, Nebus, 2006), the team (Hansen et al., 2005), intrafirm (Tsai and Ghoshal, 1998) and between firms, for example strategic alliances (Gulati et al., 2000). Knoke and Kuklinski (1994) make mention of other, more sociology-based levels such as class, status and nation. Given the justification of the individual as the unit of analysis in this research (i.e. Section 2.1.5 above), this thesis will continually refer to studies that focus at the ego level.

Typology	Description	Authors
Unit of Analysis	<ul style="list-style-type: none"> - Individual or ego-centric - Team - Intrafirm - Interfirm 	(Cross and Cummings, 2004, Nebus, 2006, Hansen et al., 2005, Tsai and Ghoshal, 1998, Gulati et al., 2000)
Internal/external	<ul style="list-style-type: none"> - Internal- i.e. Intrafirm - External- outside the firm 	(Tsai and Ghoshal, 1998, Borgatti and Cross, 2003, McDonald et al., 2008, Mors, 2010)
Formal/informal	<ul style="list-style-type: none"> - Formality as professional relatedness i.e. “formal” as trade associations; “informal” as friends - Formability as organisational hierarchies - Formality as formal commercial relationships (contracts) with customers and suppliers; 	(Felzensztein et al., 2010, Lorenz, 1994, McDonald and Westphal, 2003) (Jansen et al., 2006, Tucker, 2008, McDermott and Archibald, 2010, Mors, 2010)

Table 2.10: Social network typologies

Regarding organisational boundaries, empirical studies fall into two dominant approaches: studies exploring the networks inside the firm (i.e. internal); and studies exploring external networks. Internal studies typically focus on mapping the internal networks of a firm or business function using survey instruments concerned with who-knows-who (i.e. Borgatti and Cross, 2003, Cross et al., 2001, Tsai and Ghoshal, 1998). This approach is also known as Social Network Analysis (SNA) which provides a systematic means of assessing networks by mapping and analyzing dyadic relationships among people, teams, departments or even entire organizations (Cross et al., 2001). The issue with such studies is that to effectively map the network, there is a great deal of repetition in the survey that can lead to fatigue (i.e. do you know x, do you know y, do you know z etc). Hence, sample size is typically smaller, for example 35 participants in Borgatti and Cross (2003) and 45 participants in Tsai and Ghoshal (1998). On the positive side, the detailed results provide rich insight into key phenomena. Cross et al. (2001), for example, used social network analysis within a group of 20 executives to identify individuals that were focal to the network structure. In doing so, individuals were cross referenced to their managerial position to highlight the discrepancies between hierarchically defined influence, and actual influence. Tsai and Ghoshal (1998), who provide the first empirical evidence for Nahapiet and Ghoshal’s (1998) key conceptual

work on Social Capital, examined the relationships within a multiunit company based on the structural, relational, and cognitive dimensions of social capital and used this to explain the patterns of product innovation within the company. This Thesis adopts the view that internal relationships provide benefits in terms of access and ease of engagement (c.f. Jack, 2010), however, external relationships provide access to knowledge and information that is more valuable and thus of greater interest. This value lies in the collection of alternate perspective to produce greater novelty (McDonald et al., 2008, Mors, 2010); the expansion of knowledge bases by accessing new ideas (Bierly III et al., 2009) or through knowledge renewal (Schulz, 2001); or developing peripheral vision to proactively detect threats and opportunities in the market (Lettice and Parekh, 2010). The dominant use of external network research in the operations management field, as Matthews and Marzec (2012) suggest, has been used in SCM studies and particularly in describing buyer-supplier behaviour (c.f. Cousins et al., 2006, Krause et al., 2007, Lawson et al., 2008, Carey et al., 2011). Thus, the use of external networks in a process improvement context is novel.

Finally are formal or informal networks, of which two perspectives are observed. Felzensztein et al., (2010) suggests formality as professional relatedness, such as with trade associations. Conversely, Tucker (2008), McDermott and Archibald (2010) and Mors (2010) suggest formality as formal organisational hierarchies, “*people with formal influence*” (Tucker, 2008; p2025) or “*huddling around conference tables, comparing data, trading insights, and arguing over designs*” (McDermott and Archibald, 2010; p84). In their review of learning, knowledge and firm growth, Macpherson and Holt (2007) suggest that the preference for informal and social network contacts and the limitations of technical knowledge networks both contributes to and limits the types of knowledge resources available. In doing so, they suggest that familiarity may smooth transaction costs, but at the expense of exposure to new knowledge, a remark that is consistent with Granovetter’s (1973) strength of weak ties argument. It is this particular argument that has lead to the focus of this research on ties that are more informal in nature. In summary then, this research explores the less formal aspects of an individual’s social networks, external to the firm. The following section thus provides insight into the theoretical underpinnings for this research scope.

2.5.2 Why Social Networks?

The focus on networks, albeit social, is timely for a number of reasons. Firstly, the growing importance of supply chain management and competitiveness as a function of the extended supply chain, emphasises that an atomistic view of the firm is inadequate (Lejeune and Yakova, 2005). Secondly, the astonishing leaps in competition from the emergence of Asian economies, advances in technology and the rise of small entrepreneurial firms, is forcing the consideration of threats from less traditional perspectives (Nohria, 1992). Thus, a wider view of competition is required. Thirdly, firms are increasingly taking a broader view of business processes, particularly the activities, procedures, and behaviours that occur within and between organizational units (Bhatt and Stump, 2001). Finally, bounded rationality suggests that a finite number of processes, technologies or lines of research can be pursued at any one time, and so with rapid changes in technology and pressures driven by globalization of markets, it has become difficult for firms to “go it alone” (Koufteros et al., 2007).

Consequently, a more effective view is to consider individuals and firms as embedded in a network of social, professional and exchange relationships (Gulati et al., 2000). These networks can provide access to a range of knowledge, resources and technologies that can be leveraged to create value (Inkpen and Tsang, 2005). In particular, this research purports to the view that the key resource to sustained competitive advantage is knowledge, with the understanding that the most valuable form of knowledge is tacit which requires social interaction in order to be acquired. In doing so, the focus on networks external to the firm comes from the observation that firms are increasingly becoming reliant on external knowledge to foster innovation and to enhance their performance (Lichtenthaler, 2009). Accordingly, knowledge from outside the firm is seen as an important stimulus for change and organizational improvement (Inkpen and Tsang, 2005) and by triggering divergent thinking, it aids in developing technology and innovation (Nemanich et al., 2010). Furthermore, it expands a firm’s knowledge base and provides access to new ideas that promote the generation of new technology (Bierly III et al., 2009)

2.5.3 Knowledge and Social Networks: Merging the Two Streams

Fundamentally, this research argues that social networks provide a conduit to acquire knowledge, as this section demonstrates. *Appendix 4* thus summarises the literature pertaining to the crossover between social networks and knowledge.

2.5.3.1 Type of Knowledge and Networks

Möller and Svahn (2006) investigated the role of knowledge in the creation of business networks. They suggest three generic types of business networks– ‘current business nets’, ‘business renewal nets’, and ‘emerging new business nets’. *Current business nets* are concerned with exploiting current actor competencies. To facilitate this, Möller and Svahn (2006) suggest that highly codified knowledge is of benefit as it will improve the ease of sharing amongst members. *Business renewal nets* aim to “*increase the efficiency of the existing system, [and also] lead to more effective solutions that could turn into new business opportunities*” (p990). In doing so, it requires a balance between exploiting existing specialized knowledge and expanding knowledge through exploration activities. In this case, knowledge is partly explicit in that they have explicit goals and timelines; and partly tacit stemming from adjustments to business processes and new solutions (Möller and Svahn, 2006). Lastly, *emerging new business nets* are future oriented nets aimed at creating networks through which new technologies, products or business concepts can be commercialized (Möller and Svahn, 2006). As such ideas are often fuzzy, ambiguous and widely dispersed, hence knowledge is essentially tacit (Möller and Svahn, 2006). In a second example, Sammarra and Biggiero’s (2008) work examined the types of knowledge that is exchanged and combined in networks to foster innovation. Using social network analysis, the study mapped three types of knowledge: 1) *managerial knowledge*, the competences and know-how to coordinate and supervise organizational resources and processes; 2) *technological knowledge*, knowledge to respond to the rapidly changing technological environment; and 3) *market knowledge*, organized and structured information on the market (Sammarra and Biggiero, 2008). They found that within firms, the three types of knowledge had unique network structures. Technological knowledge sharing was significantly higher than managerial or market knowledge which indicatively suggests the relationship between networks and technical knowledge such as in process improvement.

2.5.3.2 Clustering and Network Density

A number of studies also premise the idea of clustering, geographic closeness, and network density as a source of advantage. Karamanos (2003) emphasises that network embeddedness is a source of firm value and argues that “*neglecting the network context in which firms are embedded leads to an incomplete understanding of the value of the firm*” (p1871). The study concentrates on two processes of knowledge exchange: firstly, knowing through learning that emphasises the normative and cognitive proximity of exchange partners that benefit from dense networks. Secondly, 'knowing through fads' which concentrates on information on who has adopted the innovation rather than about the innovation itself. In this scenario, Karamanos (2003) suggests network density plays a significant role. Arikan (2009) also explores the interface between knowledge exchange and network density by suggesting that clusters are venues for enhancing knowledge creation. Of particular note, Arikan conceptualises a number of the key enablers to interfirm exchange that have considerable similarities to those proposed by the conceptual model in this research (see Chapter 4), namely: a) they are theorised as moderating variables; b) the key enabler of cooperation orientation or *Organisational Climate* in this research; and c) connectivity akin trust in this research (Hypothesis 1 and 2).

In terms of the effect of network density on other knowledge based activities, Soh's (2010) study found that firms with high network density coupled with a strategic intent to acquire and share knowledge broadly lead to better innovation performance. Secondly, Padula (2008) examines the contradiction surrounding network density, namely that cohesive alliances imply partners are highly connected, trusting and cooperative, thus value from knowledge processes is almost guaranteed. On the contrary, sparse alliances imply that alliance partners are disconnected but expose firms to: 1) novel and varied knowledge flows; and 2) break the tendency for cohesive alliances to produce redundancy thus are a more valuable form of alliance. Thus, they promote a complementary relationship between sparse and cohesive alliances, operationalised through bridging ties and boundary spanning.

2.5.3.3 Network Centrality

As also mentioned in Karamanos (2003), network centrality also influences knowledge activities whereby high centrality resulting in higher ‘fad’ based knowledge exchanges, i.e. information on who has *adopted* what innovation rather than *about* the specific innovation itself. In investigating knowledge transfer in intraorganisational networks, Tsai (2001) argues that “*organizational units can produce more innovations and enjoy better performance if they occupy central network positions*” (p996). The findings suggest that a unit's centrality in its intraorganisational network does not contribute directly to its performance but does contribute directly to innovation. Most interestingly, it found that the effect of network position on innovation and performance was dependent on a unit's absorptive capacity, which reinforces this study's interest in absorptive capacity. A study by Lee et al. (2010) explored knowledge exchange in two network positions- between central units, and between peripheral units. Using two knowledge strategies to guide their qualitative inquiry (the strategy to amalgamated knowledge, and the strategy to transfer amalgamated knowledge), they conclude by making five “*lessons for managers in business groups and diversified companies*” (p604), namely: 1) the exchange of exploitative technological knowledge tends to take place voluntarily whilst sharing explorative technological knowledge is less clear and more difficult to predict; 2) the balance between explorative and exploitative knowledge exchange needs to be supervised and co-ordinated by top management; 3) exchanging both explorative and exploitative technological knowledge can fruitfully augment and diversify reservoirs of technological knowledge; 4) performance of foreign subsidiaries is directly influenced by the strength and quality of technological reservoirs; and finally, “*to overcome the problem of unfamiliarity and disruption of pioneering technologies and to exploit the advantages, the HQ unit should provide supervision and guidance for the transfer process*” (Lee et al., 2010; p604).

2.5.3.4 Network Diversity

As suggested by McDonald et al., (2008), Padula (2008) and Macpherson and Holt (2007) above, diversity in the form of external networks may provide access to new and novel knowledge. Bacharach et al. (2005) further this by suggesting that benefits of diversity, albeit employee diversity in business units, depends on supportive peer relations. These relations are operationalised as a support climate, task interdependence (aka autonomy), and homophily. This conceptually supports the research's interest in

accounting for organisational characteristics in networking and knowledge acquisition activities (see Hypothesis 6 of conceptual model, Chapter 4). Cummings (2004) takes a more holistic stance in their examination of external knowledge sharing, by defining it as “*the exchange of information, know-how, and feedback with customers, organizational experts, and others outside of the group*” (p352). The findings suggest that external knowledge sharing is more strongly associated with performance when work groups are more structurally diverse in terms of their affiliations, roles, and positions.

2.5.3.5 Seeking Behaviour

In support of works by Borgatti and Cross (2003) and Nebus (2006) on advice seeking behaviour at the individual level as outlined in Section 2.1.6.2, the work by Cowan et al. (2007) on the formation of innovation networks investigated the organisational-level factors that influence the selection of partner firm in forming innovation networks. They suggest that previous collaborations increase the probability of a successful collaboration as familiarity can build common knowledge, similar ways of thinking and trust. In advice seeking behaviour as defined in the section above, this can be interpreted as *knowing*. They also suggest that successful collaboration and innovation performance is dependent on structural embeddedness (i.e. network density and structural holes) and particularly the *perceived value* of a potential partner firm. Again, this is a concept explicitly suggested in the advice seeking behaviour discussions above.

2.5.3.6 Knowledge Creation

In addition to the myriad of knowledge creation studies mentioned above, the work of Schilling and Phelps (2007) work proposes that knowledge creation through network diffusion and search depends on two factors: 1) *clustering*, i.e. the dense clustering of alliance partners enhance information transmission; and 2) *reaching*, i.e. the tapping of a wider range of knowledge resources for newness (aka network diversity). Using a longitudinal analysis, they found that in the short term, the exclusive use of *clustering* or *reaching* were both significantly related to knowledge creation, but a combined approach of clustering and reach was not significant. In the medium and long term however, only reach and the combined clustering-reaching approach was significant, albeit a focus only on *reach* was negative and the combined approach was positively related to knowledge creation. Thus, the study implies that in the long term (i.e. for sustained competitive advantage), a single minded focus on either network diversity or network

density/centrality is less fruitful than taking a more *ambidextrous* approach in balancing the two (i.e. see the theory of organisational ambidexterity, Section 2.1.6.4)

2.5.3.7 Knowledge Acquisition

In explicitly relating knowledge acquisition and social networks, aside from Soh's (2010) previously mentioned study on network density and the strategic intent to acquire knowledge, Yli-Renko et al. (2001) relate knowledge acquisition and network type by proposing that social capital facilitates external knowledge acquisition which leads to knowledge exploitation. Of interest to this research, their findings found that social capital is statistically associated with knowledge acquisition. It was noted that the structural dimension of social capital was positively related to knowledge acquisition, a finding consistent with absorptive capacity in relation to network characteristics such as size and range (Zahra and George, 2002). However, the relationship quality (i.e. the relational dimension of social capital) was found to be negatively associated with knowledge acquisition. In justifying this, Yli-Renko et al. (2001) suggest that high relationship quality could lead to "over-embeddedness" which could restrict access to external sources, a notion consistent in this research as outlined in earlier discussions on internal vs. external networks (see section 2.5.1). Secondly, Li et al. (2010a) explored the knowledge-acquisition and network-type interface in investigating the relational mechanisms for acquiring tacit and explicit knowledge. Their study suggests that when partners share common goals, greater levels of both explicit and tacit knowledge are acquired; but trust between the two parties promotes greater levels of tacit knowledge acquisition than explicit knowledge acquisition. The latter finding is somewhat contrary to the suggestions by Padula (2008) and Cowan (2007) above who suggest closeness and trust is more beneficial in transferring and integrating new knowledge, rather than in its actual acquisition. This Thesis then may shed light on this issue.

Lastly, Sullivan and Marvel (2011) draw the knowledge-based view and social network theory together to develop and test a conceptual model of knowledge acquisition. In doing so, they find that an entrepreneur's reliance on their network positively moderates the relationship between technical knowledge acquisition and innovation, but not between market knowledge acquisition and innovation. Thus their findings explicitly support the intentions of this study.

2.5.3.8 Knowledge Sharing

Bacharach et al. (2005), Cummings (2004) and Cowan et al. (2007) all introduced themes surrounding knowledge transfer activities in networks. As used throughout the discussions in the literature review, the study by Hansen et al. (2005) is of particular importance to this research. In summary, it explores three knowledge sharing phases (deciding whether to seek knowledge, the search costs incurred when sharing knowledge, and the transfer costs in knowledge sharing). These are juxtaposed against three firm-based networks: within team network, transfer networks (i.e. the network of direct contacts where knowledge transfer has previously taken place), and intersubsidiary networks (i.e. all direct contacts with subsidiaries that a team has). The findings suggest that the decision to search for knowledge is inversely related to team size and strength, in other words when a team is stronger there is less need to search for knowledge. However, with intersubsidiary networks, as frequency and closeness increases, there is a greater tendency to search for knowledge as this supportive environment fosters and encourages such behaviour.

2.5.3.9 Knowledge Transfer

In addition to the study by Tsai (2001) on knowledge transfer and networks, the meta-analysis of Van Wijk et al. (2008) of the literature examined the impact of knowledge, organization and network antecedents on organizational knowledge transfer. The study suggests that the organisational antecedents of firm size and absorptive capacity, and knowledge antecedents of ambiguity, are positive and statistically related to organizational knowledge transfer. The network antecedent of centrality, trust, strength of ties, and shared vision were all also found to be positive and statistically related to organizational knowledge transfer suggesting that the factors pertaining to the discussion in this section are merited. A second key study is the multilevel examination by Zhao et al. (2005) of knowledge transfer in the Chinese automotive industry. This study examined various network factors on two types of knowledge transfer: 1) Multinational Enterprise (MNE) source networks into International Joint Venture (IJV) networks; and 2) IJV networks to local supplier networks. Of interest here is their conclusion that within the setting of their study, the ‘stark’ asymmetry in capabilities between the MNE and IJP means, *“quite simply, the recipient firms commonly lack absorptive capacity needed to understand and incorporate many of the source firms’ skills.”* (p140).

2.5.3.10 Unspecified knowledge activities

The final set of literature documents those studies that consider the interplay between knowledge and networks but are not explicit in defining specific knowledge activities. Tortoriello and Krackhardt (2010) propose that ties that span organizational boundaries (bridging ties) are conducive to the generation of innovations as also suggested by Padula (2008). A direct measure of bridging found that it had no advantages to innovation *per se*. However in considering simmelian ties (ties embedded in cliques), a positive and significant effect was found for bridging simmelian ties on innovation, a finding which supports Padula's (2008) suggestion on the merit of coherent alliances. Almeida and Phene (2004) explored the influence of external knowledge on innovation with respect to characteristics of the knowledge network (richness and diversity). Richness in this case indicated the total innovative knowledge that resides within the firm and diversity as the breadth of the technological knowledge. The findings concur conceptually to the propositions of absorptive capacity (Cohen and Levinthal, 1990), namely that performance, albeit innovation, depends on the extent of known knowledge (richness in MNC knowledge) which in turn permits the absorption of more new knowledge (knowledge diversity in host). Mors (2010) similarly investigates innovation performance and in particular how individual managers utilize their informal relations to create new knowledge. The study found that: 1) operating in homogeneous contexts, the primary challenge is to access diverse information and hence low-density networks are beneficial; and 2) in the context of operating across firm and geographic boundaries, dense networks lead to higher innovation performance by facilitating the integration of diverse information. Lastly, Hughes et al. (2007b) argue that past business incubation and network research does not adequately examine how they subsequently pursue and realise value. They define a business incubator, as "*a facility that houses young, small firms to help them develop quickly into competitive businesses*" (p155) and propose four types based on a 2x2 matrix typology of resource pooling activity (resource-seeking behaviour), strategic network involvement (knowledge-seeking behaviour). Firstly, *enclosed incubators* have narrow resource pooling activity and narrow strategic networks and are characterized by firms that either attempt to share or draw on network resources. Secondly, *specialized incubation* has extensive resource pooling activity but narrow knowledge-based interactions that enable them to maximise the use of the joint resource base of the network. Thirdly, *community incubation* has extensive strategic network involvement to seek knowledge but minimal resource pooling activity resulting in

outcomes that leverage off the joint knowledge base. Lastly, *dynamic incubation* represents extensive resource pooling activity in conjunction with extensive knowledge seeking through network involvement. Their subsequent analysis suggests that dynamic incubation was superior to all other forms of incubation in regards to radical, technology and process innovation. Within the context of this research, specialized incubation was found to be the next best type for technology innovations, or conceptually process improvement, second to dynamic incubation. Consequently, as specialized incubation focuses primarily on resource pooling activities, an additional focus of knowledge-seeking behaviour (as suggested by this research), will improve technological innovation and process improvement by transforming it from specialized incubation to the superior form of dynamic incubation.

2.5.3.11 Operations Management Literature

Contextualising the discussions in the OM literature reveals that the majority of the crossover in this literature pertains to supply chain and planning issues. For example information sharing (or lack of) leading to the bullwhip effect (Fiala, 2005) or the role of ICT in supporting these functions (Soroor et al., 2009) which is not the intension of this research due to its focus on level 3 and 4 knowledge (See Section 2.1.1). Koskinen and Vanharanta (2002) provide the first relevant study by conceptually outlining the different forms of knowledge that can be accessed through different communication media to enhance innovation processes. Their discussions suggest that during the invention phase of innovation, the management of tacit knowledge is central to fostering creativity. During the development phase where intangible ideas are transformed into something tangible for production, a conflict arises based on the need to justify development activities with explicit financing and regulation information, yet radical ideas with which superior value can be obtained are “*often the ones that are the hardest to defend in documents*” (Koskinen and Vanharanta, 2002; p62). During the final stage, marketing, Koskinen and Vanharanta (2002) suggest that smaller firms have better communication and tacit knowledge with customers as communication is informal and with the people that have decision-making power and so could conceptually be superior. However, in practice, their small firm size may limit their market power. Gloor et al. (2008) attempted to examine the influence of social network structure on individual and organizational performance by mapping virtual innovation networks using social network analysis. However, the study failed to contribute anything significant to this research, primarily

due to its focus on a university module and a piece of student course work. Finally, the most relevant piece of work comes from literature review of Buhman et al. (2005) of research in operations management. This review proposes that OM should embrace a business model where the organization is viewed as a network and suggests the integration of technology, people and processes such that “*operations management research future lies in establishing this science from an interdisciplinary perspective*” (p1). This research subsequently attempts to address this call.

2.5.4 Theories

2.5.4.1 Social Capital Theory

In clarifying the distinction between social network theory and social capital theory, this research views social network theory as the more structural interpretation of networks, namely the nodes/entities/actors and the links/relationships of the network (Leidner and Jarvenpaa, 1995, Bhatt and Stump, 2001, and Cross et al., 2001). Social capital theory on the other hand, is focused on the relational aspects of the network and how resources can be gained through these relations (Carey et al., 2011, Cousins et al., 2006, and Houghton et al., 2009). In converging the literature on social capital, Nahapiet and Ghoshal (1998) suggest three dimensions of social capital- structural, relational, and cognitive, which have become the foundation to much of the empirical work in this area (Matthews and Marzec, 2012). The structural dimension of social capital includes social interaction, for example how individuals can access personal contacts to get a job, facilitated by aspects such as the strength of the ties and the extent of the network (Nahapiet and Ghoshal, 1998, Tsai and Ghoshal, 1998). The relational dimension reflects the roots of these relationships such as trust, respect and goodwill (Nahapiet and Ghoshal, 1998, Carey et al., 2011, Tsai and Ghoshal, 1998). Finally, the cognitive dimension facilitates common understanding and enables sense making based on elements such as shared goals, norms and common language (Nahapiet and Ghoshal, 1998, Carey et al., 2011, Tsai and Ghoshal, 1998).

Lin’s (1999) work can be seen as the second key address on social capital in the management context, second to Nahapiet and Ghoshal (1998) above. Lin (1999) suggests three ingredients to his theory- embeddedness, accessibility and mobilisation.

Embeddedness is defined as the structural elements of the network. Reflecting on the three dimensions of social capital mentioned above, limiting embeddedness to only structural elements is inadequate and explains why Nahapiet and Ghoshal (1998) work is valuable. Second, Lin refers to the ability to *access* resources. The aspect of learning in social networks investigated by Cross et al. (2001) and Borgatti and Cross (2003) builds on this suggesting in the theory of advice seeking behaviour. Lastly, Lin (1999) refers to *mobilisation* or the action-orientated aspect of a social network. In this context, Lin suggests that mobilisation is the use of one's networks and contacts to achieve financial benefits (i.e. wealth and power), and personal benefits (i.e. life satisfaction, physical health).

2.5.4.2 Social Network Theory

Social network theory, a term originating in sociology (Nahapiet and Ghoshal, 1998), provides a theoretical perspective to examine the advantage gained through more structural elements of social networks (Carey et al., 2011, Houghton et al., 2009). In an organisational context, it suggests that firms embed themselves in a network to access knowledge and other capital outside its ownership that can be used to increase returns (Inkpen and Tsang, 2005). Thus, firms enter partnerships when they sense strategic interdependencies with one another or can envisage a complimentary role of resources (Koufteros et al., 2007). Koufteros et al. go on to suggest that due to bounded rationality, manufacturers focus on enhancing their own core competencies and depend on complimentary competencies that can be collected from the involvement of their suppliers. Past research has typically used this to explain relationships, the transfer of knowledge, and its effect on performance. For example, Krause et al. (2007) use it to explain how long-term relationships between firms and suppliers can improve firm performance.

The use of social network theory in a business context dates back to the 1930's in organizational research (Jack, 2010). It was originally used to describe the relational resources that are useful for the development of individuals in organisations (Tsai and Ghoshal, 1998). Nahapiet and Ghoshal's (1998) work on developing a theory to explain the organisation as a knowledge system propelled social network theory into business research and provided many of its core foundations. Firstly, it contrasts the relationship-building and system wide perspective of network theory with the transactional cost's

perspective emphasis on opportunism. The view is that the transaction cost perspective stresses the efficiency in reducing the cost of a transaction, whilst a network approach considers the benefits from optimizing not just a single transaction, but the firm's entire network of transactions (Gulati et al., 2000). A case in point is emphasised by the contrasting approaches of the US and Japanese in the automotive industries where adopting an approach of supplier integration (i.e. the Japanese) provided greater benefits than adopting a strict cost minimisation approach as viewed by transactional cost theory (Krause et al., 2007). Secondly, consistent with the notion of Teece et al. (1997) of capabilities as a source of competitive advantage, Nahapiet and Ghoshal (1998) argue that organisations contain capabilities that create and share knowledge which can lead to distinct competitive advantage. In particular, they suggest that these capabilities are those that facilitate the creation and sharing of tacit knowledge and are influenced by how individuals are structured, coordinated, and communicated to within the organisation, how they cooperate, and the social communities present within the organisation. This highlights the shift from the acquisition of knowledge to the creation of knowledge. Koufteros et al. (2007) illustrate this in their suggestion of resource-sharing where know-how or tacit knowledge is accumulated verses knowledge spillover where information and facts are conversed through relatively simple communication. Finally, and consistent with previous research (ie Granovetter, 1973) it stresses the use of social capital, which they define as *"the sum of the actual and potential resources embedded within, available through and derived from, the network of relationships possessed by an individual or social unit"* (p243), as a resource for social action. In conclusion, Nahapiet and Ghoshal (1998) summarise by suggesting that the differences between firms, including performance, may stem from the differences in how firms create and exploit social capital, a notion that this research endeavours to examine.

2.5.4.3 Social Exchange Theory

Social Exchange Theory suggests that "persons that give much to others try to get much from them, and persons that get much from others are under pressure to give much to them" (Homans, 1958; p606). Consequently, this theory helps describe the motivating factors surrounding the sharing of resources in social networks. The use of this theory is most evident in the field of co-creation which suggests value is co-created between the firm and its consumers (Vargo and Lusch, 2004). Given this assumption, research in this field examines why consumers engage in co-creation activities and hence the value of

social exchange theory. Füller (2010) suggests that this theory helps explain “why humans behave the way they do” (p100) by suggesting consumers interact with producers and engage in co-creation activities, such as new product development, because they expect that doing so will be rewarding. Füller (2010) also adds that the reward may not only be the outcomes of the process, but also the interaction experience itself. Wong and Boh (2010) also relate social exchange theory to social capital by suggesting that social exchanges lead to feelings of trust and obligation which are relational dimensions of social capital. They suggest that past exchanges help individuals to form trustworthiness judgments about the benefits received from past engagements or the level of obligation in returning favours, which need not involve the same resource as originally exchanged, but could include other benefits such as recognition, status, and liking.

2.5.5 Variables

Variable	Definition	Author
Network size	The number of ties	(Perry-Smith, 2006, Smith et al., 2005) (Dhanarag and Parkhe, 2006, Van Wijk et al., 2008, Cross and Cummings, 2004, Hansen et al., 2005), (Houghton et al., 2009, Wong and Boh, 2010)
Tie Strength	The closeness, duration, the frequency of interaction or degree of friendship in the relationship	(Levin and Cross, 2004) (Van Wijk et al., 2008) (Hansen et al., 2005, McDonald and Westphal, 2003, Tsai and Ghoshal, 1998, Shah, 1998, Perry-Smith, 2006)
Network density	The overall level of interaction, i.e. No. of established ties ÷ No. of possible ties	(Smith et al., 2005, Dhanarag and Parkhe, 2006) (Hansen et al., 2005, Wong and Boh, 2010, Sparrowe et al., 2001)
Network centrality	Position within an overall pattern of relationships	(Perry-Smith, 2006, Floyd and Wooldridge, 1999, Tsai, 2001, Sparrowe et al., 2001, Dhanarag and Parkhe, 2006, Van Wijk et al., 2008)
Network diversity/heterogeneity	Diversity in network demographics i.e. job position, occupation	(Smith et al., 2005, Arikan, 2009, Dhanarag and Parkhe, 2006, Wong and Boh, 2010)

2.5.6 Summary and Gaps

With social network research being as broad a topic as the knowledge-based view, the previous section focused attention on its role with knowledge. In doing so, it identified three typologies of social networks in order to position the research’s focus. It also clarified the seminal theories in the domain in addition to the possible factors that may be observed in the knowledge-based view of process improvement.

2.6 Derivation of Research Questions

The realisation of knowledge as the fundamental resource for sustained competitive advantage is the cornerstone to the most recent evolution of management thinking, the progression of the resource-based view to the knowledge-based view. This trend is now progressing into Operations Management research, yet the majority of the attention, as Table 2.9 shows, is focused on the exploitative aspects of knowledge rather than exploratory. With the understanding that the sharing, transfer and acquisition of tacit knowledge, the most valuable form of knowledge, is only possible through social interaction, this research similarly adopts a social networking view. Jack's (2010) critique of existing approaches to the study of networks research, suggests that questions relating to "how" and "why" aspects of social networks have been underexplored. Furthermore, Lawson et al. (2008) suggest that many studies have focused on well-established relationships and have not adequately incorporated less routine, ad hoc exchanges such as in process improvement. Given this, this research begins by positioning itself as an exploratory study in asking:

- RQ1: What role, if any, does social networking and knowledge acquisition play in process improvements?
- RQ2: How can social networks be fostered to enhance the acquisition of knowledge in process improvements?

Liebeskind et al. (1996) found that boundary-spanning social networks in new biotech firms could be used to source their most critical input, scientific knowledge. Carey et al. (2011) verified a link between the social capital in buyer-supplier relationships and firm performance. Koufteros et al. (2007) explores the antecedents and consequences of the level of integration between buyers and suppliers and suggests that a collaborative approach to integration had a positive impact on product innovation. These few examples illustrate that knowledge and social networks may provide a means of enhancing performance. Thus, this research sees that to appropriately motivate the knowledge-based view of process improvement, a link to performance needs to be established. To do so, the research concludes with a confirmatory study to address the question:

- RQ3: Can the acquisition of knowledge through social networks ultimately lead to enhanced process improvement?

Chapter 3: Methods

The discussions in Chapter 2 highlight the emerging field in which this research is embedded. Hence there is a tendency towards exploratory and in-depth research methods typical of qualitative approaches (Creswell, 2009). However, the researcher's desire for generalisability and practicality suggests a more quantitative approach would be required. In order to satisfy this, the research adopts a mixed methods approach. Boyer and Swink (2008) review of mixed methods in Operations Management supports this in stating "*It is our strong belief that multiple approaches are required in order to develop a holistic understanding of operations and supply chain management phenomena*" (p339).

3.1 Epistemology

Consistent with a mixed method approach and the nature of OM research, a Pragmatic epistemology is adopted. In the classical sense, Pragmatism is concerned with a focus on practice and practical life as urged by early Pragmatists such as William James, George Herbert Mead and Charles Sanders Pierce (Seale et al., 2007). Ormerod (2006), on the history and ideas of pragmatism, suggests Pragmatism as "*being practical, getting things done, not being hung up on unattainable principles and yielding on some issues in order to make progress on others*" (p894). Mingers (2004) adds that pragmatism is aimed at producing useful knowledge rather than understanding the 'true' nature of the world. These aspects are consistent then with operations management in so much that that the remit of the Journal of Operations Management, the field's premier journal, suggests that "*Highest priority is given to studies that are anchored in the real world and build, extend or test generalisable theories or frameworks of managerial significance*". Fuller and Mansour (2003) add that philosophically, OM is managerially and activity-orientated. In reflection of this practical view, Pragmatism appears fitting.

More recent conceptualisations of Pragmatism also consider a more pluralistic position, namely "*accept[ing], and indeed welcome[ing], a diversity of paradigms and research methods*" (Mingers, 2004; p88). Such consideration also improves research rigor by "*leveraging the strengths of multiple methods while mitigating their weaknesses*" (Paul, 1996; p135). Craighead and Meredith (2008) review of OM research identifies positivist,

empiricist and interpretist/constructionist studies which highlights that the OM field is already pluralist in nature, thus supporting the more pluralist sentiments of Pragmatism. Finally, in terms of mixed method research, it is widely appreciated that the primary philosophy of mixed method research is Pragmatism (Johnson et al., 2007, Creswell and Plano-Clark, 2007, Tashakkori and Teddlie, 2003). In this sense, Johnson et al. (2007) suggest three key benefits to adopting a Pragmatic approach. Firstly, for mixing approaches and methods, it offers an epistemological justification via its pluralist epistemic values. Secondly, it provides an epistemological logic that suggests the combination of methods and ideas to help frame, address, and answer to research questions. Finally, pragmatism allows the adoption of a wide range of theorists that mixed methods researchers can consider in order to aid in the inquiry.

3.2 Methodology

This research first notes Jack's (2010) review of the methodological approaches in network research in which two key methodological criticisms appropriate to this research are identified- a preference for quantitative rather than qualitative work, and issues in the application of the network concept. On the issue of the quantitative research, Jack (2010) suggests that although surveys are useful to gauge structural features of networks, they are limited in the detailed explanations of the context of relations. In response to this, and drawing on the approaches by other authors (i.e. Cross et al., 2001, Lawson et al., 2008) this research adopts an initial, qualitative exploratory phase do provide a deeper insight into these aspects. In regards to the application of the network concept, Jack (2010) suggests that *"while it would seem networks are important, questions concerning why, the role networks play, their nature, formation and function over-time remain somewhat less explored"* (p121). Understanding these issues are at the heart of this research and by balancing in-depth qualitative research with broader more generalisable quantitative research through the adoption of a mixed method approach, this research aims to address this concern.

Lastly, as Johnson et al. (2007) state, mixed methods research is an approach to theory and practice that attempts to consider multiple viewpoints and perspectives by always including both qualitative and quantitative research. In doing so, the research promotes the use of triangulation in its methods in order to complement the strengths of methods

and more importantly, mitigate their weaknesses (Paul, 1996). Modell (2009) defines triangulation as “*the mixing of multiple theories and/or methods with an emphasis on reducing bias by mixing methods to compliment strengths and weaknesses*”. Jick (1979) classifies this as a ‘between methods’ triangulation, a technique which assists in converging results and thus immediately beneficial to the research. It may also diverge results, which although catastrophic in the short term, it may trigger interesting research for the future. In this research, triangulation is achieved by mitigating the generalisability of the initial exploratory cases with the subsequent survey research; and mitigating the issue of depth and detail of the survey research with the exploratory cases.

3.3 Research Design

In order to balance the exploratory requirements whilst providing sufficient validity to the research, a sequential two-phase research design is adopted, namely: (1) qualitative exploratory phase using semi-structured interviews; and (2) quantitative deductive phase using an online survey. In doing so, the research design is based on Creswell and Plano-Clark’s (2007) seminal work on mixed method research. Mixed method research (MMR) can be seen as both a methodological approach and as a method (Creswell and Plano-Clark, 2007, Tashakkori and Teddlie, 1998). As a methodological approach, it “*involves philosophical assumptions that help guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches*” (Creswell and Plano-Clark, 2007; p5). As a method, its “*central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone*” (Creswell and Plano-Clark, 2007; p5). Consequently, MMR can be seen as having four key benefits over and above traditional designs. Firstly, as suggested earlier by Jick (1979), MMR provides strengths that offset weaknesses. Quantitative research is typically weak in understanding context and somewhat divorced from participants, whilst the high interaction with participants in qualitative work permits deeper understanding thereby mitigating these weaknesses (Creswell and Plano-Clark, 2007). Qualitative work on the other hand, requires personal interpretations potentially leading to bias (Saunders et al., 2003); the broader use of participants in quantitative research moves to address this concern (Creswell and Plano-Clark, 2007). Secondly, by encouraging the combination and broader use of methods, epistemic positions and theories, MMR provides more a comprehensive coverage of the

research problem (Creswell and Plano-Clark, 2007). Thirdly, and as an extension to this point, MMR can answer questions that cannot be answered by either qualitative or quantitative studies alone. Finally, and of particular relevance to OM, MMR is practical in the sense that: (a) the researcher is free to use all methods possible to address the research problem (Creswell and Plano-Clark, 2007) as encouraged by such OM studies as Gattiker and Parente (2007), Boyer and Swink (2008), Singhal et al. (2008), Chopra et al. (2004) and Barnes (2001); and (b) that in reality, individuals tend to solve problems with *both* words and numbers rather than a single data type, as replicated by a MM design (Creswell and Plano-Clark, 2007).

These benefits are not without limitations. In order to gain the detail and depth of research as suggested previously, it is considerably more time and resource consuming to undertake both qualitative and quantitative data collection and the requirement of a solid knowledge of both methodologies to adequately analyse and interpret the data (Creswell and Plano-Clark, 2007). This researcher is well aware of these issues and justifies the added pressure in light of the PhD as an *academic apprenticeship* where experience in both quantitative *and* qualitative research would position a candidate well for their future career. There is also a concern regarding the complication of blending both qualitative and quantitative research (Creswell and Plano-Clark, 2007). Given the sequential design of the qualitative and quantitative stages, and the clear understanding of the purpose of each stage (see Section 3.4.1 and 3.5.1), this issue is of minimal concern.

Creswell and Plano-Clark (2007) suggest that the decision to adopt a mixed method design rests on three key considerations- the epistemological stance, the basics of qualitative and quantitative methods, and whether the inquiry requires a MMR. Creswell and Plano-Clark (2007) state there is one “best” paradigm or worldview that fits MMR, namely Pragmatism, which concurs with the above discussions. The second consideration is having a sufficient understanding of the basic tenant of both qualitative and quantitative methods. Creswell and Plano-Clark (2007) suggests that fundamentally, in qualitative research, the intent is to learn about the views of participants on a topic, and in quantitative research, the intent is to see how data provided by participants fit an existing theory. The training done on the PhD course provided a basic understanding of these principles, with the majority of the learning from extended discussions with colleagues, presentations at conferences, and most importantly, learning by doing. The third and final

consideration is whether the research problem justifies a MM design for which Creswell and Plano-Clark (2007) offer three scenarios:

- When only one approach is inadequate and the subsequent combination of the methods provides “*a more complete picture*” (Creswell and Plano-Clark, 2007; p33).
- The need to enhance the study through the triangulation of data
- The need to further explain or interpret quantitative results through qualitative research

Lastly and the reason why MM is adopted in this research, is the need to first explore qualitatively. This scenario suggests that qualitative research may provide an adequate exploration of a problem and assist in identifying variables, taxonomies and constructs, but where such exploration is not sufficient (Creswell and Plano-Clark, 2007). Consequently, the addition of a quantitative phase provides the necessary means of concluding the inquiry.

In order to promote MM as a suitably robust approach, and a comparable alternative to either a qualitative or quantitative study alone, Creswell and Plano-Clark (2007) go to lengths to suggest four major types of MM design. In saying this, Tashakkori and Teddlie (2003) notes in their review of the literature, they found nearly 40 different types of MM designs and hence converging these to a more manageable number is welcomed. A detailed examination of each of these modes is believed to be unwarranted for this research; instead, the discussions shall focus on the selected design. For completeness, *Appendix 5* provides a detailed summary of these four designs. In terms of the process for selecting which design to use, Creswell and Plano-Clark (2007) first note that as with all research, the design should match the research problem. They subsequently suggest a three-stage decision process as illustrated in table 3.1 below. Firstly, the decision on the order in which the researcher uses the data, be it concurrent or sequential, and if it is sequential, whether qualitative or quantitative data first. Given the emerging nature of the knowledge-based view of process improvement, an initial exploratory qualitative phase is considered necessary in order to elicit understanding about its relevance and current practices- thus a sequential design with the qualitative phase first was selected. Secondly, the decision of the relative emphasis of the two types of data, as dependent on: (1)

worldview, i.e. a positivist will prefer quants, a constructionist quals, and the pragmatist can either assume equal or unequal weights; (2) the strength of the method and its relation to the research goals; (3) practical considerations such as time and resources; (4) the researcher's experience and competencies; and (5) the audience to which the research is addressing. Given the author's background in Applied Mathematics and Engineering, a focus on quantitative data is fitting. Furthermore, in Craighead and Meredith's (2008) study into the trends in research approaches within OM, they found that over 52% of surveyed literature is deductive/quantitative and reflects the comments of Meredith et al. (1989) on the field's focus on quantitative modelling and statistical analysis. The final selection criterion is the approach taken to combine the qualitative and quantitative data. Creswell and Plano-Clark (2007) subsequently suggest three forms: a) *merging* where the two datasets are brought together either during interpretation (by analysing them separately and merging results), or during analysis by transforming data. Secondly, *embedding*, where for example, qualitative data is collected during quantitative research such as open questions in surveys. Thirdly, *connecting*, where results of previous stages inform subsequent stages which is the approach adopted in this research. Table 3.1 below subsequently illustrates this procedure.

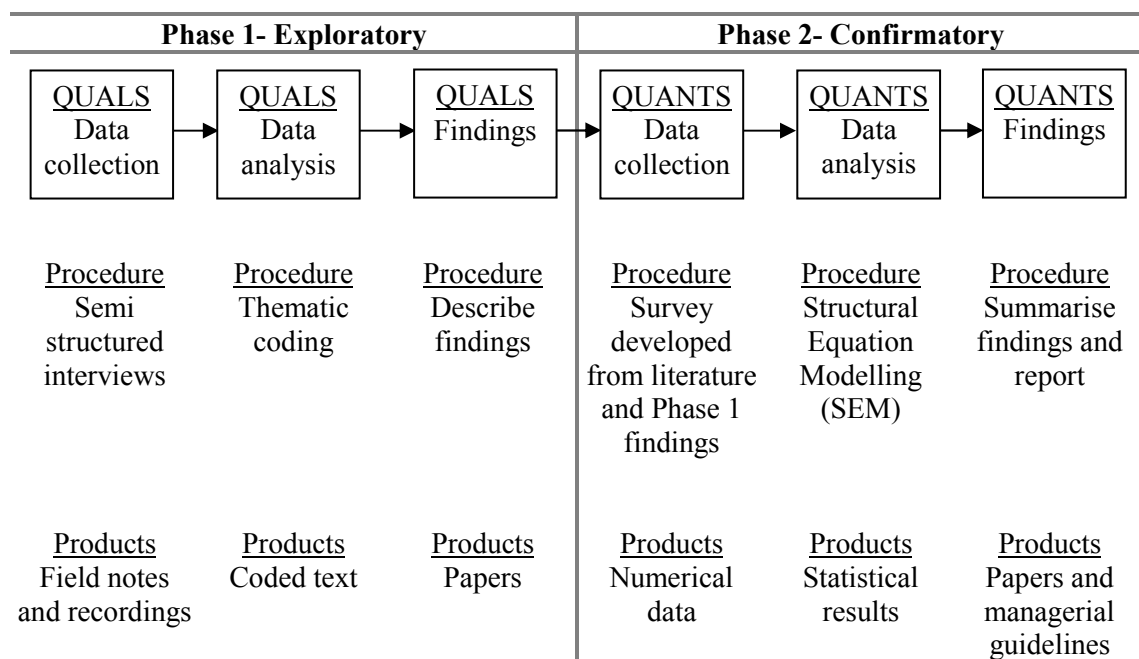
Decision Steps	Triangulation Design	Embedded Design	Explanatory Design	Exploratory Design
Step 1: Embedded vs. Sequential	Embedded	Embedded	Sequential	Sequential
Step 2: Equal vs. Unequal emphasis	Either	Either	Unequal, typically quants	Unequal, typically quals
Step 3: Data combination	Merging	Embedded	Connecting	Connecting

*Table 3.1: Decision process for selecting Mixed Method Design
(From Creswell and Plano-Clark, 2007)*

Given these discussions on the procedure for selecting the research design, an overview of the selected design, notably the Exploratory Design can now be undertaken. This design is used to identify important variables, explore a phenomenon in more detail and test emerging theories (Creswell and Plano-Clark, 2007) and so is perfectly aligned to this research's intent as detailed in the literature review. It incorporates a two-phase design commencing with a qualitative phase where qualitative results guide the

quantitative phase as done in the studies in OM studies by Carey et al. (2011) and Lawson et al. (2008). An outline of the full research inquiry is illustrated in figure 3.1 below. The key benefits of this design is that firstly, the sequential two-phase design makes implementing, analysing and writing up the inquiry easier (Creswell and Plano-Clark, 2007). Secondly, the inclusion of quants can make a quals based inquiry more acceptable in some domains (Creswell and Plano-Clark, 2007).

Equipped with the justification of the use of a MM design, the following sections expand on the two phases.



*Figure 3.1: Visualisation of the Research Design
(adapted from Creswell and Plano-Clark, 2007)*

3.4 Phase 1: Exploratory Case Interviews

3.4.1 Purpose

The aim of this phase is to identify the key theories and variables pertaining to a knowledge acquisition perspective of the knowledge-based view of process improvement. In doing so, it address RQ1 and RQ2 by first looking to understand the relevance of social networks and knowledge acquisition in process improvement. Secondly, it seeks to understand the approaches and drivers to acquiring knowledge that reside in networks, thus responding to RQ2. By addressing these concerns, the findings shape the development of the conceptual framework, which forms the foundation to the survey research in the following stage.

3.4.2 Method and Data Collection

Guided by an appropriate protocol developed from theory and aspects suggested by Yin (2009) and Stuart et al. (2002), this phase utilises single respondent, exploratory case interviews in order to simultaneously build and confirm theory. Primary data was collected in the form of semi-structured interviews in order to examine the existing processes used by professionals and to contrast them to the theories suggested in the literature (Saunders et al., 2003). As this phase is concerned with “*find[ing] out what’s happening [and] to seek new insights*” or what Robson (2002) defines as exploratory semi-structured interviewing, this form of interviewing is ideal suited (Saunders et al., 2003; p248). Moreover, interviewing provides an opportunity to probe more deeply in comparison to surveys or questionnaires and is a practical balance between the resource intensive ethnographic/participatory observation methods which can provide the deepest level of understanding (i.e. Creswell, 2009, Seale et al., 2007) within the time constraints of the PhD.

The criticisms to such an approach are three fold. Firstly, the in-depth findings from a small number of cases are limited in their generalisability (Creswell, 2009, Seale et al., 2007). The research acknowledges this limitation and this is why a confirmatory approach has been proposed in a subsequent phase. Secondly, and in particular reference to theory building, is that such research may “*always begins from scratch instead of using whatever theoretical and conceptual resources that are already to hand*” (Seale et al.,

2007; p90). As illustrated by the literature review in Chapter 2, this research has given suitable acknowledgement to extant literature, making this issue of minor concern. Finally, the presence of the researcher may inherently bias responses (Creswell, 2009, Paul, 1996) or what Yin (2009) suggests is reflexivity- “*interviewee gives what interviewer wants to hear*” (p102). As the intention of the interviewing is to explore the phenomenon of the KBV of PI rather than in making profound causal inferences, in addition to the receiving opinion on a larger scale in the subsequent stage, this is of limited significance. Overall, the use of semi-structured interviews is mutually supportive of the research intent and with the subsequent phase.

3.4.3 Subjects Selection and Administration

As suggested by Eisenhardt (1989), purposeful sampling rather than random sampling was employed. Consequently, project managers and management consultants were targeted for two key reasons. Firstly, due to their need to draw from knowledge repositories, past projects and the experiences of others, they fitted the research need for participants with networking roles. Secondly, they are inherently organisational problem solvers and routinely gather and adapt information to new settings, thus providing a mutual source of process improvement and knowledge creation experience. Furthermore, given that project managers and management consultants work on a variety of projects in diverse industries, products, and companies, they are potentially able to draw from a far greater variety of experience and settings. In comparison, improvement experts who operate within a single firm may only be able to draw from experience within their particular firm. Maintaining such broad selection criteria then allowed for varied and diverse perspectives (Niemi et al., 2009) which is important within exploratory research (Yin, 2009). The only caveat to this may be in relation to only having temporary engagement with clients/projects. Hence, factors which may take time to fully recognise, such as firm culture, may be difficult to fully comprehend. However, just as internal process improvement experts may be able to provide considerable depth to such factors but in a relatively narrow scope, consultants and project managers can offer considerably more breadth which may be as equally enlightening. Furthermore, the survey used in the subsequent stage of this research specifically asked about such factors, hence accounting for such concerns. Candidates were subsequently sourced from serendipitous networking and the authors’ personal contacts as summarised in table 3.2 below.

On the justification for single cases, Beach et al. (2001) in their review of qualitative research in production management research suggest that for an exploratory study, a single case may be all that is needed provided sufficient 'within-case variation'. Similarly, the Stuart et al. (2002) review of case research in operations management suggests that to demonstrate internal validity, cases should be selected that are “*maximally different on important dimensions to help establish if the same phenomenon exists*” (p425). Consequently, the selection of interviewees with various job roles although principally concerned with either problem solving, networking and/or knowledge creation provides support for the use of single case responses.

Case	Job title	Sector	Firm Size	Data
1	Director/ Consultant	Training and Consultancy	<50	30 minute interview, field notes, participant observation
2	Project Manager	Financial service	10000+	30 minute interview, field notes
3	Project Manager	Consumer goods manufacturing	1000-5000	Written communication
4	Management Consultant	Information Technology	10000+	60 minute interview
5	Management Consultant	Operations/Supply Chain	51-250	45 minute interview
6	Management Consultant	Operations/Supply Chain	10000+	80 minute interview
7	Management Consultant	Higher Education	<50	60 minute interview
8	Management Consultant	Non-profit	<50	45 minute interview

Table 3.2: Profile of cases

Finally, there is the issue of *saturation* and the argument related to the number of cases. Grounded theorists (Glaser and Strauss, 1967) and theory builders (Eisenhardt, 1989, Meredith, 1998) suggests saturation is when: (a) no new or relevant data is emerging; (b) the categories are well developed; and (c) the relationship amongst categories are well established (Bryman, 2008). As the onus is on finding evidence of the existence or extent of a theory in addition to the later formal, confirmatory empirical stage, saturation in this sense is not as critical. The findings from these cases provide sufficient insight and to develop the conceptual model outlined in Chapter 4. Furthermore, Bryman (2008)

suggests sufficiency in the number of cases when there are “*well developed categories*”, for which table 4.1 in Chapter 4 clearly demonstrates.

3.4.4 Research Instrument: Interview Protocol

Consistent with methodology literature (ie Eisenhardt, 1989), an appropriate interview protocol was used to guide the discussions as shown in *Appendix 6*. As observed, the protocol opened by contextualising the research and expressing the notes on data privacy. Cautions here were taken so as not to overly define the topic, which may inherently lead discussions. To ensure a theory-driven foundation for research, the nature of the questions in the formal interview part were developed from the literature, the exception being the open introductory question. Question 2 asked *why do people turn to their network for assistance?* This question was in response to the literature on bounded rationality (March, 1991b), networks and connectivism (McDermott and Archibald, 2010, Nebus, 2006, Inkpen and Tsang, 2005, Carroll and Teo, 1996), and the nature of process improvement, albeit problem solving (Naylor et al., 2001, Choo et al., 2007b, Amabile, 1983). Question 3 asked *why people help others? What motivates them to share information/knowledge/experience?* This question was principally drive from the literature on advice seeking behaviour (c.f. Cross et al., 2001, Borgatti and Cross, 2003, Nebus, 2006). Question 4 asked *what do you see as the characteristics/elements of relationships?* This question was principally based on social capital theory (Nahapiet and Ghoshal, 1998, Lin, 1999, Tsai and Ghoshal, 1998, Adler and Kwon, 2002). Finally, question 5 asked, *what and how is information/knowledge shared? What are the barriers to this?*, a question base solidly in the knowledge management field concerning authors such as Nonaka (1994), Zahra and George (2002), March (1991a) and Carayannis (1999).

3.4.5 Analysis Method

Yin (1994) suggests data analysis as examining, categorising, tabulating, or otherwise recombining evidence to address the propositions of the study, which in this context is the identification of key theories and variables in the knowledge-based view of process improvement. A thematic analysis procedure by Creswell (2009) was subsequently employed to provide a structured methodology to the analysis to enhance the research’s reliability and validity- see the following section for an extensive discussion on *the*

quality of qualitative research. The first stage of this process is to organise the data. Thus, transcription of the interviews allows the data to be presented and organised in a structured and easy-to-use format (Seale et al., 2007).

With the data organised, the next step is the major section of the analysis- the coding process (Creswell, 2009). Since the purpose of this phase is to elicit key theories and variables, a chain of evidence approach rather than a binary (yes/no) or word frequency approach was taken (Eisenhardt, 1989, Yin, 1994). The chain of evidence approach derives codes and themes from the data based on seeking a clear chain of evidence from the raw data to the final theme (Eisenhardt, 1989, Yin, 1994). For example, Hughes and Perrons' (2011), who's paper incidentally provided considerable guidance in formatting/presenting the qualitative findings, applied such a technique and remarked that:

The case interview evidence was analyzed iteratively by clustering and organizing the data around key words drawn from the theory of social capital to discover patterns. This approach made it possible to identify and make sense of the social capital activities of [Company X] and its managers, and to explore the interaction between the evidence and existing theory (p166)

Within this step, Creswell (2009) suggest two types of coding strategies. First, are the more content-based codes- those that readers would expect to find from common sense and literature; codes that are surprising and that were not anticipated; codes that are of conceptual interest to the reader; and codes that address a larger theoretical perspective of the research. Secondly, setting and contextual codes such as:

- perspectives held by subjects
- subject's way of thinking about other people and objects
- process codes
- activity codes
- relationship and social structure codes
- strategy codes

Given also that the purpose of this phase is to identify the key theories and variables from those identified in the literature review, it adopts a similar coding procedure as the meta-analysis of Van Wijk et al. (2008) of the organisational knowledge transfer literature. This approach used a triple coding system to analyse the literature in terms of: a)

knowledge characteristics; then b) organisational characteristics; and finally c) network characteristics. By viewing the data in three distinct stages and perspectives, it provided “a more fine-grained analysis of how organizations may enhance knowledge transfer” (Van Wijk et al.; p831). Consequently, a similar three stage coding strategy was also applied- from a knowledge perspective; social network perspectives; then as a consequence of identifying the underlying theory, from an absorptive capacity perspective. Table 3.3 below subsequently summarises this strategy. The first stage of coding viewed the data from a knowledge perspective of the data based on the extensive literature review in Chapter 2 and aided by categories obtained from Macpherson and Holt’s (2007) literature review, a paper deemed fit due to its convergence of literature on learning, knowledge and firm growth. The second stage took a network perspective and used codes derived from Jack’s (2010) literature review on network research in addition to points highlighted in Chapter 2. Finally, codes based on absorptive capacity, notably Zahra and George’s (2002) work on the theory.

Theory Codes (Absorptive Capacity)	Knowledge codes (Macpherson and Holt, 2007)	Network codes (Jack, 2010)
Potential knowledge creation	– Systems for exploration	– Resources
Realised knowledge creation	– Capitalising on opportunities – Systems for exploitation	– Growth and Performance – Opportunity recognition
Social integration mechanisms	– Trust and familiarity – Active management of social capital – Limitations to networks – Organisational practices – Institutional mechanisms – Interpreting and “buying in” – Culture	– Embeddedness – Social Capital – Particular ties/characteristics

Table 3.3: The triple code framework

The last step in the analysis process is to generate and document the major themes. This is done by converging, grouping and categorising codes and displaying them in a suitable format in order to express the major findings of the inquiry (Creswell, 2009). Eisenhardt (1989) refers to this stages as *hypothesis shaping*. Thus, the themes are melded with extant literature in an iterative process of refining the construct/theme’s definition, and

building evidence to support these themes in order to derive or *shape* hypothesis (Eisenhardt, 1989). The discussions presented in Chapter 4 provide the details on this final stage, in addition to work presented in Marzec and Tan (2011) and Marzec and Matthew (2012). The resulting analysis and coding of the qualitative data is presented in both thematic analysis form (i.e. Tables 4.2-4.8 in Chapter 4), and as within case summaries based on the Interview Protocol (see Appendix 9).

3.4.6 Determining Quality of Qualitative Research

Creswell and Plano-Clark (2007) state that in undertaking MM research, a solid appreciation of both qualitative and quantitative research is necessary. It is fitting then to acknowledge what makes ‘quality’ qualitative research. Easterby-Smith et al. (2008a) highlight the pluralistic nature of qualitative methods and encourage a more dynamic perspective of quality, suggesting it as the process of quality-making rather than a static list of criteria. They subsequently see quality through such activities as careful scholarship, acute understanding of existing perspectives, a systematic process of inquiry, well-supported research claims, and the creation of distinct values relative to some theoretical and/or applied domain. Seale (2007) provides a more ‘static’ account of quality assessing it on four factors. Firstly, through the rigorous adoption of a theoretical and epistemological perspective. Secondly, quality in terms of the relevance of the study and how important is it to the community. Thirdly, quality in terms of a commonsense evaluation of whether the claims made by the study are plausible given one’s existing knowledge. Finally, and what Seale sees as most critical, is whether the credibility of the claims are supported by sufficient evidence. In a similar way, Barker (2003) proposes five key points that can be used to evaluate quality, namely:

- *Research materials and data:* How systematically are the materials made accessible to fellow researchers? How closely relevant do they remain to the research tasks undertaken?
- *The encounter between evidence and concepts:* Has the research anywhere taken its materials or its conceptual framework as self-evident, or self-explanatory? What are the origins and provenance of the concepts deployed in the research?

- *Elaborating the conceptual and theoretical framework*: How far does the research identify, make clear, and explain the wider implications and implicit claims that are consequent upon its claims, and how might these be tested?
- *Laying the basis for further research*: How far does the research make visible some further tests which would both more securely ground its claims, and associate its findings with other related research?
- To whom is the research relevant, and how might it have practical consequences or implications? Whose understanding of the world might be altered by the findings of the research?

Finally, this research finds the framework proposed by Lincoln and Guba (1985) in their classical work to adequately capture the intent of these authors. Not only does it provide a refined version of Barker's (2003) five key points as well as encapsulating Seale's (2007) four views, its terminology allows the assessment of the quality of qualitative research to be more acceptable in a predominately quantitative field such as OM. Furthermore, by actively addressing these three points in an inquiry, it incorporates Easterby-Smith et al. (2008a) *intent of quality making* view. The following section examines Lincoln and Guba's (1985) framework, depicted in Table 3.4 below, in detail and how this research has addressed their concerns.

Traditional Criteria for Quantitative Research	Alternative Criteria for Qualitative Research
Internal validity	Credibility
External validity	Transferability
Reliability	Dependability

*Table 3.4: Comparison of judging criteria for Qualitative and Quantitative research
(adapted from Lincoln and Guba, 1985)*

3.4.6.1 Internal Validity and Credibility

Creswell (2009) suggests that internal validity in quantitative research are factors that account for threats in the design of the inquiry and thus the ability to draw inferences from the data. In Lincoln and Guba's (1985) work, this is interpreted as *credibility* in qualitative research, namely the truth of the data and in its interpretation. Lincoln and Guba subsequently see credibility as the overriding goal for a qualitative inquiry by

establishing confidence in the findings. This can be achieved through *peer debriefs*, where work is presented to disinterested parties or peers to critically examine the research (Lincoln and Guba, 1985). The presentation of this research at conferences, journal submissions, and annual reviews is consistent with this approach. Secondly, Lincoln and Guba (1985) suggest that analysis and findings be presented back to participants to get agreement on content, as well as to get reflections on the findings. In this way, the paper developed for EurOMA was returned to the interviewees for comment- see Section 4.1.1 for details. Finally, in light of background of the participants selected (i.e. company size, experience, profession etc.) and hence the perceived value of the findings elicited from them, it was considered that these interviewees were sufficiently qualified to provide insight to the inquiry.

3.4.6.2 External Validity and Transferability

External validity, or *transferability* (Lincoln and Guba, 1985), refer to the generalisability of the data and the extent to which findings can be applied in other groups and contexts (Lincoln and Guba, 1985, Creswell, 2009). To gain transferability, Lincoln and Guba (1985) suggest providing “thick descriptions” of the data and the findings so the reader can evaluate the applicability of the findings to other contexts. It is along these lines that a comprehensive and “thickly descriptive” literature was presented in Chapter 2. In addition, the use of an established and structured methodology for analysing the data provides rigour to the process and thus to the results produced as a consequence. Finally, the method by which the data is presented in the discussions (Chapter 4) is done in such a way that a clear logic from raw quotes through to final themes is demonstrated.

3.4.6.3 Reliability and Dependability

The intention with reliability and dependability is to examine the stability of the data and to address the question: would the findings of an inquiry be repeated if it were replicated with the same (or similar) participants in the same (or similar) context? (Creswell and Plano-Clark, 2007, Lincoln and Guba, 1985). Reflecting then on the two previous concerns, Lincoln and Guba (1985) argue that there are close ties between credibility and dependability and that a demonstration of the former goes some distance in ensuring the latter. To address this concern more directly Shenton (2004) also suggests: 1) the use of overlapping methods, which the MM research design encapsulates; and (2) the detailed reporting of the research process, which this chapter is hoping to capture.

3.5 Phase 2: Confirmatory Survey

3.5.1 Purpose

This phase builds on the exploratory findings of the previous phase and provides generalisability to these results. In doing so, it empirically tests the conceptual framework developed in Chapter 4 and provides evidence to address RQ2 and RQ3. Findings from this stage are also used to develop guidelines for practitioners.

3.5.2 Method and Data Collection

A survey-based method is adopted in this phase consistent with the majority of empirical studies within OM (Craighead and Meredith, 2008) as well as in network-based studies (Jack, 2010). Creswell and Plano-Clark (2007) also suggest that survey research helps “*identify broad trends in a population*” (p32) and hence is ideally suited given the purpose above. Within network-based empirical work, two distinct forms of inquiry are observed. Firstly are inquiries that map network actors and dyadic relationships and subsequently utilise a matrix style instrument. For example (Tsai and Ghoshal, 1998) examined the relationships between 45 participants in a multiunit company and used the subsequent pattern of relationship to help explain product innovation performance. The second form of instrument is used in the study of external networks and particularly at the intersection of knowledge and network studies. In this case, networks are not explicitly mapped; instead, questions concerning the general size or strength of one’s network are raised (i.e. Smith et al., 2005, Tu et al., 2006). Following this cue, such a design is incorporated by this research. The following sections justify this decision and the actions taken to ensure quality in this phase of the research.

3.5.3 Research Instrument: Online Questionnaire

3.5.3.1 Design and Format

Precautions were taken when designing the survey so that it was perceived as both interesting and non-tedious in order to encourage respondents to complete the survey. The first design issue was to acknowledge the importance of the first questions in enticing respondents. This question needed to be both simple yet interesting. As the final survey was administered electronically via the social media platform LinkedIn (see

Section 3.5.4), the first question asked for details on respondents network (i.e. network size, network reach) which LinkedIn provides a summary of. This question was deemed interesting as it: a) provided respondents with a feature of LinkedIn that they may not be aware of via a simple link; b) encouraged respondents to start thinking about characteristics of their network and what role they might play to engage their minds for the remainder of the survey; and c) allowed the use of diagrams and screenshots from the onset to make the questionnaire visually appealing. Secondly, the survey was made to look as professional as possible to give face validity and creditability to the survey. Consequently, features such as appropriate headers, coloured text, status bar (percentage completed) and the University of Nottingham logo were used on all pages- a screenshot of this is in Appendix 7. Thirdly, the survey was prefaced with a simple 170 word abstract-style cover letter (see Appendix 7) which: a) positioned the problem that the survey was addressing; b) announced the important themes; c) emphasises the deliverables of the survey and the research in general; d) informs that the questionnaire will not take long to complete; e) detailed the incentive structure- an executive report and a donation to Charity; and lastly, it mentions that the survey will ask questions from their LinkedIn account and why this is necessary and interesting in order to prepare the respondents in advance.

The final design feature was the general order of the questions. As mentioned above, the survey started with questions on networks. Following this, questions were asked about their process improvement practices and the outcomes to provide context to the survey. Where possible, questions were randomised to aid in the statistical robustness of the questionnaire, but to also prevent respondents biasing the survey out of perceived expectations. Then questions were asked about critical factors that enabled or prevented knowledge flows in order to re-spark interest and thinking regarding the role of networks. Finally and importantly, demographic questions were placed at the end of the survey as: a) feedback from the pilot testing suggested this; and b) if respondents reneged from the survey before full completion, having the less important demographic data at the end meant that the questions vital to the study would more likely to have been answered and thus potentially allowing the case to be included in the data analysis.

The final survey was a total of 92 items and eight pages including a cover page and thank you page- the complete survey instrument can be found in Appendix 8. According to the

timestamps provided by surveymonkey.com with the removal of extreme times (e.g. 3+ hours), the survey took an average of 26 minutes to complete.

3.5.3.2 Measures

Consistent with general quantitative practices, construct measures were adapted from previous works and more specifically, from 3- and 4-star journals in order to ensure a high level of quality. The precise measures used in the survey instrument are documented in the empirical section of this phase (Chapter 5), as commonly done in quantitative studies. In addition, there is the question surrounding the number of response categories or points on the scale to use for each item. Jacoby and Matel (1971) conclude that "too few categories result in too coarse a scale and loss of much of the raters' discriminative powers...too fine a scale may go beyond the raters' limited powers of discrimination" (p495) in addition to pragmatic concerns of having a high number of categories (Green and Rao, 1970). As such, there is evidence to suggest that 6- to 7-point scales are optimal with 6-points being an ideal minimum (Jacoby and Matell, 1971, Green and Rao, 1970). Consequently, all measures used were converted to 7-point likert scales.

3.5.4 Subject Selection and Administration

The survey was developed via the web-based survey platform, [surveymonkey.com](https://www.surveymonkey.com). In order to encourage response, a £2 donation to the Red Cross was given per respondent in addition to an executive summary of the findings, an approach similarly used by Siemsen et al. (2008).

In obtaining suitable candidates, respondents were sourced from LinkedIn. LinkedIn was selected as the medium for administering the questionnaire for three key reasons. Firstly, a core remit of this research is to explicitly explore networking behaviour. LinkedIn is well regarded as being the premier social networking platform for professionals, thus sourcing respondents from there is well aligned to this networking remit. Secondly, LinkedIn provides a means of viewing respondent's "virtual CVs" and thus insight into their professional background. In doing so, individuals with specific training, experience, and current job roles can be targeted such that respondents are optimally suited to the research enquiry- in other words, LinkedIn is exceptionally well aligned to the process improvement remit of this research. This level of detail is not possible through traditional administration modes such as via professional associations or Institutes (c.f. Cousins et

al., 2006). Details on the procedure used to identify and select these optimum respondents is given in the paragraph below. Thirdly, Khalifa and Liu (2008) found that 95% of business professionals consider computer-mediated discussions as one of the top three enablers of knowledge acquisition. LinkedIn is not only useful due to its networking abilities as mentioned before, but its special interest groups are an example of such computer-mediated discussions. Thus LinkedIn is also well aligned to the third and final remit of this research, knowledge acquisition remit.

The survey was subsequently administered to candidates in a two-step process. Firstly, a total of six special interest boards were identified which had specific interest in area of process improvement as shown in table 3.5 with their full profiles summarised in Appendix 8. Following this, 2056 customised covering letters detailing the motivations for the research, the benefits and a web-link to the survey were sent to individual members that met the following criteria- the number of letters sent to members per group are shown in table 3.5 below:

- they were direct contacts (i.e. "Tier 1 contacts") or friend-of-a-friend contacts (i.e. "Tier 2 contacts") so as to avoid simply cold-calling strangers;
- if this criteria was met, individual profiles were checked to see if they actually had a *history* in working in process improvement/continuous improvement/Lean/Six Sigma/LSS etc;
- Finally, if this criterion was met, then profiles were also checked to see if their *current role* involved process improvement/continuous improvement/Lean/Six Sigma/LSS etc.

Group	Letters Sent
Lean Business System	417
Lean Six Sigma	596
Continuous Improvement, Six Sigma, & Lean Group	292
Business Process Improvement	345
Business Improvement, Change Management & Performance	103
PEX Network & IQPC - Lean Six Sigma & Process Excellence	273
Personal contacts	30
TOTAL	2056

Table 3.5: Summary of survey invitations and LinkedIn Special interest boards

3.5.5 Analysis Method

The following discussions detail the techniques used to analyse the conceptual framework developed in Chapter 4. It begins with a discussion on structural equation modelling, the normative statistical technique now used in analysing survey based data. Following this, it details the three advanced techniques required to analyse the conceptual model. Figure 3.2 below illustrates and summarises these three key techniques- formative measure analysis to analyse potential absorptive capacity; interaction analysis (aka moderator analysis) to analyse the individual effects of the social integration mechanisms; and multigroup analysis to analyse the dyadic relationship suggested in Dyad 2 and Dyad 3 (see Chapter 4 for further information on these).

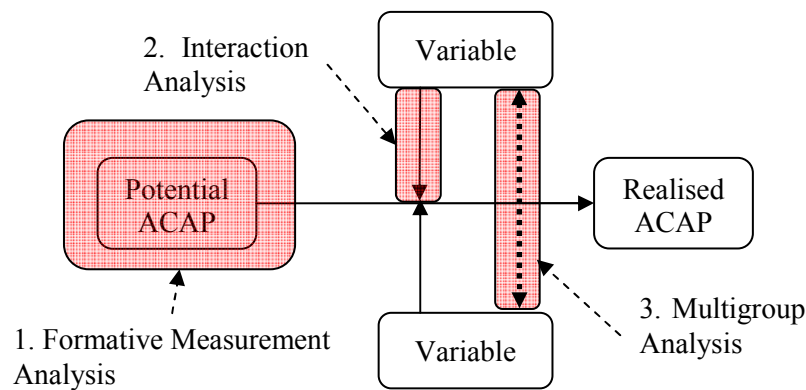


Figure 3.2: Analysis Techniques with respect to Conceptual Model

3.5.5.1 Structural Equation Modelling- Partial Least Squares (PLS)

This section begins with an explanation for the use of structural equation modelling (SEM) as an overarching statistical technique. For practical reasons, the intent here is to cover the key topics in structural equation modelling (SEM) rather than the detailed mathematical derivations and origins. Following this, attention is turned to the debate on the two dominant approaches to SEM- covariance based *linear structural relations* (LISREL), and variance based *Partial Least Squares* (PLS) and the subsequent selection of PLS.

3.5.5.1.5 An Introduction to Structural Equation Modelling (SEM)

Structural equation modelling is a technique that specifies, estimates, and evaluates models of multiple linear relationships simultaneously (Shah and Goldstein, 2006). This definition highlights the two important characteristics of SEM- linear relationships, and simultaneous specification. There are two main types of linear relationships in SEM as figure 3.3 below shows. First are those between the observed variables represented as rectangles on SEM models (aka manifest variable, measured variable, measure indicator, predictor, items), and the unobserved variables (the circles; aka latent variables, construct). These are the relationships represented by the arrow from MV1 to LV1 and are called loadings in the case of reflective measures, or weights in the case of formative measures- Section 3.5.5.2 explains these two measurement types in further detail. The second type of relationship are those between the latent variables, i.e. from the circle LV1 to LV2, typically called path coefficients. In this regard, an additional layer of terminology is used to further define latent variables. In the simplest model we can define LV1 as an antecedent or independent variable, and LV2 as a consequent, dependent variable or outcome. If there was another variable between LV1 and LV2 (i.e. LV3), this would represent a *mediating* variable, in other words, a variable that mediates the relationship between LV1 and LV2 (c.f. Baron and Kenny, 1986). Conversely, a variable may change the strength or direction of the relationship between LV1 and LV2, for example age may change the relationship between occupation type (i.e. LV1) and the number of millionaires (i.e. LV2). These types of variables are called *moderators* such as LV4 (c.f. Baron and Kenny, 1986) and are explicitly seen in the conceptual framework developed in Chapter 4. The final type of latent variables is a combination of the previously mentioned types. Exogenous variables are similar to antecedents but more specifically represent variables that *only* have arrows pointing away from them, i.e. LV1 and LV4 (Henseler and Fassott, 2010, Rigdon, 1994). On the other hand, endogenous variables are any latent variable that have arrows pointing at them, i.e. LV2 and LV3 (Henseler and Fassott, 2010, Rigdon, 1994).

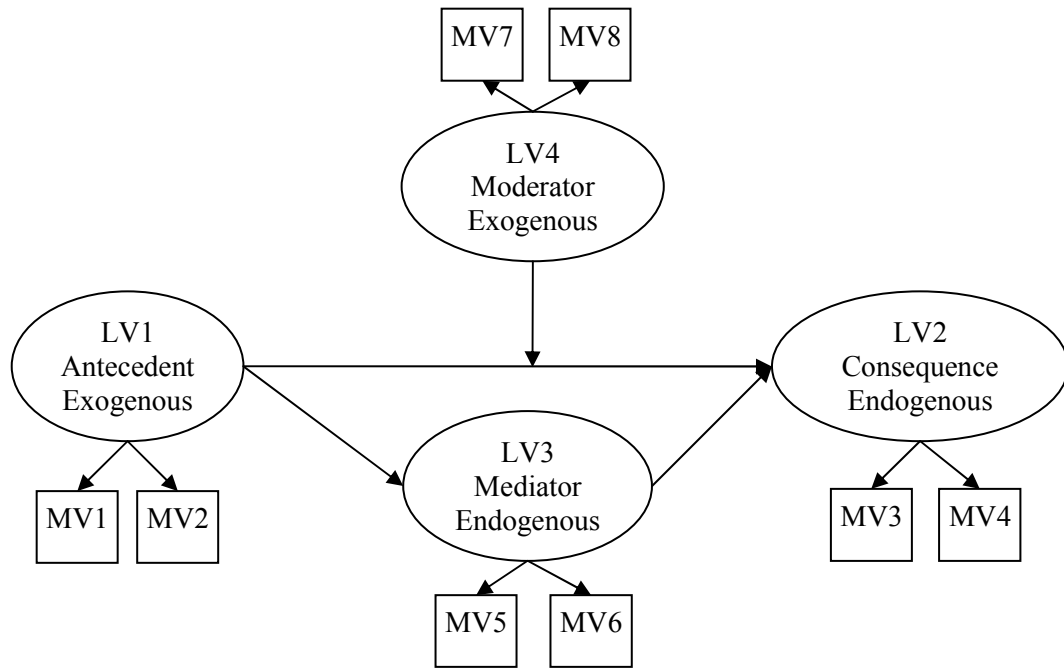


Figure 3.3: An example of a Structural Equation Model

(Adapted from Shah and Goldstein, 2006)

With regard to the simultaneous specification aspect, the technique undergoes an iterative procedure in calculating the loadings/weights and the path coefficients until a certain terminating criteria is met. In covariance-based SEM (LISREL), a maximum likelihood function is used to minimise the value of a fit function between the estimated covariance matrix generated by the model and the original covariance matrix inputted from data (Diamantopoulos and Siguaw, 2000). Conversely, variance-based SEM (PLS) uses a four-stage procedure, iterating between the *outer* measurement model, and *inner* structural model (Ringle and Henseler, 2011, Peng and Lai, 2012, Henseler and Chin, 2010, Haenlein and Kaplan, 2004) as follows:

1. *Outer estimation of the latent variable scores:* Outer estimates of the LVs are calculated as linear combinations of their respective indicators (at initiation, weights/loading set to 1)
2. *Estimation of the inner weights:* Next, the inner paths are calculated based in the outer estimates via one of three schemes: a) the centroid scheme which utilises the sign of correlations between a latent variable; b) the factor weighting scheme, which utilises the magnitude of the correlations; and c) the path weighting scheme which is a regression-based technique.

3. *Inner estimation of the latent variable scores*: Thirdly, new values for the LVs are calculated derived by the linear combination of the inner paths and outer estimates
4. *Estimation of the outer weights*: Finally, the outer factor weights/loadings are re-estimated as either covariances between the inner estimates and the indicators, or as regression coefficients. The algorithm terminates when the change from one iteration to the next is less than 10^{-5} .

With an understanding of SEM, Haenlein and Kaplan (2004) discuss the limitations of "first generation" techniques such as regression-based approaches and factor analysis, which SEM can overcome, namely: (a) the postulation of a simple model structure; and (b) the assumption that all variables can be observed. Regarding the postulation of a simple model structure, regression models can typically contend with only one layer of linkages (i.e. multiple independent variables, single dependent variable models) and thus regression-based approaches may be too limiting for more complex and realistic situations as found in management research (Haenlein and Kaplan, 2004). SEM on the other hand can simultaneously optimise multiple and interrelated variable functions (Fornell and Larcker, 1981, Hair et al., 2006). With respect to the second limitation, very few variables in management research can be directly observed or measured (i.e. age, gender, profit) with the majority of hypothesised variable being unobserved and measured instead by a battery of indicators (Haenlein and Kaplan, 2004). Without having direct observations, regression-based techniques would not be possible. In doing so, SEM has the ability to represent unobserved concepts and account for errors in the estimation (Hair et al., 2006). Consequently, the ability of SEM to analyse latent variables dramatically improves the arsenal of models that researchers can analyse. One final advantage of SEM stems from the technique's ability to explain the entire set of relationships as one entity (Hair et al., 2006). By doing so, SEM can emphasise the fit of the entire model, in addition to the individual relationships, in order to assess the empirical validity of the complete theoretical model (Kline, 2010)

3.5.5.1.6 Covariance vs. Variance-based SEM, and the adoption of PLS

Covariance-based SEM, commonly referred to as LISREL, is a maximum likelihood technique developed by Jöreskog (1994, 1978, 1982). It concerns the fit between the estimated covariance matrix from the model, and the observed covariance matrix from the data (Diamantopoulos and Siguaw, 2000). A two-stage procedure is used to assess

models as illustrated in figure 3.4 below. First, a confirmatory factor analysis is undertaken via a "measurement model" to identify and remove troublesome indicators- thus is achieved by freeing all exogenous and endogenous variables (Cadogan and Lee, 2010). Goodness of fit (GoF) measures such as χ^2 and root mean square error of approximation (RMSEA), and reliability (average variance extracted and composite reliability) are used to assess measurement model fit and thus any issues with measures (for further details on GoF measures, see the review by Shah and Goldstein, 2006). Once the measurement model has met appropriate quality standards, the path model is constrained (as guided by the hypothesis) to form the structural model. This stage formally tests the theory proposed by the model based on GoF measures, path coefficients, and significance of paths (Shah and Goldstein, 2006).

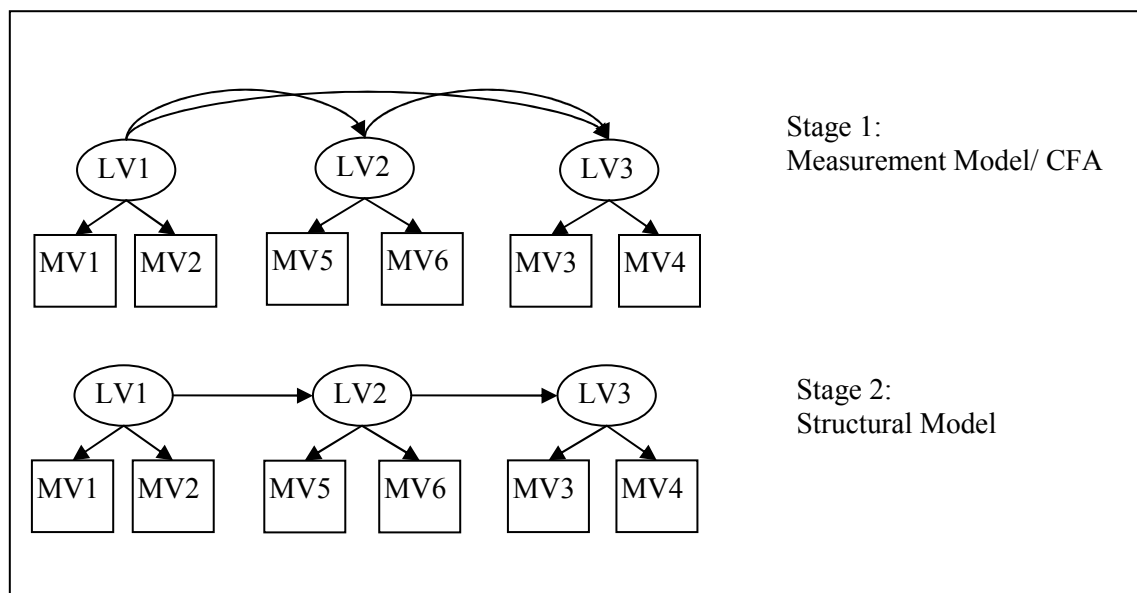


Figure 3.4: Two stages of Covariance-based SEM (LISREL)

PLS on the other hand is founded on the works by Herman Wold's NILES (nonlinear iterative least squares) algorithm in 1966, and its later renaming to NIPALS (nonlinear iterative partial least squares) in 1973 and 1975 (Haenlein and Kaplan, 2004, Tenenhaus et al., 2005). The PLS algorithm is a least square approach which minimizes residual variances and maximises the variance of the dependent/endogenous variables through a series of OLS regression (Fornell and Bookstein, 1982, Hair et al., 2011). Thus, the weights, loadings and path coefficients can be interpreted as standardised beta coefficients (Ringle and Henseler, 2011). Aside from the fundamental distinctions in the

mathematical algorithms, there are two other key points of difference between PLS and LISREL. First, unlike the separation of the measurement and structural model in LISREL, PLS refers to a single model with the measurement model as the *outer* model consisting of the relationships between the indicators and the latent variables; and the structural model as the *inner* path model between the exogenous and endogenous variables (Hair et al., 2011), as illustrated in figure 3.5 below. Secondly, LISREL is capable of generating path values and path significances in a single operation; PLS on the other hand requires separate stages for path values (the PLS algorithm) and path significance estimations (bootstrapping).

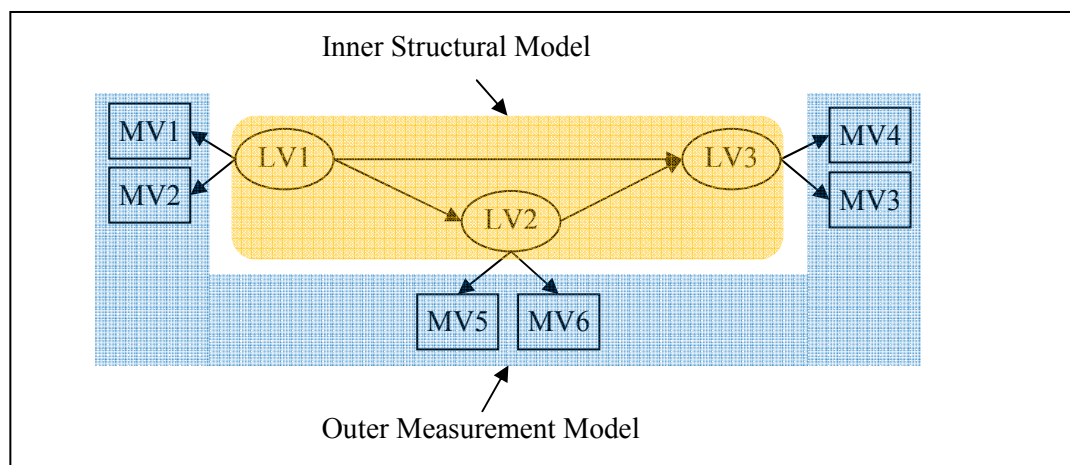


Figure 3.5: Inner/Structural and Outer/Masurement Models of PLS

Bootstrapping is one of several resampling techniques such as jackknifing and cross-validation (Fox, 2002, Wu, 1986). Simplistically, bootstrapping creates multiple datasets for which a desired statistic (e.g. mean, variance, correlations) is calculated for each dataset to generate a distribution function which can be used for further analysis (Efron and Gong, 1983). It does this by making n random draws *with replacement* from an existing sample of n values so the resulting dataset is an identical size to the original (Efron and Gong, 1983). This is repeated a large amount of times (typically 500-5000 times). Table 3.6 below illustrates an example of the bootstrapping procedure (from Ringle and Henseler, 2011). In the case of PLS, path significance though bootstrapping is achieved by the following procedure (Ringle and Henseler, 2011). Firstly, the path coefficient is calculated from the original dataset, β_0 . Secondly, bootstrap datasets are generated and path coefficients calculated to create a dataset of path confidants [β_1 , β_2 ,

$\beta_3 \dots \beta_n$]. In PLS, the default is 200 subsamples however there have been recommendations for 500 (Peng and Lai, 2012) and 5000 (Henseler et al., 2009). Given the advances in computational power, a 500 resample was used in this research. Thirdly, the mean and standard deviation (σ) of the bootstrap set of path coefficients is found. Finally, a t -value is calculated by dividing the original path coefficient by the standard deviation of the bootstrap samples (β_0/σ) where a t -value of 2.576 or greater represents a significance level of 1%, a t -value of 1.96 is confidence to the 5% level, and 1.645 at the 10% level.

Original			Bootstrap #1			Bootstrap #2			Bootstrap #3		
ID	IV	DV	ID	IV	DV	ID	IV	DV	ID	IV	DV
1	105	5.6	6	141	8.9	1	105	5.6	4	123	7.4
2	106	5.0	4	123	7.4	6	141	8.9	5	134	6.1
3	114	7.1	3	114	7.1	1	105	5.6	3	114	7.1
4	123	7.4	5	134	6.1	2	106	5.0	6	141	8.9
5	134	6.1	2	106	5.0	6	141	8.9	1	105	5.6
6	141	8.9	5	134	6.1	4	123	7.4	6	141	8.9
Corr		0.744	Corr		0.561	Corr		0.987	Corr		0.743

Table 3.6: Example of Bootstrapping Correlations

3.5.5.1.7 The Selection of PLS

In justifying the use of PLS over the more traditional LISREL approach, Hair et al. (2011) provide "Rules of Thumb for Selecting CB-SEM or PLS-SEM" which are utilised as summarised in table 3.7 below. The first factor is the goals of the research, whether it is for theory testing or theory exploration. In Peng and Lai's (2012) review and guidance notes of partial least squares in operations management research, they suggest that when there are well-established theories underlying the proposed research model, CBSEM is more appropriate. Conversely, when the nomological network is not well understood or researchers are trying to explore relationships among the theoretical constructs, then PLS can be considered. This notion of exploratory work is aligned with this research given that it is initiating empirical work on Zahra and George's (2002) social integration mechanisms in Absorptive Capacity. Secondly, Hair et al. (2011) question aspects of the measurement model, and specifically the use of formative measures- further details of which are provided in Section 3.5.5.2 on formative analysis. Although the presence of formative constructs does not preclude the use of CBSEM, CBSEM generally lacks the

ability to estimate formative constructs as they imply zero covariance among indicators (Peng and Lai, 2012). The PLS algorithm conversely has no issues specifying formative constructs. In the case of this research, potential absorptive capacity is a formative measure, thus justifying the use of PLS. Thirdly, Hair et al. (2011) consider the complexity of the Structural Model. Peng and Lai (2012) clarify this by suggesting that, amongst others, moderator analysis (i.e. the social integration mechanisms- see Section 3.5.5.3) and higher-order factors (i.e. the second-order construct of Potential ACAP- see Section 3.5.5.2), can increase the total number of parameter estimates and lead to model identification and convergence issues in CBSEM. PLS on the other hand, can deal with greater complexity though the iterative and separate estimation of factor loadings (i.e. outer measurement model) and structural paths (i.e. inner structural model) (Peng and Lai, 2012). Given inclusion of the higher-order factors and moderator analysis leading to higher model complexity, PLS is again seen as the most viable choice. The final aspect is the characteristics⁶ of the data (Hair et al., 2011), and namely the key assumption made by CBSEM for multivariate normal distribution (Fornell and Larcker, 1981). As Section 5.4.4 shows, the dataset in this research did not demonstrate multivariate normality, thus the use of PLS was again justified.

Objective	Choose PLS	Choose LISREL
Research Goals	If the research is exploratory or an extension of an existing structural theory	If the goal is theory testing, theory confirmation, or comparison of alternative theories
Measurement Model Specification	If formative constructs are part of the structural model	If error terms require additional specification, such as covariation
Structural Model	If the structural model is complex (many constructs and many indicators)	If the model is nonrecursive
Data Characteristics	If multivariate normality is not found	Assumptions of multivariate normality met

Table 3.7: Rules of Thumb for Selecting CB-SEM or PLS-SEM

(Adapted from Hair et al., 2011)

⁶ Hair et al. (2011) and Peng and Lai (2012) also include discussions on sample size in association to data characteristics, but given the large dataset acquired, it suitably met the requirements of both LISREL and PLS so becoming a redundant argument.

3.5.5.2 Formative Analysis

Potential absorptive capacity required the use of two advanced statistical techniques in order to appropriately analyse it- formative measurement and higher orders (second order) constructs. It must be critically emphasised that the use of these techniques is not a data mining exercise in order to "find" significant results, but rather consistent with theory. The seminal work by Diamantopoulos and Winklhofer⁷ (2001) on formative measures explains the key differences between the commonly used reflective measures and the formative measures, as illustrated in figure 3.6 below.

3.5.5.2.1 *Reflective vs. Formative Measures*

In management research, there is “almost automatic acceptance of reflective indicators” (Diamantopoulos and Winklhofer, 2001; p274), resulting in grave concerns about the misspecification of measurement models (Diamantopoulos and Winklhofer, 2001, Diamantopoulos et al., 2008, Cenfetelli and Bassellier, 2009, Becker et al., 2012). Formative indicators were first proposed by Curtis and Jackson (1962) who challenged the condition of positively intercorrelated measures (Diamantopoulos et al., 2008). The first ramification of this is the direction of causation from the item/measure/indicator/manifest variable to the latent variable. As figure 3.6a shows, reflective items have the arrows from the latent variable to the indicator. In other words, the indicators *reflect* the intent of latent variable. Conversely in figure 3.6b, formative measures have the arrows from the indicators to the LV such that the indicators *form* the construct (Diamantopoulos and Winklhofer, 2001). Consequently, the first key difference is that reflective indicators are essentially interchangeable whilst items in formative measures are essential parts of the construct (Diamantopoulos and Winklhofer, 2001). Consequently, a key property of reflective constructs is that all measures/indicators must be positively intercorrelated, whilst formative should demonstrate low or zero correlations despite capturing the same concept (Diamantopoulos et al., 2008).

⁷ "Winklhofer" refers to Prof Heidi Winklhofer, Chair of Marketing and Director of Doctoral studies at NUBS. Thus there is an inherent school of thought on formative measures residing in our University.

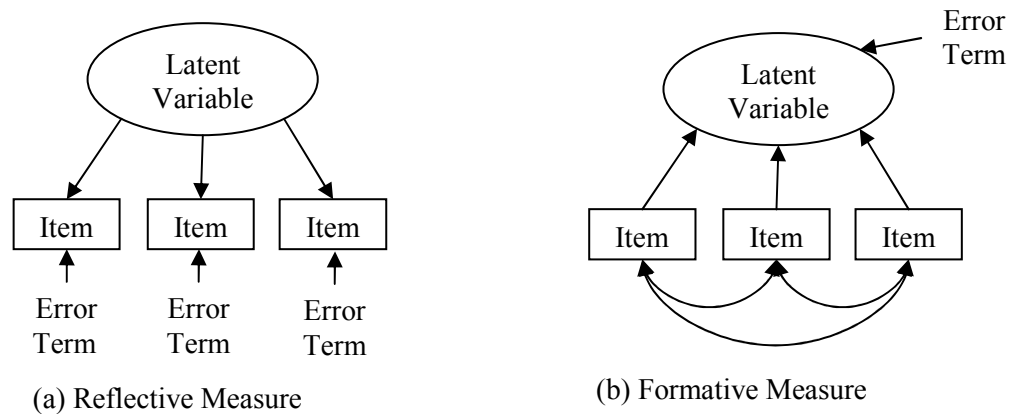


Figure 3.6: Reflective vs. Formative Measures

Secondly and building on this, the removal of items in reflective measures does not change the nature of the underlying construct, but with formative indicators, "omitting an indicator is omitting a part of the construct" (Diamantopoulos and Winklhofer, 2001, p271; citing Bollen and Lennox 1991). In other words, formative measures are a function of, shaped by and get meaning from their items so the removal of a formative indicator changes the underlying meaning of the formative construct (Diamantopoulos and Winklhofer, 2001). The third distinction concerns the nature and positioning of the error term. Recalling that indicators are the only observed or measured elements in latent variable analysis, then in the case of reflective measures where the indicators reflect the construct, the error term is located at the indicator level and represents measurement error between the meaning of the construct and what the indicator actually measures (Diamantopoulos et al., 2008). Conversely, in the case of formative measures, the error term represents the impact of all remaining causes other than those represented by the indicators. To put it somewhat differently, "the error term captures aspects of the construct's domain that the set of indicators neglect" (Diamantopoulos et al., 2008; p1216). The fourth and final key difference is that in formative measures, if any of the indicators increase, the latent variable would similarly increase even if the other indicators did not change (Diamantopoulos and Winklhofer, 2001). Conversely, in reflective measures, and given the intercorrelation and interchangeability between items, a change in the latent variable will cause a similar change in all indicators simultaneously (Diamantopoulos and Winklhofer, 2001).

Table 3.8 below summarises these key differences, which can be better illustrated through an example- socioeconomic status (SES). SES is a formative measure and is a function of education, income, occupation, and residence (Diamantopoulos and Winklhofer, 2001), verified as follows. First it can be seen that none of these four measures are similar (i.e. interchangeable) yet a meaningful construct can still be envisaged. Secondly, SES does not have adequate meaning if one or more of the items are removed- it would not be possible to interpret one's SES without, say, considering one's education (Diamantopoulos and Winklhofer, 2001). Thirdly, SES can be improved by increasing one item without necessarily improving any or all others- there may even be a reduction! For example a Professor at a poorly ranked University may take a Senior Lectureship position at a Russell Group University to improve their SES by working in a more reputable Institute (i.e. improve occupation), but received similar or less pay (i.e. reduce income).

	Formative	Reflective
Definition	Indicators <i>form</i> Construct	Indicators <i>reflect</i> construct
Direction of Causality	Item to Latent Variable	Latent Variable to Item
Removal of an Item	Critical- removing an item is removing part of the construct	Minimal- items are interchangeable
Location of Error Term	Latent variable- error implies lack of overall construct meaning and/or absence of critical dimension	Item- error implies measurement error
Change in Indicator	Change in Construct but not necessarily change in other indicators	Change in Construct and change in other indicators

Table 3.8: Summary of differences between Reflective and Formative Measures

3.5.5.2.2 Justifying Potential Absorptive Capacity as a Formative Construct

In justifying the theoretical foundation for a formative measure of potential absorptive capacity, Zahra and George's (2002) original argument distinguishes between two distinct knowledge sources (experience and external knowledge) as antecedents to their ACAP process. They state that "clearly, firms acquire knowledge from different sources in their environment, and the diversity of these sources significantly influences the acquisition and assimilation capabilities" (Zahra and George; p192). Smith et al. (2005) later developed a "knowledge creation capability" for which significant parallels can be drawn

between this and Zahra and George's ACAP process. The knowledge creation capability (KCC) was defines as a worker's ability to access knowledge from others (i.e. acquire), combine knowledge into new knowledge (assimilate and transform), and perceive value from the exchange and combination process (i.e. exploit). The importance here is that the Smith et al. (2005) hypothesis knowledge stocks as the antecedence for KCC, identical to Zahra and George. In doing so, they define knowledge stocks as experience, education, functional heterogeneity, number of direct contacts, network range and the strength of network ties. Importantly though, it was the direction of causation from these knowledge stocks to the KCC which reflects the formative mode proposed here. Finally, Diamantopoulos and Winklhofer (2001) state that for formative measures, the items must cover the entire scope of the construct. The definition adopted in this enquiry of potential ACAP as "the total stocks of knowledge accessible to individuals" in light of the works mentioned above, would imply two key loci of knowledge stocks- the *individual* stemming from personal experience and education; and knowledge that resides externally in one's *network*, permissible by aspects such as the number of contacts, the strength of the relations and the network range. Given these causal and content reasoning, potential absorptive capacity is viewed as a formative measure.

3.5.5.2.3 Higher Order Constructs

With the appreciation and understanding of potential absorptive capacity as a formative construct, the following section examines the rationale for examining it as a second-order construct. To begin with a definition, a second order construct is one which can be justified as having multiple dimensions (i.e. first order constructs) with its measurement items not located at the construct level but at the first order level (Diamantopoulos et al., 2008). Becker et al. (2012) summarise the four distinct types of second-order constructs in figure 3.7.

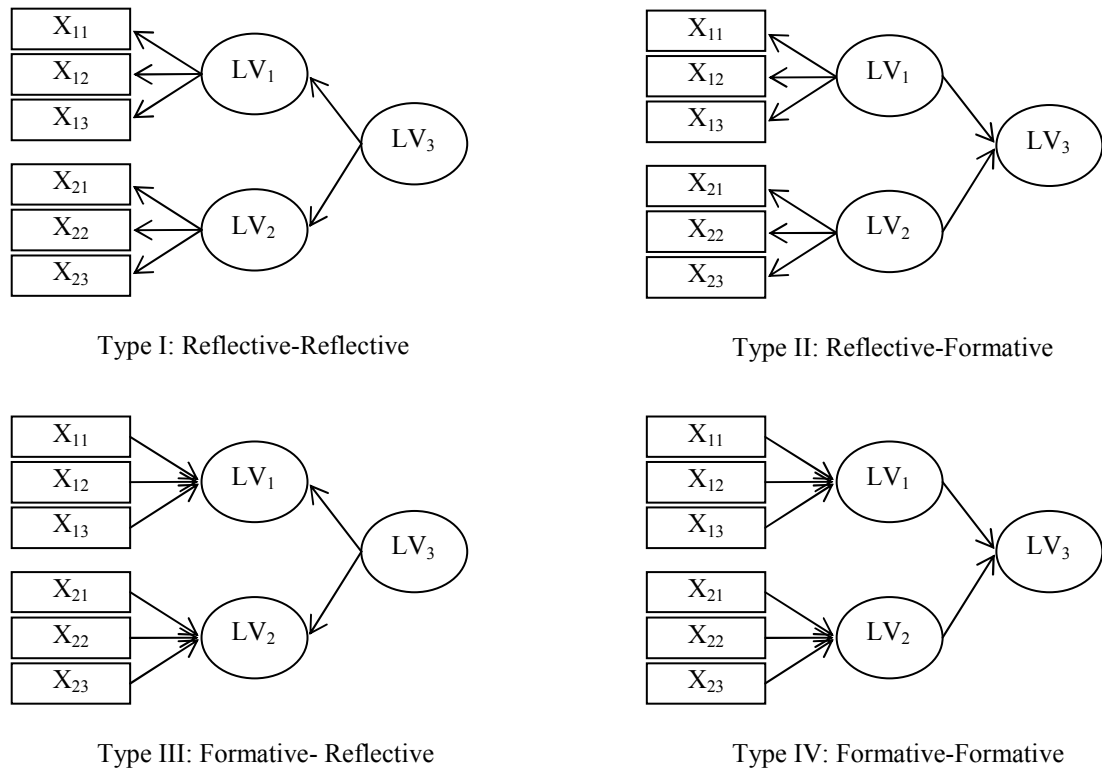


Figure 3.7: The four types of hierarchical latent variable models

(Becker et al., 2012)

For this research, Potential ACAP is viewed as a Type IV model- formative first order, formative second order. The distinction between individual-base knowledge and network-based knowledge observed in Zahra and George's (2002) original work initiates the motivation for considering Potential ACAP as a higher order construct. Following this, Granovetter's (1973) paradigm shifting "strength of weak ties" argues that it is not the presence of strong ties which provides superior advantage from knowledge flow, but those relationships which are weaker and more distant. In this manner, two distinct network-based knowledge dimensions can be observed- knowledge stocks that are a function of strong ties; and knowledge stocks that are a function of weak ties. Subsequently, potential absorptive capacity defined in this enquiry, may improve thought the acquisition of either individually-held knowledge, strong-ties network knowledge, or weak-tie network knowledge, as depicted in figure 3.8 below, such that "if any one of these measures increases [PAC] would increase even if the other indicators did not change" (Diamantopoulos and Winklhofer, 2001; p270), thus implying a formative first order relation.

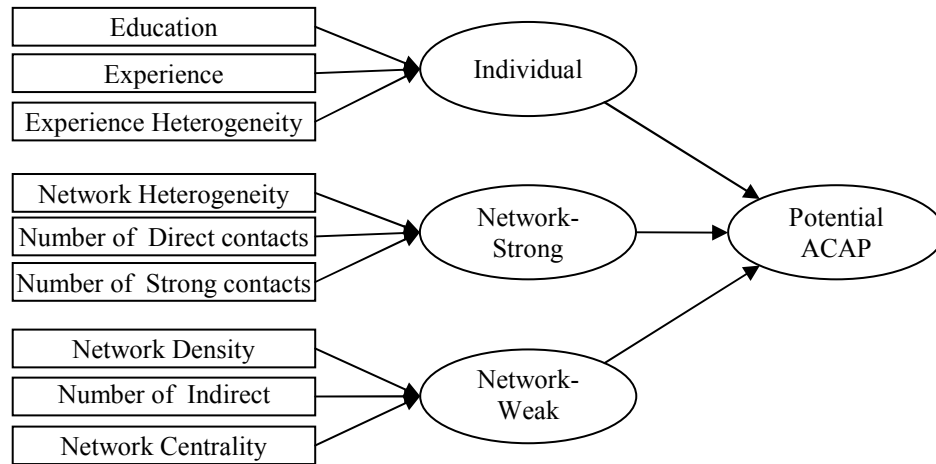


Figure 3.8: The conceptualisation of Potential Absorptive Capacity

Regarding the formative association between the indicators and the first order constructs, an explanation for defining the indicators to their respective first order construct is first provided. Smith et al. (2005) viewed knowledge stocks in terms of experience, education, functional heterogeneity, number of direct contacts, network range and the strength of network ties. From this, a clear distinction can be made between network attributes, and attributes of an individual. In addition other authors have considered individually held knowledge in terms of experience (Simonin, 1999, Carpenter and Westphal, 2001, Borgatti and Cross, 2003, Cross and Cummings, 2004, Perry-Smith, 2006, Wong and Boh, 2010), education (Carpenter and Westphal, 2001, Perry-Smith, 2006, Wong and Boh, 2010), and functional heterogeneity (Carpenter and Westphal, 2001, McDonald and Westphal, 2003). To delineate strong-ties network knowledge and weak-tie network knowledge, Granovetter's (1973) notion of "more distant" ties was used. Here, any variable associated with links beyond direct ties were considered as weak-tie network knowledge, notably network centrality (where you are positioned in the network) and network density (the overall connectedness of the network) (Sparrowe et al., 2001, Dhanarag and Parkhe, 2006, Perry-Smith, 2006, Wong and Boh, 2010). Conversely, aspects such as network size, strength of ties and network heterogeneity were considered strong-tie network knowledge as they all concern the attributes of direct contacts (Hansen et al., 2005, Dhanarag and Parkhe, 2006, Perry-Smith, 2006, Van Wijk et al., 2008, Wong and Boh, 2010). Again, based on Diamantopoulos and Winklhofer's (2001) "increase even if the other indicators did not change" argument, it can be observed that for each item an argument can be made that this holds, for example undertaking further education

at University will increase individually-held knowledge, but may not necessarily increase one's heterogeneity of work experience.

3.5.5.2.4 Analysing Higher-Order Formative Measures

Given the issues with LISREL's ability to analyse formative measures, the PLS literature was called upon for guidance. PLS is computationally capable of dealing with first order formative measures as they would behave as reflective measures. However, issues arise when moderating effects and higher-order constructs are involved, such as the case in this research (Henseler and Fassott, 2010, Becker et al., 2012). In dealing with higher-order constructs, two approaches are recommended- the repeat indicator approach, and the two-stage approach (Becker et al., 2012). However, the two-stage approach is recommended when formative measures are used in interaction analysis (Henseler and Fassott, 2010), thus the two-stage approach was selected over the repeat indicator approach. The main concern with higher-order formative measures is that the repeated use of indicators at the second level and the first level results in the perfect or near perfect explanation of the variance in the construct (Gaskin, 2012). This means, especially in the case of endogenous formative measures, that other variables would demonstrate a zero effect on the measure rendering the model useless (Gaskin, 2012). Consequently, the two stage approach mitigates this by firstly computing the latent variable scores for the second order construct to obtain estimates for the behaviour of the variable based on its indicators. Then in the second stage, all the first-order constructs and indicators are replaced with a single reflective measures (the latent variable score from the first stage), to account for the measure's behaviour in the context of the structural model (Gaskin, 2012, Becker et al., 2012).

3.5.5.2.5 Assessing the quality of Formative Measures

The final point in this section is to introduce the issue of assessing the quality of formative measures. In formative measures, "internal consistency (reliability) is of minimal importance because two variables that might even be negatively related can both serve as meaningful indicators of a construct" (Diamantopoulos and Winklhofer, 2001, citing Nunnally and Bernstein 1994, p489). Furthermore, construct validity (i.e. convergent and discriminant validity) is not meaningful given that intercorrelation of items is not desired (Henseler et al., 2009). Subsequently, the commonly applied quality measures such as Composite Reliability, Cronbach Alpha, and Average Variance

Explained are not valid in this context. The following discussion details the formative measurement assessment criteria, for which the summary of the assessment of formative measure of Henseler et al. (2009) is used. The assessment of formative measures occurs at two levels, the indicator level and the overall construct level as shown in Table 3.9 below.

Level	Test	Description	Assessment Criteria
Construct Level	Theoretical Justification	Is there theoretical justifications for the formative measure and its items	
	External/Nomological Validity	How well the variable relates to other variables- is the path between formative antecedent and outcome significant	t -value greater then 1.645 (10%), 1.96 (5%), 2.576 (1%)
Indicator level	Multicollinearity	Do the Variance Inflation Factors between items indicate collinearity	VIF <10, ideally <3.3
	Statistical Relevance	Do the items significantly load onto the construct	t -value greater then 1.645 (10%), 1.96 (5%), 2.576 (1%)

Table 3.9: Summary of Quality Test for Formative measures

(From Henseler et al., 2009)

Indicator level assessment

The first assessment occurs at the item level through the use of two tests: multicollinearity and significance of indicator loadings (Henseler et al., 2009). The significance of the loading provides a clear indication as to whether the item is a true contributor to the measure- a non-significant loading would imply no relation to the construct and hence its irrelevance so can be removed (Diamantopoulos and Winklhofer, 2001). In PLS, significance is determined by bootstrapping (see section 3.5.5.1 for details on this technique).

The second test involves the checking for multicollinearity between the items as excessive collinearity between items makes it difficult to separate the distinct influence of the individual items on the latent variable (Diamantopoulos and Winklhofer, 2001). Furthermore, high levels of collinearity implies a near perfect linear combination of items and hence the measure is like to contain redundant information (Diamantopoulos and Winklhofer, 2001). Subsequently, elimination of items is recommended if high levels of multicollinearity are found (Götz et al., 2010). The assessment of multicollinearity can be

done independently of the structural model by assessing the Variance Inflation Factor (VIF), a quality check in regression. A VIF of greater than 10 is seen as having high levels of multicollinearity (Henseler et al., 2009) and VIFs of less than 3.3 would indicate its absence (Peng and Lai, 2012). The issue of multicollinearity is also reflected in the literature on interaction/moderator analysis, a technique that is also utilised in this research. The suggestions made there is for the standardisation of all variables (i.e. mean centred to zero with a variance of 1) in order to minimise these effects (Aiken and West, 1991, Henseler and Fassott, 2010, Henseler and Chin, 2010).

Construct level assessment

The next level of assessment is at the overall construct level. Consistent with other authors (Götz et al., 2010, Diamantopoulos et al., 2008, Diamantopoulos and Winklhofer, 2001, Camisón and Villar-López, 2012, Peng and Lai, 2012), construct level quality consists of a theoretical justification for interpreting the measure as formative as done at the start of this section; and external/nomological validity which can be assessed statistically. External validity is concerned with the extent to which the formative measure links to other constructs with which it would be expected to be linked (Diamantopoulos and Winklhofer, 2001). Ideally, this is done by including reflective items along with the formative items and estimating the resulting multiple indicators and multiple causes (MIMIC) model as shown in figure 3.9(a). Alternatively, this can be done through the two-construct model where the formative measure regresses to a “phantom variable” corresponding to a reflective measure of the same construct as shown in figure 3.9(b) (Diamantopoulos and Winklhofer, 2001, Götz et al., 2010). In the absence of an available reflective measure, as the case in this research, nomological validity can be investigated by means of the significance between the formative measure and the other latent variables with which a high significance is expected (Götz et al., 2010, Diamantopoulos et al., 2008, Diamantopoulos and Winklhofer, 2001).

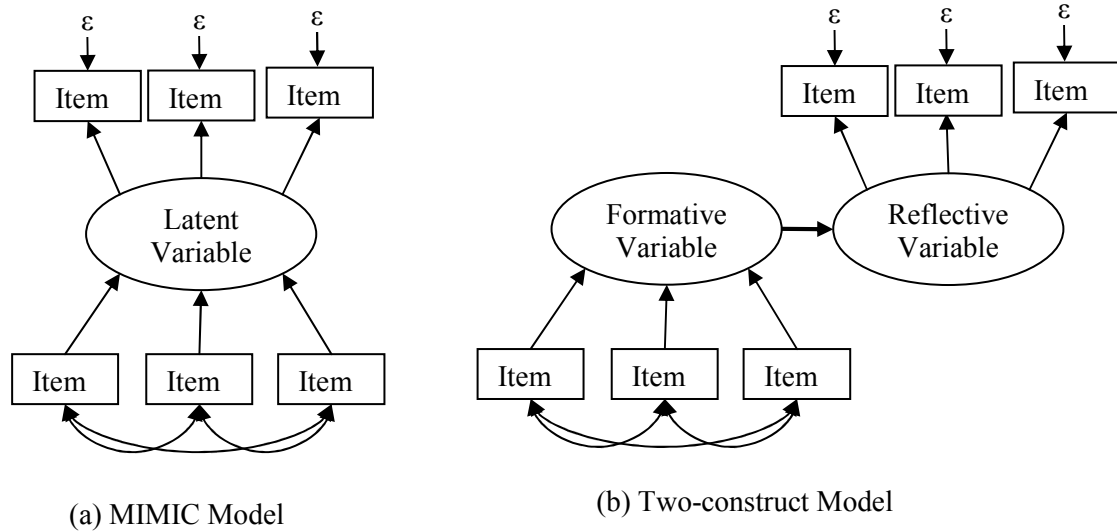


Figure 3.9: External Validity and the MIMIC vs. Two-Construct Model

3.5.5.3 Interaction Analysis

Baron and Kenny's (1986) seminal work on the behaviour, understanding and distinction between moderator and mediator variables has played an important role in empirical theorising- the distinction between them is illustrated in figure 3.10 below. As this research utilises moderator variables, the following discussions will be directed accordingly. A moderator is defined as a "variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable" (Baron and Kenny, 1986; p1174).

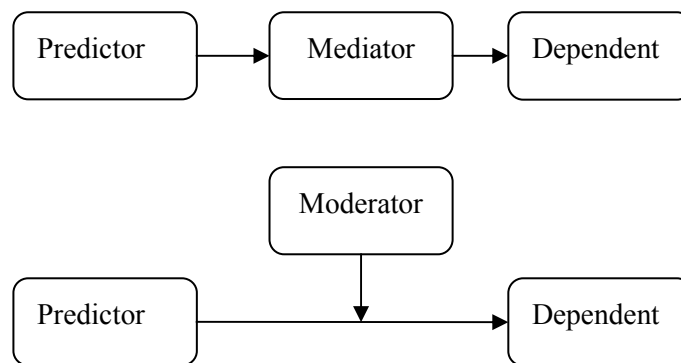


Figure 3.10: Moderator vs. Mediator variables

Moderators can be defined in to a number of categories as Sharma et al. (1981) discusses. The typology of moderators depends on two features, whether it is related to the dependent variable, and if it is related to the predictor variable, as summarised in figure 3.11. If a hypothesised moderator variable (i.e. specification variable) is related to the dependent variable but not the predictor, then the variable is simply an exogenous variable or antecedent. Thus the three remaining variants correspond to one of two type of moderators- those that influence the statistical *strength* of the relationship between the predictor and the dependent, and those that influence the *form* of the relationship (Sharma et al., 1981).

When the moderator does not interact with the predictor and is not related to the dependent, then it is classified as a *homologizer*. These moderators influence the statistical *strength* of the relationship by reducing the error term and increasing the amount of variance explained (Sharma et al., 1981). When a moderator is not related to the dependents but also interacts with the predictor, is it deem a *pure* moderator (Sharma et al., 1981). Conversely, when a moderator is a predictor itself as well as interacting with the predictor, it is considered a *quasi* moderator due to its antecedent like behaviour as well. Pure and quasi moderators affect the form of the relationship, in other words the magnitude and/or direction of the regression coefficients.

A clear explanation of the two effect types (strength vs. form) can be found via the mathematical representation of moderation. Equation 1 below represents the linear relationship between the dependent variable y , the predictor x , the moderator z , with ε representing the error term or the residual variance of y not explained by x . Using this, a homologizer affects the error term ε in accordance with schematic (a) in figure 3.11 below. Conversely, pure and quasi moderators behave like the variable z where a change in z changes the slope of the regression line and thus the *form* of the relationship between x and y as illustrated in schematic (b).

$$y = a + (b_1 + b_2z)x + \varepsilon \quad (1)$$

	Related to Dependent	Not related to Dependent
No interaction with Predictor	No Moderation- Exogenous or Antecedent	Homologizer
Interaction with Predictor	Quasi-Moderator	Pure-Moderator

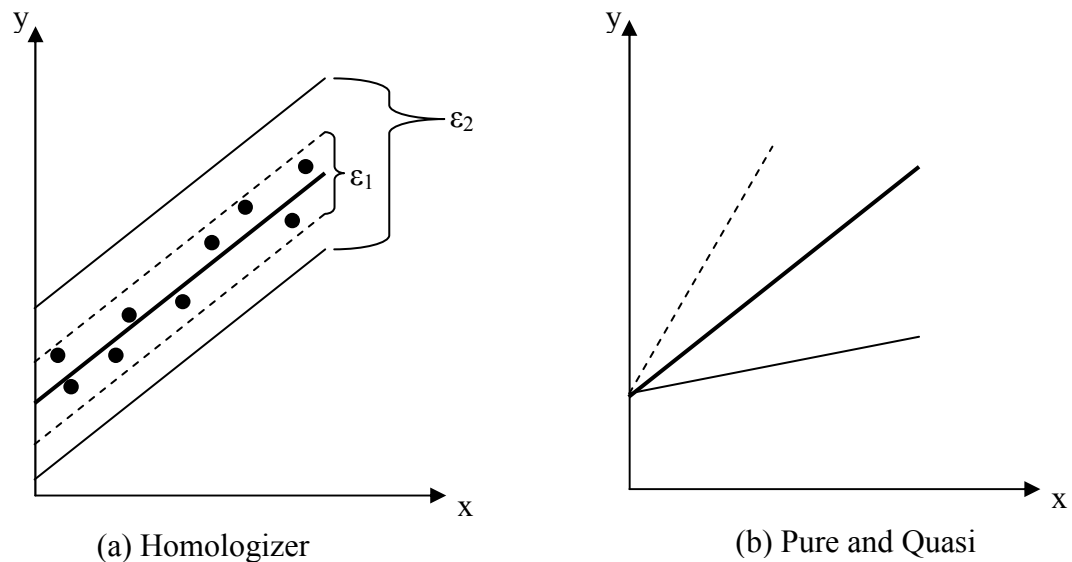


Figure 3.11: Types of moderators

In regards to the analysis of interactions/moderators, Ping (1995) identifies three general approaches: product term regression analysis, subgroup analysis, and indicant product analysis. Product term regression analysis, as endorsed by Aiken and West's (1991) seminal work on interaction analysis, regresses a dependent variable on multiple independent variables and multiple interaction variables and is generally recommended for continuous variables. This approach has two key limitations; firstly, that it produces inconsistencies for variables measured with error, such as latent variables; and the complexity of the model is limited as only one dependent variable can be investigated at a time. The second approach, subgroup analysis, involves dividing a database into subgroups based on the moderator variable and is especially useful when the moderator is a categorical variable, e.g. gender, age groups (Ping, 1995). Consequently, a model is estimated for each of the subgroups and the statistical differences between each group/model tested. Given that structural differences can be identified for different subgroups, it is good for theoretical reasons; however it severely reduces statistical power by reducing the effective sample size used for each model and thus the likelihood of false

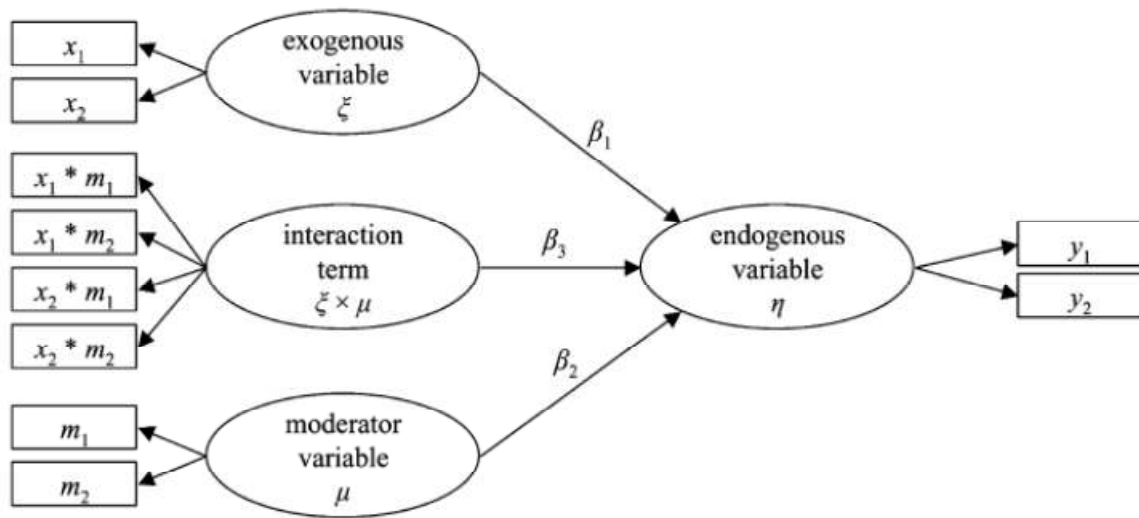
disconfirmation (Ping, 1995). Finally, indicant product analysis specifies interaction latent variables in a structural equation model using a product/interaction term. Given the justification for structural equation modelling in Section 3.5.5.1, this approach has been adopted in this inquiry. Ping (1995) suggests two key limitations to this approach which PLS SEM is able to address. Firstly, that this technique requires the formation of many additional variables (i.e. the interaction/product terms) which can increase the complexity of the model leading to convergence and infeasible solution issues. PLS however, as remarked in Section 3.5.5.1, is capable of dealing with higher complexity models (Peng and Lai, 2012). Secondly, interaction/product terms may not be normally distributed which precludes the use of popular estimators such as Maximum Likelihood/LISREL. Consequently, PLS non-parametric assumption is particularly poignant here.

3.5.5.3.1 Interaction Analysis for Reflective Measures Vs Formative Measures

With the understanding of indicant product analysis as the accepted approach, Chin et al. (2003) highlight that different techniques must be used between reflective and formative measures “since formative indicators are not assumed to reflect the same underlying construct (i.e., can be independent of one another and measuring different factors), the product indicators between two sets of formative indicators will not necessarily tap into the same underlying interaction effect” (Appendix D).

In the case of reflective measures, two approaches are generally accepted, the product-indicator approach and the Orthogonalising approach. The product-indicator approach constructs a set of indicators from the multiplication (aka *product*) of the independent variable indicators and the moderator indicators (Henseler and Chin, 2010, Ringle and Henseler, 2011). These indicators then become the indicators for the interaction term as figure 3.12 below shows (Henseler and Chin, 2010, Ringle and Henseler, 2011). The alternate approach for reflective measure interaction is the Orthogonalising approach. This approach derives its name from the observation that the interaction term should ideally be uncorrelated (i.e. orthogonal) to the independent variable (Henseler and Chin, 2010). To ensure this, the approach utilises a two-stage residual centring procedure. In the first stage, each product term is regressed against the indicators of the predictor and moderator variables to produce a residual term as shown on the left hand side of figure 3.12. These residual terms are then used as indicators for the interaction term (Henseler and Chin, 2010). In doing so, the variance of the interaction term contains only the

unique variance that represents the interaction effect, independent of both the moderator and predictor influences (Henseler and Chin, 2010).



*Figure 3.12: Product-indicator approach to interaction analysis
(from Henseler and Chin, 2010)*

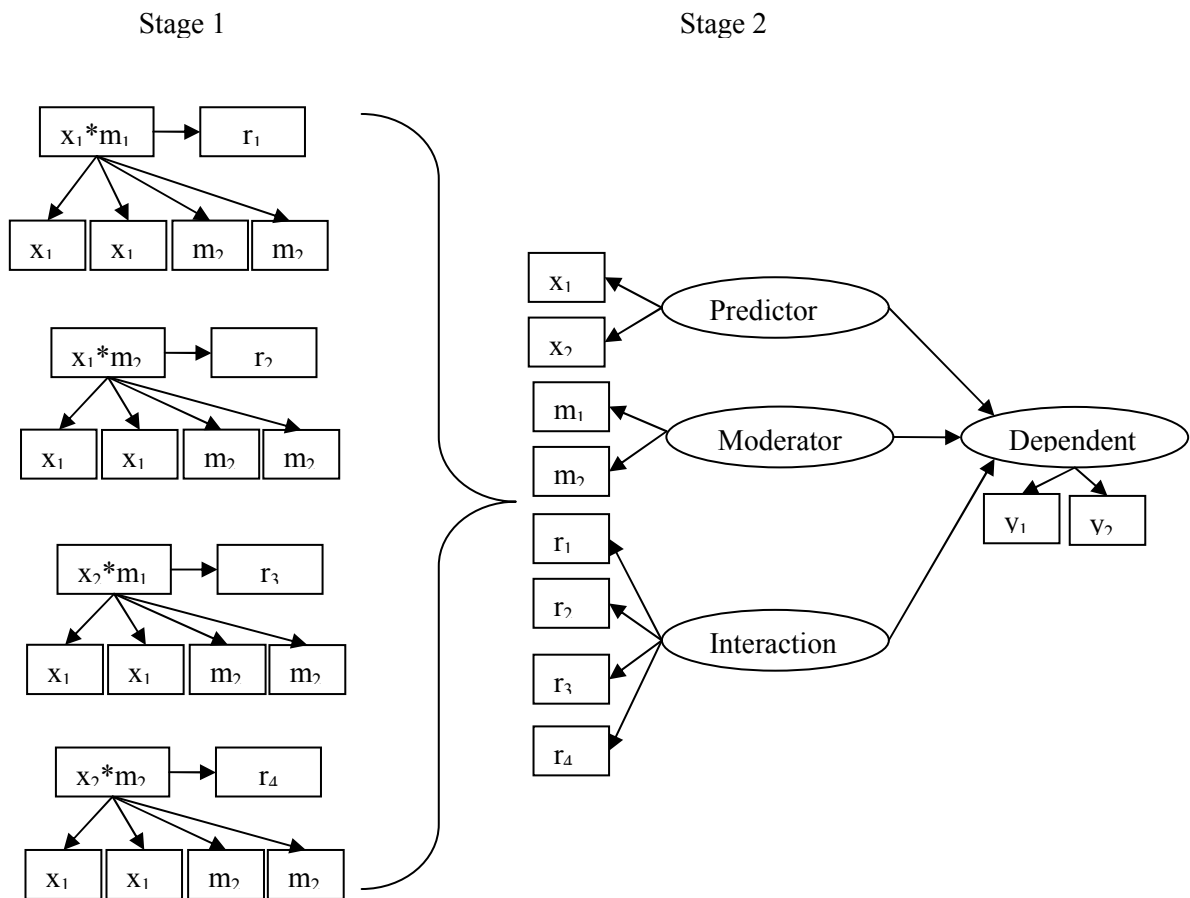
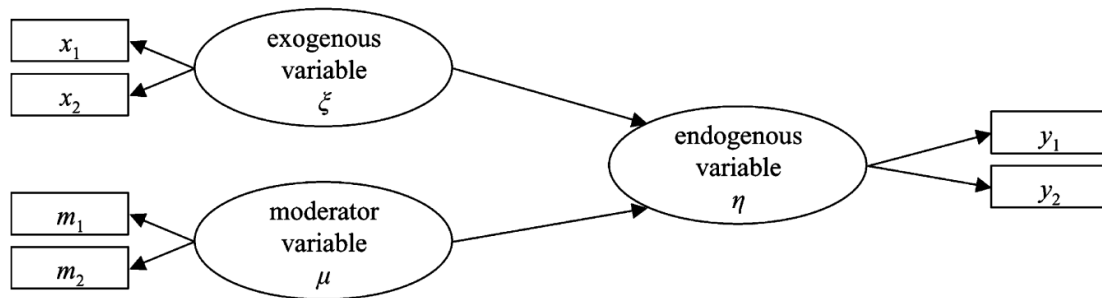


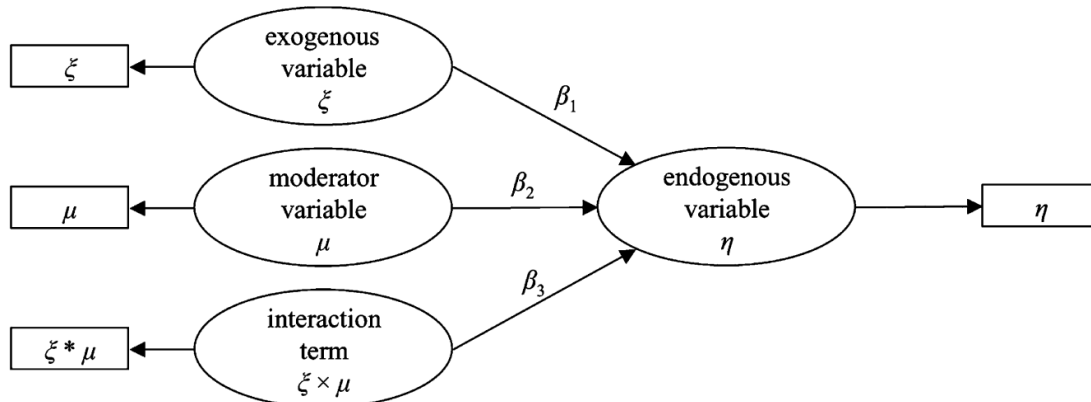
Figure 3.13: Orthogonalising approach to interaction analysis

In terms of interaction for formative measures, “if the exogenous variable or the moderator variable are formative, the pairwise multiplication of indicators is not feasible” (Henseler and Chin, 2010; p86) and thus ruling out the two techniques above. Instead, the two stage approach, as mentioned in Section 3.5.5.2.3, is required (Henseler and Chin, 2010, Ringle and Henseler, 2011). In this context, the two-stage approach operates slightly differently as follows. In the first stage, the main effects (aka direct effects) of the predictor and moderator variables are run to obtain estimates for the latent variable scores (Henseler and Chin, 2010, Ringle and Henseler, 2011). Then, in the second stage, an interaction term is constructed as the product of the latent variable scores of the predictor and the moderator, and the three variables (predictor, moderator and interaction) are used as independent, exogenous variables as shown in figure 3.14 below.

Stage 1:



Stage 2:



*Figure 3.14: Two-stage approach to interaction analysis
(from Henseler and Chin, 2010)*

3.5.5.3.2 *Scaling interaction variables*

As highlighted by the orthogonalising approach above, in the ideal state the predictor and moderator variables should not be correlated. To achieve this, two data conditioning approaches have been suggested in conjunction with the formal analysis techniques above. First is to means-centre both the predictor and the moderator where the mean of the variable is subtracted from each individual score, as recommended by Aiken and West (1991) in their seminal work on product term regression analysis. Robinson and Schumacker (2009) empirically showed the merits of this as summarised in the table below. Noting that VIF is the variance inflation factor, a measure of multicollinearity where values greater than 10 suggest high levels of collinearity, and values below 3.3 suggest its absence (Henseler et al., 2009, Peng and Lai, 2012).

Factor	VIF
Ethnicity x Academic Hope - Uncentred	39.198
Ethnicity x Academic Hope - Centred	1.653
Ethnicity x Self Efficacy- Uncentred	34.380
Ethnicity x Self Efficacy- Centred	1.825
Ethnicity x Optimism- Uncentred	29.795
Ethnicity x Optimism- Centred	2.059

*Table 3.10: Empirical evidence for the use of mean-centring in interaction analysis
(From Robinson and Schumacker, 2009)*

The alternate approach is to *standardise* both variables, as recommended by Rosenzweig (2009), whereby the mean of the variables are set to zero, and the standard deviation is set to 1. This is obtained by subtracting the mean from each score, similar to means-centring, then dividing each score by the standard deviation (Rosenzweig, 2009, Henseler and Fassott, 2010). Aiken and West (1991) cautions this approach in so much that the z-scores of the product term does not generally equal the products of the two z-scores, or to put it somewhat differently, a standardized interaction term does not equal the product of its standardized factors. Thus it is specifically recommended that the interaction term should not be standardised (Henseler and Fassott, 2010). Given the more advanced nature of this approach, and that SmartPLS, the statistical package used to analyse the data, contains a feature that automatically standardises data, this approach was adopted.

3.5.5.3.3 *Interpreting moderator effects*

Adopting either means-centring or standardising, as discussed above, provides an additional benefit when interpreting the moderation effect. In the scenario of moderation, the regression coefficient between the predictor and the dependent represents the slope of the regression *when the moderator has a value of zero* (Henseler and Fassott, 2010). Thus “if zero were not an existing value on the scale of [the moderator], the reference point would not be a particularly sensible choice” (Henseler and Fassott, 2010; p728) and so centring provides a means of shifting the reference point to a meaningful value and hence facilitate the interpretation of the variable (Henseler and Fassott, 2010). Thus the explanation of a moderator effect is as follows: given the influence of X (predictor) on Y (dependent) is b (regression coefficient) with d being the moderator regression coefficient, then a 1 standard deviation increase of the moderator will result in a d increase of b such that the total effect of X on Y becomes $b+d$ (Henseler and Fassott, 2010).

The final note is understanding that the magnitude and significance of the moderator regression coefficient corresponds to the *influence* of the moderator on the X - Y relationship. What this does not cover is the overall effect of the this term on the full model (Henseler and Fassott, 2010). The effect size (designated by f^2) of the moderator is calculated based on the proportion of variance (R^2) explained by the moderator as per Equation 2 below (Henseler and Fassott, 2010).

$$f^2 = \frac{R^2_{\text{Moderation-Included}} - R^2_{\text{Moderation-Excluded}}}{1 - R^2_{\text{Moderation-Included}}} \quad (2)$$

The norm is to assess the resultant effect size based on Cohen's criteria where an effect size f^2 of 0.02 is regarded as weak, 0.15 medium, and 0.35 as strong (Henseler and Fassott, 2010). However, these values have been challenged by Aguinis et al. (2005) who's review of moderator-based research found a mean effect size of moderators of 0.009 and a median effect of 0.002. They conclude then that there is a “need to minimize the influence of artefacts...and put into question the use of conventional definitions of moderating effect sizes” (p94). Consequently, David Kenny, one of the forefathers on moderator/mediator research (c.f. Baron and Kenny, 1986), subsequently suggests a more

realistic standard 0.005, 0.01, and 0.025 for small, medium, and large (Kenny, 2011). A cautionary caveat is that a low effect size does not necessarily imply that a negligible moderator effect (Henseler and Fassott, 2010)- “even a small interaction effect can be meaningful under extreme moderating conditions, if the resulting beta changes are meaningful, then it is important to take these conditions into account” (Chin et al. 2003, p. 211).

3.5.5.4 Multigroup Analysis

As will be explained in Chapter 4 (Model and Hypothesis development), the findings from the exploratory interviews in conjunction with literature resulted in three dyadic relationships: the question of whether benevolence- or competence-based trust is more valuable; the conflict between the cost of searching incurred by the knowledge seeker versus the motivations for sharing by the knowledge giver; and the alignment between firm culture and individual attributes. In particular, the research looks to establish which types of motivations may negate search costs, and which firm level attributes may enhance individual attributes. To do this, the research employs multigroup analysis as follows. In dyad 2 (Search costs vs. Motivations for sharing), search costs is used as the grouping variable and subgroups created corresponding to “high” and “low” levels of cost. Separate models are then run for these “high” and “low” groups and tested for significant differences between the resultant motivation scores. In dyad 3 then (Firm culture vs. Individual attributes), the procedure is repeated with the grouping variable as individual attributes and the significant difference tests done on firm culture.

Multigroup Analysis (MGA) tests in PLS can be divided into two main categories: those that contain a distributional assumption (i.e. parametric approach) and those that are distribution free, i.e. non-parametric approaches (Sarstedt et al., 2011). The parametric approach is a modified version of the two independent samples t-test, thus it requires the data to be normally distributed (Sarstedt et al., 2011). This approach can operate under equal variances and non-equal variance assumed, where Levene’s test for equal variance is used to identify the appropriate mode (Sarstedt et al., 2011). The operationalising of this approach is done via a Microsoft Excel spreadsheet available from Hair et al. (2013) which provides a shortcut for the arithmetic computation and requires the insertion of only 6 variables- the path coefficient from the PLS path modelling algorithm, the

standard errors from bootstrapping, and the sample size, for the two groups. From these, the spreadsheet calculates a p-value for the two-tailed t-test.

Sarstedt et al. (2011) go on to clarify two main non-parametric procedures. The key benefit of this approach and why it has been adopted in this research is due to its distribution-free assumption, which is aligned with the distribution-free nature of PLS. The first non-parametric approach is the permutation-based approach as developed in part by Chin and Dibbern (2010) and clarified by Sarstedt et al. (2011) as follows: first, the data is randomly permuted, that is, observations are randomly exchanged between the two subgroups by drawing without replacement and assigning it to the other group. In accordance with commonly suggested rules of thumb for bootstrapping, this is repeated a minimum of 5000 times. For each of the 5000 permutations, group-specific parameter estimates are obtained by running the PLS path modelling algorithm. Finally, the differences in the group-specific parameter estimates per permutation are computed and the null hypothesis that the population parameters are equal across the two groups is tested (i.e. difference equals zero). Eberl (2010) however cautions against this approach due to its practicality as it requires a huge number of simulations, and given this, it was not adopted in this study.

The second main approach is Henseler's PLS Multigroup Analysis (Henseler et al., 2009, Henseler, 2012). This approach tests that the conditional Probability $P(b_1 > b_2 | \beta_1 \leq \beta_2)$ is less than some significance level, typically 5-10%. To put it differently, it tests whether the probability that the bootstrap estimate for group 1 b_1 is greater than the bootstrap estimate b_2 when the population estimate β_1 of group 1 is in fact less than or equal to the population estimate β_2 of group 2 (Henseler et al., 2009). Operationalising the approach is as follows: first, the two models corresponding to each of the subgroups are exposed to a minimum of 5000 bootstrap permutations to create two sets of parameter estimates (Henseler et al., 2009). Next, instead of relying on distributional assumptions to test for a significant difference between the groups (i.e. the *t*-test), the approach generates a probability that the second group's population parameter is greater than that of the first group by: i) comparing respective estimates in the second subgroup to the first; then ii) tallying the number of occurrences where the second group estimate is larger than the first group. A probability is then found by dividing the number of such occurrences by the total number of comparisons (Sarstedt et al., 2011, Henseler, 2012, Henseler et al.,

2009). It should be noted that this is a rather general interpretation of the algorithm in order to get the general principle of the approach across. To aid in this analysis, a pre-fabricated Excel spreadsheet was obtained by contacting Professor Jörg Henseler of Henseler et al. (2009). Given the relative ease of its computation in comparison to the permutation-based approach, and that there was a spreadsheet available to do the analysis, this approach was selected for the subsequent analysis.

3.5.6 Determining Quality of Quantitative Research

To close this section, attention is now turned to examining how concerns in the quality of this research phase have been addressed.

3.5.6.1 Internal Validity

Internal validity or how the threats in research design have been accounted for is first examined (Creswell and Plano-Clark, 2007). Firstly, the validity of the survey instrument is established by grounding it in existing literature whenever possible (Li et al., 2011). The questionnaire is presented in *Appendix 7* along with the corresponding authors from which the measures were obtained. Consistent with the procedural norm (i.e. Lawson et al., 2008, Tu et al., 2006), the questionnaire received several iterations of pilot testing prior to its full release, as Section 5.2 details.

3.5.6.2 External Validity

External validity are threats occurred when incorrect inferences are drawn from the sample to other people, settings or situations (Creswell, 2009). Creswell (2009) suggests two types of threats to external validity relevant to this study. Firstly, similar characteristics in the candidates selected or uniqueness of the setting can lead to difficulties in generalising more widely. In addressing this concern, Creswell's (2009) suggestion to conduct additional research in other groups is noted. Acknowledging this, there is the potential for concerns to be raised if respondents were only sourced from a particular process improvement methodology (i.e. only lean practitioners, or TQM practitioners). As such, sourcing respondents from a variety of LinkedIn groups as shown in *Appendix 8* goes to lengths to address this point.

Secondly, Creswell (2009) suggests that as a quantitative inquiry is a “snap shot” of extant practices and so time bounded, generalisations to past or future situations are difficult. A case in point is the substantial technological advances in computing since the 1980's. Gloor et al. (2008) state that “*the advent of the Internet has provided new opportunities for collaboration thought impossible just a few years ago*” (p1357). Given the ease of sharing and transferring knowledge and the proliferation of social networking media that we now face (Facebook, twitter, LinkedIn etc), research on such subjects would not be as relevant now as they might have been a decade or so ago. Consequently, by focusing the research in an emerging field, this research hopes to move in part to address this issue.

3.5.6.3 Reliability

Reliability is the characteristic of an inquiry which test whether scores are consistent and stable over time (Creswell and Plano-Clark, 2007), or in other words, if results are repeatable. Bryman and Cramer (2009) subsequently identify two forms on reliability-external and internal. External reliability is the degree of consistency of the measure over time. The use of previously defined measures from the literature, as used in this research, goes to lengths in addressing this. Internal reliability on the other hand questions whether the scales used are measuring a single idea (Bryman and Cramer, 2009). Bryman and Cramer (2009) and Li et al. (2011) both suggest the use of measures such as Cronbach alpha to assess internal reliability, which is incorporated into the analysis.

Chapter 4: Model Development and Exploratory Case Interviews

4.1 Introduction

The literature review carried out in Chapter 2 highlighted the timeliness for research into the knowledge-based view of process improvement, as well as the dearth of attention given to the explorative knowledge acquisition perspective. In doing so, it emphasised the social aspects to knowledge acquisition and posed questions regarding the role, fostering and performance effects of knowledge acquisition in process improvement. Resting on the theories identified in the literature, this chapter begins by discussing the identification of the theoretical lens used to interpret the research questions from the exploratory case interviews. Following this, the case interviews in tandem with the literature are used to develop hypothesis and the conceptual model.

4.1.1 Case and Conference Feedback

An earlier version of this analysis was developed into a paper and returned to the cases for comment and submitted to the EurOMA Conference in 2011. Feedback from the cases was mostly a simple “Thank you”. One commented that the paper was a little too academic, thus in part emphasising the need for the Guidelines (Appendix 12). Another stated that they had “learnt a few things from it”. Feedback from the conference and reviews was considerably more constructive, the key points being:

Feedback: Too much attention is devoted to other works. It is often unclear if the authors are describing their findings or someone else’s work in a particular paragraph...The case study results section is missing a great deal of detail

Response: The paper relied too heavily on justifying the work from a literary/theoretical perspective, rather than through the data and findings. Considerable effort was subsequently undertaken in order to better understand qualitative analysis techniques. The findings subsequently displayed in the following Chapter were heavily motivated by this feedback

Feedback: The managerial/practical contributions need to be presented in greater detail

Response: This point reiterated the concerns mentioned by the case in the paper's overly academic focus. Furthermore, given its poor use of data, the knowledge contributions were also seen as unclear. Since this piece, a more extensive qualitative analysis has been undertaken in addition to more experience in academic writing. A revised version of this paper is now underway.

4.2 Identification of a Theory: Absorptive Capacity

In an exemplar case, a Director and key Presenter of a Network training consultancy was included in the study. In participating in a workshop on the “art” of networking, a webinar on LinkedIn and networking, an examination of his published works, and a subsequent later interview, it became apparent that the primary purpose of this training was to develop skill to increase the *size* of one's network, i.e. the volume of knowledge stocks. In conjunction, the Director/Presenter commonly used the motto of “know, like, trust” (knowing someone, liking them, and trusting them) when attempting to elicit information from people. The interpretation of this was that although network size is important, it may not directly correspond to an increase level of useable knowledge. Other factors such as friendship and trust may in fact play more crucial roles.

The notion of the difference between the total stock of knowledge verse a substantially lesser stock of knowledge that is actually used is observed in the theory of absorptive capacity (ACAP) and particularly Zahra and George's (2002) reconceptualisation as introduced in Section 2.1.6 in the Literature Review. This theory notes the distinction between “potential” absorptive capacity, the sum of available knowledge from experience and networks; and “realised” absorptive capacity, the smaller sum of knowledge that is actually used and applied. The difference between Potential and Realised absorptive capacity was accounted for by “social integration mechanisms”. Reflecting then on the exemplar case, the motto of “know, like, trust” may indicate the presence of such mechanisms.

However, Zahra and George (2002) provided only limited details on what these social integration mechanisms might be by loosely suggesting structural, behavioural, political, cognitive, and relational barriers. This is a particular concern given their suggestion that variations in firm performance can be attributed to varying abilities to convert potential absorptive capacity to realised absorptive capacity; or to put it somewhat differently, it is these social integration mechanisms that provide insight and explanations for firm performance. A review of the literature indicates that, to the knowledge of the author, no study has yet empirically explored what these mechanisms might be. Given the seemingly vital need to understand how we can effectively utilise knowledge in light of the knowledge-based view of the firm (Grant, 1996), this glaring oversight would appear to be a major gap in the literature.

Consequently, the following section employs the qualitative data in conjunction with the plethora of factors identified in the Literature Review to isolate the key social integration mechanisms in the Knowledge-Based View of Process Improvement.

4.3 Model Development

Based on the empirical qualitative data, the following section develops the conceptual model shown in the figure below. Data is presented in both thematic analysis form as tables within the text (i.e. Tables 4.2-4.8), and as within-case summaries based on the Interview Protocol (see Appendix 9). The “evidence” column in Tables 4.2-4.8 represents primary data in the form of verbatim quote, or paraphrased statements where verbatim quotes would have been excessive in length or difficult to interpret out of context. As the Tables show, this primary data subsequently went through a series of initial (i.e. “Interpretation” column), second-order (“Code” column) and higher-order (“Themes”) interpretations in order to elicit the hypotheses. It is this step-by-step converging of data which gives rise to the name of this coding style - “thematic” or “chain of evidence”. Through thematic analysis of the data, three dyads or dualities emerged as social integration mechanisms: 1) the contrast between competence-based trust, and trust based on care and compassion; 2) the conflict between the search costs incurred by Knowledge Seekers, and the motivations for sharing of the Knowledge Giver; and 3) the alignment between individual-level attitude towards process improvement, and firm-level culture.

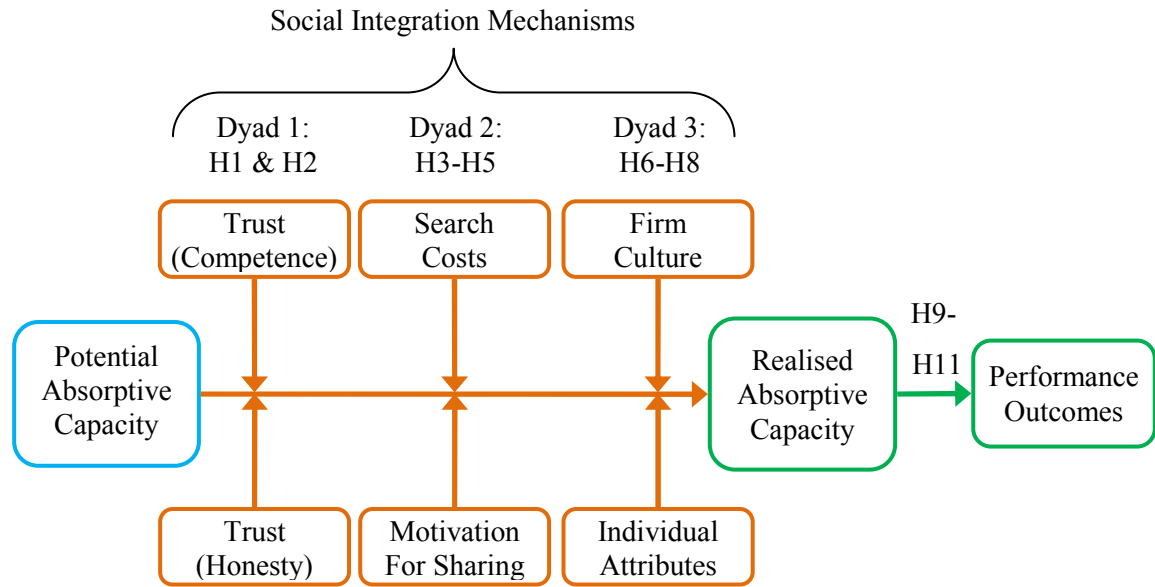


Figure 4.1: Conceptual Model

4.3.1 Potential and Realised Absorptive Capacity

In addition to the justification above, the thematic analysis further supports the adoption of Absorptive Capacity by empirically highlighting factors that are consistent with the literary definitions. Table 4.1 below provides a summary of the thematic codes with respect to the eight cases, demonstrating Bryman's (2008) "*well developed categories*" in the majority of cases.

Case	PAC		RAC	Dyad 1	Dyad 2		Dyad 3		Outcome
	Experience	Network			Costs	Motivation	Firm	Indiv	
1		✓		✓		✓	✓		✓
2	✓		✓	✓	✓		✓		✓
3	✓		✓	✓	✓	✓			
4		✓	✓		✓	✓			✓
5		✓	✓		✓	✓	✓		
6	✓	✓	✓		✓		✓		✓
7	✓	✓	✓	✓	✓	✓	✓		
8	✓		✓		✓	✓		✓	

Table 4.1: Summary of findings

4.3.1.1 Potential ACAP

Case	Evidence	Interpretation	Code
2, 8	<ul style="list-style-type: none"> Experienced technicians can get the reputation of being the one to turn to when projects are in trouble The relationship built from working previously in teams provides insight into not only their expertise You have to give them [potential clients] gifts to show you're credible and that you're worth working with 	Finding out peoples expertise	Experience
2, 3, 6, 7, 8	<ul style="list-style-type: none"> Doesn't matter who you talk to, if you explain it in terms of the business challenge before diving into solution, if diving into solution xyz i.e. to specific, don't get the context The importance of previous projects and experience means that contacts/network are mostly those within the company Suppliers are also a good source of information as they tend to be more specialised in what they do than I would be A friend... would they have the contextual understanding of environment to effectively answer questions? In project management, knowledge and experiences gained from previous projects is fundamental. Thus, being able to access people with appropriate knowledge through one's network/contacts is important She knew very little on how it may pan out but knew the problem The people who do novel and innovative work aren't any smarter, they just build a momentum of projects so people believe they are capable of doing something exciting 	Importance of prior knowledge in dealing with current issues	
1, 4, 5, 6, 7	<ul style="list-style-type: none"> [network size] Not wider network, only people you've worked with, and you collect them [network size] Participant observation in a network training workshop and examination of the published works [network size] Let's say just like a question X right, which is actually not covered in the project that we have done previously. They wouldn't actually go that extra mile to actually help you, but when you actually have a relationship... that person would have actually helped me [network heterogeneity] All groups I'm involved in are [in my specialised interest], so if looking for something outside that, [there] would be difficulties [network heterogeneity] A friend... would they have the contextual understanding of environment to 	Importance of network factors besides network size	Networks

	effectively answer?		
1, 4, 5	<ul style="list-style-type: none"> • Formal networks and repositories of information, but if have burning need for a particular project, will ring or email someone who's worked on something similar • Contact to understand in more detail, almost on a daily basis • Physically networking, chartered institute- online is easier to access, from comfort from own home; BUT serendipitous nature of going to an event; go to a physical event on a specific issue, as people would only go if interested- therefore quality of a physical event tends to be higher than through virtual networks • Face-to-face rather than internet • Networks to learn who is more useful, who to turn to, who has what topics of specialisation • Databases are ok...but more personal, more real 	Use/need of network	

Table 4.2: Analysis results of Case data: Potential ACAP

Potential ACAP refers to “*new knowledge that enters the organization*” (Todorova and Durisin, 2007; p779) and “*a firm's capability to value and acquire external knowledge*” (Zahra and George, 2002; p190). Thus, it can be seen as the *potential* for creating value from existing networks and knowledge stocks. Both Smith et al. (2005) and Zahra and George (2002) explicitly suggests two key sources of knowledge- the knowledge that resides in the individual (individual-based knowledge); and knowledge embedded in one's network (network-based knowledge). Thus the notions of *networks* and *experience* identified in the analysis above, displays consistency in the adoption of ACAP as a meaningful theoretical lens.

In disentangling the dimensions of knowledge stocks, interpretations of the case data pointed towards network size, network heterogeneity, and experience as important factors. Network size is commonly seen as a proxy for the total available volume of knowledge that can be accessed in a network (Cross and Cummings, 2004, Smith et al., 2005). However, Wong and Boh (2010) suggest that “it is not network size but advocates' non-overlapping and diverse contacts that are important because such network structures are valuable for diffusing positive information about a focal manager to people who are less informed” (p144). Thus the cases' referral to network heterogeneity is also supported. A number of other network characteristics can also be attributed to network-

based knowledge. Granovetter's (1973) strength of weak ties theory emphasises the role of distant and relationally weak ties. Thus ties strength (Levin and Cross, 2004, Van Wijk et al., 2008) and the number of indirect ties may also contribute to network-based knowledge.

On the aspect of individual-based knowledge, the cases refer to the importance of prior knowledge and thus experience. This notion of prior knowledge is explicitly referred to in theoretical developments of absorptive capacity and the cognitive perspective of the theory as discussed in Chapter 2. In addition, Naylor et al. (2001) points out that the use of opinions acquired through social connections appears to be the only useful source of knowledge during the initial stages of problem solving. In extending this then, a logical argument can be made that one's personal knowledge can also be attributed to: a) the level of formal education; and b) the diversity of one's working experience from which unique pockets of knowledge can be drawn from- notions similarly supported in the literature (c.f. Smith et al., 2005).

4.3.1.2 Realised ACAP

Case	Evidence	Interpretation	Code
5, 7, 6, 8	<ul style="list-style-type: none"> • All about finding specific problems that need to be solved • Take experience from [University 1] to [University 2] as [University 1] is higher status so take it on boards, • If work within a sector and see recurring theme • If you have integrity, i.e. not about 'I can invoice this client', that is your purpose for engaging with people • Knowledge system- to capture capabilities within a team, and in emerging markets- what are the new tech, what are new ways of working • Networking is so intertwined that it would never respond to intention to tender unless I write it...the chances are so low of winning...unless I influence them, encourage them, otherwise it's just not worth the work 	Behaviours to identifying problem	Problem Identification
5, 6	<ul style="list-style-type: none"> • Doesn't matter who you talk to, if you explain it in terms of the business challenge before diving into solution, if diving into solution xyz i.e. to specific, don't get the context • To see if worked with companies in a similar sector- clients always impressed if worked with others/their competition; i.e. if worked for Krafts, then Unilever would be interested; clients interested if you can 	Foundations to being able to recognise problems or opportunities	

	demonstrate that you've worked in that sector		
3	<ul style="list-style-type: none"> In this case I would be using PG/Wiki to try to understand more about a problem. (e.g. Why did we end up doing this (PG) OR using Wiki to find out more background about a new technology (Solar group is exploring stuff like Ceramic Fuel Cell technology – so I Google/Wiki the subject to get a better understanding of it 	Behaviours to define problem	Problem definition
2, 4, 5	<ul style="list-style-type: none"> Contact to understand in more detail, almost on a daily basis The use of networks is normally used to develop solutions and to define problems. This is somewhat of an iterative process whereby a problem is defined, solutions developed which can then lead to redefining the problem Can be both for background info and solution-depends where in the project cycle. If at beginning-then ideally would actually get those people involved 	Why networks help	
5, 6	<ul style="list-style-type: none"> Firstly, client would have a good understanding of scope and what he/she wants to achieve Problem is that label (functional vs. sector) might not have been 100% of the problem A lot of questions might not be clear, or context not clear 	Foundations to being able to recognise problems or opportunities	
5, 6, 7	<ul style="list-style-type: none"> If solution not within the portfolio of past projects- we would brainstorm internally; what is the challenge, cause effect, first principles, not constraints; to develop drivers of the problem; brainstorm some of the causes; Solution is to sit people around table and allow them to develop their own ideas If run out of ideas- why reinvent something Can be both for background info and solution-depends where in the project cycle If at beginning-then ideally would actually get those people involved 	Internal networks to come up with ideas	Idea generation
2, 3, 5	<ul style="list-style-type: none"> The use of networks is normally used to develop solutions and to define problems. This is a somewhat iterative process whereby a problem is defined, solutions developed which can then lead to redefining the problem If run out of ideas- why reinvent something Suppliers are also a good source of information as they tend to be more specialised in what they do than I would be Internal/external contacts- mostly internal, but found over past 18mth-2 years- how much input you can get from external networks, i.e. LinkedIn 	External networks to come up with ideas	
6, 8	<ul style="list-style-type: none"> For example supermarket with product not on shelf because of logistic, store manager complains to distribution centre- distributions say faults are doings short shipment- Nestle says can't understand 	Looking beyond the acute context of the problem	Solution implementation

	your ordering, so they want better forecasting etc; so it's not one area in isolation <ul style="list-style-type: none"> • It's about facilitating change...getting round the stubborn person, somebody to challenge, someone to put it together, somebody to say "this seems like what you want to do" 		
4, 8	<ul style="list-style-type: none"> • If answers are generated internally, there are emotional barriers to adoption- answers from third party breaks these barriers • Change is about building momentum, solution is relatively easily, need change, networks help build momentum 	Networks to facilitate implementation	

Table 4.3: Analysis results of Case data: Realised ACAP

Zahra and George (2002) suggest that the ability to solve problems comes from modifying and contextualising knowledge, a notion which became the basis for their realised absorptive capacity dimension. Thus, the observations above point to four specific stages of problem solving: problem identification, problem definition, idea generation, and implementation. They indicate that monitoring information in networks may lead to the identification of trends or particular opportunities that could be exploited. Several cases also referred to the initial use of project reports and the use of internet/wiki to help define a problem- failing this, they would turn to their network. The several cases also mentioned problem definition and idea generation in tandem. One suggests the iterative nature of problem definition and idea generation whilst the other is more explicit in relation to the timing and use of network-based knowledge in the problem life cycle. Finally, remarks suggesting the use of networks to facilitate change during implementation also point to the relationship to network-based knowledge, and thus the relationship to potential ACAP.

Given the emergence of problem solving from the cases, in addition to the discussions on its role in process improvement and knowledge (i.e. Section 2.3.2), the empirical data would appear to support the nature of the knowledge-based view of process improvement, and the adoption of ACAP as its theory and thus:

Hypothesis 0: Potential Absorptive Capacity is positively related to Realised Absorptive Capacity

4.3.2 Dyad 1: Trust

Case	Evidence	Interpretation	Code
7	<ul style="list-style-type: none"> Identify needs to be done and the right people [the case] is thinking of who she needs [the case] knew very little on how it may pan out but knew the problem She had to trust that the work [the case] did was sufficient When developing brief, she's thinking of who she needs Not just because you don't trust them but because how do they know about what I do, and how do I know how to work with them and how they work with me 	Trust as being dependent on abilities	Competence-based trust
1, 2, 3	<ul style="list-style-type: none"> Know like trust You must see them often, be attuned to their culture, respect them Having a good relationship with someone means you can more easily turn to that person 	Trust as in care	Benevolence-based trust
2, 3, 7	<ul style="list-style-type: none"> The element of trust is essential to them and to gain their trust you must see them often Because worked together before, there was a high level of trust Need non-business, social events to build relationship 	Trust building approaches	Building trust

Table 4.4: Analysis results of Case data: Trust

Organization theories such as transaction cost theory, agency theory and the resource based view emphasize trust as an effective mechanism to prevent opportunism and reduce governance costs (Narasimhan et al., 2008). Trust is also a familiar concept within the more socially constructed theories, particularly social capital theory. Nahapiet and Ghoshal's (1998) seminal work on the subject proposed three dimensions to social capital which leads to the creation of intellectual capital. Of particular note is the relational dimension, which accounts for the role of respect and friendship. Poignantly, the relational aspect of trust is attributed to the ability to access parties to combine and exchange intellectual capital. Furthermore, Zahra and George (2002) note specifically, albeit in their limited discussion on social integration mechanisms, the relational dimension of social capital. Within the context of process improvement and knowledge more specifically, the work of Choo et al. (2007b) on knowledge in Six Sigma noted that contextual elements of learning such as trust, enhanced exploratory learning activities, of which knowledge acquisition is a key process.

However, as the cases highlight, trust is a multifaceted construct. Motivated then by Johnson and Grayson's (2005) work, they distinguish between two key types of trust. Cognitive trust refers to trust in the competence and reliability in the partnering entity, with the expectation with some level of confidence that he/she will live up to their obligations. The second form is affective trust, the "level of care and concern the partner demonstrates...It is characterized by feelings of security and perceived strength of the relationship" (Johnson and Grayson, 2005; p501). Extant empirical studies point to the positive nature of both forms of trust. Levin and Cross (2004) found that they both factored into the receipt of useful knowledge, with benevolence/affective trust being slightly more effective than competence-based trust. Casciaro and Lobo (2005) make the observation that in practice, people prefer working with the "likeable fool" to the "competent jerk"; or to put it somewhat differently, affective trust over competence. The issue they see is that reward systems and incentives are based on competence yet in practice, people do prefer likable over competence and thus pose a paradox to team functionality. Ha et al. (2011) then empirically explore the effect of trust in information sharing and problem solving. The findings show that affective trust is more useful to information sharing than competence-based trust, yet competence is more effective in joint problem solving. In doing so, these studies raise questions regarding the relative merits of the two forms of trust leading to the following.

Hypothesis 1: Affective trust positively moderates the conversion of PAC to RAC

Hypothesis 2: Competence-based trust positively moderates the conversion of PAC to RAC

4.3.3 Dyad 2: Search Costs and Motivation

Case	Evidence	Interpretation	Code
3, 5, 6	<ul style="list-style-type: none"> • (got help on LinkedIn) Now, try to reciprocate • The person mentioned above will return the favour, not that she's on the lookout or vice versa, but when the opportunity arises. • Feel the need to help because you helped me last time 	Quid pro quo	Social costs
3, 6, 7	<ul style="list-style-type: none"> • Could be someone in somebody else's network, but social rules • You must see them often, be attuned to their culture, respect them; They expect you to eat with them, drink with them and so on • But if I never hear from you again- would I help in the future? 	Social norms/rules	
4	<ul style="list-style-type: none"> • Junior staff not confident or clear therefore do not share; • I want to look good, I want to show people. 	Mental barriers to asking for help	Psychological costs
2, 4, 7, 6, 8	<ul style="list-style-type: none"> • Experienced technicians can get the reputation of being the one to turn to when projects are in trouble, which can overburden the individual • So politics is a situation, I can't actually nail it to – I would just put it under that well of politics and not go into any more details. It's because politics comes in all shapes and forms and sizes and that is you might know • [external consultants] to put grease on the wheels, get things moving...the project then gets energy because of this, then absolutely need to manage the politics of the relations • Working around the politics • Cost of searching- flip it, what's the cost of not having it and reinventing the wheel every time 	Organisational factors that suppress searching	Institutional costs

Table 4.5: Analysis results of Case data: Search Costs

Case	Evidence	Interpretation	Code
3, 4, 7	<ul style="list-style-type: none"> • Because of a financial kick-back (they get paid to help) • Senior staff not sharing as much...busier, less time, not as interested, less incentive • Win business 	Reward and incentive-based motivation	Motivation based on some form of outcome (Extrinsic motivation)
3, 4, 5	<ul style="list-style-type: none"> • Because they have to (my boss just asked me to do this....) • Performance metric to share information, need to do it, have to do it. If emailed for my expertise, obliged to release information • In internal network, there's the expectation to help and nature of business; in external, it's different. They helped him, but didn't know him, and there's nothing in it for him 	External obligations provides the motivation	

4, 5, 7, 8	<ul style="list-style-type: none"> • I want to look good, I want to show people. • Juniors- answer also to show they're knowledgeable; go outside to learn more so to post • Sharing is a way of demonstrating your expertise to external world- not really showing off • Interested in sector, want to perform, want it to be understood. • Here you go, this is my job • Network to endorse 	Sharing expertise and knowledge to demonstrate expertise	
5, 7	<ul style="list-style-type: none"> • If it's something you're interested in and got expertise in • Interest and personal impact or change agent 	Curiosity	Motivations based on inherently personal reasons (Intrinsic motivation)
1, 3, 4, 5	<ul style="list-style-type: none"> • When you ask people for help they are flattered, but only if they like you • Because some people are that way inclined (they like to help their fellow men/women) • Because they have developed an empathy towards somebody (a new starter who needs mentoring in some way) • Interesting how easily/willing people are to help • What would incline you to help; human nature 	Altruism	

Table 4.6: Analysis results of Case data: Motivation

As outlined in the literature review, social exchange theory helps to describe the factors associated with the sharing and exchange of resources in social interaction. Particularly, it points to the notion of equivalent exchange in the value received by both parties. Inspired then by Hargadon and Bechky's (2006) "help giving" and "help receiving" interpretation of problems solving, the identification of search costs and motivation by the cases can be better described as an interrelationship between them in light of social exchange theory. In this way, search costs would refer to the difficulties the help receiver would incur; and motivation would refer to the factors why the knowledge giver would share their expertise. Other authors point to a similar dynamic such as the transmission and receipt of knowledge (Grant, 1996), the motivation to teach by the *donor* and the motivation to learn by the *recipient* (Easterby-Smith et al., 2008b), and knowledge *source* verses knowledge *recipient* (Szulanski, 1996).

Hypothesis 3: Search cost and motivation form a dyadic relationship such that search costs can be reduced by motivation

Regarding the role of search costs, Nebus (2006) identifies a number of costs involved in advice seeking. Firstly, social costs which refer to the “unwritten but understood promise of future service” (p629) which epitomize the quid pro quo observation. Secondly, institutional costs as violating organizational norms or bypassing lines of authority, as exemplified by the notions of politicking from the cases. Finally, inherently personal psychological costs as reservations in asking for advice, highlighted in the cases as confidence. Consequently, Cross (Cross et al., 2001, Borgatti and Cross, 2003) and Nebus (2006) on information seeking suggest that the decision on whom to turn to for advice is subject to trading off the perceived value of the exchange, with it the underlying cost. Hansen et al. (2005) proposed, amongst other factors, that search costs was depended on network size and strength. However, empirically, neither team’s size nor strength was found to be significantly related to search cost. The conceptualising of search cost as a moderating variable rather than a dependent variable may aid in clarifying the relationship between search cost and network size that Hansen et al. (2005) was unable to accomplish and thus:

Hypothesis 4: Search costs negatively moderate the conversion of PAC to RAC

Advice seeking behaviour and social capital both theorise that the creation and/or exchange of intellectual capital rests in part on the perceived value of the exchange, and the ability to access the knowledge source. However, as Nahapiet and Ghoshal (1998) state, “even where opportunities for exchange exist and people anticipate that value may be created through exchange or interaction, those involved must feel that their engagement in the knowledge exchange and combination will be worth their while” (p249). This points to the central role that *motivation* plays in the elicitation of knowledge. In a slightly different context yet still acutely focused on knowledge flow, the phenomenon of co-creation as “*an interactive process of learning*” (Payne et al., 2008; p84) endorses that superior value can be obtained from engaging external parties, notably consumers, “*in every part of the business system [for example] designing products, developing production processes, crafting marketing messages, and controlling sales channels*” (Prahalad and Ramaswamy, 2004; p5). In investigating the factors influencing consumer participation in co-creation activities, Füller (2010) suggests that *motivation*, in

addition to factors such as the type of co-creation task (i.e. product development), plays a fundamental role in obtaining value through co-creation activities. Füller (2010) subsequently proposes a 10 category continuum of motivation from intrinsic motivation (i.e. curiosity) to extrinsic motivation (i.e. monetary compensation) which is reflected in the analysis of the interview data above leading to the hypothesis that:

Hypothesis 5: Motivation positively moderates the conversion of PAC to RAC

4.3.4 Dyad 3: Firm Culture and Individual Attributes

Case	Evidence	Interpretation	Code	Theme
1, 5, 7	<ul style="list-style-type: none"> • What particular type of person/business would be a good referral for you • Is there anyone you would like an introduction to? • I know someone there / who can help you with that / who knows about it • Why don't I make the introduction? • Would you like me to introduce you • People pitch for jobs knowing this, then ask for you if you can help • If not an expert but know people who are, and why wouldn't you • Network Knows expertise, and interests which is important. • Take experience from Russell group to new polytechnic as Russell is higher status so take it on boards 	Actively search for opportunities or helping others rather than upon request/necessity	Proactive	Firm culture
2, 6, 8	<ul style="list-style-type: none"> • [overburdening] This can then lead to looking outside of one's typical contacts for assistance which can also provide a fresh perspective • How did they tackle it, what were the problems, has anybody come across challenge • There's no such thing as a stupid question...the culture in [Company 123] makes you want to ask questions... frank and open...therefore get things done quicker • Not about technical, most people are pretty capable of coming up with the solution, it's just about having the courage and someone to facilitate a way of working that gives you the space to do that 	Experimenting and trying different things	Risk taking	

8	<ul style="list-style-type: none"> • Client feels they are paying for an individual, not a giant consultancy • The difference between what I am paid and what the consultancy bills me is so massive...so is about trying to make you feel that your engaging others and getting knowledge beyond your individual power 	Conflict between the individual and the firm	Role of the individual	Individual Attributes
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Table 4.7: Analysis results of Case data: Firm Culture and Individual Attributes

In the framework by Smith et al. (2005) for a knowledge creation capability, an organisational climate of risk taking was found to be an antecedent to such a capability. In their study of absorptive capacity and time-based manufacturing practices, Tu et al. (2006) conclude that an open communication climate facilitates the transfer of knowledge and information. In the context of professional service firms, a notion relevant here due to the majority of the background of cases, Forstenlechner et al. (2007) similarly conclude that collaboration improves the ability to harvest knowledge more effectively. Macpherson and Holt (2007) add that specific cultural limitations can both contribute to and limit the types of knowledge resources available. The suggestion of these studies is the importance of organisational climate in fostering both the sharing of knowledge, and in exploratory knowledge acquisition behaviour.

Thus the cases references to risk taking and proactiveness point to *entrepreneurial orientation*, an organisational theory which explains that the nature of entrepreneurial behaviour is attributed to the underlying culture of risk taking, innovativeness and proactiveness (c.f. Lumpkin and Dess, 1996). Correlating knowledge acquisition with an entrepreneurial orientation, Skerlavaj et al. (2007) suggest that “information acquisition positively effects information interpretation, which is nothing other than the ability to recognize entrepreneurial opportunities” (p360). Empirically, Li et al. (2011) found that entrepreneurial orientation successfully moderated the manufacturer-distributor relationship, and the manufacturer knowledge acquisition propensity. Entrepreneurial orientation has similarly been linked with process improvement, albeit through innovativeness. Terziovski (2010) states that “Innovation in the manufacturing sector generally focuses on process improvements” (p893), and Bell (2005), recalling the close association between problem solving and process improvement, defines innovation as

“the development and implementation of new ideas to solve problems” (p288), giving rise to the suggestion that:

Hypothesis 6: Firm culture in the form of entrepreneurial orientation positively moderates the conversion of PAC to RAC

The statement from the cases regarding *frank and openness* epitomises the impact that firm culture has on knowledge flows. However, as Nonaka (1994) notes, such activities fundamentally happen at an individual level. Furthermore, Cohen and Levinthal (1990), the forefathers of absorptive capacity, the underlying theory of this research, explicitly note in the inherent relationship between a firm’s absorptive capacity, and its organisational member’s absorptive capacity. Matusik and Heeley (2005) extends this point by purporting to two dimensions of absorptive capacity- the normative *collective* dimension, and individual dimension. In this work, the individual dimension focuses on the role of the individual’s prior experience as providing the foundation to organisational memory, but more importantly, it suggests that “the probability that individuals within an organization will route information to others is positively related to the individual’s view that such information is relevant to others” (p556). In doing so, it clarifies: a) the intimate role of the individual in knowledge flows; and b) the role that firm culture must play in endorsing such activities by fostering such individual behaviour. This later point is similarly supported by the case analysis where the firm’s role is suggested to provide an environment that allows individuals to go beyond their individual power. Consistent then with the trend in absorptive capacity, entrepreneurial orientation has also seen work on distilling it to the individual level. Douglas and Shepherd (2002) explore, *Entrepreneurial Intentions*, people’s attitudes toward initiating entrepreneurial ventures by starting their own business based on income, independence, risk, and work effort. Zhao and Seibert (2006) examined this slightly differently by viewing entrepreneurial intentions based on the big five personality dimensions- conscientiousness, openness to experience, neuroticism, agreeableness and extraversion. Most recently, Bolton and Lane (2012) adapted the seminal firm-level scale of entrepreneurial orientation by Lumpkin and Dess (1996, 2001, 2009) to the individual level, and thus the suggestion that:

Hypothesis 7: Individual attributes in the form of Entrepreneurial orientation positively moderates the conversion of PAC to RAC

Hypothesis 8: Firm culture and Individual attributes form a dyadic relationship such that Individual attributes can be enhanced by Firm culture

4.3.5 Outcomes

Case	Evidence	Interpretation	Code	Theme
1, 4	<ul style="list-style-type: none"> • Consultants and third party to get fresh perspective • Outside, fresh perspective • Management consultant, third party new perspective for new answers and reduce emotional barriers 	Getting new perspectives	Novelty	Radical
6	<ul style="list-style-type: none"> • For example, supermarket with product not on shelf because of logistics, store manager complains to distribution centre- distribution says the faults are due to short shipments- Nestle says can't understand your ordering, so they want better forecasting etc; so it's not one area in isolation 	Need to look beyond traditional boundaries	Getting the job done correctly	Effectiveness
6	<ul style="list-style-type: none"> • A lot of questions might not be clear, or context not clear- A lot of the response might be relevant, but not for the application, therefore not useful. 	Contextual understanding of responses		
2	<ul style="list-style-type: none"> • The business environment of [Company XYZ] means that everything is urgent. Consequently, the main reason for turning to one's network is because of time constraints 	Time constraints in projects	Performance measures in projects	Efficiency
6, 8	<ul style="list-style-type: none"> • If run out of ideas- why reinvent something • If it's happened somewhere else, it's pretty hard to argue that it's not possible 	Identifying existing solutions	Enhancing the process of problem solving	

Table 4.8: Analysis results of Case data: Outcomes (Radicalness, Effectiveness and Efficiency)

The final outcome to ACAP according to Zahra and George (2002) is sustained competitive advantage. Poignantly, they argue that the outcome of Realised absorptive capacity leads to product and *process* innovation. In doing so, their subsequent argument

mirrors Imai (1986) familiar cycle of incremental and radical/breakthrough improvements as illustrated in the figure below. Zahra and George (2002) note that in regard to radical innovations, the nature of competence traps as the acute focus on exploitative knowledge routines which can cause firms to get blindsided by radical innovations. They suggest these competence traps as *familiarity traps* through overemphasising existing knowledge and refinement; *Maturity traps* which limit knowledge exploration through the perceived need for reliable and predictable outputs; and *propinquity* (nearness) *traps* reflect the intrinsic nature of exploring knowledge close to existing expertise. Thus, the search and acquisition of knowledge external to the firm will likely mitigate these competence traps, resulting in a great ability to develop radical improvements. Furthermore, literature (c.f. Macpherson and Holt, 2007, McDonald et al., 2008, Padula, 2008, Mors, 2010) in addition to the cases, point to the use of external networks to provide different points of view that can lead to novel solutions, thus:

Hypothesis 9: Realised ACAP from external knowledge acquisition is positively related to the radicalness of process improvement initiatives

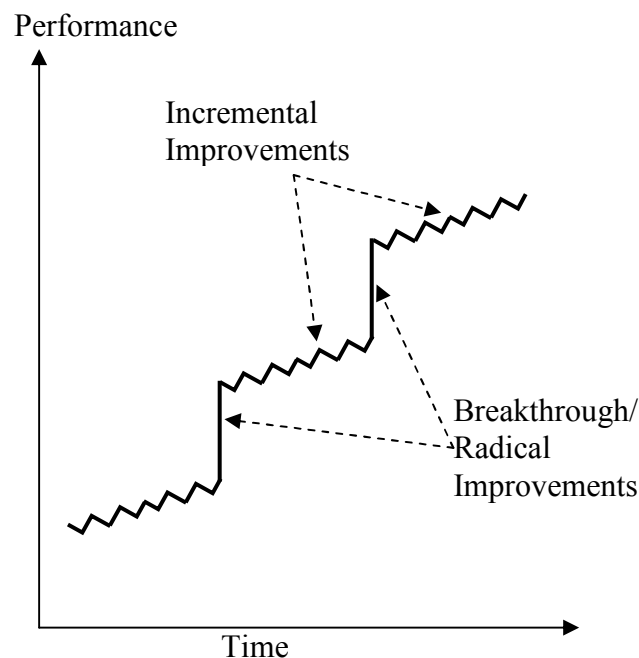


Figure 4.2: The continuous improvement process
(adapted from Imai, 1986)

Zahra and George (2002) then relate ACAP to incremental improvements by referring to the renewal of knowledge stocks to enhance the efficiency and effectiveness of processes. They suggest that well-developed capabilities of acquisition and assimilation are likely to lead to proficiencies in revamping knowledge stock. Such proficiencies enhance a firm's ability to track changes in their industries (*ibid*) and in doing so, allow their actions and strategies to be more *effective*. Hipkin (2001) concurs to this from a purely process improvement perspective in that "knowledge, as a factor of production, is increasingly recognised for its relatively untapped contribution to more effective performance" (p1358). Zahra and George (2002) then go on to suggest that by building such proficiencies, the costs associated with the process decrease overtime, thus it also becomes more *efficient*. For example, De Toni and Nassimbeni (2001) suggest that suppliers are a source of identifying existing or standardised solutions to prevent "reinventing the wheel". As then reflected in the cases, by not reinventing the wheel whilst also identifying solutions that have been used in practice elsewhere, the time spent on generating ideas as well as in the final implementation of the solution are reduced, thus:

Hypothesis 10: Realised ACAP from external knowledge acquisition is positively related to the effectiveness of process improvement initiatives

Hypothesis 11: Realised ACAP from external knowledge acquisition is positively related to the efficiency of process improvement initiatives

Chapter 5: Confirmatory Study

5.1 Introduction

Following the development of the hypothesis and conceptual model in Chapter 4, the following section details the results obtained from data collection and the statistical analysis.

5.2 Pilot testing

The survey underwent a two-stage pilot testing procedure prior to the final administration utilising convenience sampling in both stages. Vandenbosch and Saatcioglu (2006) note that targeting individuals that are readily accessible and who would be open to providing feedback, such as in convenience sampling, can be used to substantiate internal validity, i.e. how the threats in research design have been accounted for (Creswell and Plano-Clark, 2007). Given that the nature of piloting is to assess the design of the survey, convenience sampling was consistent with these objectives.

The first pilot of the questionnaire was administered to 202 postgraduate students from the Nottingham University Business School: 69 MBA students, 48 Operations Management Masters students, and 85 PhD candidates. Aside from being readily accessible, these respondents were targeted for the following reasons: *MBA Students*- by definition these candidates have professional experience and so were elicited for their practical and professional understanding; *Operations Management Masters students*- as process improvement is a central topic in operations management, these students were targeted due to their knowledge of the area; and *PhD candidates* were targeted to critique the theoretical and methodological rigor of the research. Two rounds of emails were issued to the MBA and Masters students. PhD candidates were elicited via the Nottingham University Business School Doctoral Society and via face-to-face requests.

The questionnaire was developed using surveymonkey.com and was a total of 16 pages including a title page, a concluding “thank you” page, and a “thank you” page half way through, an approach taken by Smith et al. (2005). The survey took roughly 35 minutes with a total of 164 items including sections at the bottom of each page asking for

"Feedback" on: a) the wording of the questions; b) if any items required them to think too long or hard before responding; c) if any items were confusing or ambiguous; and d) any other comments. The items were as follows:

26 items on respondent's network, experience, education and demographic background (Smith et al., 2005, Fosfuri and Tribó, 2008, Loknath and Tarun, 1997, Shah, 1998, Wong and Boh, 2010);

41 items on Absorptive capacity as both individual level (da Mota Pedrosa and Jasmand, 2011a, ter Wal et al., 2011) and the firm level measures (Jansen et al., 2005) were included;

- 24 items on process improvement (Tu et al., 2006, Bhatt and Stump, 2001, Füller, 2010, Krause et al., 2007, Levin and Cross, 2004);
- 9 items on knowledge creation (Choo, 2010, Perry-Smith, 2006, Matusik and Heeley, 2005);
- 5 item on Radicalness (Gatignon et al., 2002, Pérez-Luño et al., 2011);
- 15 items on social capital (Ha et al., 2011, Levin and Cross, 2004, Villena et al., 2011, Hansen et al., 2005, Smith et al., 2005);
- 10 items on the tacitness of Knowledge (Hansen et al., 2005, Hult et al., 2006, Kogut and Zander, 1993, Pérez-Luño et al., 2011);
- 16 items on Advice seeking behaviour (Borgatti and Cross, 2003, Füller, 2010, Hansen and Nohria, 2004); and
- 18 items on organisational culture (Hughes et al., 2007a, Nemanich et al., 2010, Premkumar and Roberts, 1999)

Although excessive in length, the wide scope of the pilot survey provided information on the relevance of a range of topics, which was considered essential for future refinement of the instrument. A total of 19 responses were collected giving a response rate of 9.4%. The low response rate is attributed to: 1) the excessive length of the survey; and 2) the timing of administration. It was thought that administering the survey in the 2 week period between student's coursework deadlines in December and Christmas would mean that respondents would have more free time to undertake the survey- this appears not to be the case. Given the low response rate and small overall sample size, a statistical analysis would have been of little benefit. However, comments and feedback on the survey

design, specifically its length and lack of focus, helped to significantly reshape the content, which had substantial repercussions on the design of the final survey.

In total, this first pilot nearly halved the length of the survey to a total of 88 items:

- 20 items to measure of Individual-level absorptive capacity;
- 5 items to assess network characteristics;
- five moderators (aka ‘social integration mechanisms’)
 - Management support (4 items)
 - Knowledge complexity (4 items)
 - Search costs (6 items)
 - Motivation (9 constructs)
 - Organisational culture (19 items);
- Finally, four outcomes:
 - The degree of Radicalness (5 items)
 - Problem solving steps (3 items)
 - Process improvement outcomes (5 items)
 - Project efficiency and effectiveness (8 items).

Following a rigorous reworking of the survey design, the second round of pilot testing sort qualitative feedback from four practitioners, three academics and two colleagues, as table 5.1 below justifies.

Respondent	Details	Why Selected
Practitioner	Process Development Technologist	\\ To assess practical relevance and non-academic terminology
Practitioner	Business Analyst	
Practitioner	Senior Buyer	// As above plus non-English native speaker
Practitioner	Quality and Audit Expert	
Academic	Associate Professor in Marketing	Research interest in networks and radical innovations
Academic	Associate Professor in Marketing	Research interest in networks and learning
Academic	Research Fellow	Engineering Background to relate to process improvement
Colleague	PhD Research in Business Ethics	As they had little understanding about the topic, used to assess “face validity” and general understanding of the enquiry
Colleague	MSc student in International Politics	

Table 5.1: Classification of Absorptive Capacity Measures

5.3 Measures

5.3.1 Controls

Firm size (1-item): As the survey asks about processes, there needed to be assurance that respondents had adequate process in place for change to happen. To do this, firm size was used as a proxy.

Employee status (1-item): As the research was looking for candidates who have regular access to process that can be changed, students, retirees, or unemployed respondents were screened out.

Frequency of improvement activities (1-item): This variable was used to explicitly ensure that process improvement was being undertaken by the respondent and not just something they are interested in which lead them to join the Group.

Training in Process Improvement (1-item): Similar to the above, this variable was used to ensure respondents engaged in process improvement- those with no formal training were screened out.

Use of LinkedIn (1-item): LinkedIn has many uses, from personal branding to job hunting and recruiting. This variable was used to purposely control for respondents that actively use LinkedIn to gather and share knowledge via the Group discussion boards as a proxy for the use of real-life networking.

5.3.2 Absorptive Capacity

Given the wide application of the theory, there have been numerous ways in which absorptive capacity has been operationalised leading to "diversity and lack of consensus regarding operationalisation of ACAP (Kostopoulos et al., 2011; p4). Works by Kostopoulos et al. (2011) and Volberda (2010) aid in rationalising the perspectives taken which are summarised in Table 5.2 below. At its most generic level, Kostopoulos et al. (2011) suggest that measures can be categorised as either quantitative or qualitative. Quantitative measures refer to measures such as R&D expenditure (c.f. Cohen and Levinthal, 1990, Tsai, 2001) or the amount of investment in technical training (c.f.

Mowery and Oxley, 1995). Volberda (2010) categorises these measures slightly differently, referring to them as indirect measures or proxies of ACAP. These measures are attractive given their ease of administration and somewhat objective nature, however they are criticised given that they focus solely on inputs to the process and negate the resulting outcomes (Volberda et al., 2010). Lichtenthaler (2009) also provides evidence to suggest the low explanatory power of R&D expenditure (Volberda et al., 2010).

Qualitative measures subsequently refer to self-reporting measures which aim to "capture different dimensions and processes of ACAP" (Kostopoulos et al., 2011; p4) for which Volberda's (2010) classifications provide assistance. First are those measures which distinguish between the *unit of analysis*, viewing it at the individual-level (c.f. ter Wal et al., 2011, da Mota Pedrosa and Jasmand, 2011a), team level (c.f. Nemanich et al., 2010) or firm-level (c.f. Tsai, 2001, Matusik and Heeley, 2005). Of particular debate surrounds those measures at the individual level as much of the underlying conceptualisation of the theory has focused at the firm level (c.f. Lane et al., 2006, Zahra and George, 2002). Next are those that take a *unidimensional* view of ACAP and operationalise it as a single construct. These studies typically view ACAP as an antecedent, mediating or moderating variable within a broader context rather than necessarily exploring its underlying nature. Tu et al. (2006) for example viewed it as an antecedent to the time-based manufacturing processes such as quality improvement efforts and reengineering setups which lead to improved value to the customer; and Zacharia et al. (2011) similarly used it as an antecedent for explaining supply chain collaboration for enhancing operational performance. As a mediating variable, Kostopoulos et al. (2011) used it to explain the indirect link between external knowledge inflows and financial/innovation performance; and Fosfuri and Tribó (2008) tested it as a mediator between antecedences such as R&D collaboration, and innovation performance. Lastly, as a moderating variable, Tsai (2001) used it to explain the variation in the strength of the relationship between network centrality and innovation/business performance.

The final type of qualitative measures proposed by Volberda (2010) are those that explore the construct as a *process*, which is consistent with Zahra and George's (2002) perspective adopted in this research. The first to empirically test such a perspective was Jansen et al. (2005) from which the majority of the later works builds upon. Jansen et al. developed a 20-item construct covering the two dimension/four stage process of ACAP

proposed by Zahra and George (i.e. Potential- acquisition, assimilation; and Realised- transformation, application). Lichtenthaler (2009) later added a third "transformative" dimension building upon the three-stage process by Lane et al. (2006), a dimension which reflects the need to manage and maintain knowledge flows, operationalised via the sub-routines of *maintain* (4 items) and *reactivate* (4 items). Camisón and Forés (2010) then augmented the original scale of Jansen et al. in light of several previously mentioned studies such as Tu et al. (2006), Lane et al. (2006), Matusik and Heeley (2005), and Fosfuri and Tribó (2008). Conceptually they maintained the two dimension/four stage process of Zahra and George but formed a 19-item scale with considerably different underlying items. The final construct of note follows the works by da Mota Pedrosa and Jasmand (2011a, 2012) who translated the measures of Jansen et al. from the firm level to the individual level. This construct is of interest given this research's focus on both the process view of ACAP and ACAP at the individual level. This most recent development of the construct demonstrates the timeliness of the current research.

Quantitative Measures	R&D expenditures Investment in technical training Number of employees with university education Proportion of technical personnel relative to the total number of employees
Qualitative Measures	1) Unit of analysis - Individual - Team - Firm 2) Unidimensional construct - Antecedent - Moderator - Mediator 3) Process - 2 stage process (Potential vs. Realised) - 3 stage process (explorative, Transformative, exploitative learning)

Table 5.2: Classification of Absorptive Capacity Measures

Given the overview of the construct above, the following discussion details the justification of the ACAP measures used. Of key importance to the decision on the measures, aside from the quality of the measure itself which was assured by selecting measures with heritage from 3- and 4-star journals, was the overall length of the survey.

In the initial piloting of the survey, the 20-item firm-level measure of Jansen et al. (2005), in addition to da Mota Pedrosa and Jasmand's (2011a, 2012) 20-item individual-level measure was included in an attempt to provide insight on the debate in translating ACAP to the individual level. In hindsight, this was a poor decision given the excessive length it created. Coupled with this, the focus of this research is on the social integration mechanisms that translate potential absorptive capacity to realised absorptive capacity, hence and ideally so, a greater amount of the survey instrument should be given to the inclusion of those variables. Consequently, a shorter and more pragmatic measure of ACAP was required whilst maintaining theoretical and empirical rigour. In this case, the simple inclusion of the measure of Jansen et al. (2005) alone was unsuitable given that it focuses at the firm-level; and the sole inclusion of da Mota Pedrosa and Jasmand's (2011a, 2012) measure although theoretically sound, was yet to receive empirical verification given its newness and lack of confirmation in an appropriate 3-/4- star journal. As such, the dimensions of "Potential" and "Realised" were reviewed in light of Zahra and George's underlying definitions in order to provide theoretical justification, then measures adapted from appropriate ACAP/Knowledge studies in suitable journals as detailed below.

Potential Absorptive Capacity PAC (10-items): Zahra and George (2002) define PAC as the "capability to value and acquire external knowledge but does not guarantee the exploitation of this knowledge" (p190) where "a high PAC does not necessarily imply enhanced performance" (p191). Todorova and Durisin (2007) add that PAC refers to "new knowledge that enters the organization and is not yet assimilated or transformed" (p779). In response to these, PAC was viewed as the total stocks of knowledge accessible to individuals on three points. Firstly, holistically viewing it as "the total stocks" reflects the colloquial concept of having the *potential* to achieve yet *not guaranteeing it*. Secondly, having a large stock of knowledge may not necessarily yield greater results, a response to the idea of the lack of *implied enhancement*- take our ability to access unfathomable quantities of information from the internet for example, access is so easily that it is difficult sometimes to sift the good from the bad. More theoretically, we find theories such as social capital challenging the concept of solely deriving value from network characteristics such as network size or strength, and rather, aspects such as trust and goodwill playing an equivalently important role. Finally is the notion of *non-transformed knowledge*- having a large stock of knowledge is just that, a stock of

information, experience, advice that has yet to be augmented and applied to the issue or context at hand.

Consequently, a 10-item measure adapted from Smith et al. (2005), Van Wijk et al. (2008), Carpenter and Westphal (2001) and Perry-Smith (2006) was used which assessed potential absorptive capacity by the level of individually held-knowledge stocks (years of tertiary education, years of experience, number of industries worked in) and network-held knowledge stocks (number of direct contacts, number of strong relationships, number of close contacts, number of contacts frequently interacted, number of indirect contacts, network heterogeneity by country, network heterogeneity by industry). A number of these measures received secondary treatment as follows:

- Number of Contacts: following the guidance of Smith et al. (2005), the natural logarithm of the number of direct ties T1, and the number of indirect ties T2 was taken.
- Network Strength: again guided by Smith et al. (2005), this was calculated by taking the mean of the number of strong relationships, the number of close contacts, and the number of contacts frequently of interaction.
- Network density: this was calculated by dividing the number of indirect contacts (T2) by the number of direct contacts (T1).

Realised Absorptive Capacity- RAC (5-items): Citing Kim (1998), Zahra and George (2002) suggest that "ACAP is the capacity to learn and solve problems" (p186) where the "ability to solve problems comes from modified knowledge" (p189). They subsequently define RAC as the "capacity to leverage the knowledge that has been absorbed" (Zahra and George, 2002; p190) which "involves transforming and exploiting the assimilated knowledge by incorporating it into the firm's operations" (p191). Thus, RAC can be seen as the process of modifying knowledge by means of problem solving. Furthermore, problem solving is seen as a major aspect of process improvement, thus proving a contextual alignment to the research. For example, Terziovski and Sohal (2000) state that "the underpinning principle of Kaizen is the use of various problem-solving tools for the identification and solution of work-based problems" (p540); Bessant et al. (2001) state that "the principle of CI is a belief that all individuals can make a contribution to problem-solving innovation" (p70); Anand et al. (2009) state "for CI, employees require training and apprenticeship in the use of the scientific methods for structured problem

solving" (p455); and Choo et al. (2007b) assert that "the use of a structured methods in solving quality problems represents an important component in [Six Sigma] programs" (p919). Thus problem solving provides both a theoretical *and* contextual way of operationalising RAC.

Consequently, a five-item construct adapted from Van Grundy Jr.(1997) and Choo et al. (2007b) was used which asked the respondents to use their network and contacts in the five-stages of problem solving: problem identification, defining problems, generating ideas, evaluation and selecting ideas, and implementing the solutions. A 7-point scale anchored at 1 ("not at all) to 7 ("very great extent") was used.

5.3.3 Moderators

The following section details the measures used for the social integration mechanisms which aid in translating potential absorptive capacity to realised absorptive capacity.

5.3.3.1 Dyad 1: Trust

Trust (8-items): Building on Johnson and Grayson's (2005) seminal work on trust which conceptualised two forms of trust, Cognitive trust (competence and reliability) and Affective trust (confidence generated by the level of care and concern), a review of extant measures was undertaken which identified four works of interest. Firstly, the scale proposed by Johnson and Grayson (2005) showed suitable rigour (Cognitive trust, composite reliability = 0.80; Affective trust, composite reliability = 0.80) yet the phrasing of several items (i.e. "personal loss", " warm and caring") did not appear to fit the professional context of either the LinkedIn environment nor the nature of process improvement. Secondly, Levin and Cross (2004) proposed a benevolence-based and competence-based trust scale, however it consisted of only 5 measures (benevolence 3-items, competence 2-items). This was deemed unsuitable in light of comments by Hinkin (1995) who suggests that to ensure the reliability of the measurement, constructs should contain a minimum of three items in order to minimise problems related to content validity, construct validity, and internal consistency. Thirdly, Gattiker et al. (2007) used an 8-item benevolence and honesty trust scale in their analysis of sourcing and negotiation mechanisms in buyer-supplier relations. Again, given the nature of the enquiry, the phrasing of the items such as "stepping on other people" and "getting the upper hand" was not suited to this enquiry. Finally, the scale by Ha et al. (2011) was

adopted as it provided suitable reliability (affective trust, $\alpha = 0.82$; competence-based trust, $\alpha = 0.81$), adequate length reliability (affective trust, 4-items; competence-based trust, 4-items), and the phrasing of the items was suitable given that the study was examining trust in enhancing logistics efficiency, which can be holistically viewed as improving processes. Responses were on a seven-point scale, ranging from “strongly disagree” to “strongly agree”

5.3.3.2 Dyad 2: Search cost vs. Motivations for Sharing

Hargadon and Bechky (2006) on the use of collectives in problems solving, utilised the notion of “Help Seeking” vs. “Help Giving”. “Help Seeking” is equivalent to asking questions and can be associated with the costs involved in searching for information or advice (i.e. search costs). “Help Giving” on the other hand can be seen as answering questions and thus related to the motivations as to why people share information or advice. In doing so, search costs and motivation allows for an interesting juxtaposition of behaviours.

Search costs (6-items): Morrison and Vancouver (2000) provided an extensive review on the perceived costs of information seeking and summarised its operationalisation in terms of anticipated effort, negative performance expectations, the presence of an audience, or low self-confidence. Hansen et al. (2005) took a more quantitative view by defining search costs as engineering-months spent looking for, identifying, and evaluating knowledge. The key to the operationalisation of the construct used in this enquiry stems from Nebus' (2006) work on a theory of advice network generation. Within this work, perceived search which incorporate many of the dimensions proposed by Morrison and Vancouver, were categorised as either social, psychological or institutional costs. Social costs reflect favour that the ego might incur as a result of receiving knowledge, for example unwritten but understood promise of future service or quid pro quo (Nebus, 2006) or anticipated effort by Morrison and Vancouver (2000). The deterrent and driver of the cost in this case lies in the anticipation of some unknown obligation at some unknown time. Psychological costs are those related to the hesitancy to talk about what is not known, the implications of inadequacy in competence or tainting of reputation if asking for help (Nebus, 2006), negative performance expectations or low self-confidence (Morrison and Vancouver, 2000), or discomfort in not knowing information that is 'already supposed to know' (Miller and Jablin, 1991). This cost is then founded on

the embarrassment in asking for help. Lastly, institutional costs stem from violating organisational norms of whom to contact for advice such as contacting those who are not management appointed, bypassing formal processes, and sidestepping lines of authority. The deterrent in this case are formal reprimands, or informally as negative feedback from co-workers (Nebus, 2006) or social rejection (Miller and Jablin, 1991)

Following Nebus' (2006) guidance, search cost was measured by a six-item construct adapted from this work based on social cost (costly in terms of future favours), psychological costs (imply inadequacy in own capabilities; taint reputation) and institutional costs (violate organizational norms; bypassing formal processes; bypassing lines of authority). The construct was rated on a seven-point scale from Not at all/ Very great extent.

Motivation (9-items): The conceptualisation of motivation as intrinsic (personal satisfaction) or extrinsic (satisfaction from independent or external sources) is "well-established and widely empirically supported" within the knowledge-based view (Osterloh and Frey, 2000; p538). In operationalising this construct, the work by Füller (2006, 2010) in understanding the motivations behind why consumers engage in co-creation activities is adopted for two key reasons. Firstly, there is contextual alignment between Füller's work and this enquiry insomuch that both works are attempting to understand why people share knowledge and advice, albeit in new product development (Füller) or process improvement (Marzec). Secondly, the measure itself provides a finer grained conceptualisation of motivation and thus a deeper understanding as summarised in Table 5.3 below. Füller again utilises the intrinsic/extrinsic dimensions, however also adds a third form called "internalized extrinsic" motivation which lies between these two extremes. In doing so, they conceptualise intrinsic motivation as Intrinsic Innovation Interest (2-items, $\alpha = 0.75$) and curiosity (α N/A as single item); extrinsic motivation as Monetary Rewards (3-items, $\alpha = 0.91$) and dissatisfaction (α N/A as single item); and internalised extrinsic as gaining knowledge (2-items, $\alpha = 0.71$) and to show ideas (3-items, $\alpha = 0.71$). This scale was operationalised in the survey by asking respondents what motivates them to share information/knowledge/advice and their extent to agreement on the statements (7-point scale from strongly disagree/ strongly agree).

Dimension	Sub-dimension
Intrinsic	- Curiosity - Intrinsic Innovation Interest
Internalised Extrinsic	- Gain Knowledge - Show Ideas
Extrinsic	- Monetary Rewards - Dissatisfaction

Table 5.3: Classification of Absorptive Capacity Measures

5.3.3.3 Dyad 3: Firm Culture vs. Individual Attributes

Firm-level Entrepreneurial orientation (15-items): There is considerable literature on the measures for entrepreneurial orientation, ranging from the original nine-item scale by Miller (1983) to Lumpkin and Dess' more recent works (Lumpkin et al., 2009). However, similar to the above, finding a measure that had phrasing consistent with the nature of this enquiry was a challenge. Upon extensive review of the key literature on entrepreneurial orientation (c.f. Brown et al., 2001, Covin et al., 2006, Covin and Slevin, 1988, Kreiser et al., 2002, Kropp et al., 2008, Lumpkin et al., 2009, Lumpkin and Dess, 1996, Lumpkin and Dess, 2001, Rauch et al., 2009, Wang, 2008), a nine-item measure of risk-taking (e.g. taking calculated risks, experimentation), proactiveness (e.g. identifying opportunities, initiate actions) and innovativeness (e.g. creative, actively introduce innovations) by Hughes et al. (2007a) was used as the contextual wording of this construct was more closely aligned with this study.

Individual-level Entrepreneurial orientation (10-items): This construct was included to provide insight on personal characteristics which is consistent with the individual-level unit of analysis of this inquiry. In doing so, it becomes possible to contrast the firm wide cultural norms as elicited by the measures above, and the behaviours or attitudes of the individual in order to assess the alignment between the firm and the individual. In addition to individual entrepreneurial orientation, two other personality constructs were examined. Firstly, Douglas and Shepherd's (2002) independence-risk-work effort construct for entrepreneurial intentions which appeared to be consistent with the firm-level view of autonomy, risk taking and proactiveness but was not included as it is operationalised empirically via experiments and conjoint analysis rather than as a

questionnaire construct. Secondly, the "Big Five" personality traits: conscientiousness, openness, neuroticism, agreeableness and extraversion (i.e. Zhao and Seibert, 2006). This is commonly used in the applied psychology literature for measuring entrepreneurial traits; however, it was not included due to the size of the construct and its considerable departure from the current line of research. Consequently, a 10-item measure was included (seven-point scale from "strongly disagree" to "strongly agree") which measured an individual's propensity to be proactive, risk-taking and innovative (Bolton and Lane, 2012) as per the firm-level construct.

5.3.4 Outcomes

Several outcomes of problem solving were also included to understand the results of knowledge acquisition in process improvement. Firstly, acquiring new knowledge may help to enhance the improvement process itself such as the ability to shorten the length of the project by acquiring ready-made solutions (Mintzberg et al., 1976) or the reduction of costs through the sharing of learning experiences (Morris et al., 2006). Secondly, the use of external networks has been suggested to provide fresh perspectives (McDonald et al., 2008, Mors, 2010) and/or the ability to offer new concepts (Morris et al., 2006) which could lead to greater novelty. Consequently, the following measures were included:

Project Performance (8 items): an eight-item construct by Levin and Cross (2004) that measured project effectiveness (e.g. project's value, project's quality) and project efficiency (e.g. coming in on-budget, shortening project time) on a seven-point scale from not at all to a very great extent

Radicalness (5 items): To measure the concept of novelty, the Schumpeterian idea of *radicalness* (Schumpeter, 1934) was used as it reflects aspects such as revolutionary innovations, fundamental changes and departures from existing practices (Johannessen et al., 2001). Consequently, five-item scale measuring the degree of radicalness developed by Gatignon et al. (2002; $\alpha = 0.78$) and later confirmed by Pérez-Luño et al. (2011; $\alpha = 0.90$) was also included.

5.4 Data Purification

A four-stage purification process of the data was undertaken as guided by Hair et al. (2006).

5.4.1 Stage 1: Case-wise missing data

The first stage dealt with case-wise missing data. From the 2056 letters sent, a total of 291 responses were received yielding a first pass response rate of 14.2%. As recommended by Hair et al. (2006) and Zacharia et al. (2011), cases with less than 90% completed responses were deleted resulting in 91 cases removed. Table 5.4 below shows the summary of the purification process.

Total Responses	Stage 1: Case-wise missing data	Step 2: Variable-wise missing data	Step 3: Outlier Analysis	Step 4: Normality
291	200	200	200	Multivariate normality not met but no cases removed
				Total sample size: 200

Table 5.4: Summary of survey invitations and LinkedIn Special interest boards

5.4.2 Stage 2: Variable-wise missing data

The second stage was an analysis of missing data by variable in which Hair et al. (2006) suggest to analyse it at the univariate level (i.e. missing based on the variable itself), bivariate (i.e. missing data based on the relationship between two variables) and multivariate (i.e. missing data based on the relationship between a number of variables). The first stage assessed univariate missing data where variables with greater than 5% missing data is considered questionable- table 5.5 below shows the results. It is worth noting that these variables were for the LinkedIn network statistics as it was found that access and platform design of LinkedIn was not consistent across the Globe- a work around was later found, but more importantly at this analysis will demonstrate, this was not a cause for concern statistically.

	N	Mean	Std. Deviation	Missing	
				Count	Percent
No. Direct ties	186	472.19	401.772	14	7.0%
Strength- close	185	69.21	105.234	15	7.5%
Strength- duration	185	151.98	160.784	15	7.5%
Strength- frequency	185	81.88	844.335	15	7.5%
No. Indirect ties	164	310752	1202554	36	18.0%
Work heterogeneity	156	93.06	136.906	44	22.0%
Network heterogeneity	156	67.53	128.250	44	22.0%

Table 5.5: Summary of Univariate missing data

The next step utilised the standard bivariate test available in the SPSS package. This procedure runs a series of *t*-tests based on those variables identified with greater than 5% missing data (i.e. as above in table 5.5) to the remaining variables. The critical value for this test is a *p* value less than 0.05- the following are bivariate relations that are considered problematic.

	T1 CLOSE	COST 5	COST 6	MOT 7	iINNO 2	iINNO 4	T2	COST 4	MOT 1	iRT 3
No. Direct ties	.	.257	.136	.754	.214	.915	.	.304	.028	.102
Strength- close	.	.157	.080	.802	.385	.741	.	.191	.558	.077
Strength- duration	.	.157	.080	.802	.385	.741	.	.191	.558	.077
Strength- frequency	.	.157	.080	.802	.385	.741	.	.191	.558	.077
No. Indirect ties	.030	.052	.056	.017	.109	.232	.	.211	.209	.020
Network heterogeneity	.019	.030	.009	.130	.010	.049	.042	.032	.121	.088

Table 5.6: Summary of Bivariate missing data

The final step was to assess multivariate missing data by way of Little's Missing Completely at Random (MCAR) test, which tests the null hypothesis that the data is missing completely at random (MCAR). Here, a *p*-value of 0.137 was found which is greater than the critical value of 0.1 (Rosenzweig, 2009, Hair et al., 2006) and hence the missing values can be assumed to be completely at random. The result of the above

procedure is that these are not concerns with variable-wise missing data so no cases or variables were deleted.

5.4.3 Stage 3: Outliers

The third step is to detect any outliers and examine their potential effect. Although Outlier procedures operate in a similar procedure to the above, namely at the univariate, bivariate and multivariate levels (Hair et al., 2006) the bivariate stage was dropped as the multivariate procedure incorporates this. Univariate procedures test for outliers with respect to the variable itself and come in two forms: Dixon tests, which utilise a procedure similar to t -test where a test statistic (i.e. the Grubb Statistic) is generated per variable and tested against a critical value- this provides a yes/no test if outliers exist rather than identifying the outlier per se; and through the identification of cases that reside outside $\pm X$ standard deviations from the mean, i.e. ± 3 standard deviations from the mean as in Statistical Process Control (SPC) hence the existence and case-wise identification of outliers can be identified. The limitation of univariate procedures is that cases may not be shown to be outliers in the context of the variable, however when analysed with respect to another they may become outliers. In this case, bivariate procedures simplified as scatter plots can be used. The figure below illustrates this scenario- in figure 5.1(a), the circled case in variable X does not appear to be an outlier given that it lies fairly centrally to the plot, however, when contrasted to variable Y in figure 5.1(b), it can clearly be seen as an outlier. A more rigorous extension to this is through multivariate procedures.

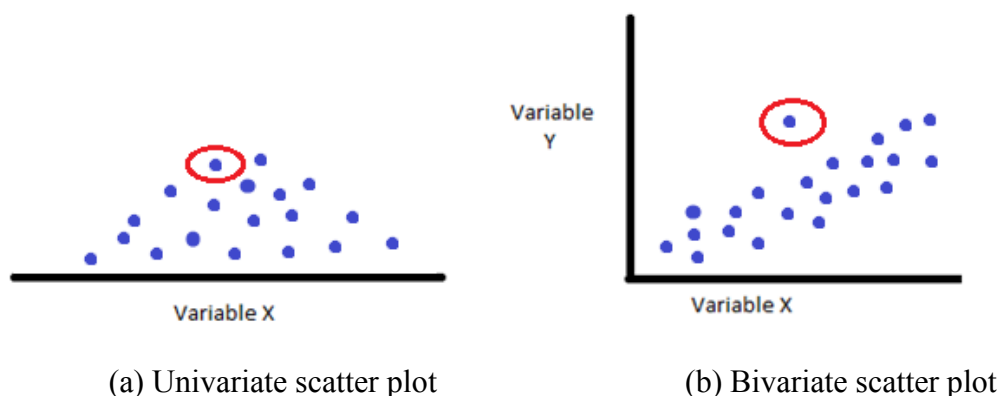


Figure 5.1: Illustration of the limitation of Univariate Outlier Procedures

Following the suggestions by Hair et al. (2006), a univariate analysis was done using a ± 3 standard deviations procedure as well as the Grubb Statistic for comparison. The Dixon/Grubb method identified 79 variables with potential outliers and the other method identified 29 variables. Given this, the 27 variables that failed both tests were analysed further.

As suggested by Hair et al. (2006), Mahalanobis distance was used to analysis the 29 subject variable simultaneously at the multivariate level. This is a regression-type technique which produces a figure akin to a z-score that represents the distance a case is from the centroid of the independent variables- the larger the value, the further from the centroid and the more likely it is to be a outlier. Given that it is a regression type technique, these suspect variables would need to be regressed against a dependent variable. Fortunately, all of the suspect variables are hypothesised as being predictors/IVs to a common outcome/DV, thus simplifying the analysis as only a single test needed to be run. In this case, the 27 variables were regressed against the dependent variables of "Problem Solving" which showed no univariate outliers. Noting also and although jumping ahead somewhat in the analysis procedure, the dependent variable was a composite variable which meets suitable reliability constraints (Factor analysis: communalities > 0.5 , eigenvalue > 1 with $> 60\%$ variance explained; Reliability: Cronbach alpha > 0.7). This was done to enable a larger amount of variance to be included in the regressions in order to establish a greater level of confidence.

Once the Mahalanobis distances where calculated for each case, a corresponding probability needs to be calculated in order to contrast the values to a standard critical value. Subsequently, the distances are converted to probabilities based on a cumulative Chi-squared distribution where the degrees of freedom are the number of variables used, in this case 27. Subsequently, those cases with a probability less than 0.001 are problematic- in this case, nine cases were detected.

Although the Mahalanobis distance technique is proficient at identifying outliers, it is limited in its ability to examine the individual effect of each case and thus if they can be deleted. To assess the effect of the outliers, the DFBETAS statistic was employed, "a deletion statistic that compares regression coefficients when case i is included versus not included in the sample" (Cohen et al., 2003; p404). Cohen et al. (2003) suggest that cases

with DFBETAs $> \pm 1$ for small and medium sample sizes, and DFBETAs $> \pm 2/\sqrt{n}$ for large sample sizes are considered influential/biasing and should be deleted, where a small sample size is less than 30, and a large sample size is greater than 1000 (Hair et al., 2006; p75). Consequently, the sample size was deemed medium and DFBETAs calculated for the nine questionable cases over the 27 questionable variables. In this case, no instances were found to lie above 1 thus no outliers were considered influential/biasing and needed to be deleted.

5.4.4 Stage 4: Normality

The key assumption in Structural Equation Modelling (SEM) is the need for multivariate normality (Chin and Dibbern, 2010, Henseler, 2012, Looney, 1995, Kaplan, 2009, Kline, 2010) and subsequently, only multivariate normality (MVN) was tested. The issue is that although MVN is a key assumption to SEM and critically the most widely used form, LISREL, the vast majority of studies do not report or formally test this assumption. This has two profound effects, firstly the underlying merit of the finding of these studies may be in questions; and secondly, due to their lack of use, common software packages (i.e. SPSS) do not have a MVN analysis feature as standard. A search for mechanism to address this shortfall lead to the work by DeCarlo (1997) in Psychology who published a code/syntax for SPSS which undertakes a MVN analysis based on multivariate skewness (Small's (1980) Q1, and Srivastava's (1984) β_{1p}^2 test), multivariate kurtosis i.e. "peakiness" (Small's (1980) Q2, and Srivastava's (1984) β_{2p} test) and an omnibus test based on Small's (1980) Q3 ($Q3 = Q1 + Q2$). Looney (1995) provides guidance regarding the tests and the critical values in order to interpret the results from DeCarlo's (1997) code.

To begin, as normality is being assessed at the variable level, rather than the item level, variables/constructs were created as composites of their related items via factor analysis. Table 1 in Appendix 10 shows the reliabilities of the constructs that were subsequently used in the MVN analysis. As there are six moderators hypothesised in the research, six MVN analyses were run, the results of which can be found in Table 2 (Skewness), Table 3 (Kurtosis) and Table 4 (Omnibus) of Appendix 10. In all cases for multivariate skewness, kurtosis and omnibus tests, results were not significant suggesting the violation of MVN assumptions and the conclusion of non-multivariate data (Looney, 1995). Consequently, the norm of using covariance-based SEM (LISREL) was not possible.

Subsequently, SmartPLS (Ringle et al., 2005), a Partial Least Squares and variance-based technique, was adopted as it is not constrained by distributional assumptions.

5.5 Sample Size

Following this purification, a total of 200 responses were received from a sample of 2056 giving an effective response rate of 9.7%. This response rate compares moderately well to other web-based studies (Cousins et al., 2006- 14.8%) and Absorptive capacity studies in OM (Tu et al., 2006- 10.7%). However, as Siemsen et al. (2008) acknowledge, a response rate of 11 to 16% is low but not atypical when long surveys are used. In the case of the inquiry by Siemsen et al. (2008), it took respondents half an hour to complete, which is comparable to the one administered in this study. In terms of the sample size, $n = 200$ is deemed adequate for LISREL (Cadogan and Lee, 2010) with Shah and Goldstein's (2006) review of SEM/LISREL in Operations Management research showing studies ranging from $n=52$ to $n= 840$ and a median of $n=202$. Furthermore, PLS is typically more efficient with smaller sample sizes (Peng and Lai, 2012, Fornell and Bookstein, 1982, Henseler et al., 2009, Ringle and Henseler, 2011) so significantly smaller samples sizes have been observed in the literature by studies using PLS, e.g. 50 respondents (Rosenzweig, 2009), 91 respondents (Klein, 2007), 149 respondents (Wang et al., 2007), 205 respondents (Raymond and St-Pierre, 2010) and 218 respondents (Braunscheidel and Suresh, 2009). Finally, Ringle and Henseler (2011) and Peng and Lai (2012) note a generalised rule of thumb for a sample size in PLS as ten times the most complex relationship where the most complex relationship is the larger value between: a) the construct with the largest number of formative indicators if there are formative constructs; (2) the dependent latent variable (LV) with the largest number of independent LVs influencing, i.e. maximum number of arrows pointing on a latent variable. In this research, the maximum number of formative indicators is two, and the maximum number of arrows pointing on a latent variable is 11 (i.e. see figure 5.6: 5 moderator variables, 5 interaction terms, and 1 dependent variable). This suggests a minimum sample size of 110, thus the achieved sample size of 200 is more than satisfactory.

5.6 Data Analysis and Results

5.6.1 Descriptives Statistics

All respondents to the survey had received some form of process improvement training suggesting confidence in the respondent's contextual understanding of the enquiry. The vast majority had received training in Lean (91%), Project Management (91%) or Six Sigma (81%) as summarised in table 5.7 below. Of the Six Sigma/Lean Six Sigma (LSS) respondents, 37% were Master Black Belts, 27% Black Belt, 13% Green Belts and 4% of respondents were Yellow Belts. The use of LinkedIn showed that the majority of respondents used it to grow and/or maintain their network (i.e. build relationships) which is consistent with this enquiries focus on social networking. Furthermore, it shows a strong tendency towards the use of LinkedIn to glean knowledge, albeit actively by sharing in discussions or asking questions (42%), or passively via monitoring board feed and generally keeping tabs (62%).

The responses in terms of firm size showed two clear extremes- 58% of responded worked in larger firms (1000+ employees) whilst 23% worked in small firms (less than 50 employees). Examining this further, it was found that 58% of respondents who work in small firms were also self employed or on contracts, suggesting that the majority of these candidates were involved in consulting type work. Extending this, the average professional experience was 21.5 years at an average of 5.8 years tertiary education (i.e. Undergrad + Masters/MBA). The average number of industries worked in was six with a maximum of 24 and the majority of respondents worked in manufacturing (70%), Consulting (58%), Automotive (42%), Teaching/Training (33%) and Logistics (31%).

Finally, it was also possible to explore the country of origin of the respondents as SurveyMonkey, the web platform through which the survey was design and administered, provides the IP address of each response by default. Given the IP addresses, it was then just a case of searching for the location of the address (whatismyipaddress.com, http://www.projecthoneypot.org/search_ip.php, and ipdb.at were used to do this). 34% of respondents were found to be from the US and 24% from the UK. In total, 78% were from native English speaking countries.

Process Improvement Training	Percentage
Lean	91%
Project Management	91%
SS/LSS	81%
Master Black Belt	37%
Black Belt	27%
Green Belt	13%
Yellow Belt	4%
SPC	79%
TQM	61%
Business Process Reengineering	54%
Theory of Constraints	54%

LinkedIn Use	Percentage
Build Relationships	84%
Passive Searching	63%
Career Management	55%
Active Information Searching	42%
Recruitment	39%
Business Development	28%

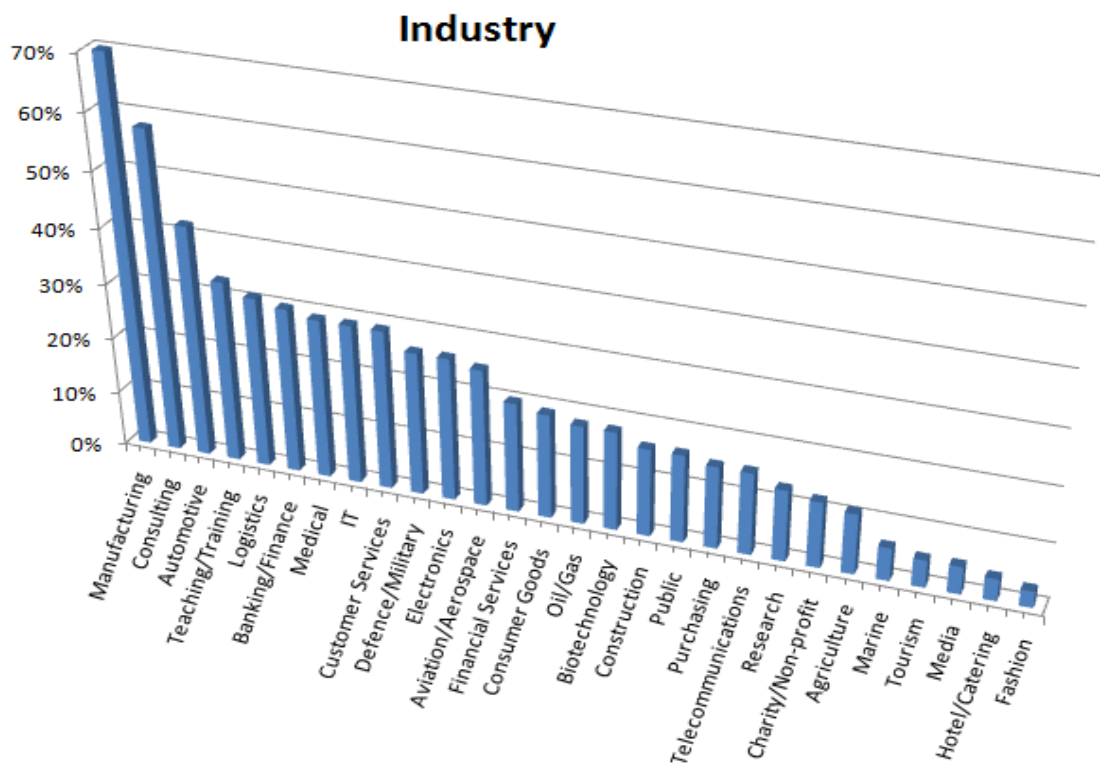
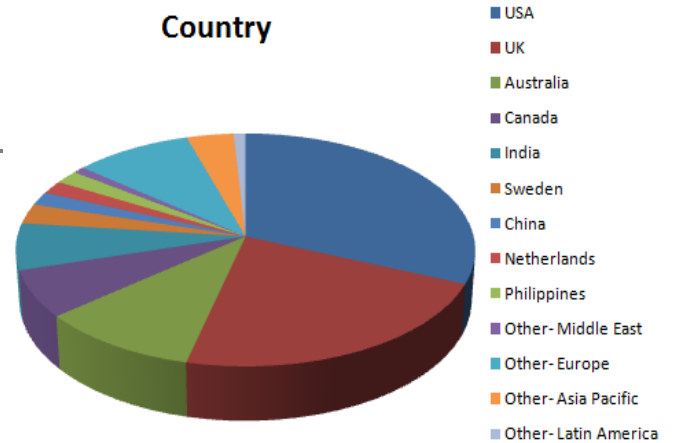
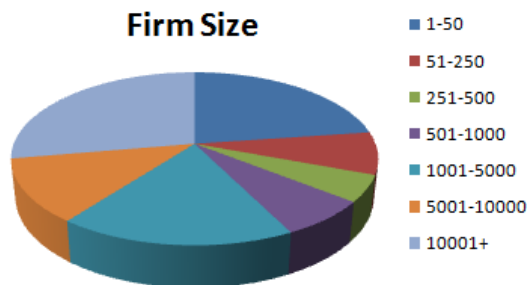


Table 5.7: Summary of Descriptive results

5.6.2 Controls

Three of these demographic variables were subsequently assessed for bias in responses- firm size, country of origin, employee status. Firm size contained seven groups as above; country of origin was condensed to 8 groups- USA, UK, Australia/NZ, Canada, India, Europe (other), Greater China, South East Asia (SEA, other); and employee status, 6 groups (Self employed, Full time permanent, Part time permanent, Contract, Unemployed, Other). To assess the potential bias, a series of one-way ANOVA's were run between the four control variables and the major dependent variables namely problems solving (aka realised ACAP), radicalness, project efficiency, and project effectiveness. The results of these are in table 5.8 below.

Variance (equal if sig >0.05)				
	Problem Solving	Radical	Effective	Efficient
Firm Size	0.298	0.235	0.914	0.919
Country	0.759	0.741	0.015	0.127
Employee Status	0.443	0.313	0.111	0.24
Means (equal if sig >0.05)				
	Problem Solving	Radical	Effective	Efficient
Firm Size	0.116	0.291	0.315	0.329
Country	0.91	0.704	0.352	0.211
Employee Status	0.913	0.678	0.572	0.687

Table 5.8: Control Variable Results (significance values)

The first procedure done in one-way ANOVA's is to test the assumption of equal variance between groups. In this case, it is desired that the significance level be greater than 0.05, which suggests the "acceptance" of the null hypothesis that the variances are equal. Following this, a similar procedure is done for the mean, i.e. a significance of greater than 0.05 suggests that the null hypothesis that the means are equal cannot be rejected. As observed in table 5.8, there does not appear to be any bias in the data (i.e. means all equal). However noting that Effective/Country has a significance value less than 0.05 for the variance test, it fails to meet the assumption of equal variance. In this case, a post-hoc test for testing the means where unequal variance is assumed was applied (Tamhane's T2 test). The table below shows the corresponding significance levels between the groups.

As observed, all values are greater than 0.05 suggesting that the means of the groups do not statistically differ. Given this, there does not appear to be any indication of that these controls may skew the results, indicating that further analysis is possible.

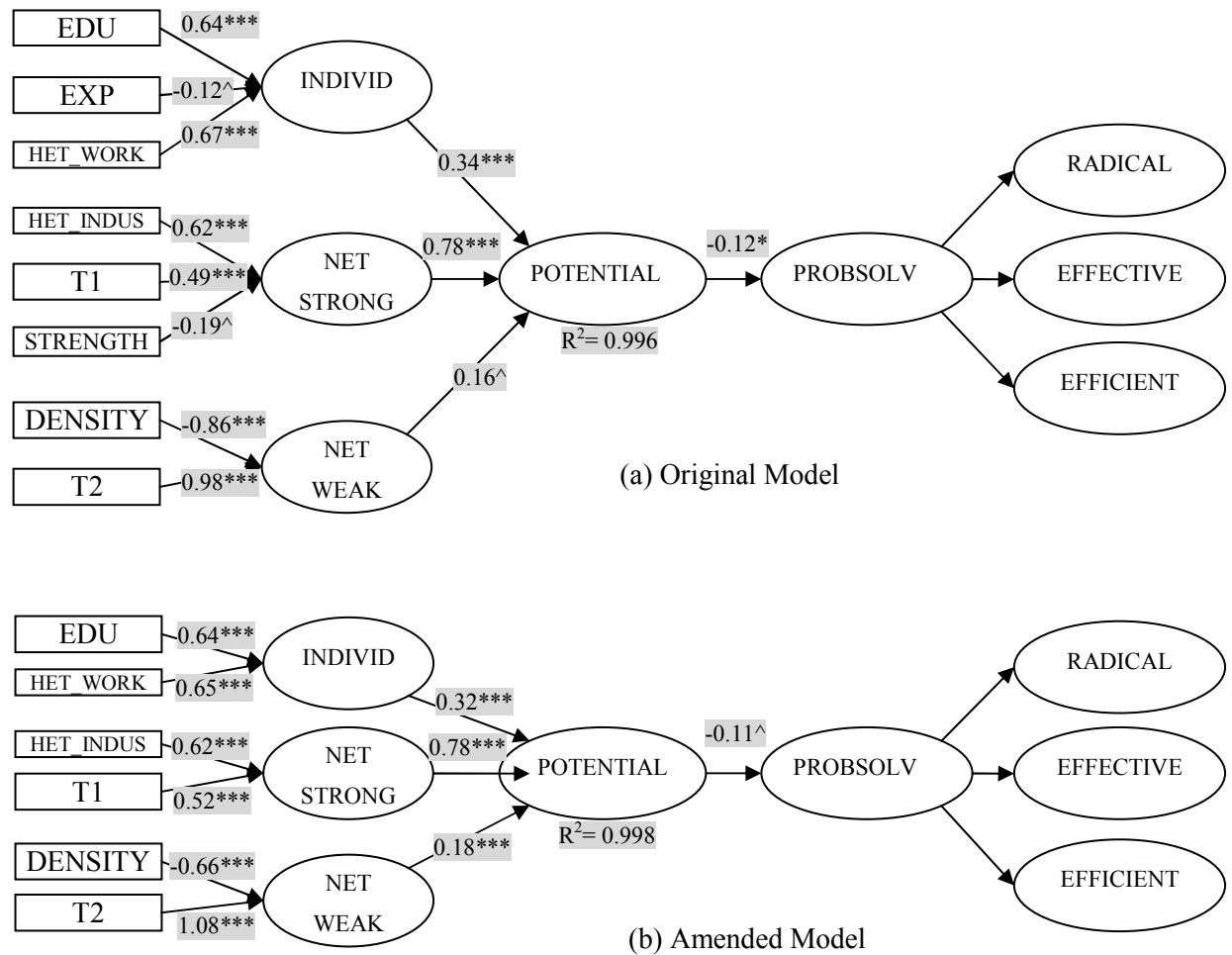
	1	2	3	4	5	6	7
1. USA							
2. UK	0.98						
3. Australia/NZ	1.00	1.00					
4. Canada	1.00	1.00	1.00				
5. India	1.00	0.72	0.93	1.00			
6. Europe	1.00	0.75	0.95	1.00	1.00		
7. Greater China	1.00	1.00	1.00	1.00	1.00	1.00	
8. SEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 5.9: Tamhane's T2 post-hoc test results (significance values)

5.6.3 Potential Absorptive Capacity- A Second Order Formative Construct

5.6.3.1 Indicator Level Assessment

In order to assess the quality of the second-order formative measure, a simplified version of the conceptual model was run without any of the moderating variables such that the sole effect could be ascertained. The first test is the significance of the item paths to their respective construct. As observed in the original model (figure 5.2a), experience and network strength both had non-significant loading and were subsequently removed (Diamantopoulos and Winklhofer, 2001). The resulting measure (figure 5.2b) showed significant robustness. As can be seen, all variables are significant at the 5% and the majority at the 1% level. Noting also that *Density* is negative but significant which is acceptable in formative measures, given the suggestion that "internal consistency is of minimal importance because two variables that might even be negatively related can both serve as meaningful indicators of a construct" (Diamantopoulos and Winklhofer, 2001, citing Nunnally & Bernstein 1994, p489). Furthermore, the first order constructs similarly load strongly and highly significant (<1%) to the final second order construct suggesting satisfaction of this requirement.



*** = 1% ** = 5% * = 10% ^ = Not Significant

Figure 5.2: The conceptualisation of Potential Absorptive Capacity

The second test at the formative level is to assess the extent of multicollinearity between the measurement items by means of the variance inflation factor (VIF). As the VIF are only calculated between the predictors, an iterative series of regressions was undertaken where each item became the dependent variable and regressed against the remaining five items such that VIF can be obtained for all items. Table 5.10 below summarises these results. As can be observed, the maximum VIF achieved was 1.714 indicating an absence of multicollinearity (Peng and Lai, 2012). Given this in association with the significance above, the formative construct was deemed acceptable at the indicator level.

	Dependent Variable					
	1	2	3	4	5	6
1. Work heterogeneity	--	1.083	1.108	1.101	1.060	1.083
2. Network heterogeneity	1.570	--	1.222	1.603	1.586	1.541
3. No. Direct ties	1.714	1.304	--	1.628	1.499	1.705
4. Network density	1.315	1.321	1.257	--	1.024	1.313
5. No. Indirect ties	1.532	1.581	1.400	1.238	--	1.601
6. Yrs of Education	1.077	1.057	1.096	1.093	1.102	--

Table 5.10: Summary of Multicollinearity results

5.6.3.2 Construct-Level Assessment

At the construct level, nomological validity is ascertained by the significance of the path from the formative measure to a theoretically justified outcome, in this case the path from Potential ACAP (PAC) to *Problem Solving*. However, there is a critical theoretical dilemma- this Thesis posits in accordance with Zahra and George (2002), that the relationship between one's stock of potential knowledge (PAC) may only have minimal direct and isolated effects on the ability to realise value, and rather this relationship is subject to the presence of a number of moderating variables (i.e. the three Dyads). Thus, we would expect that the direct and unmoderated effect of PAC on *Problem Solving* to be minimal, whilst the moderated effects to be significant- fortunately we can observe this phenomenon. Figure 5.2b shows the unmoderated relationship as not significant; however, the moderated relationships observed in the later structural model (figures 5.3-5.8) are significant. Given the consistency between the theory and the observed, nomological validity is seen as acceptable.

Given the sufficing of all tests at the indicator and construct level, the formative measure is deemed acceptable and is adopted for the remaining analysis.

5.6.4 Dyad 1: Trust

The following results are structured as guided by Henseler et al. (2009), namely the results of the outer measurement models which is concerned with reliability and validity of the reflective/formative constructs; then the evaluation of the inner structural model by path characteristics and variance explained, and effect sizes. Give that the two-stage approach is required for the analysis of formative constructs, the first stage permits the assessment of the measurement model, with the second stage providing the structural model.

5.6.4.1 Outer Measurement Model

5.6.4.1.1 Assessment of Reflective Measures

The assessment of the reflective measures is a relatively straightforward process given that the vast majority of the empirical studies pertain to these measures. As such, three measures of quality are used- reliability, convergent validity and discriminant validity.

Reliability is assessed using Cronbach alpha and composite reliability. Cronbach alpha is the more traditional method and is biased due to its assumption of equal loading of the variables and thus the underestimation of reliability (Henseler et al., 2009). Given that PLS is able to prioritise indicator loadings, it is possible to generate the more robust measure of composite reliability which assumes differences in indicator loading (Henseler et al., 2009). This is consistent with the critical values for the measures- Cronbach alpha as greater than 0.7 due to its underestimation (Nunnally, 1967), and composite reliability as greater then 0.6 (Fornell and Larcker, 1981), slightly more relaxed given it's greater robustness. The table below summarises the results and demonstrates acceptance on both reliability measures. One key exception was the measure of radicalness. The original 5-item scale demonstrated poor fit and upon further investigation by factor analysis in SPSS, the first item (*represented a minor improvement, reverse item*) showed a communality of 0.045 and was removed. Thus the reliability values below are for the revised 4-item measure.

	Composite Reliability (> 0.6)	Cronbachs Alpha (> 0.7)	AVE (> 0.5)
Effective	0.977	0.969	0.915
Efficient	0.950	0.930	0.827
Problem Solving	0.944	0.926	0.773
Radical	0.905	0.878	0.708
Affective trust	0.930	0.899	0.770
Competence-based trust	0.916	0.879	0.731

Table 5.11: Reliability and Convergent validity results of Dyad 1: Trust

Convergent validity assesses that the indicators represent one and the same underlying construct (Henseler et al., 2009). This is achieved by assessing whether the Average Variance Extracted (AVE) is greater than 0.5 (Fornell and Larcker, 1981), in other words, "the latent variable is able to explain more than half of the variance of its indicators on average" (Henseler et al., 2009; p299). As shown in table 5.11, all reflective items meet this criterion.

The final quality measure for the reflective measures is discriminant validity which "refers to the condition when different scales used to measure different constructs have no significant correlation among the different scales" (Wang et al., 2007; p2429) or more simply, two conceptually different concepts should exhibit significant difference (Henseler et al., 2009). In this case, two tests are proposed- the Fornell–Larcker criterion, and the cross- loadings. The Fornell–Larcker criterion (Fornell and Larcker, 1981) suggest that the "the AVE of each latent variable should be higher than the squared correlations with all other latent variables" (Henseler et al., 2009; p300), or conversely the square root of the AVE should be higher than the correlations. This second interpretation is shown in table 5.12 below and demonstrates acceptance. The second test is the cross-loadings where an indicator should have its highest loading on its respective construct (Wang et al., 2007, Lawson et al., 2008). Given the size of the resulting tables, they have been placed in Appendix 11. As observed, all indicators loaded to their respective construct. Given this, discriminant validity is found.

	1	2	3	4	5	6
1. Effective	0.96					
2. Efficient	0.79	0.91				
3. Problem Solving	0.50	0.47	0.88			
4. Radical	0.39	0.46	0.13	0.84		
5. Affective trust	0.07	-0.04	0.25	-0.03	0.88	
6. Competence-based trust	0.10	-0.04	0.18	0.03	0.77	0.86
7. Potential	0.03	0.01	-0.10	-0.01	-0.02	-0.05

Note: Bold numbers on the diagonal show the square root of the AVE; Numbers below the diagonal represent construct correlations

Table 5.12: Discriminant validity results of Dyad 1: Trust

5.6.4.1.2 Power analysis

When we discuss significance, significance levels, p-values, t-values etc., we are determining the risk (α) of making Type I errors i.e. incorrectly rejecting when it is true. The converse of this is the failure to reject, a Type II error (β). For example, if we test the null hypothesis that a model fits a population well although it actually fits poorly, the correct outcome is rejection of the null hypothesis. However, the failure to reject would be a Type II error which would have significant repercussions for the research's credibility (MacCallum et al., 1996). Consequently, it is possible to assess Type II errors given the inverse relationship between statistical power and Type II errors. However, as Cohen (1992) states, "the continued neglect of statistical power analysis in research in the behavioural sciences is the inaccessibility of or difficulty with the standard material" (p155) and indeed this is still the case today. Shah and Goldstein's (Shah and Goldstein, 2006) review of structural equation modelling in operations management research states that "few studies in our review mentioned power and none estimated power explicitly" (p155). Following a trying review of the literature, a procedure guided by MacCallum et al. (1996), Rigdon (1994), Cohen (1992) and Preacher and Coffman (2006) was pieced together. Based on MacCallum et al. (1996), Power is a function of sample size (n), the probability of Type I error (α), the null value of the root-mean-square error of approximation (ϵ_0), the alternate value of the root-mean-square error of approximation (ϵ_a) and the degrees of freedom of the model (df). More specifically, ϵ_0 and ϵ_a represent the

degree of fit between the model and the population where the difference between the values represent the effect size and thus the closeness of fit (MacCallum et al., 1996). To test the hypothesis of a close fit, accepted values are $\alpha = 0.05$, $\varepsilon_0 = 0.05$ and $\varepsilon_a = 0.08$ (MacCallum et al., 1996). Given the discussions above, we know that the sample size is 200, thus the final variable that needs to be determined is the degrees of freedom of the proposed model. To do so, we utilise the procedure and formula developed by Rigdon (1994) below:

$$df = m * (m + 1) / 2 - 2 * m - \xi * (\xi - 1) / 2 - g - b + s$$

Where:

m = number of measures

ξ = number of exogenous variables i.e. variable that only have arrows going away from them

g = number of direct effects of exogenous constructs on endogenous constructs

b = number of direct effects of endogenous constructs on endogenous constructs

s = number of single-item measures

For the model, there are 33 measurement items m (potential = 6, problem solving = 5, affective trust = 4, competence-based trust = 4, radicalness = 4, project efficiency = 4, project effectiveness = 4); 5 exogenous variable (ξ); 5 direct exogenous effects (g); 4 endogenous-endogenous effects (b); and no single effect. This results in a model with 415 degrees of freedom.

Given that all variables necessary to compute power are now known, and that the degree of freedom exceeds the typical range of most Power Tables (MacCallum et al., 1996, Cohen, 1992, Cohen et al., 2003), the web-based power calculator by Preacher and Coffman (2006) is used. From this, a power value of 0.999 is returned which suggest that there is a 99.9% chance of correctly rejecting a false null hypothesis, suggesting adequacy in the sample size.

5.6.4.2 Inner Structural Model

Based on recommendations by Henseler et al. (2009) and Tenenhaus et al. (2005), the inner model was assessed by the magnitude and significance of path coefficients; the R^2

of the endogenous variables; the effect size of the moderators; and a global goodness-of-fit. The resulting model of the second-stage of the two-stage approach for formative measures is below. In this stage, latent variable scores for each construct obtained by bootstrapping the first stage model replace the original measurement items such that each construct now only has a single item (Henseler and Fassott, 2010). Following this, the new interaction terms can be created as the element-wise product of the latent variable scores of the predictor (Potential ACAP) and the moderators (Trust) (Henseler and Fassott, 2010). Figure 5.3 below is a screenshot of this model as developed in *SmartPLS* (Ringle et al., 2005) where: a) the yellow items represent the single item measures from the latent variable scores; b) the light blue circles are the exogenous variables (Potential, Trust_aff, and Trust_comp) and the endogenous variables (i.e. problem solving, radicalness, effective and efficiency); and c) the light purple ovals are the resulting interaction terms. This model was subsequently run, the results of which are shown in figure 5.4.

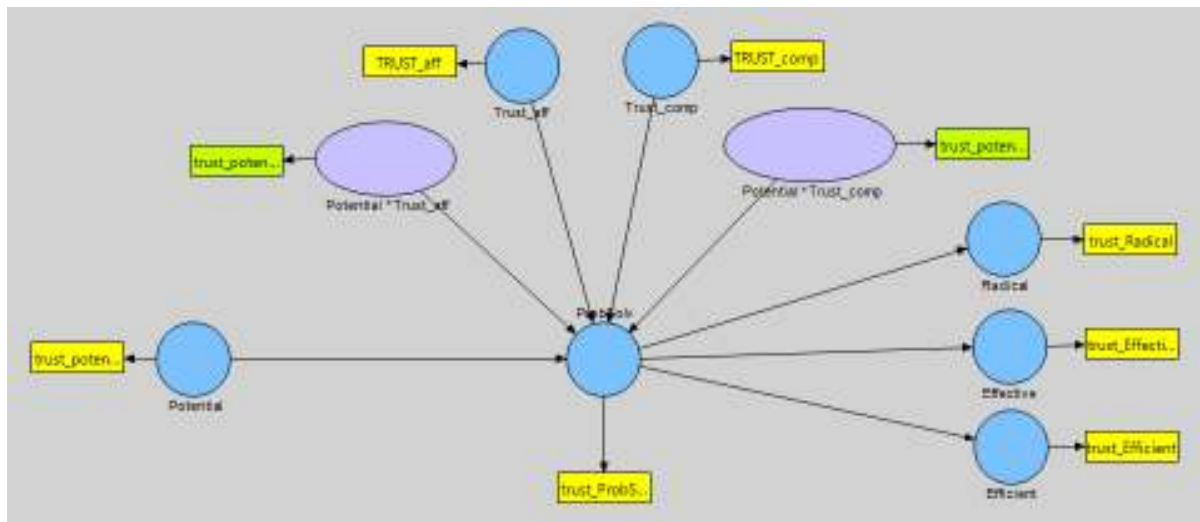


Figure 5.3: Screenshot of the Second-stage Model, Dyad 1: Trust

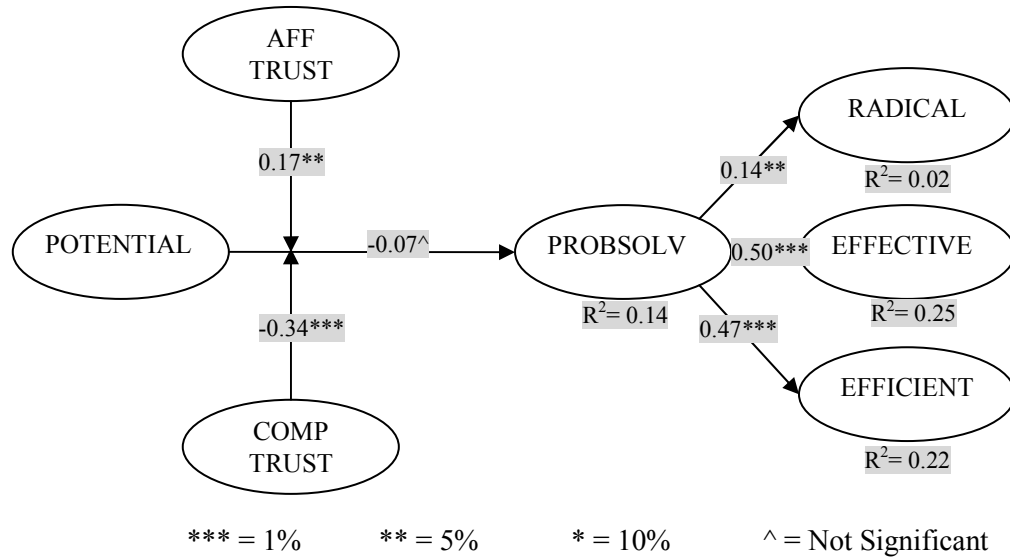


Figure 5.4: Structural Model for Dyad 1: Trust

5.6.4.2.3 Assessment of Structural Model

To determine the significance of the paths and the path coefficients, a bootstrap procedure with 500 subsamples was used (Camisón and Villar-López, 2012). In addition, the individual sign change option was used to mitigate against arbitrary sign changes that may occur during bootstrapping which can reduce the t -value and thus the possibility of rejection (Henseler et al., 2009). Results are summarised in Table 5.13 and Figure 5.4.

Hypothesized links	Standardised Coefficients	t -value
Potential → Problem Solving	-0.067	1.127
Aff trust*Potential → Problem Solving	0.167	2.165
Comp trust*Potential → Problem Solving	-0.337	3.352
Problem Solving → Radicalness	0.139	1.972
Problem Solving → Effectiveness	0.497	7.685
Problem Solving → Efficiency	0.470	7.565

Table 5.13: Path Coefficients, Dyad 1: Trust

The predictive value of the constructs were evaluated by their R^2 values were a minimum value of 0.1 is recommended (Camisón and Villar-López, 2012). Table 5.14 shows the R^2 values which suggest initially that radicalness may be problematic as the model only

explains approximately 2% of the variance of the construct. Based on these values, a global goodness-of-fit (GoF) measure can be calculated by taking the square root of the product of the average communality and the average R^2 :

$$Gof = \sqrt{Ave.Community \times Ave.R^2}$$

This yields a GoF of 0.397, which is above the recommended minimum of 0.31 (Camisón and Villar-López, 2012, Tenenhaus et al., 2005).

Factor	R²	Communalities
Effectiveness	0.250	1
Efficiency	0.224	1
Problem Solving	0.139	1
Radicalness	0.018	1
Potential	-	1
Aff trust*Potential	-	1
Comp trust*Potential	-	1
Average	0.158	1
Goodness-of-fit (GoF)	0.397	

Table 5.14: R², Communalities and Goodness-of-fit, Dyad 1: Trust

The last assessment criterion is to test the effect size of the interactions. As per the discussions in Chapter 3, the suggested ranges of effects size by Kenny (2011; small- 0.005, medium- 0.01, large- 0.025) rather than Cohen's criteria (Henseler and Fassott, 2010; small- 0.02, medium- 0.15, large- 0.35) are used. Results of the effect sizes are subsequently shown below.

Factor	With Moderator	Without Moderator	f²	Cohen's Criteria	Kenny's Criteria
Affective Trust	0.075	0.072	0.003	Weak	Weak
Competence-Based Trust	0.096	0.040	0.062	Weak	Strong
Both	0.139	0.073	0.077	Weak	Strong

Table 5.15: Effect sizes, Dyad 1: Trust

5.6.4.3 Testing the hypotheses

As observed in figure 5.4, the relationship between Potential ACAP and problem solving is not significant ($\beta = -0.067$, $t = 1.127$), and only becomes significant when interacted with the moderators. Thus Hypothesis 0 is rejected. With regards to Hypotheses 1 affective trust demonstrates a significant interaction effect ($\beta = 0.167$, $t = 2.165$), however it displays a weak effect size suggesting only partial support for the hypothesis. Competence-based trust demonstrates a highly significant interaction term ($\beta = -0.337$, $t = 3.352$) and a strong effect size ($f^2 = 0.062$). However, the path coefficient demonstrated a sign contrary to a priori expectations so Hypothesis 2 is rejected. In all, 14% of the variance in problem solving ability is explained by these hypothesised variables which is satisfactory given the suggested minimum of 10% (Camisón and Villar-López, 2012). Figure 5.4 also illustrates strong support for Hypothesis 10 (Project Effectiveness- $\beta = 0.497$, $t = 7.685$, $R^2 = 0.250$) and Hypothesis 11 (Project Efficiency- $\beta = 0.470$, $t = 7.565$, $R^2 = 0.224$). Lastly, Radicalness demonstrates significance at the 5% level ($\beta = 0.139$, $t = 1.972$), however the overall variance explained is weak ($R^2 = 0.018$) suggesting only partial support for Hypothesis 9.

Hypothesis	Conclusion
Hypothesis 0- PAC: RAC	Rejected- not significant
Hypothesis 1- Affective Trust	Supported
Hypothesis 2- Competence-based Trust	Rejected- Sign reversed
Hypothesis 9- Radicalness	Partial Support- Weak R^2
Hypothesis 10- Effectiveness	Supported
Hypothesis 11- Efficiency	Supported

Table 5.16: Hypothesis Conclusions, Dyad 1: Trust

5.6.5 Dyad 2: Search cost vs. Motivations for Sharing

The following results concern the duality between the costs of the knowledge seeker and the motivations for the knowledge sharer. First, the individual constructs of search costs and motivation will be examined to provide insight on their isolated effects for converting potential ACAP to realised ACAP. Following this, the duality between them will be examined by exploring the motivations that might aid in reducing search costs.

5.6.5.1 Outer Measurement Model

5.6.5.1.1 Assessment of Reflective Measures

Table 5.17 below shows the reliability and convergent validity results for search costs and motivation. Social cost, curiosity, money and dissatisfaction are all single item constructs and hence unity in their reliability results. Institutional cost exhibited unsatisfactory results with the original three measurement items (CR= 0.495, alpha= 0.898, AVE= 0.306). Further analysis revealed that item 4 did not load well with the other two items. Once dropped the remaining items loaded sufficiently (item 5: λ = 0.978, t = 4.170; item 6: λ = 0.943, t = 3.864) and the AVE, CR and alpha values were all satisfactory. The motivation dimension "show ideas" also proved troublesome. A factor analysis in SPSS showed that one item had an unsatisfactory communality of 0.319 and was removed. The alpha resulting from the remaining two items was only 0.55 so the construct was removed from the analysis. The remaining reflective measures were all satisfactory.

		Composite Reliability (> 0.6)	Cronbachs Alpha (> 0.7)	AVE (> 0.5)
Search Costs	Social costs	1	1	1
	Psychological costs	0.950	0.902	0.904
	Institutional costs	0.960	0.921	0.923
	Effectiveness	0.978	0.970	0.916
	Efficiency	0.950	0.930	0.828
	Problem Solving	0.945	0.927	0.775
	Radicalness	0.892	0.876	0.680
Motivation	Curiosity	1	1	1
	Dissatisfaction	1	1	1
	Money	1	1	1
	Intrinsic Innovation	0.859	0.709	0.755
	Effectiveness	0.978	0.970	0.917
	Efficiency	0.950	0.930	0.827
	Problem Solving	0.948	0.931	0.785
	Radicalness	0.902	0.879	0.703

Table 5.17: Reliability and Convergent validity for Dyad 2: Trust

Following this, discriminant validity was assessed by the Fornell–Larcker and cross-loadings criterion. The Fornell–Larcker criterion states that the square root of the AVE should be greater than the correlations between any of the latent constructs. The below demonstrated that this is found for both search cost (table 5.18a) and for motivation (table 5.18b).

(a) Search Costs	1	2	3	4	5	6	7
1. Psychological costs	0.95						
2. Social costs	0.62	1					
3. Institutional costs	0.576	0.496	0.961				
4. Effective	0.012	0.005	-0.115	0.957			
5. Efficient	0.121	-0.002	0.014	0.784	0.910		
6. Problem Solving	-0.049	-0.175	0.040	0.503	0.478	0.880	
7. Radicalness	0.042	0.091	-0.042	0.396	0.445	0.133	0.825
8. Potential	-0.057	-0.102	-0.229	0.058	0.021	-0.095	0.019

(b) Motivation	1	2	3	4	5	6	7	8	9
1. Effective	0.957								
2. Efficient	0.784	0.909							
3. Gain Knowledge	0.275	0.233	0.914						
4. Intrinsic Inno	0.305	0.259	0.335	0.869					
5. Curiosity	-0.03	-0.06	0.19	0.289	1				
6. Dissatisfaction	-0.02	-0.09	0.089	0.227	0.217	1			
7. Money	0.128	0.133	0.013	-0.28	0.065	0.024	1		
8. Problem solving	0.512	0.490	0.277	0.293	0.077	-0.01	-0.01	0.886	
9. Radicalness	0.398	0.454	-0.08	0.021	0.012	-0.15	0.139	0.137	0.838
10. Potential	0.039	0.001	0.035	0.001	0.035	-0.148	0.139	-0.10	-0.01

Note: Bold numbers on the diagonal show the square root of the AVE; Numbers below the diagonal represent construct correlations

Table 5.18: Discriminant validity results for Search costs and Motivation, Dyad 2

The cross-loadings test for discriminant validity should demonstrate that an indicator or (aka measurement item) should have its highest loading on its respective construct. Tables 2a (search cost) and table 2b (motivation) in Appendix 11 provide the tabulated results of this test. It can be observed that all items meet the requirements.

Given the above, the reflective items were found to be acceptable and were used for further analysis.

5.6.5.1.2 Power analysis

The procedure outlined in Section 5.6.5.1.2 is followed again to determine the statistical power for the two models. Using the Rigdon (1994) equation, the search model was found to have 326 degrees of freedom⁸, and the motivation model 368 degrees of freedom⁹. These values were subsequently used in Preacher and Coffman's (2006) statistical power calculator and a test for close fit was used ($\alpha = 0.05$, $\epsilon_0 = 0.05$ and $\epsilon_a = 0.08$) for a sample size of $n=200$. For both models, a power value of 0.999 was found, suggesting adequacy in the sample size.

5.6.5.2 Inner Structural Model

5.6.5.2.1 Assessment of Structural Model- Search Costs

As the structural model (figure 5.5) and table 5.19 shows, the interaction effects for the three types of search costs are significant, suggesting congruence with theory. Predictive value was again accessed via R^2 and the goodness-of-fit. As table 5.20 shows, the R^2 values for project efficiency and effectiveness were sufficient (greater than 0.1, Camisón and Villar-López, 2012), however: a) radicalness again demonstrated a poor R^2 value of 0.02; and b) Problem solving showed a borderline result of 0.10. The resulting GoF however was sufficient at 0.386 (greater than 0.31, Camisón and Villar-López, 2012, Tenenhaus et al., 2005).

⁸28 measurement items (m) (potential = 6, problem solving = 5, radicalness = 4, project efficiency = 4, project effectiveness = 4, social cost = 1, psychological costs = 2, institutional costs = 2); 6 exogenous variable (ξ); 6 direct exogenous effects (g); 4 endogenous-endogenous effects (b); and 1 single effect.

⁹30 measurement items (m) (potential = 6, problem solving = 5, radicalness = 4, project efficiency = 4, project effectiveness = 4, curious = 1, money = 1, dissatisfied = 1, gain knowledge = 2, intrinsic innovation = 2); 8 exogenous variable (ξ); 8 direct exogenous effects (g); 4 endogenous-endogenous effects (b); and 3 single effect.

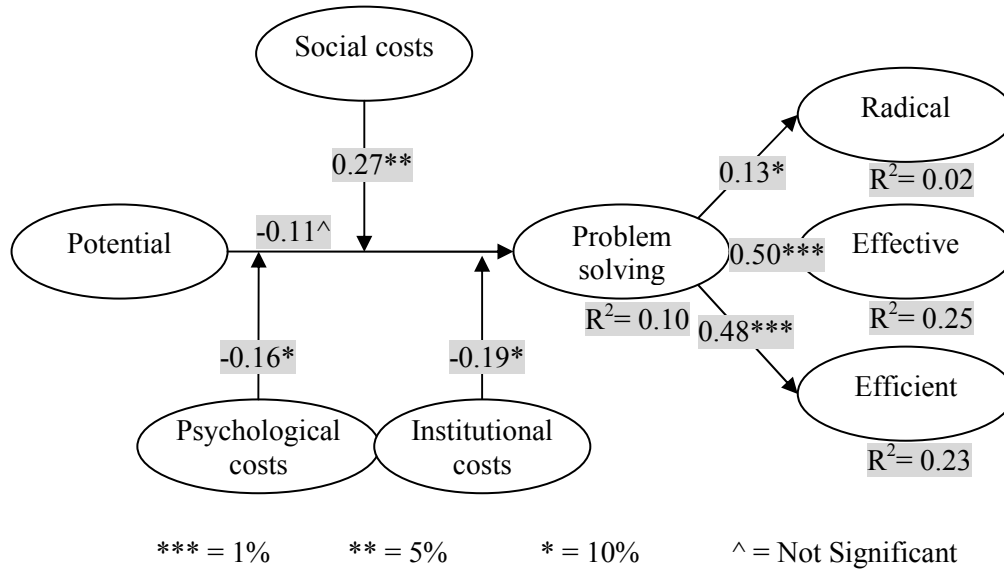


Figure 5.5: Structural Model for Search costs, Dyad 2

Hypothesized links	Standardised Coefficients	t-value
Potential → Problem Solving	-0.111	1.505
Social Cost*Potential → Problem Solving	0.270	2.138
Psychological*Potential → Problem Solving	-0.160	1.731
Institutional*Potential → Problem Solving	-0.193	1.904
Problem Solving → Radicalness	0.133	1.912
Problem Solving → Effectiveness	0.503	8.493
Problem Solving → Efficiency	0.478	8.287

Table 5.19: Path Coefficients, Dyad 2: Search Costs

Factor	R ²	Communalities
Effectiveness	0.253	1
Efficiency	0.229	1
Problem Solving	0.096	1
Radicalness	0.018	1
Social Cost*Potential	-	1
Psychological*Potential	-	1
Institutional*Potential	-	1
Average	0.149	1
Goodness-of-fit (GoF)	0.386	

Table 5.20: R², Communalities and Goodness-of-fit, Dyad 1: Trust

As table 5.21 shows, the total effects of the interactions are strong with the individual effects being weak to moderate in accordance to the recommendations by Kenny (2011; small- 0.005, medium- 0.01, large- 0.025).

Factor	With Moderator	Without Moderator	f ²	Cohen's Criteria	Kenny's Criteria
Social Cost	0.044	0.044	0.000	None	None
Psychological cost	0.025	0.012	0.013	None	Moderate
Institutional cost	0.021	0.009	0.012	None	Moderate
All	0.096	0.060	0.040	Weak	Strong

Table 5.21: Effect sizes, Dyad 2: Search Cost

5.6.5.2.2 Assessment of Structural Model- Motivation

The resulting structural model and corresponding path coefficients are shown below. The resulting R² values showed similar patterns to the above, namely problem solving, project effectiveness and project efficiency demonstrating satisfactory levels of variance explained; and radicalness showing poor levels. However, there was a marked increase in the GoF value to 0.429.

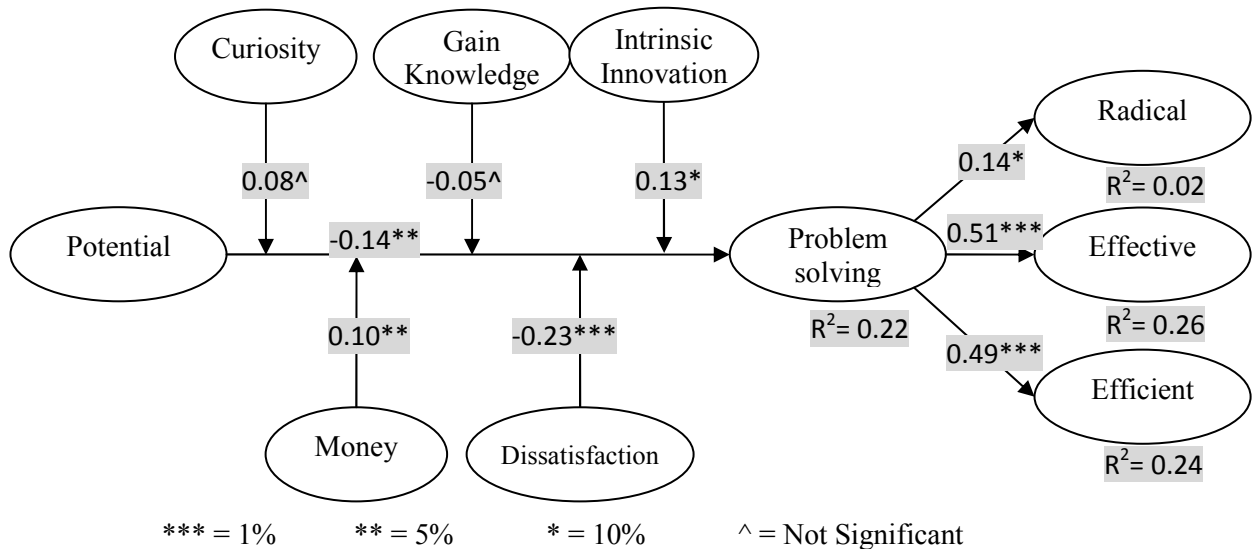


Figure 5.6: Structural Model for Motivation, Dyad 2

Hypothesized links	Standardised Coefficients	t-value
Potential → Problem Solving	-0.142	2.239
Curious*Potential → Problem Solving	0.083	1.283
Gain know*Potential → Problem Solving	-0.052	0.784
Intrinsic Inno*Potential → Problem Solving	0.13	1.886
Money*Potential → Problem Solving	0.102	2.047
Dissatisfied*Potential → Problem Solving	-0.229	3.273
Problem Solving → Radicalness	0.137	1.927
Problem Solving → Effectiveness	0.512	8.514
Problem Solving → Efficiency	0.49	7.986

Table 5.22: Path Coefficients, Dyad 2: Motivation

Factor	R ²	Communalities
Effectiveness	0.262	1
Efficiency	0.240	1
Problem Solving	0.216	1
Radicalness	0.019	1
Potential	-	1
Curiosity*Potential	-	1
Gain know*Potential	-	1
Intrinsic Inno*Potential	-	1
Money*Potential	-	1
Dissatisfaction*Potential	-	1
Average	0.184	1
Goodness-of-fit (GoF)	0.429	

Table 5.23: R², Communalities and Goodness-of-fit, Dyad 2: Motivation

Finally, the total effect of the five interaction terms show a strong effect size according to Kenny (2011). Most interestingly, the individual effect of *dissatisfied*, the motivation stemming from dissatisfaction with existing products/processes, also shows a strong effect size. More on this point will be discussed in the assessment of the hypothesis in Section 5.6.6.3 below.

Factor	With Moderator	Without Moderator	f ²	Cohen's Criteria	Kenny's Criteria
Curiosity	0.020	0.018	0.002	None	None
Gain Knowledge	0.099	0.090	0.010	None	Weak
Intrinsic Innovation	0.113	0.097	0.018	None	Moderate
Money	0.017	0.012	0.005	None	Weak
Dissatisfaction	0.058	0.013	0.048	Weak	Strong
All	0.216	0.154	0.079	Weak	Strong

Table 5.24: Effect sizes, Dyad 2: Motivation

5.6.5.2.3 Multigroup Analysis

Consistent with PLS' distribution-free methodology, Henseler's non-parametric multigroup analysis (MGA) was used (Sarstedt et al., 2011, Henseler, 2012) to investigate the duality between search costs and motivations for sharing. Groups were formed by taking the upper and lower thirds of the search costs (social, psychological and institutional) and running MGA's accordingly to identify the effects on motivation. Such an approach is consistent with Aiken and West's (1991) simple slopes analysis, the final stage of their seminal interaction analysis methodology as it is here. Table 5.25 below summarises the results.

Search Cost	Motivation	Non-Parametric MGA (Probability)	t-value		Bootstrapped β	
			Hi	Low	Hi	Low
Social	Gain Knowledge	0.033	2.374	0.045	-0.515	-0.207
	Intrinsic Innovation	0.483	1.147	1.132	0.360	0.347
	Curiosity	0.165	1.940	1.095	0.772	0.320
	Dissatisfaction	0.269	1.935	1.191	-0.515	-0.379
	Money	0.547	1.134	0.651	0.348	0.451
Psychological	Gain Knowledge	0.004	1.802	1.212	-0.473	0.327
	Intrinsic Innovation	0.146	1.622	0.099	0.406	0.305
	Curiosity	0.198	1.743	0.315	0.320	0.288
	Dissatisfaction	0.140	1.675	0.329	-0.406	-0.256
	Money	0.281	1.141	0.703	0.271	0.774
Institutional	Gain Knowledge	0.162	1.663	0.660	-0.477	-0.237
	Intrinsic Innovation	0.254	0.294	1.073	0.241	0.293
	Curiosity	0.397	1.338	1.250	0.427	0.310
	Dissatisfaction	0.264	1.993	1.794	-0.665	-0.404
	Money	0.325	0.785	1.287	0.315	0.426

Table 5.25: Multigroup analysis results, Dyad 2: Motivation

The non-parametric MGA probability in the table above refers to the probability that the "high" subgroup (i.e. upper third) has a larger population parameter, in this case path coefficient as standardised beta coefficients, than the "low" subgroup (i.e. lower third). Consequently, this test can only be applied to single tail tests (e.g. "greater than" or "less than" hypothesis) and due to its non-parametric nature freeing up assumptions, this test is "rather conservative...in rendering a certain difference significant" (Sarstedt et al., 2011; p211). This effect is observed here in that only a single motivation is found to differ-Gain Knowledge (Social cost- 0.033; psychological cost- 0.004). Furthermore, no motivations were found to differ with respect to institutional costs. However, additional insight can be gleamed by observing the changes in significance of path coefficients between "high" and "low", particularly the case where it is significant at one level and not the other. For social and psychological costs, motivations based on gaining knowledge, curiosity and dissatisfaction are observed to be significant at higher levels of social cost but not significant at lower social costs. For institutional costs, motivations based on gaining knowledge appears to be the only type which effect the acquisition of knowledge by transferring it from potential ACAP to realised ACAP.

5.6.5.3 Testing the hypotheses

5.6.5.3.1 Search Costs

Hypothesis 4 postulated the moderating relationship of search costs, represented as social, psychological, and institutional costs. Psychological and institutional costs were found to be fully supported in sign, significance and effect size at the 10% level (psychological- $\beta = -0.160$, $t = 1.731$, $f^2 = 0.013$, moderate; institutional- $\beta = -0.193$, $t = 1.904$, $f^2 = 0.012$, moderate). Search cost however demonstrated significance at the 10% level but returned an opposite sign as well as displaying no effect, thus this dimension of the hypothesis was rejected. The outcomes yielded a similar pattern displayed in Dyad 1, namely the partial support of hypothesis 9 due to the weak R^2 (Radicalness- $\beta = 0.133$, $t = 1.912$, $R^2 = 0.02$) and the full support for hypotheses 10 and 11 (effectiveness- $\beta = 0.503$, $t = 8.493$, $R^2 = 0.253$; efficiency- $\beta = 0.478$, $t = 8.287$, $R^2 = 0.229$). Table 5.26 below summarise these conclusions.

Hypothesis	Conclusion
Hypothesis 4- Social	Rejected- Sign reversed and no effect
Hypothesis 4- Psychological	Supported
Hypothesis 4- Institutional	Supported
Hypothesis 9- Radicalness	Partial Support- Weak R ²
Hypothesis 10- Effectiveness	Supported
Hypothesis 11- Efficiency	Supported

Table 5.26: Hypothesis Conclusions, Dyad 2: Search Costs

5.6.5.3.2 Motivation

The analysis of the structural model (figure 5.6) shows that motivations based on curiosity and gaining further knowledge were not significant, and in addition to showing poor effect sizes, these aspects of Hypothesis 5 were rejected (Curious- $\beta = 0.083$, $t = 1.283$, $f^2 = 0.002$; Gain knowledge- $\beta = -0.052$, $t = 0.784$, $f^2 = 0.010$). Support was found for motivations based on monetary rewards ($\beta = 0.102$, $t = 2.047$, $f^2 = 0.005$) and an intrinsic interest in innovation ($\beta = 0.130$, $t = 1.886$, $f^2 = 0.018$).

Finally, dissatisfaction with current practices showed remarkable strong significance ($t = 3.273$), effect size ($f^2 = 0.048$) and magnitude of the path coefficient ($\beta = -0.229$) except that it displayed a negative sign. The interpretation is thus that the more satisfied one is with existing practices, the more likely you are to share knowledge- in this regard then, the hypothesis is fully supported. Consistent with the above findings on the outcomes, hypotheses 9 (radicalness) was only partially supported, whilst hypothesis 10 (effectiveness) and 11 (efficiency) were both fully supported.

Hypothesis	Conclusion
Hypothesis 5- Curiosity	Rejected- not sig, no effect
Hypothesis 5- Gain Knowledge	Rejected- not sig, weak effect
Hypothesis 5- Intrinsic Innovation	Supported
Hypothesis 5- Money	Supported
Hypothesis 5- Dissatisfaction	Supported
Hypothesis 9- Radicalness	Partial Support- Weak R ²
Hypothesis 10- Effectiveness	Supported
Hypothesis 11- Efficiency	Supported

Table 5.27: Hypothesis Conclusions, Dyad 2: Motivation

5.6.5.3.3 *Search costs VS Motivation*

Finally, regarding the contrast of search cost and motivation proposed in hypothesis 3, only motivation based on gaining knowledge was found to consistently reduce all three search costs as shown in table 5.28 below (social cost- Prob= 0.033, change in beta high $\Delta\beta = 0.308$, fully supported; psychological cost- Prob= 0.004, $\Delta\beta = 0.800$, fully supported; institutional cost- Prob= 0.162, $\Delta\beta = 0.241$, partially supported- see below for explanation). As can be seen, this motivation was especially effective in reducing psychological costs. Noting that although a number of motivations display a negative path coefficient which is counter intuitive, this analysis examines the differences between the high and low states of cost and hence for changes in values rather than that absolute values themselves. There are also several instances for partial support for the hypotheses in light of a change in significance. Social costs were also found to be strongly reduced by curiosity ($\Delta\beta = 0.452$) and weakly by dissatisfaction ($\Delta\beta = 0.136$); and psychological costs were found to be weakly reduced by curiosity ($\Delta\beta = 0.031$) and dissatisfaction ($\Delta\beta = 0.150$). This reduction in the beta value from "high" to "low" is theoretically consistent in so much that when there are less costs, there is a lesser need to motivate sharing as knowledge will flow more freely.

Search Cost	Motivation	Conclusion
Hypothesis 3- Social	Gain Knowledge	Supported
	Curiosity	Partially supported- high probability but sig change
	Dissatisfaction	Partially supported- high probability but sig change
Hypothesis 3- Psychological	Gain Knowledge	Supported
	Curiosity	Partially supported- high probability but sig change
	Dissatisfaction	Partially supported- high probability but sig change
Hypothesis 3- Institutional	Gain Knowledge	Partially supported- high probability but sig change

Table 5.28: Hypothesis Conclusions, Dyad 2: Multigroup Analysis

5.6.6 Dyad 3: Firm Culture vs. Individual Attributes

The third and final dyad explores the relationship between individual-level attitudes towards process improvement and firm-level culture. Taking a similar approach as in Dyad 2, the individual effects of individual attitudes and firm culture are examined, followed by a multigroup analysis to explore the interrelationships.

5.6.6.1 Outer Measurement Model

5.6.6.1.1 Assessment of Reflective Measures

Reliability was again assessed by Cronbachs alpha and composite reliability. All items loaded sufficiently to their respective constructs resulting in no items being removed. The resulting reliability measures are summarised in table 5.29 below with all measures indicating consistency with appropriate standards (Composite Reliability > 0.6, Fornell and Larcker, 1981- minimum CR= 0.810, Cronbachs alpha >0.7 Nunnally, 1967- minimum alpha = 0.700). Convergent validity assessed by Fornell and Larcker's (1981) criteria of the Average Variance Extracted (AVE) greater than 0.5 also showed consistency given a minimum AVE found was 0.534 (individual-level innovativeness).

Level		Composite Reliability (> 0.6)	Cronbachs Alpha (> 0.7)	AVE (> 0.5)
Individual-level	Effectiveness	0.978	0.970	0.917
	Efficiency	0.951	0.931	0.829
	Problem Solving	0.944	0.926	0.773
	Radicalness	0.907	0.881	0.713
	Innovativeness	0.820	0.728	0.534
	Proactiveness	0.810	0.700	0.592
	Risk Taking	0.840	0.717	0.638
Firm-level	Effectiveness	0.978	0.970	0.918
	Efficiency	0.951	0.931	0.830
	Problem Solving	0.945	0.927	0.774
	Radicalness	0.901	0.877	0.699
	Innovativeness	0.877	0.800	0.706
	Proactiveness	0.842	0.765	0.648
	Risk Taking	0.912	0.856	0.776

Table 5.29: Reliability and Convergent validity results of Dyad 3: Entrepreneurial Orientation

Discriminant validity was again assessed by the Fornell–Larcker criterion and cross-loadings method. Table 5.30 shows the results of the Fornell–Larcker criterion where all construct correlations were found to be less than the square root of the AVE and so display discriminant validity. The results of the cross-loading test are shown by Tables 3a (individual level) and Table 3b (firm level) in Appendix 11. It can be observed that the individual level results are satisfactory and so confidence in discriminant validity can be concluded. At the firm level however, item 3 of Proactiveness cross loads onto innovativeness rather than its respective construct, indicating there may be concerns. In investigating this phenomenon, Farrell's (2010) paper on "insufficient discriminant validity" suggests either the removal of offending items or to combine constructs into one overall measure but caveats it by highlighting "the trade-off between the number of scale items (for face validity or construct coverage) or measurement scales that perform well and discriminate" (p326). Given that construct reliability and convergent validity were adequate; the Fornell–Larcker criterion for discriminant validity sufficed; and that there are only three items, the troublesome item was not removed and the construct retained as it stands.

(a) Individual level	1	2	3	4	5	6	7
Effectiveness	0.958						
Efficiency	0.785	0.910					
Problem Solving	0.501	0.488	0.879				
Radicalness	0.401	0.463	0.128	0.844			
Innovativeness	0.124	0.172	0.277	0.086	0.731		
Proactiveness	0.094	0.137	0.178	0.018	0.157	0.769	
Risk Taking	0.146	0.221	0.195	0.011	0.539	0.163	0.799
Potential	0.042	0.009	-0.114	-0.002	0.152	0.139	0.228

(b) Firm level	1	2	3	4	5	6	7
Effectiveness	0.958						
Efficiency	0.786	0.911					
Problem Solving	0.522	0.496	0.880				
Radicalness	0.404	0.455	0.147	0.836			
Innovativeness	0.353	0.313	0.143	0.473	0.840		
Proactiveness	0.295	0.331	0.235	0.346	0.704	0.805	
Risk Taking	0.365	0.286	0.213	0.350	0.829	0.736	0.881
Potential	0.043	0.008	-0.099	-0.005	0.135	0.049	0.190

Note: Bold numbers on the diagonal show the square root of the AVE; Numbers below the diagonal represent construct correlations

Table 5.30: Discriminant validity results of Dyad 3: Entrepreneurial Orientation

5.6.6.1.2 Power analysis

Using the Rigdon (1994) equation, the individual-level model was found to have 470 degrees of freedom¹⁰, and firm-level model 439 degrees of freedom¹¹. These values were subsequently used in Preacher and Coffman's (2006) statistical power calculator and a test for close fit was used ($\alpha = 0.05$, $\varepsilon_0 = 0.05$ and $\varepsilon_a = 0.08$) for a sample size of $n=200$. For both models, a power value greater than 0.999 was found, suggesting adequacy in the sample size.

5.6.6.2 Inner Structural Model

5.6.6.2.1 Assessment of Structural Model: Individual-level Attributes

The resulting structural model for the individual-level attributes is shown in Figure 5.7 and Table 5.31 below. Significant path interactions were only found for risk taking. A slight increase in predictive value was also found given the rise of Problem solving's R^2 to 0.170. Behaviour of the outcomes show similarities to the results in previous models in that radicalness shows a low variance extracted (1.6%), and all paths are significant at the 10% level. The resulting goodness-of-fit measure of 0.411 from Table 5.32 exceeds the minimum threshold of 0.31 (Camisón and Villar-López, 2012, Tenenhaus et al., 2005) thereby suggesting confidence in the model.

¹⁰33 measurement items (m) (potential = 6, problem solving = 5, radicalness = 4, project efficiency = 4, project effectiveness = 4, risk taking= 3, proactiveness= 3, innovation= 4); 6 exogenous variable (ξ); 6 direct exogenous effects (g); 4 endogenous-endogenous effects (b); and zero single effect.

¹¹32 measurement items (m) (potential = 6, problem solving = 5, radicalness = 4, project efficiency = 4, project effectiveness = 4, risk taking= 3, proactiveness= 3, innovation= 3); 6 exogenous variable (ξ); 6 direct exogenous effects (g); 4 endogenous-endogenous effects (b); and zero single effect.

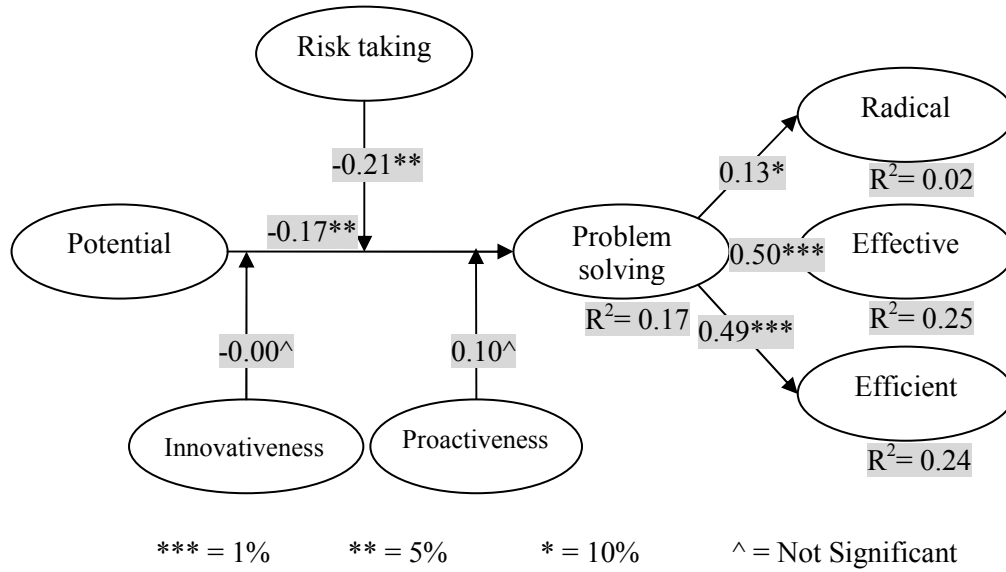


Figure 5.7: Structural Model for Individual-level attributes, Dyad 3

Hypothesized links	Standardised Coefficients	t-value
Potential → Problem Solving	-0.165	2.349
Risk taking *Potential → Problem Solving	-0.213	2.536
Innovativeness *Potential → Problem Solving	-0.001	0.015
Proactiveness *Potential → Problem Solving	0.103	1.532
Problem Solving → Radicalness	0.128	1.848
Problem Solving → Effectiveness	0.501	8.122
Problem Solving → Efficiency	0.488	8.249

Table 5.31: Path Coefficients, Dyad 3: Individual-level attributes

Factor	R ²	Communalities
Effectiveness	0.251	1
Efficiency	0.238	1
Problem Solving	0.170	1
Radicalness	0.016	1
Risk taking *Potential	-	1
Innovativeness *Potential	-	1
Proactiveness *Potential	-	1
Average	0.169	1
Goodness-of-fit (GoF)	0.411	

Table 5.32: R², Communalities and Goodness-of-fit, Dyad 3: Individual-level attributes

The effect size of the interactions follow those found by the path coefficients. Risk taking demonstrates a moderate effect and the two non-significant interactions (Innovativeness and Proactiveness) display no effect (Kenny, 2011).

Factor	With Moderator	Without Moderator	f ²	Cohen's Criteria	Kenny's Criteria
Risk taking	0.080	0.065	0.016	none	mod
Innovativeness	0.104	0.102	0.002	none	none
Proactiveness	0.054	0.051	0.003	none	none
All	0.170	0.131	0.047	Weak	Strong

Table 5.33: Effect sizes, Dyad 3: Individual-level attributes

5.6.6.2.2 Assessment of Structural Model: Firm-level Culture

The firm-level model shows strong and significant interactions of risk taking and Innovativeness at the 5% level (Figure 5.8). In stark contrast, Proactiveness, however, displayed zero influence as represented by a β value of 0.00 (Table 5.34). Regarding predictive power, all endogenous variables except radicalness show an acceptable level of variance explained (greater than 0.1- Camisón and Villar-López, 2012) with a sufficient goodness-of-fit value of 0.400 (Table 5.35).

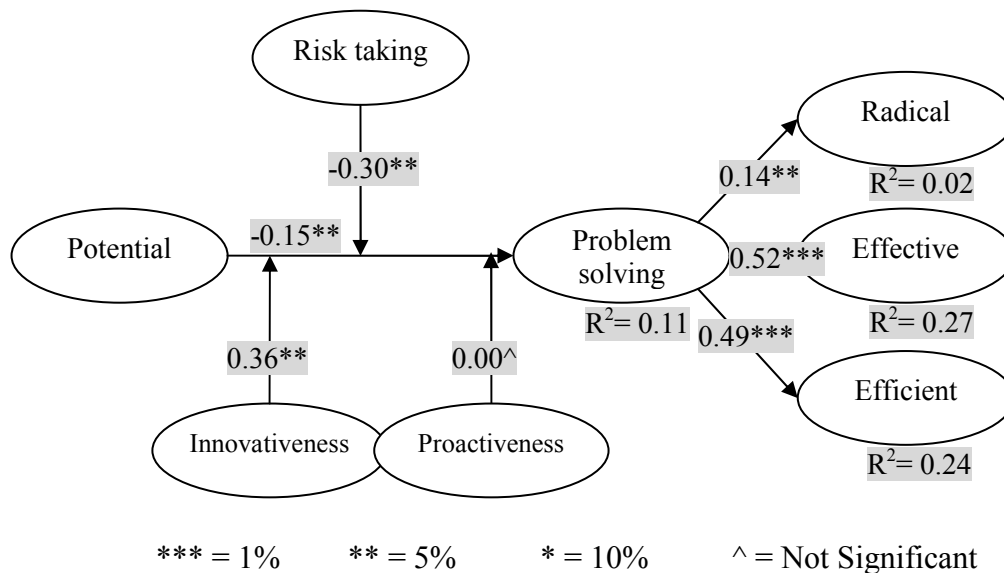


Figure 5.8: Structural Model for firm-level culture, Dyad 3

Hypothesized links	Standardised Coefficients	t-value
Potential → Problem Solving	-0.152	2.150
Risk taking *Potential → Problem Solving	-0.304	1.979
Innovativeness *Potential → Problem Solving	0.364	2.028
Proactiveness *Potential → Problem Solving	0.001	0.016
Problem Solving → Radicalness	0.140	2.035
Problem Solving → Effectiveness	0.519	8.252
Problem Solving → Efficiency	0.493	7.911

Table 5.34: Path Coefficients, Dyad 3: firm-level culture

Factor	R ²	Communalities
Effectiveness	0.270	1
Efficiency	0.243	1
Problem Solving	0.106	1
Radicalness	0.020	1
Risk taking *Potential	-	1
Innovativeness *Potential	-	1
Proactiveness *Potential	-	1
Average	0.160	1
Goodness-of-fit (GoF)	0.400	

Table 5.35: R², Communalities and Goodness-of-fit, Dyad 3: firm-level culture

Finally, the total effect of the three interaction terms show a strong effect size according to Kenny (2011). Innovativeness and Proactiveness show results are expected from their path coefficients, i.e. Innovativeness as moderate effect and Proactiveness as no effect. However, risk taking demonstrated a strong path coefficient yet the effect size of the interaction was negligible.

Factor	With Moderator	Without Moderator	f ²	Cohen's Criteria	Kenny's Criteria
Risk taking	0.060	0.060	0.000	none	none
Innovativeness	0.042	0.030	0.013	none	mod
Proactiveness	0.064	0.063	0.001	none	none
All	0.106	0.078	0.031	Weak	Strong

Table 5.36: Effect sizes, Dyad 3: firm-level culture

5.6.6.2.3 Multigroup Analysis

Henseler's non-parametric multigroup analysis (MGA) was again used (Sarstedt et al., 2011, Henseler, 2012) to investigate the relationship between individual and firm level attributes and their impact on knowledge acquisition. Given that the unit of the analysis of this investigation is the individual, groups were formed by taking the upper and lower thirds of the individual-level construct so as to elicit the firm-level attributes that support such behaviour. Table 5.37 below summarises the results.

Individual-level	Firm-level	Non-Parametric MGA (Probability)	t-value		Bootstrapped β	
			Hi	Low	Hi	Low
Risk taking	Risk taking	0.502	0.250	0.253	-0.407	-0.401
	Innovativeness	0.307	1.243	0.731	0.581	0.427
	Proactiveness	0.104	0.802	0.810	0.262	-0.374
Innovativeness	Risk taking	0.086	0.660	2.418	-0.449	-0.968
	Innovativeness	0.441	1.406	1.644	0.768	0.817
	Proactiveness	0.001	2.106	1.105	-0.530	0.401
Proactiveness	Risk taking	0.330	0.692	0.225	-0.424	-0.352
	Innovativeness	0.403	0.706	0.524	0.524	0.396
	Proactiveness	0.275	0.297	0.644	0.322	-0.370

Table 5.37: Multigroup analysis results, Dyad 3: Entrepreneurial Orientation

From the non-parametric MGA probability scores, it would appear that a culture which encourages proactive behaviour aids in fostering risk taking behaviour. In addition, individual-level innovativeness attitudes are supported by a firm culture of risk taking and proactiveness. A lack of firm-level support was found for individual-level proactiveness under both the probability scores test as well as the previously mentioned

significance level change test as no dimension was found to change from significant to non-significant.

5.6.6.3 Testing the hypotheses

5.6.6.3.1 Individual-level Attributes

Hypothesis 7 suggested the positive impact of individual level attributes in the form of entrepreneurial orientation on the conversion of potential ACAP to realised ACAP. Although risk taking demonstrated high significance and moderate effect size, its sign was contrary to expectations so was rejected ($\beta = -0.213$, $t = 2.536$, $f^2 = 0.016$). Proactiveness and innovativeness were also rejected as the path coefficient was found to be not significant (Proactiveness- $t = 1.532$; innovativeness- $t = 0.015$). Hypothesis 10 and 11 were found to be fully supported given their strong significance, appropriate sign and adequate variance extracted (Effectiveness- $\beta = 0.501$, $t = 8.122$, $R^2 = 0.251$; Efficiency- $\beta = 0.488$, $t = 8.249$, $R^2 = 0.238$). Partial support was also found for the radicalness hypothesis (#9) given its weak R^2 yet appropriate sign and significance.

Hypothesis	Conclusion
Hypothesis 7- Risk taking	Rejected- sign change
Hypothesis 7- Innovativeness	Rejected- not significant
Hypothesis 7- Proactiveness	Rejected- not significant
Hypothesis 9- Radicalness	Partial Support- Weak R^2
Hypothesis 10- Effectiveness	Supported
Hypothesis 11- Efficiency	Supported

Table 5.38: Hypothesis Conclusions, Dyad 3: Individual-level

5.6.6.3.2 Firm-level Attributes

In similar behaviour at the individual-level, risk taking demonstrated significance, however its sign was contrary to expectations in addition to a negligible effect size so was rejected ($\beta = -0.304$, $t = 1.979$, $f^2 = 0.000$). The Firm-level innovativeness hypothesis was fully supported given its significant path coefficient and moderate effect size ($\beta = 0.364$, $t = 2.028$, $f^2 = 0.013$). Proactiveness was also rejected as the path coefficient was found to be not significant ($t = 0.016$). The outcomes for the radicalness, effectiveness, and efficiency

hypothesis were identical to those found at the individual-level as shown in Table 5.39 below.

Hypothesis	Conclusion
Hypothesis 6- Risk taking	Rejected- sign change, weak effect
Hypothesis 6- Innovativeness	Supported
Hypothesis 6- Proactiveness	Rejected- not significant
Hypothesis 9- Radicalness	Partial Support- Weak R ²
Hypothesis 10- Effectiveness	Supported
Hypothesis 11- Efficiency	Supported

Table 5.39: Hypothesis Conclusions, Dyad 3: Firm-level

5.6.6.3.3 Individual-level VS Firm-level Attributes

Hypothesis 8 suggested the supporting behaviour of firm-level entrepreneurial orientation on individual attributes. Proactiveness was found to support risk taking at the individual level given its sufficient probability and high change in beta values (Prob= 0.104, $\Delta\beta = 0.636$). Noting that: a) in this Dyad, we are expecting to see an increase in beta when going from the lower group to the upper compared to the reverse in Dyad 2 as that is associated with costs; and b) as above, although a number of cases show a negative path coefficient, this analysis examines the differences between the high and low states and hence for differences in values rather than absolute values. Alignment between firm-level risk taking and individual-level risk taking was also not found due to the high probability score (Prob= 0.502). This lack of alignment between dimensions is also observed in the remaining two cases, namely innovativeness (Prob= 0.441) and proactiveness (Prob= 0.275). In supporting innovativeness at the individual level, only a climate of risk taking showed full support (Prob= 0.086, $\Delta\beta = 0.519$). Firm-level proactiveness was found to in fact heavily reduce individual innovativeness and was therefore rejected due to its negative change in beta, although it's probability score was quiet significant (Prob= 0.001, $\Delta\beta = -0.931$). Finally, no support was found for firm-level attributes that support proactive behaviour at the individual level. For all cases, probability scores lay well beyond and acceptable region of 10%.

Individual-level	Firm-level	Conclusion
Hypothesis 8- Risk taking	Risk taking	Rejected- high Prob
	Innovativeness	Rejected- high Prob
	Proactiveness	Supported
Hypothesis 8- Innovativeness	Risk taking	Supported
	Innovativeness	Rejected- high Prob
	Proactiveness	Rejected- negative $\Delta\beta$
Hypothesis 8- Proactiveness	Risk taking	Rejected- high Prob
	Innovativeness	Rejected- high Prob
	Proactiveness	Rejected- high Prob

Table 5.40: Hypothesis Conclusions, Dyad 3: Multigroup Analysis

5.7 Chapter Summary

A dataset of 200 responses was acquired post-data purification from the 2056 letters sent out yielding an effective response rate of 9.7%. Given the use of a formative measure and that multivariate normality not found, variance-based modelling (SmartPLS, Ringle et al., 2005) was required rather than the norm of covariance-based modelling (LISREL, Jöreskog and Sörbom, 1978). Potential ACAP was found to be a second-order formative construct consisting of three dimension- individually held knowledge (years education and heterogeneity in work experience), network knowledge from strong ties (number of direct contacts and heterogeneity in contact's profession), and network knowledge from weak ties (number of indirect contacts and network density).

The results of the three hypothesised dyads can be summarised as follows:

- Affective trust (care and concern) positively moderated the PAC/RAC relationship however Competence-based trust does not
- Psychological costs (i.e. embarrassment in asking for help) and Institutional costs (violating organisational norms) negatively moderated the conversion of PAC to RAC however social costs or quid pro quo does not
- Intrinsic interest in innovation, monetary rewards and satisfaction¹² with current practices positively moderated the PAC/RAC relationship
- Motivations to gain knowledge, curiosity, and dissatisfaction help to reduce social and psychological costs with institutional costs reduced by motivations to gain knowledge.
- An innovative firm culture positively moderates the conversion of PAC to RAC
- No supporting evidence was found for individual-level proactiveness, innovativeness or risk taking behaviour to convert PAC to RAC
- Individual-level risk taking is supported by a culture of proactiveness; and individual innovativeness is similarly supported by a culture of risk taking.
- In all three dyads, the outcome of RAC yields improvements in the effectiveness of process improvement outcomes as well as improving the efficiency of the process improvement projects themselves. RAC also positively effects radicalness of project outcomes, however rather weakly.

¹² Note that the measure asked about the level "dissatisfaction" which has a negative path coefficient. Thus the lower the dissatisfaction means the less the negative effect. Conversely, removing the double negative in the argument, this can also be interpreted as an increase in "satisfaction" leading to a positive effect.

Chapter 6: Discussion

This study sought to provide empirical insight into the knowledge-based view of process improvement from a knowledge acquisition perspective. The findings unravelled aspects of our knowledge stocks and contextual factors that affect our ability to mobilise knowledge to solve problems, which in turn, impact key performance outcomes of process improvement. The following discusses the implication of these on extant thinking based on four juxtapositions as annotated in figure 6.1 below. A shortened, more practitioner account is given in Appendix 12 “Guidelines- *The Fish!*”.

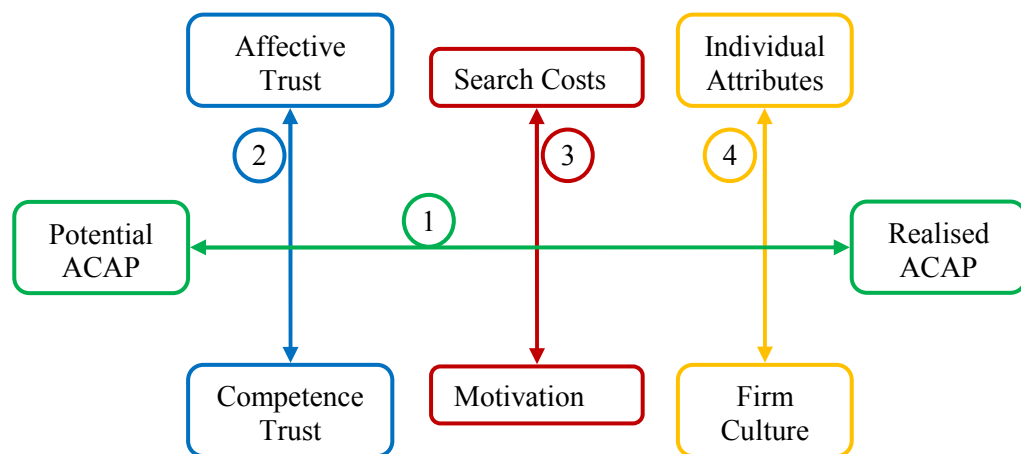


Figure 6.1: Research Implications

6.1 Potential vs. Realised

The opening juxtaposition itself is not overly novel; however, the intricacies gleamed from the empirical findings shed new light on the idiosyncrasies of each concept. This juxtaposition relates to the discrepancy between one’s *potential* for knowledge use, i.e. the total stocks of knowledge available; and the substantially less volume of knowledge actually used or *realised* in a knowledge intense activity such as problem solving. The first key insight relates to the *relationship* between the total stocks of knowledge and problem solving. As the test for nomological validity suggests, there should be a significant relationship between a formative measure and a variable with which a high significance relationship is expected (i.e. Götz et al., 2010, Diamantopoulos and Winklhofer, 2001). However, the rejection of Hypothesis 0 confirm the presence of a

theoretical dilemma. On one hand, a greater amount of total knowledge should logically relate to an increase in ability to realise or use this knowledge and thus better performance; on the other hand, according to Zahra and George (2002) and the theory of Absorptive Capacity, total knowledge stocks only has minimal direct and isolated effects on the ability to realise value. Rather, this relationship is far better explained with the presence of variables that moderate this relationship (i.e. the “social integration mechanisms”). Consequently, the non-significant relationship observed in the “Construct-level Assessment” of Potential ACAP (Figure 5.2) clearly confirms the later argument. The implication of this in practice is that the overt focus on growing the volume of total knowledge stocks appears to be far less rewarding than focusing on the mechanisms for translating extant knowledge stock to useable/realised knowledge, as the three remaining juxtapositions suggest.

The second key insight relates to *potential* ACAP itself. The finding of potential ACAP as a second-order formative construct casts remarkable light on the nature of our knowledge stocks. It first verifies the existence of three dimensions of knowledge sources- individually held knowledge, network-held knowledge from strong ties, and network-held knowledge from weak ties. The validity of the formative interpretation confirms the commonly held belief of multiple ways of expanding our knowledge base and brings together two important aspects. Absorptive capacity theory suggests knowledge stocks reside as either individually-held knowledge, or as knowledge that resides in networks (c.f. Zahra and George, 2002, Cohen and Levinthal, 1990). In contrast, Granovetter's (1973) "strength of weak ties" theory suggests two types of network-based knowledge- knowledge from strong direct ties, and knowledge from indirect, weaker ties. Thus, the incorporation and empirical verification of strong and weak ties knowledge provides a refined view of Absorptive Capacity's network held knowledge.

In addition to confirming the existence of the three dimensions of knowledge, the measure and empirical results also provide a means of ranking the relative merits of these knowledge dimensions as Table 6.1 below summarises. At the first-order construct level (i.e. the β values), the results show that network-based knowledge from strong ties is approximately twice as effective as individually held knowledge in building total knowledge stocks; and individually held knowledge is approximately twice as effective

as network-based knowledge from weak ties ($\beta_{\text{Network Strong}} = 0.78$; $\beta_{\text{Individual}} = 0.32$; $\beta_{\text{Network Weak}} = 0.18$). These findings are in particular contrast to Granovetter's (1973) hypothesis which suggest that weaker ties, rather than strong ties, are more productive. The implication of this in practice is that the belief that training is the best and/or only way to improve knowledge stocks is not necessarily true; but rather efforts to improve and encourage the use of network-held knowledge may be more rewarding.

In explaining this result, social network technologies such as LinkedIn are fundamentally changing our perceptions of tie strength. As per Granovetter's (1973) definition, strong ties are effort intensive, requiring close, frequent interaction over a long duration. Technologies such as LinkedIn are easing our ability to stay connected by enabling individuals to interact with considerably less effort. Thus, these technologies circumvent the traditional view of tie strength based on relational/social effort by enabling a more structural and direct approach. Furthermore, LinkedIn is the first technology of its kind to enable individuals to visualise the entirety of their network, including both direct ties and indirect "friend-of-friend" ties. Thus previously unknown, "weaker ties" with which Granovetter speaks of, now become known and directly accessible through more structural means, resulting in ties strength becoming more a function of social distance, then relational strength. Given this, the contrasting finding to Granovetter's hypothesis can be explained by an overall strengthening of ties as a result of the ease of interaction and access to individuals that these technology provides, as well as a shift in the definition of tie strength from social/relational factors, to more socially distant, direct/indirect ties.

1 st level Construct	Indicator	1 st to 2 nd Order loadings (β)	Indicator to 1 st Order loadings (λ)	Total effect ($T = \lambda * \beta$)
Network-Strong	Network Heterogeneity	0.78	0.62	0.48
	No. Direct Ties (Dir)	0.78	0.52	0.41
Individual	Heterogeneity in experience	0.32	0.65	0.21
	Years of Education	0.32	0.64	0.20
Network-weak	No. Indirect Ties (Indir)	0.18	1.08	0.19
	Network Density (Indir \div Dir)	0.18	-0.66	-0.12

Table 6.1: Total effects of Indicators

Taking this further to the indicator level, it is possible to examine the total effect of a particular element of knowledge stocks (i.e. the T values in table 6.1 above). As observed, the superior contributor to our knowledge stocks, over and above network size, appears to be the diversity in functional background ($T_{\text{Network Heterogeneity}} = 0.48$). This finding is consistent with McDonald's research on external advice-seeking behaviours of CEOs which found that seeking advice from executives who are similar in background (i.e. network homogeneous not heterogeneous), reduces the propensity to change strategy in response to poor performance (McDonald et al., 2008, McDonald and Westphal, 2003). At about half the total effect of network heterogeneity and network size, are those elements which make up individually held knowledge, confirming the rather moderate role that education and training play in enhancing our total stock of knowledge. There are two caveats to this with which the data does not shed light on. Firstly, the cognitive perspective of absorptive capacity suggests that the more knowledge we know, the more we are able to know (i.e Cohen and Levinthal, 1990). Thus the benefits possible from network knowledge are somewhat reliant on individually held knowledge, the intricate mechanisms of which are beyond the scope of this research. Secondly, social capital theory suggests that educational experience help develop a common language and shared narratives with which social capital can be built (Nahapiet and Ghoshal, 1998). This social capital subsequently gives rise to the creation of new intellectual capital (aka knowledge) via the combination and exchange of intellectual capital (Nahapiet and Ghoshal, 1998). Thus, omitting the opportunities to develop these shared phenomena, such as the opportunity that training presents, may adversely affect knowledge flows. The implication of this in practice is that although network-based efforts may yield greater results over training and education, negating these totally may indirectly and adversely affect the ability to acquire new knowledge and reduce the ability to later assimilate it.

The research's avoidance of these "intricate mechanisms" between individually-held knowledge and network-held knowledge may raise questions on endogeneity, which could critically undermine this research. There is no doubt that endogeneity (such as these) can be raised in any and all studies, and it is in the clarity of methodology, rigour of analysis and theoretical founding for which a reasonable judgement on its effect needs to be assessed. The lengths to which this research has gone to in its articulation of the literature and intensive use of Absorptive Capacity suggests a theoretically sound

mechanism for addressing endogeneity concerns. Methodologically, the appreciation of the newness of the domain coupled with the quantitative preference in Operations Management research demonstrates that a mixed method design is ideal. Furthermore, the efforts taken to identify suitable candidates for data collection and the total number of responses achieved go to lengths in mitigating respondent-based endogeneity concerns. Finally, the logical “chain of evidence” approach in eliciting the qualitative findings coupled with the intensive statistical analysis suggest confidence in results from which these conclusions can be extracted. Given these points, these caveats are noted but deemed not damning enough to pose serious questions on the rigor of this research.

At a similar level to education is the number of indirect "friends of friends" ties, a dimension of weak network-based knowledge ($T_{\text{Education}} = 0.20$ vs $T_{\text{Indirect ties}} = 0.19$). This is of particular interest given that the effectiveness of weak network-based knowledge is approximately half that of individually held knowledge, as mentioned above. These rankings (network heterogeneity > network size > education), are considerably different than those found by Smith et al. (2005). Smith et al., in the context of knowledge creation, found that that education was superior to network size and network heterogeneity respectively, and concludes that “hiring and training well-educated employees with varying functional expertise seems to increase the likelihood that such employees will combine and exchange their ideas to form new knowledge” (p355). In contrast, the implications of this research suggest a far greater emphasis on well connected individuals rather than on the educated elite.

The third and final key insight for this juxtaposition relates to *realised* ACAP and its subsequent enhancement of performance. Problem solving (i.e. Realised ACAP), is at the heart of process improvement, whether it be the proactive search for problems exemplified by Kaizen; or reactively from quality audits, corrective actions or line stoppages. The results suggest that the knowledge gleamed from networks outside firm boundaries can significantly help to improve the effectiveness and efficiency of process improvement initiatives. These findings complement extant “knowledge-based view of process improvement” authorities who have looked at more exploitative, internal and knowledge creation perspectives (c.f. Linderman et al., 2006, Anand et al., 2010). The implication of this research to process improvement is two-fold. Firstly, utilising expertise in one’s network may result in the acquisition of knowledge that can enhance the *effectiveness* of process improvement outcomes. For example, by turning to networks,

it may highlight alternate ways to view the problem (i.e. problem definition) or uncover technical issues that others have found (i.e. solution implementation). Furthermore, the colloquial notion of “two heads are better than one” may similarly aid in helping derive appropriate solutions. Secondly, networks may help the process of process improvement itself by making it more *efficient*- Table 6.2 below provides a few examples of how knowledge from networks may assist in making problem solving more effective, and more efficient. In the context of efficiency and as the qualitative cases highlight, networks provide a means of finding solutions to problems, thus dramatically reducing the cost of generating ideas. Networks may also support the identification of problems by monitoring new tools and techniques that can help enhance processes; or help to find the root cause to the problem (i.e. problem definition) by coming into contact with people who have experienced similar problems.

In either context, making the distinction between the impact of knowledge on problem solving outcomes (effectiveness) or the problem solving process (efficiency) is unique. In Levin and Cross (2004), they measured the “usefulness of received knowledge” as a single construct by combining measures of efficiency and effectiveness. Cross and Cummings’ (2004) measure of “performance” was similarly intertwined with undisclosed items reflecting the quality of output, and process efficiency. Hansen (1999, 2002) on the other hand focused solely on efficiency with the study on networks and completion time of projects. Finally and more commonly, was to associate networks and knowledge with the outcomes of the process, for example the number of new products (Smith et al., 2005), financial performance such as Market-to-Book Value and Return on Assets (McDonald et al., 2008), and creativity (Perry-Smith, 2006).

Problem Solving Stage	Effectiveness	Efficiency
Identify		- New tools/techniques
Define	- Knowledge of other considerations	- Similar problems
Generate	- More people to bounce ideas off	- Pre-existing solutions
Select	- Trial and Error suggestions - More people to bounce ideas off	
Implement	- Knowledge of other considerations	

Table 6.2: Possible effects of network-based knowledge

Finally, the research found strong support for the influence of knowledge/network to enhance the occurrence of radical process improvements. This result is aligned with extant literature on the use of networks for radical innovation (c.f. the upcoming special issue¹³ in the *Journal of Business & Industrial Marketing* titled “The role of relationships and networks in radical innovation”, guest edited by Nottingham University Business School’s Dr Vicky Storey). However, these mechanisms only account for 2% of the variance explained for radicalness, leaving much too still be found about such a phenomenon. In light of this, a review of the literature on radicalness, albeit it briefly, suggests additional factors /such as shared vision, capabilities, fulfilling obligations, communication, social capital, tacitness and knowledge complexity (Li et al., 2008, Pérez-Luño et al., 2011).

6.2 Affective vs. Competence-based Trust

As the above highlight, focusing explicitly on growing knowledge stocks may not be as rewarding as focusing on those factors that enable the conversion of extant knowledge stock to useable/realised knowledge. The first of these factor identified in this research was trust. More so, the qualitative findings coupled with the literature pointed towards a distinction between two forms of trust- trust based on care, compassion and honesty (affective trust), and trust in the capability of individuals (competence-based trust). It was found that competence-based trust negatively impacted the conversion of knowledge stocks to a useable form in problem solving. This notion is counter to the theory of advice seeking behaviour (c.f. Cross and Cummings, 2004, Nebus, 2006) which purports to the need to “value” the expertise of an individual when seeking advice. Rather, it seems that the more capable people are less likely to share and provide assistance. This could be due to those superior individuals being in positions of greater responsibility, greater stress, or time limitations resulting in a constrained ability to share their knowledge. A second explanation may be the tendency to caution against information leakage, an argument used by Ha et al. (2011) to explain their non-significant finding of competence trust on information sharing. This may be of special significance given the previous point, where due to the elevation of responsibility, the knowledge held by superiorly competent

¹³ http://www.emeraldinsight.com/products/journals/call_for_papers.htm?id=3738

individuals is more commercially sensitive, thus heightening beliefs of information leakage and limiting knowledge sharing.

The second key finding is the positive and significant impact of affective trust. This is consistent with Casciaro and Lobo's (2005) finding that it is likability, rather than competence, that best explains help seeking. This is similarly seen by Levin and Cross (2004) who found affective trust to be highly significant to the perceived receipt of useful knowledge, whilst competence-based trust was not significant. The implication of this in practice, as first mentioned by the cases, is to caution against overburdening these individuals and maintaining social capital. Secondly, is to manage these "loveable fools" and "competent jerks" as described by Casciaro and Lobo, notably: the former should be positioned strategically to link networks or mitigate against organisational resistance; and the latter extrinsically motivated for good (rewarded) or bad behaviour (punished), socialised and coached for a change of mindset, or repositioned to more independent roles.

6.3 Search Costs vs. Motivations to Share

The qualitative phase highlighted the differing characteristics between help givers and help receivers (Hargadon and Bechky, 2006), knowledge source and knowledge recipients (Szulanski, 1996) and knowledge donors and knowledge recipients (Easterby-Smith et al., 2008b). In doing so, this research explored not only these unique characteristics and their effect on knowledge acquisition, but more importantly, the interrelationships between them. The findings can then be viewed from three perspectives- the *motivations* to share knowledge from the perspective of the knowledge giver; the *costs* incurred from the perspective of the knowledge seeker; and in response to these, the subsequent motivations that can be used to *mitigate* these search costs. Poignantly, the literature on information seeking, or what this research coins more broadly as the theory of advice seeking behaviour (see Section 2.1.6.2) has yet to appreciate this trade-off (c.f. Cross and Cummings, 2004, Nebus, 2006).

In terms of the *motivations* for sharing knowledge and their effect on converting knowledge stocks to useable knowledge in problem solving, a continuum from extrinsic motivation to intrinsic motivation was deployed (c.f. Fuller, 2010). Accordingly, the

intrinsic motivation of enjoying taking part in process improvement activities was found to support knowledge conversion. This result concurs with Füller's (2010) study that showed intrinsic interest positively impacted the intensity of interest in co-creation activities, and in the complete range of co-creation tasks. At the other extreme, the extrinsic motivation of the expectation for monetary compensation was also found to support knowledge acquisition, which is somewhat of a surprise. On the one hand, the social-come-community feel of the LinkedIn groups imply a degree of informality, which would appear to be divorced from monetary expectations. In this sense, one would expect such extrinsic motivations to be negatively related to knowledge acquisition, or in the very least be not significant. In conflict and verging on cognitive dissonance, LinkedIn is widely viewed as the premier medium for professionals to establish their professional profile, build and engage their professional network, and importantly, to discover new opportunities¹⁴. In this sense, sharing knowledge could be seen as a means of inevitably engaging future clients, thus an expectation for monetary compensation. An alternative explanation is that all respondents were specifically targeted as they currently work in the area of process improvement. Given this, there is the expectation of monetary compensation when a service, such as advice, is provided.

However, the most influential motivation in the conversion of potential knowledge to useful knowledge was the level of dissatisfaction with existing products and processes. In this case, the greater the dissatisfaction, the lower the ability to acquire knowledge. To put it somewhat differently, this equally means that the less dissatisfied one is with existing practices (i.e. more satisfied), the "lesser" it lowers the ability to acquire knowledge (i.e. improves knowledge acquisition). By viewing the results this way, interpreting the findings becomes considerably easier, namely that when one is more satisfied with current processes at work, the more likely they are to share their knowledge. This can be attributed to two factors: firstly, individuals are more likely to want to share their professional experiences and knowledge when their own professional environment is positive and running smoothly. Secondly, satisfaction and the inference that processes are running well may mean that knowledge givers are in a position of having more time and thus the luxury of being able to spend more time/effort to share their knowledge.

¹⁴ Points adapted from http://help.linkedin.com/app/answers/detail/a_id/45

In terms of the search *costs*, Nebus (2006) takes a more nuanced view by suggesting three types of *costs*- social, psychological and institutional. Social costs (i.e. quid pro quo) was not found to adversely affect the conversion of knowledge stocks, possibly due to this type of cost being viewed as normative “business as usual” rather than a personal threat, as the cases explain. Psychological costs refer to the embarrassment in asking for help or the feeling that asking for help would imply inadequacy in one’s ability. These costs were found to significantly and adversely affect knowledge acquisition. Similarly, institutional costs, the violation of organisational norms or lines of authority, were likewise found to be significant and negatively related to knowledge acquisition. In doing so, the findings provide evidence to support Nebus’ (2006) theorising and thereby contribute empirical insight into the theory of advice seeking behaviour.

In the final step, the *interrelations* were examined between costs and motivations to determine the type of motivations that can mitigate search costs. In regards to psychological costs, motivations of curiosity, dissatisfaction (aka satisfaction), and to gain knowledge were found to reduce these effects. The earlier comments on empathising with struggling individuals reflects the emotional support that individuals that are motivated by curiosity and satisfaction may be able to offer these psychologically constrained individuals, thus the potential to mitigate this cost. In terms of the motivation to gain knowledge, these individuals are motivated to share in order to improve and test their skills. Here, the seemingly fragile context created when psychological costs arise may provide an ideal opportunity for hesitant individuals to test their knowledge and get equally compassionate feedback on it. Thus, a secondary *pseudo*-dialogue may be created by the knowledge giver as a means of challenging or reinforcing their own thinking.

In the case of institutional costs, only the motivation to gain knowledge (improve or test skills) was found to reduce the effect. As these costs are political and authoritarian in nature, the confidence exhumed by individuals looking to test their expertise may be perceived as subject matter expertise, thus rendering the perception that knowledge acquired from these individuals is from a credible source. Thus, the seemingly high quality of knowledge gained from these individuals could be leveraged against disciplinary action or aid in justifying the violation if/when it is needed. An alternate means of reducing the effects of institutional cost comes from the realisation that formal

structures can aid in knowledge flows by systematising the process (Zahra and George, 2002), or as the cases suggest, a means of standardising knowledge content. Consequently, rather than using formal process to restrict and discipline, they could be used to an advantage by augmenting them to "[facilitate the distribution of] information within the firm as well as gathering interpretations and identifying trends" (Zahra and George, 2002; p194).

6.4 Individual Attributes vs. Firm Culture

The fourth and final juxtaposition explored the alignment between individuals and their firm and how it fosters or inhibits the flow of knowledge. To do so, the propensity to act entrepreneurial (aka entrepreneurial orientation) was used due to its well established heritage, its multi-dimensional view, and consistency with both knowledge management research and process improvement (Hughes et al., 2007a, Wang, 2008, Li et al., 2010b, Li et al., 2011, Jones, 2005). Thus, individual attributes and firm culture were contrasted along three dimensions- proactiveness, innovativeness, and risk taking. In terms of *individual attributes*, only risk taking was found to be significant, but negative. In other words, an individual's propensity for risk taking and experimenting appeared to adversely affect knowledge acquisition. It was expected that risk taking behaviour would positively support the conversion of total knowledge stocks due to one's propensity to be more open to ideas and enjoy experimenting with new approaches. Rather, it appears that risk taking may in fact manifest more as confidence in one's extant thinking, resulting in less reliance on networks for support and recommendations and hence the negative relationship.

In regards to *firm culture*, risk taking was similarly found to be significant and negative, justified along similar lines as the above. Fortunately, firm-level innovativeness behaved as expected and positively supported knowledge acquisition efforts. In this way, a creative work environment may support creative exercises such as bouncing ideas off network counterparts in brainstorming-style activities, or adapting ideas from outside the firm. In these cases, such culture may aid in overcoming the "not invented here" syndrome, the "overemphasis on internal technologies, ideas or knowledge" (Mortara et al., 2009; p46). Alternatively, a creative environment may help endorse the use of networks and knowledge in interesting new ways. Such novel behaviours may result in

the connecting different loci of knowledge, which according to Schulz (2001), would result in the generation of novel and new knowledge and thus competitive advantage.

The exploration of the *alignment* between entrepreneurial orientation at the individual and the firm as motivated in the final stage of this analysis is, to the knowledge of the author, the first of its kind. Typically it focuses either at the firm level (Covin and Slevin, 1989, Lumpkin and Dess, 1996, Ireland et al., 2009, Rauch et al., 2009), or individual level (Douglas and Shepherd, 2002, Zhao and Seibert, 2006, Bolton and Lane, 2012), with only a limited number of studies explicitly exploring it in different contexts (i.e. cross culturally English/French by Knight, 1997). The most obvious observation that the analysis uncovers is that alignment in likeminded attitudes does not appear to be significant; in other words, innovativeness, proactiveness and risk taking at an individual level does not appear to be supported by firm-level innovativeness, proactiveness and risk taking respectively. Rather, what firstly appears is that risk taking at the individual-level is supported by proactiveness at the firm level, i.e. a firm culture that encourages the initiation of action supports one's propensity to be adventurous, bold, and experimental. Thus, if a firm is driven to find opportunities as motivated by a *kaizen* mindset of continuous improvement, having people that are experimental supports this, as they are more likely to take risks and try new things, thereby encouraging action that is aligned to the firm culture.

Secondly, an individual that is innovative was supported by a risk taking culture, i.e. a person that is creative is complemented by a culture that supports and encourages experimentation and calculated risks. Rationalising this, personal creativity is seen as a blessing when the firm likes to experiment with creative/unique approaches, thus the new ideas you create are fundamentally valued by the firm, which in turn further motivates you. In turning to the literature on creativity to aid in explaining these findings, Amabile (1983, 1996), a seminal writer on creativity, highlights that the work environment affects individual creativity. She focused particularly on the role of intrinsic and extrinsic motivation, a concept consistent with the motivation construct used earlier in this Thesis. Here, we can observe the inherent, intrinsic motivation of the individual for creativity, which is further enhanced by the extrinsic motivations of the firm through their valuing of new creative/unique ideas. Similar views are shared by Shneiderman (2000) who describes several perspectives of creativity. Of particular relevance here is the

situationalist view which emphasises the social context of creativity where ideas are influenced by mentors, peers and the community. In taking this further, De Dreu et al. (2008) explored the influence of activating moods (e.g., angry, fearful, happy, elated) and deactivating moods (e.g., sad, depressed, relaxed, serene) on the development of ideas. Their findings demonstrate not only the influence of external factors on creativity, but in reference to the observations made in this Thesis, that more original/novel ideas were generated when participants were in an activating mood, as may be stimulated by risk taking pressures, rather than in a deactivating mood.

Thirdly and also in relation to personal creativity, a firm's propensity for proactiveness appeared to hinder such behaviour, elements consistent with Shneiderman's (2000) situationalist view and empirical observations by De Dreu et al. (2008). Here, the conflict may stem from the firm's desire for action and feasibility in solutions, while the individual has a preference for ideas and creativeness in solutions. The conflict on the orientation for action is poignantly highlighted by Mintzberg and Waters' (1990) commentary on decisions and change in organizations. They argue that traditional views of decision making that focus on rationality and a methodological approach, "get in the way" of viewing decisions as a commitment to action. Thus they spawn an action-orientated view of change and decision making which focuses on the patterns of actions, rather than on the stages of the decision making process. In doing so, we see similar orientations between the creative individual who focuses on maximising the process of decision making; and the proactive firm who focuses on the patterns of action. Similarly, an argument can be made in support on the conflict over the nature of solutions. Drawing on the comprehensive review by Dean et al. (2006) on the evaluation of ideas, they distinguish between two fundamental attributes to an idea- *novelty*, i.e. originality and paradigm relatedness; and *quality*, i.e. implimentability, acceptability, applicability and effectiveness. In this way, a focus on action can be attributed to a focus on the *quality* of ideas, and the creative on the *novelty* of ideas.

Chapter 7: Conclusion

This research examined the role of social networks in knowledge acquisition in process improvement through a knowledge-based view (KBV). In the wake of the Global financial crises and the emergence of the Knowledge Economy, the need for research into process improvement and knowledge management is timely. The research aims to fill two important gaps: firstly, to contribute to the under-researched domain of exploratory and acquisition-based knowledge activities in process improvement; and secondly, to derive and empirically test the social integration mechanisms in the process-view of Absorptive Capacity proposed by Zahra and George, an exercise that, to the author's best knowledge, has yet to be done. Focusing on the knowledge-based view and underpinned by Absorptive Capacity theory, a framework of three dyadic relationships was developed and guidelines produced to help professionals enhance their ability to acquire knowledge from networks in process improvement initiatives. Section 7.1 discusses and summarises the findings from the research. Section 7.2 presents the contribution to knowledge. Finally, the recommendation on future research is then made in Section 7.3.

7.1 Summary of Findings

The main outcome of this research is to provide insight into those factors that catalyse or restrict our ability to acquire knowledge that resides in our network, and convert it to useable knowledge that is advantageous in process improvement. The research utilised a mixed method research design and was developed in two phases. With the knowledge-based view of process improvement still in its infancy as a research domain, the first phase utilised qualitative case interviews and was explicitly exploratory in nature. An extensive and systematic review of the literature was first undertaken to develop a comprehensive set of plausible underlying theories and variables in order to find a balance between purely grounded research, having sufficient literary and theoretical backing and not reinvent the wheel. With this insight, eight case interviews with management consultants and project managers were undertaken to identify the key variables and theories. These respondents were chosen due to their knowledge and experiences in networking, knowledge management and improving organisational processes. Subsequently, key mechanisms that emerged included: trust, search costs,

motivations for sharing, firm culture, and the theory of absorptive capacity. Upon further refinement by reflection on the literature, three dyads or dualities emerged: 1) the contrast between trust based on competence, and trust based on care and compassion; 2) the conflict between search costs incurred by Knowledge Seekers, and the motivations for sharing on behalf of the Knowledge Giver; and 3) the alignment between individual-level attitude towards process improvement, and firm-level culture. In the second research phase, these dyads were tested and verified through quantitative survey research, an explicitly confirmatory phase in order to provide generalisability to the case findings. Survey respondents were sourced via the social media platform LinkedIn as it permitted the explicit identification of process improvement professionals as well as providing a proxy for ensuring networking behaviour. The resulting dataset was analysed using SmartPLS, a variance-based structural equation modelling package, and the use of three advanced statistical techniques- the *Two-Stage Approach* for assessing the formative measures of Potential ACAP; *interaction analysis* to analyse the moderating role of the three dyads; and *multigroup analysis* to investigate the contrasts within each of the dyads.

Next, a summary of the research findings is discussed and the research questions addresses through the achievement of the five research objectives described in Chapter 1.

7.1.1 The Knowledge-Based View of Process Improvement: a Knowledge Acquisition Perspective and an Empirical Study

With problem solving forming the heart of process improvement activities and the basis for contextualising and transforming new knowledge, the Knowledge-Based View (KBV) of Process Improvement is an inevitable evolution of this domain and one that I am proud to profess to. Its recent emergence is consistent with the emergence of the Knowledge Economy lead by the broader research trends that are advancing from the resource-based view which purports to competitive advantage gained from valuable, rare, inimitable and non-substitutable resources, to the understanding that this key resource is in fact Knowledge. In this way, advantageous capabilities can be explained as the unique bundling of knowledge and the flow of this knowledge through the firm. Such knowledge activities are typically viewed as being either exploratory or exploitative in nature. This research investigated the exploratory aspects and particularly Knowledge Acquisition- the activity of identifying and acquiring externally generated knowledge. Literature suggests

that amongst other things, knowledge acquisition mitigates against core rigidities formed by over exploitation; increases the likelihood that novel ideas are generated; and with the intensity of the current market environment, firms may not have the luxury of developing solely from internally generated ideas. Findings from the qualitative stage first concur with the suggestion that knowledge acquired from networks increase the possibility of novelty by providing "fresh perspectives". Secondly, it may aid in identifying opportunities by observing trends by piecing together various pockets of information, or via serendipitous interactions. Thirdly, the vast knowledge residing in networks would help to understand issues and problems in more detail. Finally, it may provide savings in both cost and time by not "reinventing the wheel". In the second, quantitative phase, such suggestions were tested at a more generalisable level using survey-based research. The findings suggest that network-based knowledge was significantly related to problem solving expertise as the qualitative phase suggested. In particular, the net outcome of acquiring network-based knowledge leads to a significant improvement in the effectiveness of process improvement projects, and also improvements in the efficiency of the projects themselves. Finally, there were indications to suggest that knowledge acquisition may also improve the radicalness of process improvement outcomes, thus providing greater competitive advantage.

7.1.2 Key variables and theories in the Knowledge-Based View of Process Improvement

With the plethora of theories and variables identified in the broader context of the KBV in Chapter 2 (Literature Review) in addition to the infancy of the Knowledge-based view of Process Improvement, there was a distinct need to initiate a discussion on which of these mechanisms may be critical. Based upon eight case interviews, a primary and secondary theory in addition to nine key variables were identified that effect knowledge acquisition. It is noted that these are not suggested to be comprehensive- rather they should be viewed as a "peg in the sand" to initiate the discourse. The primary theory identified was Absorptive Capacity (ACAP) and particularly Zahra and George's (2002) process perspective, defined as "set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability" (p186). Here they make the distinction between two subsets of the process- Potential Absorptive Capacity, the capacity to value and acquire external

knowledge; and Realised Absorptive Capacity, the capacity to leverage acquired knowledge and incorporate it into operations to improve performance. A secondary theory which played an important supporting role to ACAP was Social Capital, "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" that can provide privileged access to information and to opportunities (Nahapiet and Ghoshal, 1998; p243). This theory reinforced the value of network knowledge as well as providing insight into important network characteristics which may be fundamental in mobilising this knowledge.

Regarding the key variables, the network characteristics of network size and heterogeneity were highlighted by the cases. Insight gained from the network training consultant suggested that "networking" as a professional activity was primarily aimed at increasing network size, although network theories suggest several other network characteristics that may be more valuable. Network heterogeneity on the other hand received a mixed response. On one side, it provided access to actors with contextual understanding of the subject in question and thus deeper knowledge, but in turn may restrict novelty; on the other side, highly diverse actors may not have sufficient contextual understanding to adequately address the issue, resulting in the wasting of time and effort. In addition to these, the factors that later formed the three dyads were also identified, namely trust (Dyad 1); search costs and motivations for sharing (Dyad 2); and organisational culture (Dyad 3). Finally, the tacitness of knowledge emerged from the qualitative research as an important variable, however due to time restrictions of the PhD and the neat formation of the three dyads, it was dropped from the subsequent quantitative analysis.

7.1.3 A theoretical framework for knowledge acquisition in process improvement

The emergence of Absorptive Capacity as the underlying theory for this research provided a strong theoretical foundation to the colloquial *Fish!* Framework for a knowledge acquisition perspective of the KBV of Process Improvement. First, both the Potential and Realised ACAP constructs were redefined. To provide alignment with the process improvement in addition to the broader knowledge management domain,

Realised Absorptive Capacity (RAC) was conceptualised as the five stages of problem solving- problem identification, problem definition, idea generation, concept selection, and implementation. In order to incorporate the social network perspective, Potential Absorptive Capacity (PAC) was defined as the total stock of knowledge accessible to an individual. Secondly, the variables that were identified were conceptualised as the social integration mechanisms that "facilitate the sharing and eventual exploitation of knowledge" (Zahra and George, 2002; p194) which moderate the relationship between PAC and RAC. From further refinement of the variables in light of the literature, they formed three contrasting and dyadic relationships: 1) the comparison of competence-based trust vs. caring and honestly-based trust; the conflict between the costs for searching for information/knowledge, and the motivations for sharing in return; and 3) the alignment between individual attitudes toward process improvement, and firm-level culture.

7.1.4 Validation of key variables and theory for knowledge acquisition in process improvement

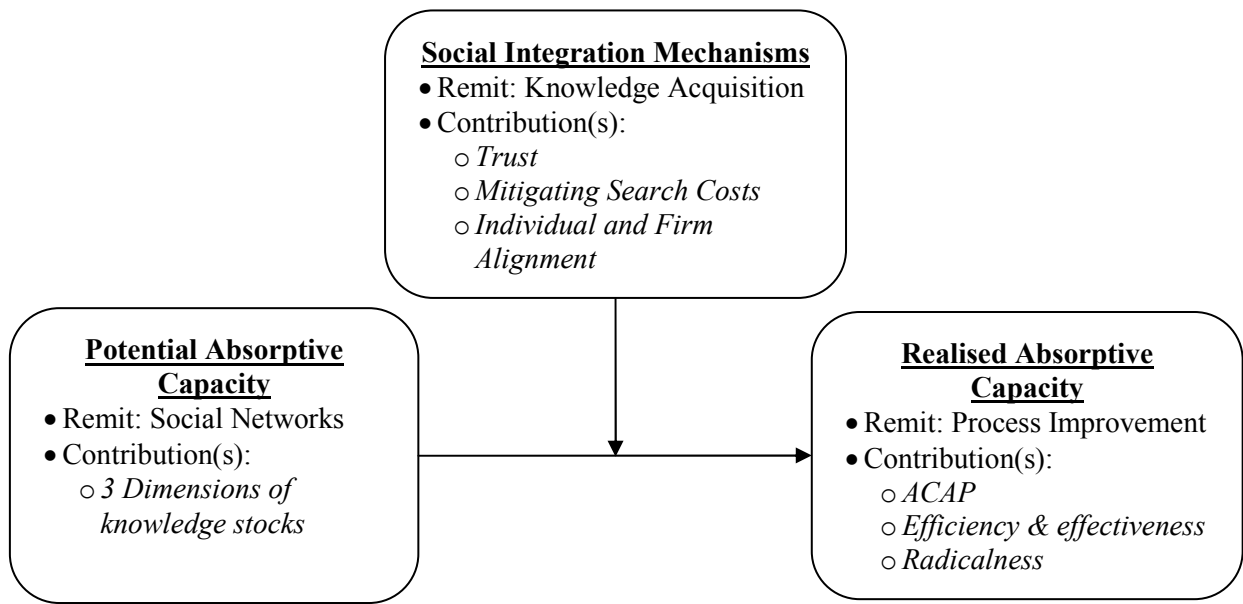
The theoretical model was tested via survey-based research. Data were analysed using variance-based structural equation modelling (SmartPLS) and three advanced statistical methods: *two-stage approach* for formative measures; *interaction analysis* for the social integration mechanisms; and *non-parametric multigroup analysis* for the dyadic relations. Consequently, PAC was justified as a second-order formative measure consisting of three dimensions- individual held knowledge, network-based knowledge from strong ties, and network-based knowledge from weak ties. The outcomes of knowledge acquisition was found to be improvements in the radicalness of project outcomes, project efficiency and project effectiveness shown by significant relationships between these and RAC. Search costs, motivations, affective trust, and firm culture were found to moderate the relationship between PAC and RAC and thus can be viewed as social integration mechanisms. Finally, regarding the dyadic relationships, motivations to gain knowledge, curiosity and dissatisfaction help to reduce social and psychological costs; institutional costs were reduced by motivations to gain knowledge; Individual-level risk taking is supported by a culture of proactiveness; and lastly, individual innovativeness is similarly supported by a culture of risk taking.

7.1.5 Guideline for Practitioners

The quantitative testing results provided the final level of refinement to the theory and the subsequent formation of *The Fish!* Guidelines as outlined in Appendix 12. The guidelines divide knowledge acquisition into three main areas: *the Tail*, *the Head*, and *the Body*. *The Tail* details the sources of knowledge and provides insight into the effectiveness of each source in order to guide practitioners in knowledge search and knowledge development. *The Head* summarises the outcomes of process improvement and the strategies that knowledge acquisition can provide to obtain these outcomes. Finally, *the Body* describes the cultural, behavioural, and individual factors that help elicit the conversion of knowledge from the sources, to knowledge that can provide advantage. In addition, it details the complimentary relationships that exist between these factors that can aid to either reduce barriers, or enhance benefits.

7.2 Contributions to Knowledge

This research purports to Grant's (1996) philosophy that knowledge is the key strategic resource to sustained competitive advantage. Zahra and George (2002) go on to postulate that competitive advantage rests on the ability to convert newly acquired knowledge (Potential Absorptive Capacity, PAC) to a useable and exploitable format (Realised Absorptive Capacity, RAC). Thus, an understanding of the mechanisms that aid in converting PAC to RAC would appear to be paramount to our understanding of competitive advantage. However, what appears in the literature to date is a dearth in understanding and empirical work on these conversion mechanisms, or what Zahra and George (2002) term as "Social Integration Mechanisms". The contributions of this research thus lie in the refinement of Absorptive Capacity theory, as figure 7.1 below shows.



Remit	Qualitative Phase	Quantitative Phase
Process Improvement	ACAP as key theory	Outcomes of ACAP
Knowledge Acquisition	Identification of SIMS	3 Dyads
Social Networks		3 Dimensions

Figure 7.1: Schematic summary of Research Scope and Contributions

The remit of this research was to explore the intersection of knowledge acquisition, process improvement, and social networks at the individual level. In terms of process improvement, the first contribution identified in this research was Absorptive Capacity (ACAP) as an applicable theory to a knowledge acquisition perspective of the knowledge-based view of process improvement. The emphasis of this theory throughout the research as a result of this finding responds to the concern of Schmenner et al. (2009) on the lack of theory utilised within operations management research. Furthermore, the identification of ACAP provides an alternate theoretical perspective to knowledge creation and the SECI model (c.f. Anand et al., 2010, Choo et al., 2007b) and goal theory (c.f. Linderman, Schroeder et al. 2003). In doing so, this research has helped to motivate the domain of the Knowledge-Based View of Process Improvement by contextualising a major management theory to process improvement.

The second contribution to the process improvement literature comes from the understanding that problem solving forms the basis of both process improvement and the application of knowledge, contextualised here as Realised Absorptive Capacity. The outcomes of ACAP can then be seen as outcomes of process improvement, and vice versa. The contribution then lies in this shared view on performance outcomes. Outcomes of ACAP have traditionally been associated with innovation and new product development performance (c.f. Cohen and Levinthal, 1990, Zahra and George, 2002). Outcomes of process improvement on the other hand¹⁵, are typically measured with respect to the five performance dimension of Operations Management- quality, cost, flexibility, speed, and dependability. Just as Anand et al. (2010) emphasise the need for studies into knowledge creation in a process improvement context, separate to new product development projects due to their ad hoc and shorter time frames, this enquiry makes its departure by focusing on outcomes based on cognitive and behavioural changes (c.f. Garvin, 1993, Szulanski, 1996), rather than tangible outcomes such as the number of new products (i.e. ACAP) or physical improvements in product quality or cost (i.e. Process Improvement). It does so by empirically demonstrating the link between network-enhanced problem solving and the *effectiveness* of initiatives (i.e. satisfaction of outcomes, value to firm, project quality); and network-enhanced problem solving and in the *efficiency* of the process (i.e. on-budget, on-time, lead time reduction). Interestingly, the results demonstrated that networks equally enhance both the effectiveness and efficiency of process improvement initiatives. In a less conclusive finding on outcomes, the research agrees in part that external networks produce knowledge that is more novel (c.f. McDonald et al., 2008, Mors, 2010). Although the relationship between RAC and radicalness was strong, only a fraction of the variance was explained. This suggests there are many other factors that influence radicalness, such as communication, social capital, and knowledge complexity (Li et al., 2008, Pérez-Luño et al., 2011).

The findings above go to length to support Grant's (1996) notion of competitive advantage and knowledge. In summary, it shows that knowledge acquired through networks leads to more effective, efficient and radical process improvements, which in turn form a source of competitive advantage.

¹⁵ Terziovski (2010) indecently suggests that "innovation in the manufacturing sector generally focuses on process improvements" (p893).

In regards to the knowledge acquisition remit, the identification of ACAP as the underlying theory during the qualitative phase provided the foundation from which to interpret the factors that emerged from the qualitative data and the subsequent quantitative confirmation. These factors were interpreted as the social integration mechanisms that convert Potential Absorptive Capacity to Realised Absorptive Capacity as highlighted above to be central to our understanding of competitive advantage. To the author's knowledge, this is one of the first empirical studies to do this and thus provides a significant contribution to the refinement of Absorptive Capacity theory. Zahra and George (2002), in their brief description of these social integration mechanisms, categorise them as structural, behavioural, cognitive or political barriers. Explicitly then, the social integration mechanisms of this research are equated to Zahra and George's work in the table below. Only a single political barrier was elicited from the findings, the violation of organisational norms or lines of authority (i.e. institutional costs, Nebus, 2006). In mitigating such costs, collaborating with individuals who are looking to challenge and test their skill gives the perception that they are subject matter expertise and therefore a credible source. Thus, the high quality of knowledge gained from these individuals can be leveraged against disciplinary action, ergo mitigating political concerns. Behavioural barriers were identified as:

- The preference for affective trust over competence based trust which concurs with Casciaro and Lobo (2005) but challenges the works by Cross (Borgatti and Cross, 2003, Cross and Cummings, 2004)
- The expectation for monetary compensation to motivate the sharing of their knowledge, raising questions on the informality of networks; and
- A firm culture that supports innovative behaviour, possibly through the use of novel behaviours and connection of distinct loci of information (Schulz, 2001)

Cognitive barriers were seen as those factors innate to an individual's disposition rather than those that can be learnt or developed such as those above. Having an intrinsic interest in the subject positively supported the sharing and thus acquisition of knowledge, thereby concurring with Füller's (2010) study. Secondly, the greater the dissatisfaction in existing processes, the less willing one is to share knowledge. Similarly, this implies that a greater level of satisfaction stimulates knowledge sharing; possibly due to the positive and uplifting working conditions that it creates, or having more time to share as processes

are running well. Finally, the embarrassment in asking for help (aka psychological costs), was proposed by Nebus (2006) to be counterproductive to knowledge flows. This work not only empirically confirms this, but also follows up with two suggestions on how its effect can be reduced- empathetic support by collaborating with individuals who are curious in the subject or are satisfied with their current work processes; or by collaborating with individuals looking to test their skills as the fragile context provides a similarly conducive environment for them to affirm or contest their current thinking without excessive retribution.

Finally, the contrasts in individual and firm characteristics provide three scenarios of cognitive and behavioural barriers. In this case, the experimental nature of a risk taking individual is supported by the action orientated nature of a proactive firm. Secondly, a creative individual is supported by a firm's culture of experimenting and risk taking. Finally, individual innovativeness and creativity appears to be stifled by an action orientated firm.

Social Integration Mechanism - Thesis	Social Integration Mechanism - Zahra and George (2002)
1. Institutional costs	Political
2. Affective trust over competence	Behavioural
3. Monetary rewards	Behavioural
4. Firm innovativeness	Behavioural
5. Intrinsic motivation	Cognitive
6. Dissatisfaction (satisfaction)	Cognitive
7. Psychological costs	Cognitive
8. Individual risk taking and firm proactiveness	Cognitive/behavioural
9. Individual innovativeness and firm risk taking	Cognitive/behavioural
10. Individual innovativeness and firm proactiveness	Cognitive/behavioural

Table 7.1: Comparison of Social Integration Mechanisms

The social network remit was manifested in the operationalisation of potential absorptive capacity as the total stocks of knowledge. It contributes particularly to Granovetter's (1973) *Strength of Weak Ties* discourse. Through the theoretical justification and later empirical validation of the total stocks of knowledge as a second order formative construct comprised of individual-held knowledge, network-held knowledge from strong ties, and network-held knowledge from weak ties, it confirms Granovetter's distinction in

network-based knowledge. In making this distinction, it also contributes to Absorptive Capacity as to date, the theory only distinguished between individual-held knowledge (experience) and network knowledge (external sources) (c.f. Zahra and George, 2002). In doing so, it provides a more finely grained view of the key antecedent to Absorptive Capacity.

Taken in tandem, viewing the three remits above from the perspective of the individual provides a final contribution to ACAP. Cohen and Levinthal's (1990) original conceptualisation of Absorptive Capacity details the intimate role of individuals in firm-level Absorptive Capacity. Subsequent Reconceptualisation (Zahra and George, 2002), Reification (Lane et al., 2006) and Re-reconceptualisation (Todorova and Durisin, 2007) of the theory have developed it towards a firm-level dynamic capabilities view which has lost attention at the individual level. This research has gone back to the origins of the theory and attempted to re-motivate research into the role of the individual, a view consistent with other ACAP authors (da Mota Pedrosa and Jasmand, 2011b, Da Silva and Davis, 2011, ter Wal et al., 2011) and microfoundation trends exploring the foundations to capabilities (c.f. Felin and Foss, 2005, Foss et al., 2010). It thus contributes to the individual Absorptive Capacity discourse by first empirically demonstrating the occurrence of the “Potential vs. Realised” phenomenon proposed by Zahra and George (2002) at the individual level. Secondly, the original thinking highlights the interrelationship between the individual and the firm in creating absorptive capacity. This notion of embeddedness in a wider community is reflected in this research as embeddedness of the individual in a firm (i.e. Dyad 3), and in the wider network (i.e. Dyad 1 and 3)

Finally, there are two minor methodological points of interest. Firstly, this research contributes to the emerging use of Partial Least Squares modelling as an alternative statistical tool to LISREL in Operations Management research. Secondly, it uses three advanced statistical techniques- formative measure analysis, interaction analysis and non-parametric multigroup analysis. In doing so, it hopes to guide and equip researchers in the use of these tools, which may open up other, unexplored, areas of empirical research.

7.3 Limitations and Future Research

While this study has made significant contributions, there are limitations that need to be considered. Firstly, the quantitative data was collected via LinkedIn in an attempt to ensure that respondents were suitable "network" savvy. This may have introduced some form of bias, for example with the more IT confident individuals. Thus, repeating a similar study on respondents gained from other sources may be an opportunity for further validation of the findings, for example sourcing respondents from Associations/Institutes, or making a sector specific enquiry. The latter point is particularly plausible given the extant focus of technology hubs, clustering and knowledge spillovers (Tallman et al., 2004, Bell, 2005, Camisón and Villar-López, 2012). An addition opportunity within the LinkedIn context, albeit for the wider professional community rather than an avenue for further academic interest, is given the empirical support for the formative measure of potential absorptive capacity; it could be developed into a feature for the LinkedIn platform. In doing so, this research would formally give something back to the LinkedIn community.

As justified in the methods section, a mixed method approach is fitting due to the emergent nature of this field. However due to the time constraints, only eight case interviews were undertaken. Given the infancy of this field, it may well benefit from larger scale qualitative studies in order to support its maturation from conceptualising to empirically confirmed, process improvement specific, features of knowledge management.

Thirdly, the study explicitly concerned itself with knowledge acquisition. In line with extant knowledge theories such as Absorptive capacity and Nonaka's theory of Knowledge Creation (Nonaka, 1994), future works could address the subsequent stage of knowledge assimilation. This limitation is also aligned with the focus on external networks. Here, the thesis was motivated by the concept that the most effective means of acquiring knowledge is via external network. Thus to explore the subsequent assimilation of knowledge, it may be more appropriate to investigate it from an internal network angle.

Finally, the research took a brave stance in adopting the individual as its unit of analysis, rather than the firm as so typically done. Although justified, it limits itself by not attempting to examine the subsequent dissemination of knowledge to the team and firm level as suggested in other works as (c.f. Zhao and Anand, 2009, Nemanich et al., 2010). Future works could find inspiration from the work of Crossan et al. (1999) which proposed a four stage approach to Organisational Learning linking the individual, group, and organizational levels. In doing so, “feed forward” learning mechanisms from the individual to the organisational level; and “feedback” learning from the organisational to the individual level were proposed. Alternatively, Sun and Anderson (2010) in a more recent account, examine the link between Absorptive Capacity and Organisational Learning by relating the four stage model by Crossan et al. (1999), with the four stage model of Zahra and George (2002) used here. Sun and Anderson’s work however, was conceptual. Future empirical research could address both the limitations of this Thesis, as well as providing empirical support for Sun and Anderson.

Appendix 1: Perspectives of Knowledge

Hierarchical perspective	Authors	Secondary Perspective	Description	Example
Level 1: Data text, fact, code etc	(Carayannis, 1999, Ackoff, 1989)		The most basic state of knowledge	Raw MRP data
Level 2: Information: Organized, structured, interpreted, summarized data	(Carayannis, 1999, Alavi and Leidner, 2001, Nonaka, 1994)	Knowledge is explicit	Information is processed, interpreted and personalized data	Rules of thumb Procedures
		Knowledge is an Object	An object to be stored, accessed and manipulated	Storing data via Intranets
Level 3: Knowledge Case, rule, process, model	(Alavi and Leidner, 2001, Nonaka, 1994, Anand et al., 2010).	Knowledge is Tacit	Knowledge is rooted in actions, experience, and involvement and difficult to imitate	Best means of dealing with specific types of problems
		State of mind	Knowledge is the state of knowing and understanding	Training
		Knowledge as a Process	Knowledge is applying expertise	Creative problem solving
Level 4: Expertise Fast and accurate advice, explanation and justification of result and reasoning	(Nonaka, 1994, Anand et al., 2010, Grant, 1996, Alavi and Leidner, 2001, Carayannis, 1999)	Knowledge is “that which is known”	Being antiquated with, familiar with, and aware of	Training and networking
		Declarative	Know-what	What drug is appropriate for an illness
		Procedural	Know-how	How to administer a particular drug
		Causal	Know-why	Understanding why the drug works
		Conditional	Know-when	Understanding when to prescribe the drug
		Relational	Know-with	Understanding how the drug interacts with other drugs
		Knowledge is a justified true belief	knowledge is justifying personal beliefs as part of an aspiration for the “truth”	“knowledge” gleamed from interviews
Level 5: Capability Organizational expertise: knowledge repository, integrated	(Nonaka, 1994, Alavi and Leidner, 2001, Grant, 1996, Carayannis, 1999)	Knowledge is the potential to influence action	Knowledge is reasoning to actively guide task execution	RBV
		Pragmatic	Useful knowledge for an organization, captured by the organization’s systems, processes, products, rules, and culture	Best practices, KMS

Appendix 2: Summary of results- Process Improvement

		Business Improvement	Continuous Improvement	Performance Improvement	Process Improvement	Quality Improvement
Science Direct	JoOM	0	5	6	5	1
Science Direct	IJPE	1	13	2	13	18
EBSCO	IJPR	1	21	4	16	29
EBSCO	POM	0	1	3	7	4
Emerald	IJOPM	7	20	14	10	13
	TOTAL	9	60	29	51	65

Appendix 3: Summary of results- Knowledge Acquisition

Database	Journal	knowledge acquisition	acquiring knowledge	knowledge sharing	information sharing	knowledge search*	information search*	Knowledge accumulation	knowledge captur*	knowledge exchange*	information exchange*	knowledge scanning	absorptive capacity	information seeking	knowledge creation
Science Direct	JoOM	1	0	3	9	0	1	1	0	0	5	0	4	0	3
Science Direct	IJPE	1	0	3	26	0	0	1	0	0	3	0	0	0	4
Science Direct	Omega	3	0	3	6	1	0	0	0	0	2	0	1	0	0
EBSCO	IJPR	9	1	6	31	0	0	2	1	0	10	0	1	0	0
EBSCO	POM	0	0	0	9	0	0	0	0	0	4	0	1	0	0
Emerald	IJOPM	3	0	4	6	0	0	1	0	0	0	0	0	0	2
	TOTAL	17	1	19	87	1	1	5	1	0	24	0	7	0	9
EBSCO	AMJ	1	0	2	6	0	1	0	0	1	0	0	4	0	5
EBSCO	AMR	1	0	2	0	0	0	0	0	2	0	0	4	0	4
EBSCO	BJM	1	0	3	1	0	0	1	0	0	0	0	2	0	4
EBSCO	MS	5	0	8	19	0	1	0	1	2	8	0	3	1	8
Wiley	SMJ	11	12	18	9	3	0	1	0	2	0	0	12	5	4
Wiley	JMS	15	10	16	5	0	2	6	2	4	2	0	4	8	19
Science Direct	LRP	0	0	4	1	0	0	0	0	1	1	0	0	0	8
Sage	JoM	0	0	0	0	0	0	1	0	0	0	0	1	3	3
	TOTAL	34	22	53	41	3	4	9	3	12	11	0	30	17	55

Appendix 4: Summary of results- Knowledge and Social Networks

	Networks						Knowledge					
		Network type	Clustering & Density	Centrality	Diversity	Seeking behaviour	Type of knowledge	Acquisition	Sharing	Transfer	Exchange	Unspecified knowledge activities
Networks	Network type	-----										
	Clustering & Density	(Carayannis, 1999, Alavi and Leidner, 2001, Schilling and Phelps, 2007)	-----									
	Centrality		(Padula, 2008)	-----								
	Diversity	(Karamanos, 2003, Mors, 2010)	(Almeida and Phene, 2004)		-----							
	Seeking behaviour	(Mors, 2010)				-----						
Knowledge	Type of knowledge	(Borgatti and Cross, 2003, Möller and Svahn, 2006, Birkinshaw, 2002, Uzzi and Lancaster, 2003, Sammarra and Biggiero, 2008)					-----					
	Acquisition	(Sullivan and Marvel, 2011, Yli-Renko et al., 2001)	(Li et al., 2010a, Soh, 2010)				(Padula, 2008) (Sullivan and Marvel, 2011)	-----				
	Sharing	(Li et al., 2010a) (Hansen et al., 2005)	(Schilling and Phelps, 2007, Soh, 2010)		(Schilling and Phelps, 2007, Bacharach et al., 2005)	(Cummings, 2004)			-----			
	Transfer	(Cowan et al., 2007, Van Wijk et al., 2008, Zhao et al., 2005, Uzzi and Lancaster, 2003)	(Padula, 2008)	(Padula, 2008)			(Tsai, 2001)	(Uzzi and Lancaster, 2003)		-----		
	Exchange	(Tallman and Chacar, 2011)	(Smith et al., 2005) (Arikan, 2009)	(Karamanos, 2003) (Lee et al., 2010)			(Karamanos, 2003)		(Sammarra and Biggiero, 2008)		-----	
	Unspecified knowledge activities	(Anokhin et al., 2011) (Tortoriello and Krackhardt, 2010)	(Tallman and Chacar, 2011)		(Mors, 2010) (Almeida and Phene, 2004)	(Mors, 2010)						-----

Appendix 5: Summary of four Mixed Method Designs

	Triangulation Design	Embedded Design	Explanatory Design	Exploratory Design
Purpose	<ul style="list-style-type: none"> • Most common approach • To obtain different but complimentary data on the same topic • Designed used to directly compare/contrast quants statistical results with quals findings 	<ul style="list-style-type: none"> • One dataset provides a supportive, secondary role 	<ul style="list-style-type: none"> • Purpose is that quals data to build on quants results 	<ul style="list-style-type: none"> • Measures or instrument not available • Variables are unknown or no guiding framework or theory • Good approach to identify important variables • For generalising finding to other groups • Test emerging theories or classifications • Explore a phenomenon in more detail the measures provide
Procedure	<ul style="list-style-type: none"> • A one phase design • Quants and quals methods implemented during same time period • Concurrent, but separate collection and analysis • Data is merged • Either bringing separate results in the interpretation/discussion; Or by transforming data to facilitate the integration of the two types of data in the analysis 	<ul style="list-style-type: none"> • i.e. embed a survey in a phenomenology study • Either one phase or two phase study • Quals and quants used to address different RQ • The role of the secondary dataset is the key question in this type of design 	<ul style="list-style-type: none"> • Two phases MM design • Begins quantitatively, hence the focus is on quants results 	<ul style="list-style-type: none"> • Similar to explanatory design • Because design begins qualitatively, typically quals is emphasised
Variants	<ul style="list-style-type: none"> • Four variants: first two differ in how they merge the data; third model is used to enhance findings from a survey; fourth used to investigate different levels of analysis <ol style="list-style-type: none"> 1. Convergent model: <ul style="list-style-type: none"> • The traditional model of MMR • Data collected and analysed separately and converged in the interpretation 2. Data transformation model <ul style="list-style-type: none"> • Data collected and analysed separately 	<ol style="list-style-type: none"> 1. Embedded experimental design <ul style="list-style-type: none"> • Qualitative embedded in experiment 2. Embedded correlation design <ul style="list-style-type: none"> • Qualitative embedded in survey to help explain how the mechanisms work 	<ol style="list-style-type: none"> 1. Follow-up explanation model <ul style="list-style-type: none"> • When quals data is needed to explain or expand quants results i.e. statistical differences amongst groups, individuals/outliers 2. Participant selection model <ul style="list-style-type: none"> • When quantitative data is required to identify and purposefully select participants 	<ol style="list-style-type: none"> 1. Instrument development model <ul style="list-style-type: none"> • To develop and implement a quants instrument base on quals findings • Quals guides item/scale development • Researchers of this variant often emphasise the quants aspect 2. Taxonomy development model <ul style="list-style-type: none"> • Quals used to identify important

	<ul style="list-style-type: none"> • After initial analysis, researcher transform one type of data into the other • Data then merged during analysis <p>3. Validating quantitative data model</p> <ul style="list-style-type: none"> • To validate and expand on quants finding form survey by including open ended question in the survey • I.e. both types of data in one survey instrument <p>4. Multi level research model</p> <ul style="list-style-type: none"> • Different methods used to address different levels in a system, • I.e. quals at client level, quants at director level, quants at organisational level 			<p>variables, develop a taxonomy, or develop an emergent theory</p> <ul style="list-style-type: none"> • Quants phase tests these results or studies them in more details • RQ formulated from quals findings • Emergent categories identified in quals and quants used to identify the prevalence
Strengths	<ul style="list-style-type: none"> • Makes intuitive sense • Efficient design- quants and quals collected at same time • Each type of data can be collected and analyses separately and independently. Hence lends itself to team research as can have individual experts in quants/quals 	<ul style="list-style-type: none"> • Useful if do not have sufficient time/resources • Can be logistically more manageable (for grad students) • Can be appealing to funding as typically the primary focus is quants 	<ul style="list-style-type: none"> • Two phase structure makes it straightforward to implement • Straightforward structure means single researcher can conduct design • Final report can be written in two phases, making it straightforward to write and clearly delineates for reader • Lends itself to multiphase research • Appeals to quants researchers as begins with strong quants phase 	<ul style="list-style-type: none"> • Two-phase design makes writing, implementing etc straightforward • The inclusion of quants can make a quals based approach more acceptable • Easy to apply to multiphase research
Challenges	<ul style="list-style-type: none"> • Much effort and expertise is required as quants and quals data carries equal weight • Difficulty if faced with the question of what to do if the quants and quals results do not agree • Difficulty of having different samples and different sample size if trying to converge the two datasets • Can be difficult converging data in a meaningful way 	<ul style="list-style-type: none"> • Researcher needs to specify the purpose of collecting the secondary data • Can be difficult to integrate the results if the two methods are used to answer separate questions as the intent is not to converge the data, as in the Triangulation Design 	<ul style="list-style-type: none"> • Length time to implement both phases, with quals phase potentially being longer than quants • Need to decide whether same individuals for both phases • Need to decide which quants results need following up or further explained • Participant selection model • How to specify criteria for selection 	<ul style="list-style-type: none"> • Two phase approach is time/resource consuming • Need to decide whether same individuals for both phases • Which data form quals phase to build quants measures from • Appropriate procedures need to be used to ensure validity and reliability

Appendix 6: Interview Protocol

Interview Guideline: Exploring the role of social networks and knowledge in Operational Improvements



Study Purpose

- Knowledge is now seen as the critical competitive resource.
- Knowledge and how it is developed and exploited is of particular interest to us.
- How and why people use their network to acquire new knowledge, albeit
 - Informally, i.e. mate to help
 - In business to help problem solving- uni, work colleague, suppliers, etc
- Three stages
 - Interviews to explore
 - Survey to quantify and broader feedback

Payoffs

- Feedback reports
- Conference
- Help out doctoral students.

Ethics

- Information is private and confidential
- Free to stop interview at any time
- QUESTION:
 - OK to record?
 - Permission to use information in thesis and published work?

Q1: What is the general role of networks/networking in process improvement/problem solving and business generally?

Q2: Why do people turn to their network for assistance?

Q3: Why people help others? What motivates them to share information/knowledge/experience?

Q4: What do you see as the characteristics/elements of relationships?

Q5: What and how is information/knowledge shared? What are the barriers to this?

Appendix 7: Survey Instrument

----- Page 1 -----

Nottingham University Business School

Exploring the role of Social Networks and Knowledge in Operational Improvements

118 13%

Process improvements are increasingly becoming more cross functional, complex and distributed across organisational boundaries and networks. To combat this, there is the need for more network-based approaches.

This survey, which will take approximately 20 minutes, hopes to deliver a best practice framework that will aid in understanding how new ideas and knowledge are best acquired through our networks in order to maximize the effectiveness of operational improvements.

As a thank you, £2 will be donated to the Red Cross for every completed survey.

A summary report of the findings will be completed sometime in November and posted on my LinkedIn account. Alternatively, if you prefer to receive a copy by email you can leave your email address at the end of the survey.

The survey also asks 4 short questions from your LinkedIn account regarding aspects of your network. To date, LinkedIn is the only tool in existence which can provide such information so we believe this will reveal some very interesting insights. We would therefore be very grateful for your assistance.

----- Page 2 -----

The following questions ask for information on your network from your LinkedIn account. To access this, [click HERE](http://www.linkedin.com/network?trk=hb_tab_net) (http://www.linkedin.com/network?trk=hb_tab_net)

Individual & Network Knowledge (Smith et al., 2005, Van Wijk et al., 2008, Carpenter and Westphal, 2001, Perry-Smith, 2006): **Regarding the size of your network**

1. How many Tier 1 connections do you have?
2. How many very close or good friends?
3. How many known for more than five years?
4. How many interact daily or several times a week?

5. How many Tier 2 connections do you have?



6. Scroll down a little further. Under “**REGIONAL ACCESS**”, how many locations do you have access to? (NB: not the “additional locations”)



7. Scroll down a little further again. Under “**INDUSTRY ACCESS**”, how many industries do you have access to? (NB: not the “additional industries”)



----- Page 3 -----

The following section explores how we use information, knowledge or advice obtained from people in improvement initiatives.

Problem solving (Van Grundy Jr, 1997, Choo et al., 2007b): **Problem solving provides the fundamental structure to many improvement methodologies. To what extent do you use your network and contacts to:**

7-point scale from Not at all/Very great extent

8. Identify problems or opportunities
9. Clarify, define or refine problem or opportunity
10. Generate ideas, problem solutions, product concepts etc
11. Evaluate and select ideas/solutions/concepts
12. Examine implementation issues of the ideas/solutions/concepts

Radicalness (Gatignon et al., 2002): **In the previous 2-3 years, the new or improved products/services/processes introduced by your company as a result of improvement initiatives:**

7-point scale from “strongly disagree” to “strongly agree”

13. Represented a minor improvement over the previous technology
14. Were based on a revolutionary change in technology
15. Were a breakthrough innovation
16. Led to products/processes that were difficult to replace with substitutes using older technology
17. Represented a major technological advance in the subsystems.

----- Page 4 -----

This section asks about the benefits obtained through improvement activities and the ways in which new knowledge creates value in your firm.

Over the last 2–3 years, to what extent has information, knowledge or advice obtained from your network helped with the following:

Project Performance (Levin and Cross, 2004)

7-point scale from Not at all/ Very great extent

(Project effectiveness)

18. Improve overall satisfaction of improvement projects
19. Improve overall performance of improvement projects
20. Improve the project’s value to your organization
21. Improve project's quality

(Project efficiency)

22. Improve projects in coming in on-budget or closer to coming in on-budget
23. Reduce the costs of improvement projects
24. My being able to spend less time on improvement projects
25. Shortening the time improvement projects took

----- Page 5 -----

The following section explores the factors which may enable (or inhibit) the way we search for information, knowledge and advice.

Search Costs (Nebus, 2006): If/when you ask questions or seek information from your network, to what extent do you:

7-point scale from Not at all/ Very great extent

26. Feel that it may be costly in terms of future favours
27. Feel that it might imply inadequacy in own capabilities
28. Feel that it might taint your reputation
29. Feel that it might violate organizational norms
30. Feel that it might bypassing formal processes
31. Feel that it might bypassing lines of authority

Motivation (Füller, 2010): What motivates you to share information, knowledge or advice when answering or responding to questions about improvement initiatives?

7-point scale from strongly disagree/ strongly agree

32. Because I hope to get a monetary compensation an appropriate reward in return.
33. Because I have ideas I want to introduce or share
34. Because I want to get in touch with others
35. To become known as co-inventor.
36. To improve my skills
37. To test my capabilities.
38. Because I enjoy dealing with improvement activities.
39. To keep up with new ideas and innovations.
40. Because I am dissatisfied with existing products/processes
41. Just because I am curious.

Trust (Ha et al., 2011): Think of the last time you sought information, knowledge or advice from someone that helped you with your improvement initiatives. To what extent did you:

7-point scale ranging from “strongly disagree” to “strongly agree”

(Affective Trust)

42. Feel they were open and did not conceal ulterior motives /objectives
43. Feel they had a positive attitude and mutual understanding
44. Believe they were honest
45. Believe they were concerned with mutual respect

(Competence-Based Trust)

46. Think they were capable of helping me
47. Think that they had unique knowledge/skills necessary to help me
48. Believe that they approached their job with professionalism and dedication
49. Given his or her track record, I saw no reason to doubt their competence and preparation

----- Page 6 -----

The following section focuses on the beliefs and attitudes you and your firm has towards improvement initiatives.

Firm-level Entrepreneurial Orientation (Hughes et al., 2007a, Lumpkin et al., 2009): **Regarding your firm, to what extent would you agree with the following?**

7-point scale from “strongly disagree” to “strongly agree”

(Risk Taking)

- 50. Our business emphasizes both exploration and experimentation for opportunities
- 51. People in our business are encouraged to take calculated risks with new ideas
- 52. Our business frequently tries out new ideas

(Innovativeness)

- 53. Our business is creative in its methods of operation
- 54. Our business is often the first to market with new products and services
- 55. We actively introduce improvements and innovations in our business

(Proactiveness)

- 56. We excel at identifying opportunities
- 57. We always try to take the initiative in every situation (e.g. against competitors, in projects and when working with others)
- 58. We initiate actions to which other organizations respond

Individual Entrepreneurial Orientation (Bolton and Lane, 2012): **Regarding your personal approach and attitudes towards to improvement activities:**

7-point scale from “strongly disagree” to “strongly agree”

(Innovativeness)

- 59. I often like to try new and unusual activities that are not typical but not necessarily risky
- 60. In general, I prefer a strong emphasis in projects on unique, one-of-a-kind approaches rather than revisiting tried and true approaches used before
- 61. I prefer to try my own unique way when learning new things rather than doing it like everyone else does
- 62. I favour experimentation and original approaches to problem solving rather than using methods others generally use for solving their problems

(Risk Taking)

- 63. I like to take bold action by venturing into the unknown
- 64. I am willing to invest a lot of time and/or money on something that might yield a high return
- 65. I tend to act “boldly” in situations where risk is involved

(Proactiveness)

- 66. I usually act in anticipation of future problems, needs or changes
- 67. I tend to plan ahead on projects
- 68. I prefer to “step-up” and get things going on projects rather than sit and wait for someone else to do it

----- Page 7 -----

This final section asks about you background

69. What is the size of your current place of employment (number of employees)? (*categories as used on LinkedIn*)

- 1-10
- 11-50
- 51-200
- 201-500
- 501-1000

- 1001-5000
 - 5001-10000
 - 10000+
70. What is your employment status?
- Self employed
 - Full time permanent
 - Part time permanent
 - Contract
 - Unemployed
 - Other _____
71. How frequently do you engage in improvement initiatives which significantly impacts operational performance in terms of cost reduction, quality improvement, throughput etc?
- 2-3 times per year
 - Once year
 - Less than yearly
 - Do not engage
72. What process improvement training have you received? Please tick all that are relevant to you. (*tick box*)
- Lean
 - Yellow/Green belt Six Sigma (SS) or Lean Six Sigma (LSS)
 - Green belt Six Sigma (SS) or Lean Six Sigma (LSS)
 - Black belt Six Sigma (SS) or Lean Six Sigma (LSS)
 - Master Black belt Six Sigma (SS) or Lean Six Sigma (LSS)
 - Total Quality Management (TQM)
 - Theory of Constraints (TOC)
 - Business Process Reengineering (BPR)
 - Process Mapping
 - Statistical Process Control/Charting
 - Other _____
 - No training
73. In the past 12 months, how would you categorize the way you use LinkedIn? Please tick all that are relevant to you. (*tick box*)
- Recruitment (i.e. Job seeking, people search, talent search, talent acquisition)
 - Passive Information Searching (i.e. monitoring news/group feeds, keeping tabs, general interest)
 - Active Information Searching (i.e. seek answers to help practice, share knowledge, help others, find content/information to make professional live better)
 - Build Relationships (i.e. grow network, network with colleagues, maintain relations)
 - Business Development (i.e. generate leads, selling, building business, marketing business, new contracts)
 - Career Management (i.e. personal branding, become a recognised subject expert, build reputation, showcase expertise, increase visibility)

Individual & Network Knowledge (Smith et al., 2005, Van Wijk et al., 2008, Carpenter and Westphal, 2001)

74. How many years of tertiary education do you have?
75. How many years of full time professional experience do you have?
76. What industries have you worked in?
- Agriculture, Fishery & Forestry
 - Automotive
 - Aviation & Aerospace

- Banking & Finance
- Charity & Non-profit
- Construction
- Consulting Services
- Customer Services & Call Centre
- Defence & Military
- Education, Teaching & Training
- Electronics
- Fashion, Design & Tailoring
- Health & Medical
- Hospitality, Travel & Tourism
- Hotel & Catering
- Information Technology
- Insurance & Financial Services
- Logistics, Warehousing & Distribution
- Marine & Allied Trades
- Media & New Media
- Oil & Gas Other
- Pharmaceutical & Biotechnology
- Public Sector
- Purchasing/Buying
- Scientific & Research
- Telecommunications
- Other (please state)

----- Page 8 -----

Thank you for your participation, your time and effort is greatly appreciated.

A report on the findings will be completed sometime in November. If you are interested in receiving a copy, please monitor my LinkedIn account or alternatively leave your email address below.

Lastly, if you know anybody who works in continuous/process improvement who may be interested and also able to help with my research, please could you kindly forward this survey onto them.

Appendix 8 LinkedIn Group Profiles

1) Lean Business System

Members: 17,500

Lean Business System is an industry focused group (not designed for consultants) run by Shingo Prize winner Prof Peter Hines. It is for those wanting to take lean beyond tool/blitz events to a full business-wide approach. The emphasis is all the elements necessary to run a successful and sustainable lean business including: Strategy & Alignment, Value Stream Management, People Enabled Processes, Tools & Techniques as well as the Extended Enterprise. It is cross industry in focus, encompassing all business processes & has an emphasis on sustainable change. Whilst the group is based in the UK it has an international flavour and welcomes members across the world.

2) Lean Six Sigma

Members: 68,000

Lean Six Sigma Professionals and Practitioners joining together to network, business development, business opportunities, best practice sharing and relationship building. We are building this community as the source of all professionals and practitioners of our methods, so I welcome you to invite all others who share in our united community.

3) Continuous Improvement, Six Sigma, & Lean Group

Members: 27,500

Our goal is to facilitate the free exchange of ideas, to ask questions, post jobs, and receive help. To that end, please take advantage of our posting boards: Discussions, Promotions, and Jobs. We welcome messages that pose difficult questions, supply useful answers, communicate opportunities, and network. If you wish to have a subgroup, drop me a note and likely we will set it up.

4) Business Process Improvement

Members: 26,600

This is a group for Business Process Improvement and Quality professionals who want to expand their network and be exposed to new ideas and tools

5) Business Improvement, Change Management & Performance

Members: 28,300

Change management, Cultural Management, Culture Change, Business development, Business improvement, Operational improvement, Performance Management, Performance Improvement, Business process reengineering, Organizational development, Business performance management, Turn around & restructuring, Turn-Around Management, Troubleshooting, Corporate recovery, Corporate Restructuring, Operational Excellence, Kaizen, Six Sigma, Six Sigma, Programme management, Strategy

6) PEX Network & IQPC - Lean Six Sigma & Process Excellence

Members: 18,600

The Process Excellence Network facilitates access to content for Process Excellence, Lean, Six Sigma, Business Process Management, BPM practitioners. Further enhanced with an online community of your peers, we will provide you with the tools and resources to help you perform more effectively and efficiently, while enhancing the quality operations within your organization. Having run global events in the Lean Six Sigma and Process Excellence community for over a decade, IQPC and the PEX Network are uniquely positioned to provide a comprehensive library of articles, podcasts, webinars, video, blogs & seminars gathered from our events & our global network with leaders in the community.

Appendix 9: Within Case Reports

Case 1

Date: November 2010

Whom: Director and consultant, Business Networking Skills Trainer

Q1: General role of networks

The case distinguished between two forms of networks. Firstly, networks within the company are used to better understand firm-specific practices, procedures, norms etc. Secondly, from his experience as a consultant, a “third party” would be used for fresh perspectives or to reduce emotional barriers when politicking was an issue.

Q2: Why do people turn to their network for assistance?

Networks were used primarily for convenience and ease of access to overcome the tediousness of searching through the internet. The case also made reference to the preference for face-to-face contact and conversation rather than databases. As a secondary reason and as mentioned above, was to help with emotional barriers.

Q3: Why people help others? What motivates them to share?

The case first suggests that when you ask people for help they are flattered and therefore will do their best to help, with the proviso that they know, like and trust you. In that way, networking was about giving first and receiving second. In a follow-up email, the case offered a list of questions that he uses when asking for assistance from his network:

Helping others

- Is there anyone you would like an introduction to?
- What particular type of person/business would be a good referral for you?
- How will I know if someone I’m talking to would be a good introduction for you?
- I know someone there / who can help you with that / who knows about
- Why don’t I make the introduction?
- Would you like me to introduce you?

Helping ourselves

- Who do you know who know about / works at / can tell me about / is looking for a job in / supplies / owns / sells / might want to buy?
- Please can you help me?
- Please can you give me some advice about.....?
- If you were me, how would you go about.....?

Q4: What do you see as the characteristics/elements of relationships?

The case emphasised that the use of networks was not just about direct contacts, rather he continued to emphasise the importance of other people they might know with whom he could refer them to. The other fact was whether “they know, like and trust you”.

Q5: What and how is information/knowledge shared? What are the barriers to this?

The case first mentioned the role of knowledge database and went on to give an example from one of his clients, a law firm that uses an intranet to reference cases. Secondly, the formatting and the content of the question where a good answer requires a good question so the better you can articulate the issue, the better the answer. Thirdly were the barriers related to the need for integrating key silos and associated with this, rewards and recognition based on efforts.

Case 2

Date: December 2010

Whom: IT Project Manager

Q1: General role of networks

In project management, knowledge and experiences gained from previous projects is fundamental. Thus, being able to access people with appropriate knowledge through one's network/contacts was seen as critical to job success.

Q2: Why do people turn to their network for assistance?

The case emphasised that the business environment means that everything is urgent and hence networks are used because of time constraints. Networks also came into play in selecting the right people for the job with an emphasis on getting this aspect right at the start of a project, rather than having to reactively use the team's network in later stages of the project. The use of networks was primarily seen to develop solutions and define problems. However in developing solutions, it can result in the need for more information about the problem, thus an iterative process between idea generation and problem definition. Finally, due the use of previous projects and experience, networking efforts were mostly with those within the company. Thus, internal networks were seen for technical assistance, and external network such as family and friends for more general advice.

Q3: Why people help others? What motivates them to share?

The case first highlighted that working together previously provides insight into not only their expertise, but also how they work. Hence prior relationships greatly attribute to reasons for wanting to share knowledge/expertise. The case went on to reflect how the "personal relations" build with an expert technician and the way [he] treated them generally affected their willingness to help, for example being mindful of their needs and not overloading them. Finally, the case made mention of the influence of hierarchy and seniority. For instance, peers or line managers might be used to help with technical problems, but more senior contacts are used to force people to help and mobilise resources.

Q4: What do you see as the characteristics/elements of relationships?

The strength of one's relationship was seen as both a positive and a negative. Having a good relationship with someone means you can more easily turn to that person, but by always turning to that same person, it can frustrate them. Furthermore, certain individuals get the reputation of being "the one" to turn to when projects are in trouble. This can overburden the individual and so one needs to be aware of the loads of such specialists. The case suggested that due to these concerns, it can trigger the need to look outside one's typical contacts for assistance (i.e. to external networks). This can also lead to a secondary benefit of providing fresh new perspectives. As an aside, the case mentioned social events as a great way of building network within the company in order to understand who else could be of assistance in the future.

Q5: What and how is information/knowledge shared? What are the barriers to this?

The discussions focused mainly on the process of transferring knowledge/information. The merits of archiving project information for future reference were discussed and acknowledged, but were not currently being done in [Company X] due to time pressures of the business. This was juxtaposed to the nature that discussing issues face-to-face was seen as; a) more fruitful; b) helps to build relationships; c) helps to learn the type of people that are more useful; and d) find out people's area of expertise.

Case 3

Date: February 2011

Whom: Senior Project and Purchasing Manager

Q1: General role of networks

The case made reference to two general approaches to finding additional information/advice. First, for something completely new and unknown to the individual, surf the net (Google / Wikipedia etc). Second, start by asking a current or past work colleague.

Q2: Why do people turn to their network for assistance?

Drawing a blank on the two options above, the case suggested a refinement of internet based searches and the use of online, subject specific forums. In terms of the use of networks, it was primarily used to either understand the background and/or question existing procedures; or in reference to managing new product development projects, to find out more on the technology or nature of the product.

Q3: Why people help others? What motivates them to share?

The case provided several examples for these motivations:

- 1/ Because some people are that way inclined (they like to help their fellow men/women)
- 2/ Because they have to (my boss just asked me to do this....)
- 3/ Because they have developed an empathy towards somebody (a new starter who needs mentoring in some way)
- 4/ Because of a financial kick-back (they get paid to help)

Q4: What do you see as the characteristics/elements of relationships?

The case first referred to cultural factors such as keeping "face", one-upmanship and "show" in maintaining and building relationships. Secondly, trust in terms of building/gaining it built over time and by actions. Thirdly, being attuned to culture and/or respect. Finally, more social expectations such as dinner/drinks. Finally, more personal attributes like positivity and humility.

Q5: What and how is information/knowledge shared? What are the barriers to this?

In summarising [his] previous comments, the case referred to four types of knowledge sharing approaches:

- 1/ Verbally (One-to-One)
- 2/ Structured (Course-Work many people)
- 3/ Experience (This is where the help thing comes into play)
- 4/ Self-Help (Reading / internet)

In terms of barriers, time constraints were seen as a major limitation and reflect the nature of the attitudes of the firm. In this way, the case reflected on the vertical integration of his firm which allowed easy access to people, but due to the nature of the firm they were. “caught in a time warp” so it was also seen as a restriction. To supplement this, suppliers were seen as a good source of information as they tend to be more specialised. The case contrasted this with a previous employee, an automotive company, where because they outsource almost every component, you were almost obliged to use external sources for assistance. In reference to the case’s purchasing role and engagement with international companies, a second barrier was seen as “language” but the distinction was made not in reference to Chinese/English, but more technical language verses layman speak.

Case 4

Date: February 2011

Whom: Senior Technology Consultant

Q1: General role of networks

The case was also researching IT-based knowledge management systems for his company so much of the discussion intertwined between our corresponding research interests. As such, all client deliverables were shared electronically where consultants would “picking pieces” from reports (i.e. analysis, organizational structure etc). By picking pieces, it provided an introduction and a mean to connect to people with the relevant skills/knowledge.

Q2: Why do people turn to their network for assistance?

Given the large size of the company in addition to its sensitive and proprietary methods, the case said that discussion were mostly within the organization had not really thought about contacting external networks. Furthermore, he questions if external contacts, such as friends, would have the contextual understanding of environment to effectively answer questions. In his experience, he utilises his internal network “almost on a daily basis” and found small, focused group to be highly effective for technical/functional questions. He also observed that when assistance is requested by someone, that the question or context might not be clear so although there might be many responses, it might not be relevant for the application and therefore not useful.

Q3: Why people help others? What motivates them to share?

The case distinguished between junior and senior staff and their behaviours in contributing to knowledge/advice requests. In the case of juniors, they want to look good and demonstrate their expertise to show they are knowledgeable. Furthermore, if they found a pocket of knowledge from external to the firm, they would post it as a means of drawing attention to their expertise and increase their visibility within the firm. In terms of seniors, it was suggested that they don’t share as much “down the ladder” with juniors as they are busier, have less time, not as interests and there are less incentives. They are not interested in technical side but share a lot manager-to-manager.

Q4: What do you see as the characteristics/elements of relationships?

Curiously, the case suggested that when it comes to networking, albeit within the company, there were limited or no relationships. The culture was such that it encouraged the sharing of knowledge, but the knowledge transaction was such that you “bomb them”- i.e. question/grill them for information, then the ‘relationship’ is terminated once the questioner has found what is needed. Further comments such as having performance metric to share information and the obligation to release information would explain such behaviour. Thus, combined with earlier comments on

sourcing people/expertise from past projects, the case suggested that when contacting people this way, the information provided by the expert would only be within the remit of the project. If a question was asked about issues outside the project, the expert wouldn't typically go the extra step. However, if one did have relationship, the case suggested they would- the case followed up with an example of this.

Q5: What and how is information/knowledge shared? What are the barriers to this?

The case first noted that there is so much variety in the type of projects and many ways to do a project, it makes it difficult to formalize knowledge. Subsequently, the company's existing knowledge system is used more to gather exploratory knowledge such as information on new technology, new ways of working, behaviours in emerging markets, and environmental changes.

Given the case's background, technology was seen as a means for finding who to get information from, and who to send too. Thus the absence of appropriate technical systems would mean that one "can't see outside the wall" and therefore would not know where or who to share with.

The third barrier relates to culture. He mentions "politics" but cautioned against going into more details during the interview. The case also reflected positively on the current firm culture saying that the frank and open culture makes you want to ask questions to get things done quicker.

Case 5

Date: February 2011

Whom: Senior Strategy Consultant

Q1: General role of networks

The case began by highlight the knowledge intense nature of consulting. Leading on from this, the case discussed that most consultancies attempt to formalise and codify knowledge through proprietary methodologies, written research pieces, cases studies etc. The problem as he saw it was two-fold: no two projects are the same, thus limiting the usefulness of reports etc; and that it relies on consultants to supply the information although there is a preference to move on to a new project rather spend time writing things down.

Q2: Why do people turn to their network for assistance?

Time constraints was highlighted as a key motive where, for example, if there is a burning need the case would ring or email someone directly who's worked on something similar. In conflict to the systems that codify knowledge, the case commented that people tend to not really read codified material, rather just pick up the phone or go straight to the person. The second motive for networks was for either background information and/or for solutions, depending where in the project cycle. If at the beginning, then ideally those with the necessary expertise would be involved from the onset; if at a later stage, networks helped in generating ideas, avoid reinvent solutions, and/or reduce the possibility of producing outcomes that would be sub-optimal. Thirdly, the case suggested that the use of networks may stem from recognising gaps in one's knowledge and to paraphrase "if you're not an expert but know someone who is, why wouldn't you".

Q3: Why people help others? What motivates them to share?

The case first distinguished between the motivates to sharing knowledge within the firm, and with external contacts. In the case of internal network, there's the expectation to help, suggesting more extrinsic motives. For external networks, the case reflected on a recent example where he used an online forum for help. Although the members did not know him, they were willing to help and perceived expectation for him to "try to reciprocate" in the future. The case also referred to the nature of sharing as a way of demonstrating expertise, stemming more from personal interest rather than "showing off". Finally, the case made an interesting point in regards to serendipity by suggesting that as careers have become more fluid, you never know who will be helpful in the future.

Q4: What do you see as the characteristics/elements of relationships?

The key point that can be attributed to this question was the merits of physically networking. In discussing an example, the case suggested that online networking (i.e. social media) is: a) easier to access; and b) painless, as it can be done from the comfort of your own home. However, if you go to a physical event, people would only go if their interest outweighs the cost of travel time, attendance fees, booking etc. Therefore, quality of a physical event tend to be higher than through virtual networks, thus providing greater value and better serendipitous opportunities.

Q5: What and how is information/knowledge shared? What are the barriers to this?

The case made reference to structure in the shaping of knowledge flows. Firstly, the use of a skills matrix within the firm to identify appropriate expertise by cross referencing functional expertise (i.e. IT, strategy, implementation) with sector expertise (i.e. defence, FMCG). Secondly, in regards to the structure of external network, he observed that networks are developed along similar lines of interest/expertise and so all groups he's involved in are for his specialized interest/expertise. Thus, if he was looking for something outside that, there would be difficulties accessing that kind of knowledge. Next, the case questioned the need to put rigid label to knowledge as in doing so, much of its original richness and value is lost. Finally in particular reference to using online forums, the case suggested being mindful on how you use it- first in regards to the frequency of posting questions and the image it portrays if one posts to regularly; and second, that the more specific one can make a question, better chance there is to get a good answer.

Case 6

Date: March 2011

Whom: Senior Management Consultant, Supply Chain and Logistics

Q1: General role of networks

The case made reference to knowledge as a standard way of working and as a consistent language. In doing so, its reuse provides a means to create future proposals and win business. Knowledge then is seen in the form of standard templates, method/techniques, tool such as "how to conduct an interview" and "top 10 questions for marketing".

Q2: Why do people turn to their network for assistance?

The case first suggested that external parties, albeit Clients turning to Consultants, are used to help build momentum and traction for initiatives, for example overcoming prior failed attempts at a particular strategy. Secondly, networks were seen as useful to help understand how others had tackled a particular issue before and what some of the problems/challenges they faced were- of course being mindful of confidentiality and not taking a 'one size fits all' approach. Finally, on the

cost of searching, the case suggested to “flip it...what’s the cost of not having it and reinventing the wheel every time”.

Q3: Why people help others? What motivates them to share?

A side from “human nature” and quid pro quo, the case based his motives for sharing primarily on the nature of the enquiry. The case had little time for broad sweeping questions and/or respondents that followed up with a battery of follow-on “and, and, and” questions. Rather, there had to be an element of collaboration and cooperation. Furthermore, the enquiry needed to be explained in terms of the business challenge or proposition, in business terms and then gradually “peel the onion to get specifics”.

Q4: What do you see as the characteristics/elements of relationships?

One of the key messages the case portrayed, as mentioned just prior, was the necessity to show evidence of prior effort work and time invested. The experience from previous engagements was also highlighted in so much as if the relationship/association was not maintained or came to an abrupt close, the case would be sceptical to help in future situations or enquiries. Thus “the good people establish contacts and maintain contacts”. Finally, was the nature of “third party introductions”, for example account managers referring consultants to previous project members, illustrating the nature of network gatekeepers and bridging structural holes.

Q5: What and how is information/knowledge shared? What are the barriers to this?

In reference to earlier comments, sharing of knowledge was seen as via: a) standard templates; b) structuring enquiries a business proposition; c) knowledge systems; and d) via introductions based on the client, sector or function.

Case 7

Date: April 2011

Whom: Management Consultant, Higher Education

Q1: General role of networks

Extensive discussions revolved around the nature of consulting and role of network as the case operated in a network of associates. This provided a somewhat different avenue for enquiry to the previous interviews as it looked at networking as a means of doing business. In that sense, network was central, whether it be in winning clients or as a means of assembling project teams. Consequently, the nature of the case’s networks was sometimes ad hoc, where based on knowing the expertise and interest of associates “people pitch for jobs, then ask if you can help”.

Q2: Why do people turn to their network for assistance?

The case pointed to a number of factors: firstly, due to limitation in one’s competence and yet supported with the understanding of the expertise of other associates in her network. Secondly, networking can be a useful to build one’s “personal brand”. The case recalled an example where she referred a Client to an associate by forwarding their LinkedIn profile. This example indecently also demonstrates the nature of the network to share and jointly win business. Thirdly, external consultant were used “to put grease on the wheels” to overcome politicking. Finally, external consultants were used to focus teams on specific projects outside of their normal day job. In doing so, the project “gets energy” and members begin to take ownership of the project in order to sustain interests and effort.

Q3: Why people help others? What motivates them to share?

The case suggested that it's "not a conscious thing" when it comes to sharing, predominately in the context of using networks to win business. In general, she would much prefer for someone to get win a job that she knew rather than someone else, and hence the reason to pass information on. In doing so, it also helped to build one 'visual identity'. Otherwise, the return of favours was central, not in a malicious way but rather "not that [she's] on the lookout, but when the opportunity arises". The case provided a finally example, describing more altruistic motives. She describes a project where she had a choice between two associates, one both equally talented, but one lacking confidence. She subsequently engaged this individual as it would benefit them more to help build their skill set for the future.

Q4: What do you see as the characteristics/elements of relationships?

The nature of direct contacts and social rules were particularly highlighted in this case. Firstly, the case would only engage with members of her direct network. Engaging members of indirect or wider network were subject to "social rules", i.e. not going around the introducing party; or the need to meet them and understand them "not just because you don't trust them but because how do they know about what I do, and how do I know how to work with them and how they work with me". Consequently, because of previously working together, a great deal of trust was generated in the relationship. In terms of more formal mechanisms, teams of associates were "held together with loose service level agreements" during a project/engagement. Finally, the case touched on the need to manage the politics of the relations.

Q5: What and how is information/knowledge shared? What are the barriers to this?

The case outlined a number of knowledge-type activities. As a foundation, the language, definitions, meanings etc of members needed to be settled on "to uncover all the prejudices, misconceptions, confusion, doubt, personal concerns" at the start of an engagement. From this, a gap analysis can be undertaken to clarify the project and develop action lists. Case studies were also mentioned but they were seen more as advertising or a means to reinforce your area of expertise to potential Clients. More often though, the case saw knowledge sharing as informal, for example catching up with a contact every three months to discuss the sector. Similarly, conferences were seen as a major means for her to exchange knowledge due to their structure, i.e. panel sessions, breakout sessions and informally at the Dinner.

Case 8

Date: October 2011

Whom: Management Consultant, Public Sector

Q1: General role of networks

Networking was seen under a number of different lights. First, the case alluded to the fact that Clients would engage him for both his experience, and his network. Second, that networking was more informal then technical. Finally, in describing the tendering process for client, it was suggested that networking is so intertwined that he would never respond to tender unless he wrote it in conjunction with the client as the chances of winning it otherwise is so low. On the issue of external networks specifically, the case stated that most organizations would like to think that they know most things, and almost in contradiction to that, people value what's rare. Therefore, if something is not known, it is viewed as being more valuable and is where consultants come in.

Q2: Why do people turn to their network for assistance?

The suggestion was made that in the vast majority of cases, clients know what they want, but want an external party, such as a Consultant, to facilitate it. Consequently, technical solutions and coming up with ideas was not seen as a key driver for networks, rather networks help to facilitate the way of working and build momentum for change. Thus, the case's job is "holding the technical process so they can come up with the technical solution". Furthermore, when knowledge/information is "borrowed" from other contexts, what ends up being used in the final solution is very small.

The decision then for a firm to engage an external party is two-fold. First, a monetary payment is a clear signal of commitment to the desired outcome, and in doing so, a mechanism in which to discipline themselves to the cause. Secondly, a monetary commitment demonstrated that the firm (and its members) are ready to hear what needs to be done and have taken appropriate work to come to this point.

Q3: Why people help others? What motivates them to share?

The predominate motive to share that the case mentioned was in relation to how it helps endorse and/or visualise expertise. The case reflected on how his firm ran Benchmarking clubs to help the exchange of knowledge. This however, always made a loss and was put down simply as a marketing tool. Secondly, by means of an example, the case explained how networks also provided a means of advertising their involvement in a new/emergent/novel project. In doing so, you become that leader in that field and gain the 'first movers' advantage.

Q4: What do you see as the characteristics/elements of relationships?

Continuing the notion of change, momentum and politics, the case mentioned the need for trust in order to overcome these obstacles. In building such trust, the case mentions that "people buy things of people they like". Thus, there is need to "give free things" such as seminars and the benchmarking clubs. The additional merit is that it provides credibility to the Consultant/firm and shows the type of "exciting things" they are doing. Furthermore, credibility is build from technical knowledge. This technical knowledge "gets you in with the Client", but it's not the work you end up doing for them (rather it is the momentum/change aspects). Lastly, the case mentions that it's all about portfolios- your recent portfolio will drive the kind of work you win, and/or can tender for in the future.

Q5: What and how is information/knowledge shared? What are the barriers to this?

The case operated in a relatively small firm which facilitated discussions on the knowledge activities between the large firms (Cases 4, 5, 6) and smaller firms. In the opinion of the case, who by chance also headed his firm's knowledge management activities, suggested that knowledge flows are a lot easier in smaller firms because of the communal atmosphere and intimacy of the firm means that you "help out cos their your mates". The case also provided insight on the nature of "innovative firms". What was suggested is that these firms aren't any smarter than others, thus challenging extant notions for the need for superior talent. Rather they just build a momentum of projects so people believe they are capable of doing something exciting.

Appendix 10: Multivariate Normality Results

Table 1: Reliability Statistics of Constructs					
Variable	Cronbach α	Variable	Cronbach α	Variable	Cronbach α
T1	N/A Single item	MOT_CUR	N/A Single item	IEO_RT	0.740
T2	N/A Single item	MOT_GAIN	0.795	IEO_INNO	0.722
DENSITY	N/A Single item	MOT_MONEY	N/A Single item	IEO_PRO	0.737
HET_INDUST	N/A Single item	MOT_DISS	N/A Single item	PROBSOLVE	0.936
EDU	N/A Single item	TRUST_AFF	0.899	RADICAL	0.852
HET_WORK	N/A Single item	TRUST_COMP	0.886	EFFECTIVE	0.970
COST_SOC	N/A Single item	FEO_RT	0.849	EFFICIENT	0.936
COST_PSYC	0.922	FEO_INNO	0.796	FEO_PRO	0.768
COST_INST	0.909	MOT_INTRINS	0.61**		

** communalities 0.723; Eigenvalue of 1.447 with 72.3% variance explained; Correlation of 0.447 with sig = 0.000; Kaiser-Meyer-Olkin measure of 0.500; Bartlett's test- chi-square of 43.77 sig = 0.00)

Table 2: Multivariate Skewness						
Moderator/ Test	Small's test (chisq)			Srivastava's test		
	Q1	df	p-value	chi(b1p)	df	p-value
SEARCH	307.2361	13	0.000	1505.4047	13	0.000
MOT	358.0921	15	0.000	1492.1946	15	0.000
TRUST_AFF	310.3288	11	0.000	1506.5073	11	0.000
TRUST_COMP	312.5355	11	0.000	1509.9858	11	0.000
FEO	297.6972	13	0.000	1501.7911	13	0.000
IEO	305.7906	13	0.000	1503.3643	13	0.000

Table 3: Multivariate Kurtosis									
Moderator/ Test	Small's test (chisq)			Srivastava's test			Mardia's test		
	Q2	df	p-value	b2p	N(b2p)	p-value	b2p	N(b2p)	p-value
SEARCH	185.728	13	0.000	11.29	67.154	0.000	336.676	39.4573	0.000
MOT	178.9121	15	0.000	9.988	60.517	0.000	389.255	32.5616	0.000
TRUST_AFF	173.604	11	0.000	12.671	72.024	0.000	287.298	46.9289	0.000
TRUST_COMP	172.372	11	0.000	12.601	71.500	0.000	288.878	47.4427	0.000
FEO	157.217	13	0.000	11.422	68.187	0.000	332.484	38.2897	0.000
IEO	160.397	13	0.000	11.287	67.089	0.000	339.949	40.3686	0.000

Table 4: Multivariate Omnibus			
Moderator/ Test	Small's test (chisq)		
	VQ3	df	p-value
SEARCH	492.9646	26	0.000
MOT	537.0042	30	0.000
TRUST_AFF	483.9337	22	0.000
TRUST_COMP	484.9077	22	0.000
FEO	454.9152	26	0.000
IEO	466.1885	26	0.000

Appendix 11: Cross-loading results

Table 1: Dyad 1- Trust						
	Effective	Efficient	ProbSolv	Radical	TRUST_aff	TRUST_comp
EFFECTIVE 1	0.95	0.78	0.48	0.39	0.05	0.07
EFFECTIVE 2	0.96	0.75	0.50	0.39	0.08	0.11
EFFECTIVE 3	0.97	0.75	0.49	0.37	0.06	0.09
EFFECTIVE 4	0.95	0.71	0.45	0.36	0.07	0.11
EFFICIENT 1	0.80	0.93	0.47	0.52	-0.03	-0.04
EFFICIENT 2	0.79	0.93	0.46	0.51	-0.02	-0.02
EFFICIENT 3	0.55	0.85	0.37	0.27	-0.04	-0.01
EFFICIENT 4	0.70	0.93	0.41	0.34	-0.08	-0.08
PS 1	0.35	0.36	0.77	0.15	0.13	0.12
PS 2	0.40	0.35	0.88	0.06	0.20	0.16
PS 3	0.43	0.44	0.91	0.07	0.29	0.18
PS 4	0.49	0.45	0.92	0.19	0.23	0.20
PS 5	0.49	0.46	0.90	0.12	0.24	0.11
RADICAL 2	0.36	0.42	0.15	0.94	-0.05	0.01
RADICAL 3	0.38	0.42	0.11	0.93	0.02	0.06
RADICAL 4	0.18	0.38	0.01	0.64	-0.07	-0.01
RADICAL 5	0.34	0.39	0.08	0.83	-0.04	0.04
TRUST AFF 1	0.09	-0.05	0.24	-0.11	0.82	0.53
TRUST AFF 2	0.01	-0.09	0.23	-0.04	0.93	0.73
TRUST AFF 3	0.04	-0.04	0.20	-0.02	0.91	0.79
TRUST AFF 4	0.09	0.04	0.21	0.07	0.84	0.68
TRUST COMP 1	0.20	0.02	0.18	0.15	0.69	0.87
TRUST COMP 2	0.10	-0.05	0.10	0.13	0.55	0.82
TRUST COMP 3	0.00	-0.09	0.16	-0.07	0.76	0.91
TRUST COMP 4	0.02	-0.04	0.14	-0.07	0.61	0.82

Table 2a: Dyad 2- Search costs							
	Cost Psyc	Cost Soc	Cost inst	Effective	Efficient	ProbSolv	Radical
SEARCH_COST_2	0.9238	0.6081	0.5152	0.0916	0.1905	-0.0309	0.1334
SEARCH_COST_3	0.977	0.5804	0.5717	-0.033	0.074	-0.0554	-
SEARCH_COST_1	0.6162	1	0.4956	0.0051	-0.0015	-0.1751	0.0909
SEARCH_COST_5	0.5497	0.4552	0.9784	-0.1229	0.0117	0.045	-0.038
SEARCH_COST_6	0.5643	0.515	0.9426	-0.0912	0.0154	0.0279	-
PROJ EFFECTIVE 1	-0.0114	-0.0455	-0.0953	0.95	0.7817	0.4794	0.391
PROJ EFFECTIVE 2	0.0085	-0.0227	-0.1765	0.9628	0.7536	0.5013	0.395
PROJ EFFECTIVE 3	0.0311	0.0336	-0.0662	0.9679	0.7509	0.489	0.3639
PROJ EFFECTIVE 4	0.0183	0.0576	-0.0991	0.9482	0.7125	0.4539	0.3657
PROJ EFFICIENT 1	0.1407	0.0706	-0.0111	0.7935	0.9251	0.4718	0.5143
PROJ EFFICIENT 2	0.0542	0.0243	-0.0192	0.7854	0.9342	0.4678	0.4978
PROJ EFFICIENT 3	0.0955	-0.1024	0.0202	0.5456	0.8474	0.3716	0.2454
PROJ EFFICIENT 4	0.1512	-0.0217	0.0674	0.6962	0.9291	0.4171	0.3222
PS 1 ID	-0.0969	-0.0494	0.0744	0.3292	0.3514	0.758	0.1399
PS 2 DEFINE	-0.0478	-0.1295	0.0689	0.4088	0.352	0.8796	0.0569
PS 3 IG	-0.0354	-0.2086	0.0167	0.4402	0.4406	0.9163	0.066
PS 4 SELECT	0.0011	-0.1494	0.0127	0.5021	0.4618	0.926	0.1917
PS 5 IMPL	-0.054	-0.2028	0.0224	0.5018	0.4748	0.9106	0.1237
RADICAL 2	0.058	0.068	-0.0323	0.3648	0.4228	0.152	0.9475
RADICAL 3	0.0231	0.0902	-0.0396	0.3734	0.4097	0.0995	0.9276
RADICAL 4	0.1071	0.096	0.0774	0.1498	0.3625	-0.0118	0.5747
RADICAL 5	0.0286	0.115	-0.0323	0.3159	0.3754	0.0628	0.7948

Table 2b: Dyad 2- Motivation									
	Effective	Efficient	Gain Know	Intrins Inn	Curious	Dissat	Money	ProbSolv	Radical
PROJ_EFFECT_1	0.950	0.782	0.239	0.269	0.043	-0.045	0.124	0.488	0.392
PROJ_EFFECT_2	0.963	0.754	0.252	0.312	-0.056	-0.022	0.131	0.509	0.396
PROJ_EFFECT_3	0.968	0.751	0.297	0.309	-0.039	-0.033	0.130	0.498	0.3677
PROJ_EFFECT_4	0.949	0.713	0.265	0.275	-0.068	-0.012	0.103	0.463	0.366
PROJ EFFICIENT 1	0.7933	0.925	0.1627	0.1862	-0.0929	-0.143	0.1757	0.4833	0.5201
PROJ EFFICIENT 2	0.7852	0.9341	0.1903	0.2155	-0.0464	-0.1501	0.1262	0.4788	0.5031
PROJ EFFICIENT 3	0.5456	0.8475	0.2303	0.2319	-0.0517	-0.0292	0.0184	0.383	0.2592
PROJ EFFICIENT 4	0.6952	0.9271	0.2788	0.3189	-0.0304	0.0012	0.1468	0.4244	0.3312
MOT_5	0.298	0.242	0.935	0.3564	0.2173	0.0705	-0.0113	0.2797	-0.097
MOT_6	0.194	0.179	0.893	0.2441	0.1314	0.0955	0.0415	0.2203	-0.061
MOT_7	0.256	0.227	0.280	0.9539	0.2524	0.19	-0.2816	0.3158	0.044
MOT_8	0.311	0.242	0.342	0.775	0.2724	0.2309	-0.2076	0.1499	-0.034
MOT_10	-0.031	-0.062	0.196	0.2888	1	0.2167	0.0646	0.0768	0.012
MOT_9	-0.029	-0.094	0.089	0.227	0.217	1	0.0243	-0.0176	-0.159
MOT_1	0.128	0.133	0.013	-0.2877	0.0646	0.0243	1	-0.0111	0.139
PS_1_ID	0.3349	0.3578	0.1993	0.1585	0.0326	-0.0554	0.0048	0.7684	0.1426
PS_2_DEFINE	0.4325	0.3863	0.2945	0.2296	0.0623	-0.0712	0	0.8926	0.0696
PS_3_IG	0.4456	0.4458	0.2221	0.31	0.0654	0.0107	-0.0094	0.9182	0.0726
PS_4_SELECT	0.5235	0.4915	0.2277	0.2862	0.091	0.0093	0.0164	0.931	0.1954
PS_5_IMPL	0.5012	0.4696	0.2803	0.2889	0.0787	0.0109	-0.057	0.9093	0.121
RADICAL_2	0.3612	0.4158	-0.0753	0.0389	0.0676	-0.1313	0.1283	0.1562	0.9356
RADICAL_3	0.3843	0.4189	-0.1418	0.038	0.0055	-0.1976	0.095	0.1119	0.9304
RADICAL_4	0.1712	0.3838	-0.1078	0.0074	-0.15	-0.0544	0.0815	0.0036	0.6269
RADICAL_5	0.331	0.391	-0.0026	-0.0433	-0.0828	-0.1	0.1623	0.0826	0.8227

Table 3a: Individual level Entrepreneurial Orientation							
	Effective	Efficient	ProbSolv	Radical	iEO_Inno	iEO_Pro	iEO_RT
PROJ_EFFECTIVE_1	0.950	0.782	0.480	0.397	0.115	0.059	0.156
PROJ_EFFECTIVE_2	0.963	0.757	0.496	0.400	0.114	0.083	0.156
PROJ_EFFECTIVE_3	0.968	0.751	0.489	0.374	0.116	0.110	0.105
PROJ_EFFECTIVE_4	0.949	0.715	0.452	0.365	0.128	0.110	0.143
PROJ EFFICIENT_1	0.795	0.926	0.481	0.526	0.151	0.069	0.180
PROJ EFFICIENT_2	0.788	0.935	0.479	0.516	0.157	0.128	0.198
PROJ EFFICIENT_3	0.548	0.849	0.383	0.269	0.161	0.143	0.221
PROJ EFFICIENT_4	0.696	0.928	0.422	0.339	0.158	0.169	0.213
PS_1_ID	0.328	0.361	0.760	0.140	0.195	0.140	0.087
PS_2_DEFINE	0.407	0.360	0.883	0.065	0.245	0.176	0.139
PS_3_IG	0.440	0.453	0.915	0.072	0.316	0.187	0.273
PS_4_SELECT	0.501	0.470	0.922	0.176	0.256	0.133	0.154
PS_5_IMPL	0.500	0.483	0.904	0.110	0.197	0.148	0.182
RADICAL_2	0.367	0.432	0.142	0.927	0.129	0.040	0.009
RADICAL_3	0.385	0.418	0.108	0.928	0.051	0.020	0.028
RADICAL_4	0.169	0.372	0.009	0.646	0.130	-0.055	-0.017
RADICAL_5	0.340	0.395	0.091	0.845	0.022	-0.018	-0.008
iEO_INNO_1	0.065	0.083	0.280	0.082	0.754	0.181	0.367
iEO_INNO_2	0.102	0.151	0.134	0.142	0.792	0.055	0.398
iEO_INNO_3	0.149	0.164	0.195	-0.002	0.752	0.103	0.463
iEO_INNO_4	0.046	0.138	0.120	0.036	0.612	0.052	0.361
iEO_PRO_1	0.109	0.131	0.097	0.052	0.094	0.670	0.221
iEO_PRO_2	0.026	0.117	0.053	0.145	0.174	0.710	0.147
iEO_PRO_3	0.074	0.099	0.192	-0.040	0.131	0.908	0.083
iEO_RT_1	-0.036	0.065	0.119	0.034	0.507	0.072	0.712
iEO_RT_2	0.139	0.213	0.174	-0.086	0.399	0.163	0.810
iEO_RT_3	0.205	0.222	0.167	0.090	0.418	0.140	0.867

Table 3b: Firm level Entrepreneurial Orientation							
	Effective	Efficient	ProbSolv	Radical	fEO Inno	fEO Pro	fEO RT
PROJ_EFFECTIVE_1	0.952	0.785	0.505	0.399	0.326	0.234	0.314
PROJ_EFFECTIVE_2	0.963	0.756	0.517	0.402	0.308	0.278	0.326
PROJ_EFFECTIVE_3	0.968	0.754	0.506	0.373	0.373	0.306	0.371
PROJ_EFFECTIVE_4	0.949	0.716	0.472	0.371	0.347	0.317	0.390
PROJ EFFICIENT_1	0.796	0.926	0.489	0.521	0.367	0.328	0.298
PROJ EFFICIENT_2	0.788	0.935	0.485	0.504	0.385	0.351	0.345
PROJ EFFICIENT_3	0.552	0.851	0.391	0.262	0.158	0.240	0.159
PROJ EFFICIENT_4	0.699	0.928	0.430	0.334	0.196	0.273	0.215
PS_1_ID	0.347	0.367	0.765	0.148	0.157	0.221	0.179
PS_2_DEFINE	0.426	0.370	0.882	0.073	0.165	0.170	0.196
PS_3_IG	0.462	0.461	0.913	0.083	0.026	0.167	0.125
PS_4_SELECT	0.517	0.472	0.924	0.195	0.156	0.227	0.222
PS_5_IMPL	0.517	0.487	0.906	0.138	0.134	0.246	0.211
RADICAL_2	0.374	0.425	0.172	0.940	0.387	0.302	0.278
RADICAL_3	0.386	0.412	0.115	0.926	0.519	0.332	0.380
RADICAL_4	0.167	0.366	0.006	0.617	0.303	0.237	0.207
RADICAL_5	0.330	0.386	0.083	0.821	0.396	0.314	0.315
FEO_INNO_1	0.271	0.279	0.123	0.319	0.871	0.624	0.755
FEO_INNO_2	0.220	0.181	0.068	0.409	0.740	0.523	0.622
FEO_INNO_3	0.366	0.300	0.147	0.478	0.901	0.624	0.716
FEO_PRO_1	0.311	0.365	0.238	0.361	0.639	0.912	0.670
FEO_PRO_2	0.195	0.213	0.196	0.229	0.571	0.875	0.606
FEO_PRO_3	0.249	0.189	0.035	0.303	0.689	0.589	0.661
FEO_RT_1	0.292	0.218	0.203	0.224	0.683	0.657	0.892
FEO_RT_2	0.367	0.269	0.175	0.380	0.769	0.655	0.880
FEO_RT_3	0.311	0.273	0.182	0.334	0.748	0.635	0.871

Appendix 12: Guidelines- *The Fish!*

The key recommendation from this research is that a focus on growing the volume of knowledge stocks appears to be far less rewarding than focusing on the mechanisms that translate it to useable knowledge. In doing so, it makes the distinction between our total stocks of knowledge, and the far smaller amount of knowledge applied in problem solving. To portray this, an analogy of a fish is used as follows- the figure below summarises this:

- The factors which determine our ability to manoeuvre and progress in knowledge intensive exercises rests on the volume of knowledge which we can draw upon, just as *The Tail* of a fish provides propulsion and its shape determining agility and speed.
- *The Head* of a fish determines what it's doing, where it is going and how it's going to get there; just as problem solving provides the process for determining goals, the means to deliver them, and the context to apply knowledge.
- Crucially, there may be ample knowledge (tail) and appropriate mechanisms to deliver goals (head), but without an appropriate means to connect the two, little would be achieved. This is the role of *The Body*. To connect the tail to the head and thereby providing the muscle to propel the fish forward.

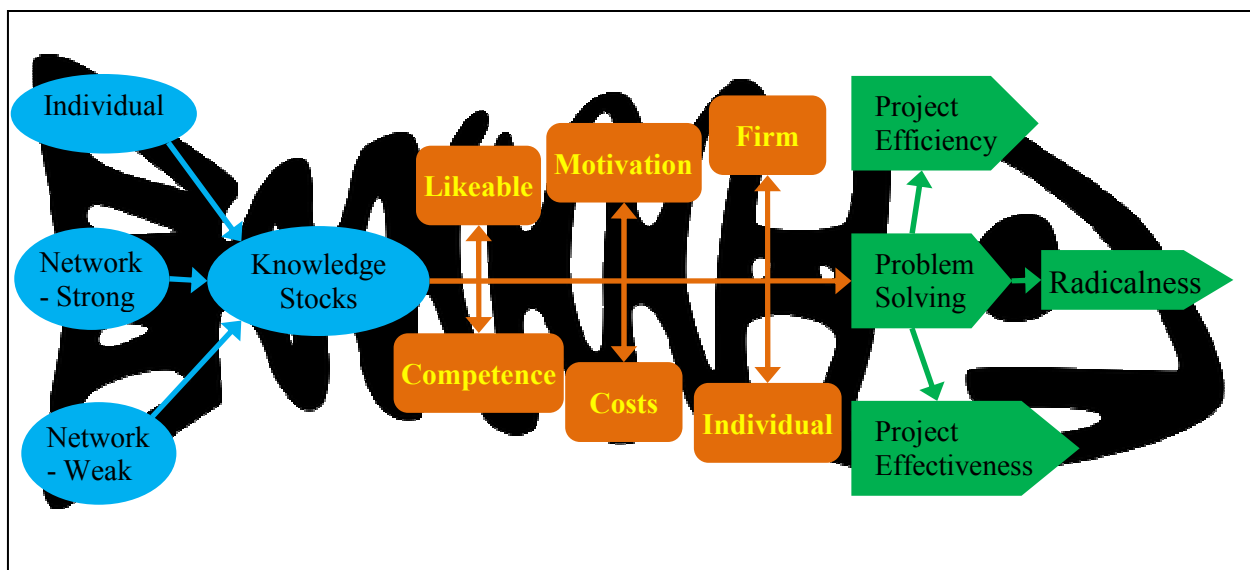


Figure 1: The Fish!

The Tail

The tail represents the total stock of knowledge which we draw on and consists of three distinct dimensions- individually held knowledge from our education and work experience; knowledge stemming from our weaker, more tenuous, indirect network ties such as “friends of friends”; and knowledge from the more readily accessible direct network ties (aka strong). The research identified that knowledge from strong network ties is approximately *twice* as effective in building knowledge stocks as individually held knowledge; and that individually held knowledge in turn is approximately *twice* as effective as knowledge from weak network ties. This finding challenges the norm that training (i.e. individually held knowledge) is the best and/or only way to improve knowledge stocks. Rather, efforts to improve and encourage the use of network-held knowledge may in fact be far more rewarding. Furthermore, it places a greater emphasis on well connected individuals, rather than on the educated elite.

Remarkably too, the diversity or heterogeneity in one's network was found statistical to be the most significant contributor to our stocks of knowledge, over and above more traditional thinking of network size. As one of the earlier cases suggests, networks are typically developed with members that share a common interest/expertise, where factors such as common training experiences, a shared language and similar professional experience aid in building the size of the network. However, the case goes on to state that if he was looking for something outside of his expertise, there would be difficulties accessing that kind of knowledge. Thus networking with members of similar expertise might make it easier to build network size, it may result in homogeneous networks, which as the statistics show, it is a mixed blessing.

The Body

The statistical findings of the research suggest first that trust based on honesty is more likely to drive knowledge flows than trust based on the perception of talent and competence. In a Harvard Business Review article, Casciaro and Lobo (2005) distinguish between perceived competence and likeableness in network formation which can be adapted here. Most obviously we want to keep those Loveable Stars and avoid those Incompetent Jerks; then condition the remaining. In the case of Loveable Fools, those actors who are networks "hubs" but are mediocre in their abilities can be repositioned to help connect networks for example in disseminating a new technology or project; or repositioned to help mitigate internal politicking or organisational resistance. In the case of Competent Jerks, those talented individuals with less than ideal social skills, can be extrinsically motivated by rewarding good behaviour and punishing bad behaviour; coached in order to socialise them; or be repositioned to more independent work to reduce the need for social compliance.

	Likeable	Jerk
Competent	Lovable Star - Desperately wanted	Competent Jerk - Reward/Punish behaviour - reposition to independent roles
Incompetent	Lovable Fools - Reposition to link networks - Reposition to mitigate organisational resistance	Incompetent Jerk - Self explanatory

Table 1: Comparison (adapted from Casciaro and Lobo, 2005¹⁶)

The second findings related the costs incurred by an individual in searching for help, and the motives of the knowledge giver to share and help. In the case of psychological costs, those cost based on the embarrassment in asking for help, it would appear that individuals with a curiosity in the subject and those who are looking to test and extent their knowledge are more likely to help. Furthermore, when an individual is more satisfied with their current work practices, the positive atmosphere appears to motivate the sharing of knowledge and aids in reducing these psychological costs.

The second key cost are institutional, those political and authoritarian costs such as bypassing formal procedures. Here, individuals motivated by the desire to test their expertise appeared to

¹⁶Casciaro, T. and M. Lobo (2005). "Competent Jerks, Lovable Fools and the Formation of Social Networks." Harvard Business Review 83(6): 92-100.

mitigate such costs. Potentially, these individuals may be perceived as subject expertise, thus the knowledge acquired from them would appear to come from a credible source. Thus the seemingly high quality of knowledge gained could be leveraged against disciplinary action or aid in justifying the violation if/when it is needed.

The third and final observation from the study is in the alignment, or lack of, between the individual and firm's attitudes towards *proactiveness* in identifying process improvement opportunities, *innovativeness* in the outcomes and approach, and level of *risk taking* or experimenting. The table below summarises the findings. The first observation is that proactiveness, innovativeness and risk taking at the individual level is not supported by proactiveness, innovativeness and risk taking at the firm level respectively. Rather what appears is that a risk taking individual is supported by a proactive firm. The logic here is that an individual who more likely to take risks and try things, encourages action which is aligned to a firm that is driven to find opportunities, for example as in *kaizen* mindset of continuous improvement.

		Firm Level		
		Proactive	Innovative	Risk taking
Individual Level	Proactive	-	-	-
	Innovative	↓	-	↑
	Risk taking	↑	-	-

Table 2: Alignment between the individual and firms attitudes

Next, innovative and creative individuals are supported by a risk taking culture. Rationalising this, personal creativity is seen as a blessing when the firm likes to experiment with creative/unique approaches, where new ideas which challenge and extend are valued by the firm, which in turn, motivates you. Finally, innovative individuals are hindered by firm proactiveness. Here, the conflict may stem from the firm's desire for action and feasibility in solutions; whilst the individual has a preference for ideas and values uniqueness and creativeness in solutions.

The Head

Finally, there was strong evidence to show that the before mentioned factors supported problem solving which in turn increased the effectiveness and efficiency of process improvements projects. Table 3 below provides some indicative reasons for this.

Problem Solving Stage	Effectiveness	Efficiency
Identify		- New tools/techniques
Define	- Knowledge of other considerations	- Similar problems
Generate	- More people to bounce ideas off	- Pre-existing solutions
Select	- Trial and Error suggestions	
	- More people to bounce ideas off	
Implement	- Knowledge of other considerations	

Table 3: Plausible effects of network-based knowledge

References

- ABELL, P., FELIN, T. & FOSS, N. 2008. Building micro-foundations for the routines, capabilities, and performance links. *Managerial and Decision Economics*, 29, 489-502.
- ACKOFF, R. L. 1989. From data to wisdom. *Journal of Applied Systems Analysis*, 16, 3-9.
- ADLER, P. & KWON, S. 2002. Social capital: prospects for a new concept. *Academy of Management Review*, 27, 17-40.
- AGARWAL, R. & TANNIRU, M. R. 1990. Knowledge Acquisition Using Structured Interviewing: An Empirical Investigation. *Journal of Management Information Systems*, 7, 123-140.
- AGUINIS, H., BEATY, J. C., BOIK, R. J. & PIERCE, C. A. 2005. Effect Size and Power in Assessing Moderating Effects of Categorical Variables Using Multiple Regression: A 30-Year Review. *Journal of Applied Psychology*, 90, 94-107.
- AIKEN, L. S. & WEST, S. G. 1991. *Multiple Regression: Testing and Interpreting Interactions*, London, Sage Publications.
- ALAVI, M. & LEIDNER, D. E. 2001. Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 25, 107-136.
- ALI, S., PETERS, L. D., HE, H.-W. & LETTICE, F. 2010. Market based organisational learning, dynamic, and substantive capabilities: an integrative framework. *Journal of Strategic Marketing*, 18, 363-377.
- ALMEIDA, P. & PHENE, A. 2004. Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation. *Strategic Management Journal*, 25, 847-864.
- ALMIRALL, E. & CASADESUS-MASANELL, R. 2010. Open vs. Closed Innovation: A Model of Discovery and Divergence. *Academy of Management Review*, 35, 27-47.
- AMABILE, T. 1983. The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, 45, 357-376.
- AMABILE, T. 1996. *Creativity in Context*, Oxford, Westview Press.
- ANAND, G., WARD, P. T. & TATIKONDA, M. V. 2010. Role of explicit and tacit knowledge in Six Sigma projects: An empirical examination of differential project success. *Journal of Operations Management*, 28, 303-315.
- ANAND, G., WARD, P. T., TATIKONDA, M. V. & SCHILLING, D. A. 2009. Dynamic capabilities through continuous improvement infrastructure. *Journal of Operations Management*, 27.
- ANOKHIN, S., ÖRTQVIST, D., THORGREN, S. & WINCENT, J. 2011. Corporate Venturing Deal Syndication and Innovation: the Information Exchange Paradox. *Long Range Planning*, In Press, Corrected Proof.
- ARGYRIS, C. 1977. Organizational learning and management information systems. *Accounting, Organizations and Society*, 2, 113-123.
- ARIKAN, A. T. 2009. Interfirm knowledge exchanges and the knowledge creation capability of clusters. *Academy of Management Review*, 34, 658-676.
- AURICH, J. C., OSTERMAYER, D. & WAGENKNECHT, C. H. 2009. Improvement of manufacturing processes with virtual reality-based CIP workshops. *International Journal of Production Research*, 47, 5297 - 5309.
- BACHARACH, S. B., BAMBERGER, P. A. & VASHDI, D. 2005. DIVERSITY AND HOMOPHILY AT WORK: SUPPORTIVE RELATIONS AMONG WHITE AND AFRICAN-AMERICAN PEERS. *Academy of Management Journal*, 48, 619-644.
- BARKER, M. 2003. Assessing the 'Quality' in Qualitative Research. *European Journal of Communication*, 26, 315-335.

- BARNES, D. 2001. Research methods for the empirical investigation of the process of formation of operations strategy. *International Journal of Operations & Production Management*, 21, 1076-1095.
- BARNEY, J. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17, 99-120.
- BARON, R. M. & KENNY, D. A. 1986. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173-1182.
- BARRATT, M. & OKE, A. 2007. Antecedents of supply chain visibility in retail supply chains: A resource-based theory perspective. *Journal of Operations Management*, 25, 1217-1233.
- BATEMAN, N. 2005. Sustainability: the elusive element of process improvement. *International Journal of Operations & Production Management*, 25, 261-276.
- BATEMAN, N. & DAVID, A. 2002. Process Improvement Programmes: a model for assessing sustainability. *International Journal of Operations & Production Management*, 22, 515-526.
- BEACH, R., MUHLEMANN, A. P., PRICE, D. H. R., PATERSON, A. & SHARP, J. A. 2001. The role of qualitative methods in production management research. *International Journal of Production Economics*, 74, 201-212.
- BECKER, J.-M., KLEIN, K. & WETZELS, M. 2012. Hierarchical Latent Variable Models in PLS-SEM: Guidelines for Using Reflective-Formative Type Models. *Long Range Planning*, 45, 359-394.
- BELL, G. 2005. Clusters, networks and firm innovativeness. *Strategic Management Journal*, 26, 287-295.
- BENNER, M. J. & TUSHMAN, M. 2002. Process Management and Technological Innovation: A Longitudinal Study of the Photography and Paint Industries. *Administrative Science Quarterly*, 47, 676-706.
- BERGER, C. R. & CALABRESE, R. J. 1975. Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication. *Human Communication Theory*, 1.
- BESSANT, J., CAFFYN, S. & GALLAGHER, M. 2001. An evolutionary model of continuous improvement behaviour *Technovation*, 21, 67-77
- BESSANT, J. & FRANCIS, D. 1999. Developing strategic continuous improvement capability. *International Journal of Operations & Production Management*, 19, 1106-1119.
- BHATT, G. D. 2000. An empirical examination of the effects of information systems integration on business process improvement. *international Journal of Operations & Production Management*, 20, 1331-1359.
- BHATT, G. D. & STUMP, R. L. 2001. An empirically derived model of the role of IS networks in business process improvement initiatives. *Omega*, 29, 29-48.
- BIERLY III, P. E., DAMANPOUR, F. & SANTORO, M. D. 2009. The Application of External Knowledge: Organizational Conditions for Exploration and Exploitation. *Journal of Management Studies*, 46, 481-509.
- BIRKINSHAW, J. 2002. Managing Internal R&D Networks in Global Firms: What Sort of Knowledge is Involved? *Long Range Planning*, 35, 245-267.
- BIRKINSHAW, J. & GIBSON, C. 2004. Building Ambidexterity Into an Organization. *MIT Sloan Management Review*, 45, 47-55.
- BISSON, P., STEPHENSON, E. & VIGUERIE, P. 2010. The productivity imperative *McKinsey Quarterly*, June, 1-7.

- BOH, W. F. 2008. Reuse of knowledge assets from repositories: A mixed methods study. *Information & Management*, 45, 365-375.
- BOLTON, D. L. & LANE, M. D. 2012. Individual entrepreneurial orientation: development of a measurement instrument. *Education + Training*, 54, 219-233.
- BORGATTI, S. P. & CROSS, R. 2003. A Relational View of Information Seeking and Learning in Social Networks. *Management Science*, 49, 432-445.
- BOYER, K. & SWINK, M. 2008. Empirical Elephants—Why Multiple Methods are Essential to Quality Research in Operations and Supply Chain Management. *Journal of Operations Management*, 23, 338-344.
- BRAH, S. A., WONG, J. L. & RAO, B. M. 2000. TQM and business performance in the service sector: a Singapore study. *international Journal of Operations & Production Management*, 20, 1293-1312.
- BRASS, D. J., BUTTERFIELD, K. D. & SKAGGS, B. C. 1998. Relationships and unethical behavior: A social network perspective. *Academy of Management Review*, 23, 14-31.
- BRAUNSCHEIDEL, M. J. & SURESH, N. C. 2009. The organizational antecedents of a firm's supply chain agility for risk mitigation and response. *Journal of Operations Management*, 27, 119-140.
- BROWN, T. E., DAVIDSSON, P. & WIKLUND, J. 2001. An operationalization of Stevenson's conceptualization of entrepreneurship as opportunity-based firm behavior. *Strategic Management Journal*, 22, 953-968.
- BRYMAN, A. 2008. *Social research methods*, Oxford, Oxford University Press.
- BRYMAN, A. & CRAMER, D. 2009. *Quantitative data analysis with SPSS 14, 15 and 16 : a guide for social scientists*, Hove, Routledge.
- BUHMAN, C., KEKRE, S. & SINGHAL, J. 2005. Interdisciplinary and Interorganizational Research: Establishing the Science of Enterprise Networks. *Production & Operations Management*, 14, 493-513.
- CADOGAN, J. & LEE, N. 2010. Workshop on Structural Equation Modelling (LISREL). www.research-training.com.
- CAFFYN, S. 1997. Extending continuous improvement to the new product development process. *R&D Management*, 27, 253-267.
- CAMISÓN, C. & FORÉS, B. 2010. Knowledge absorptive capacity: New insights for its conceptualization and measurement. *Journal of Business Research*, 63, 707-715.
- CAMISÓN, C. & VILLAR-LÓPEZ, A. 2012. On How Firms Located in an Industrial District Profit from Knowledge Spillovers: Adoption of an Organic Structure and Innovation Capabilities. *British Journal of Management*, 23, 361-382.
- CARAYANNIS, E. G. 1999. Fostering synergies between information technology and managerial and organizational cognition: the role of knowledge management. *Technovation*, 19, 219-231.
- CAREY, S., LAWSON, B. & KRAUSE, D. 2011. Social Capital Configuration; Legal Bonds and Performance in Buyer-Supplier Relationships. *Journal of Operations Management*, 29, 277-288.
- CARPENTER, M. A. & WESTPHAL, J. D. 2001. The strategic context of external network ties: Examining the impact of director appointments on board involvement in strategic decision making. *Academy of Management Journal*, 44, 639-660.
- CARROLL, G. R. & TEO, A. C. 1996. On the social networks of managers. *Academy of Management Journal*, 39, 421-440.
- CASCIARO, T. & LOBO, M. 2005. Competent Jerks, Lovable Fools and the Formation of Social Networks. *Harvard Business Review*, 83, 92-100.
- CENFETELLI, R. T. & BASSELLIER, G. 2009. Interpretation of Formative Measurement in Information Systems Research. *MIS Quarterly*, 33, 689-707.

- CHANDLER, G. N. & LYON, D. W. 2009. Involvement in Knowledge-Acquisition Activities by Venture Team Members and Venture Performance. *Entrepreneurship Theory and Practice*, 33, 571-592.
- CHEN, J. C., LI, Y. & SHADY, B. D. 2010. From value stream mapping toward a lean/sigma continuous improvement process: an industrial case study. *International Journal of Production Research*, 48, 1069 - 1086.
- CHESBROUGH, H. 2003. *Open Innovation: the new imperative for Creating and Profiting from Technology*, Boston, Harvard Business School Press.
- CHESBROUGH, H. 2006. Open Innovation: A new paradigm for understanding industrial innovation. In: CHESBROUGH, H., VANHAVERBEKE, W. & WEST, J. (eds.) *Open Innovation: Researching a new paradigm*. Oxford University Press.
- CHESBROUGH, H. & APPELYARD, M. M. 2007. Open Innovation and Strategy. *California Management Review*, 50, 57-76.
- CHESBROUGH, H. & GARMAN, A. R. 2009. How Open Innovation Can Help You Cope in Lean Times. *Harvard Business Review*, December, 68-76.
- CHILES, T. H. & CHOI, T. Y. 2000. Theorizing TQM: An Austrian and Evolutionary Economics Interpretation. *Journal of Management Studies*, 37, 185-212.
- CHIN, W. W. & DIBBERN, J. 2010. An Introduction to a Permutation Based Procedure for Multi-Group PLS Analysis: Results of Tests of Differences on Simulated Data and a Cross Cultural Analysis of the Sourcing of Information System Services Between Germany and the USA. In: ESPOSITO VINZI, V., CHIN, W. W., HENSELER, J., WANG, H. & FASSOTT, G. (eds.) *Handbook of Partial Least Squares*. Springer Berlin Heidelberg.
- CHIN, W. W., MARCOLIN, B. L. & NEWSTED, P. R. 2003. A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study. *Information Systems Research*, 14, 189-217.
- CHIN, W. W. & NEWSTED, P. R. 1999. Structural equation modelling analysis with small samples using partial least squares. In: HOYLE, R. H. (ed.) *Statistical strategies for small sample research*. Sage.: Thousand Oaks, CA.
- CHOO, A. S. 2010. Impact of a Stretch Strategy on Knowledge Creation in Quality Improvement Projects. *IEEE Transactions on Engineering Management*, 58, 87 - 96.
- CHOO, A. S., LINDERMAN, K. & SCHROEDER, R. 2007a. Method and Psychological Effects on Learning Behaviors and Knowledge Creation in Quality Improvement Projects. *Management Science*, 53, 437-450.
- CHOO, A. S., LINDERMAN, K. W. & SCHROEDER, R. G. 2007b. Method and context perspectives on learning and knowledge creation in quality management. *Journal of Operations Management*, 25, 918-931.
- CHOPRA, S., LOVEJOY, W. & YANO, C. 2004. Five decades of operations management and the prospects ahead. *Management Science*, 50, 8-14.
- COHEN, J. 1992. A power primer. *Psychological bulletin* 112.
- COHEN, J., COHEN, P., WEST, S. G. & AIKEN, L. S. 2003. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, London, Lawrence Erlbaum Associates.
- COHEN, W. M. & LEVINTHAL, D. A. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35, 128-152.
- COUSINS, P. D., HANDFIELD, R. B., LAWSON, B. & PETERSEN, K. J. 2006. Creating supply chain relational capital: The impact of formal and informal socialization processes. *Journal of Operations Management*, 24, 851-863.

- COVIN, J. G., GREEN, K. M. & SLEVIN, D. P. 2006. Strategic Process Effects on the Entrepreneurial Orientation–Sales Growth Rate Relationship. *Entrepreneurship Theory and Practice*, 30, 57-81.
- COVIN, J. G. & SLEVIN, D. P. 1988. THE INFLUENCE OF ORGANIZATION STRUCTURE ON THE UTILITY OF AN ENTREPRENEURIAL TOP MANAGEMENT STYLE. *Journal of Management Studies*, 25, 217-234.
- COVIN, J. G. & SLEVIN, D. P. 1989. Strategic management of small firms in hostile and benign environments. *Strategic Management Journal*, 10, 75-87.
- COWAN, R., JONARD, N. & ZIMMERMANN, J.-B. 2007. Bilateral Collaboration and the Emergence of Innovation Networks. *Management Science*, 53, 1051-1067.
- CRAIGHEAD, C. W. & MEREDITH, J. 2008. Operations management research: evolution and alternative future paths. *International Journal of Operations & Production Management*, 28, 710-726.
- CRESWELL, J. 2009. *Research design: qualitative, quantitative, and mixed methods approaches*, Thousand Oaks, Calif, SAGE Publishing.
- CRESWELL, J. & PLANO-CLARK, V. 2007. *Designing and conducting mixed methods research*, SAGE Publications.
- CROSS, R. & CUMMINGS, J. N. 2004. Tie and network correlates of individual performance in knowledge-intensive work. *Academy of Management Journal*, 47, 928-937.
- CROSS, R., PARKER, A., PRUSAK, L. & BORGATTI, S. 2001. Knowing What We Know: Supporting Knowledge Creation and Sharing in Social Networks. *Organizational Dynamics*, 30, 100-120.
- CROSSAN, M. M., LANE, H. W. & WHITE, R. E. 1999. An organizational learning framework: From intuition to institution. *Academy of Management Review*, 24, 522-537.
- CUMMINGS, J. N. 2004. Work Groups, Structural Diversity, and Knowledge Sharing in a Global Organization. *Management Science*, 50, 352-364.
- DA MOTA PEDROSA, A. & JASMAND, C. 2011a. Individual level Absorptive Capacity. *DRUID 2011- INNOVATION, STRATEGY, and STRUCTURE - Organizations, Institutions, Systems and Regions*. Copenhagen Business School, Denmark.
- DA MOTA PEDROSA, A. & JASMAND, C. 2011b. Individual level Absorptive Capacity: Dimensions, measurement, and nonological network. *Academy of Management Journal*, Under Review.
- DA SILVA, N. & DAVIS, A. R. 2011. Absorptive Capacity at the Individual Level: Linking Creativity to Innovation in Academia. *The Review of Higher Education*, 34, 355-379.
- DE DREU, C. K. W., BAAS, M. & NIJSTAD, B. A. 2008. Hedonic Tone and Activation Level in the Mood-Creativity Link: Toward a Dual Pathway to Creativity Model. *Journal of Personality and Social Psychology*, 94, 739-756.
- DE TONI, A. & NASSIMBENI, G. 2001. A method for the evaluation of suppliers' co-design effort. *International Journal of Production Economics*, 72, 169-180.
- DEAN, D. L., HENDER, J. M., RODGERS, T. L. & SANTANEN, E. L. 2006. Identifying Quality, Novel, and Creative Ideas- Constructs and Scales for Idea Evaluation. *Journal of the Association for Information Systems*, 7, 646-699.
- DECARLO, L. T. 1997. On the meaning and use of kurtosis. *Psychological Methods*, 2, 292-307.
- DELBRIDGE, R. & BARTON, H. 2002. Organizing for continuous improvement: Structures and roles in automotive components plants. *international Journal of Operations & Production Management*, 22, 680-692.
- DELOITTE 2009. Insights from Deloitte's 2009 Global Shared Services Survey. Deloitte Touche Tohmatsu.

- DENG, X., DOLL, W. J. & CAO, M. 2008. Exploring the absorptive capacity to innovation/productivity link for individual engineers engaged in IT enabled work. *Information & Management*, 45, 75-87.
- DHANARAG, C. & PARKHE, A. 2006. Orchestrating innovation networks. *Academy of Management Review*, 31, 659-669.
- DIAMANTOPOULOS, A., RIEFLER, P. & ROTH, K. P. 2008. Advancing formative measurement models. *Journal of Business Research*, 61.
- DIAMANTOPOULOS, A. & SIGUAW, J. A. 2000. *Introducing LISREL: A guide for the uninitiated*, London, Sage Publications Limited.
- DIAMANTOPOULOS, A. & WINKLHOFFER, H. M. 2001. Index Construction with Formative Indicators: An Alternative to Scale Development. *Journal of Marketing Research*, 38, 269-277.
- DOUGLAS, E. J. & SHEPHERD, D. A. 2002. Self-Employment as a Career Choice: Attitudes, Entrepreneurial Intentions, and Utility Maximization. *Entrepreneurship: Theory & Practice*, 26, 81-90.
- EASTERBY-SMITH, M., GOLDEN-BIDDLE, K. & LOCKE, K. 2008a. Working With Pluralism Determining Quality in Qualitative Research. *Organizational Research Methods*, 11, 419-429.
- EASTERBY-SMITH, M., LYLES, M. A. & TSANG, E. W. K. 2008b. Inter-Organizational Knowledge Transfer: Current Themes and Future Prospects. *Journal of Management Studies*, 45, 677-690.
- EBERL, M. 2010. An Application of PLS in Multi-Group Analysis: The Need for Differentiated Corporate-Level Marketing in the Mobile Communications Industry. In: ESPOSITO VINZI, V., CHIN, W. W., HENSELER, J., WANG, H. & FASSOTT, G. (eds.) *Handbook of Partial Least Squares*. Springer
- EFRON, B. & GONG, G. 1983. A Leisurely Look at the Bootstrap, the Jackknife, and Cross-Validation. *The American Statistician*, 37.
- EISENHARDT, K. M. 1989. Building Theory from Case Study Research. *Academy of Management Review*, 14, 532-550.
- FARRELL, A. M. 2010. Insufficient discriminant validity: A comment on Bove, Pervan, Beatty, and Shiu (2009). *Journal of Business Research*, 63, 324-327.
- FELIN, T. & FOSS, N. J. 2005. Strategic organization: a field in search of micro-foundations. *Strategic Organization*, 3, 441-455.
- FELIN, T., ZENGER, T. R. & TOMSIK, J. 2009. The knowledge economy: emerging organizational forms, missing microfoundations, and key considerations for managing human capital. *Human Resource Management*, 48, 555-570.
- FELZENSZTEIN, C., GIMMON, E. & CARTER, S. 2010. Geographical Co-Location, Social Networks and Inter-firm Marketing Co-operation: the Case of the Salmon Industry. *Long Range Planning*, 43, 675-690.
- FERDOWS, K. 2006. Transfer of Changing Production Know-How. *Production & Operations Management*, 15, 1-9.
- FIALA, P. 2005. Information sharing in supply chains. *Omega*, 33, 419-423.
- FLOYD, S. W. & WOOLDRIDGE, B. 1999. Knowledge Creation and Social Networks in Corporate Entrepreneurship: The Renewal of Organizational Capability. *Entrepreneurship: Theory & Practice*, 23, 123-143.
- FORNELL, C. & BOOKSTEIN, F. L. 1982. Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory. *Journal of Marketing Research*, 19, 440-452.

- FORNELL, C. & LARCKER, D. F. 1981. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18, 39-50.
- FORSTENLECHNER, I., LETTICE, F., BOURNE, M. & WEBB, C. 2007. Turning knowledge into value in professional service firms. *Performance Measurement and Metrics*, 8, 146-156.
- FOSFURI, A. & TRIBÓ, J. A. 2008. Exploring the antecedents of potential absorptive capacity and its impact on innovation performance. *Omega*, 36, 173-187.
- FOSS, N. J., HUSTED, K. & MICHAILOVA, S. 2010. Governing Knowledge Sharing in Organizations: Levels of Analysis, Governance Mechanisms, and Research Directions. *Journal of Management Studies*, 47, 455-482.
- FOX, J. 2002. Bootstrapping Regression Models: A Web Appendix to the Text. *An R and S-PLUS Companion to Applied Regression*. Sage Publications.
- FRICKÉ, M. 2009. The knowledge pyramid: a critique of the DIKW hierarchy. *Journal of Information Science*, 35, 131-142.
- FUGATE, B. S., STANK, T. P. & MENTZER, J. T. 2009. Linking improved knowledge management to operational and organizational performance. *Journal of Operations Management*, 27, 247-264.
- FÜLLER, J. 2006. Why consumers engage in virtual new product developments initiated by producers. *Advances in Consumer Research*, 33, 639-646.
- FÜLLER, J. 2010. Refining Virtual Co-Creation from a Consumer Perspective. *California Management Review*, 52, 98-122.
- FÜLLER, J., MÜHLBACHER, H., MATZLER, K. & JAWECKI, G. 2009. Consumer Empowerment Through Internet-Based Co-creation. *Journal of Management Information Systems*, 26, 71-102.
- FULLER, J. A. & MANSOUR, A. H. 2003. Operations management and operations research: a historical and relational perspective. *Management Decision*, 41, 422 - 426.
- GARRIS, R., AHLERS, R. & DRISKELL, J. E. 2002. Games, Motivation, and Learning: A Research and Practice Model. *Simulation & Gaming*, 33, 441-467.
- GARVIN, D. A. 1993. Building a learning organization. *Harvard Business Review*, 71, 78-91.
- GASKIN, J. 2012. SmartPLS Formative 2nd order Constructs
- GASSMANN, O. & ENKEL, E. 2004. Towards a theory of open innovation: three core process archetypes. *R&D Management Conference*. Sessimbra
- GATIGNON, H., TUSHMAN, M. L., SMITH, W. & ANDERSON, P. 2002. A Structural Approach to Assessing Innovation: Construct Development of Innovation Locus, Type, and Characteristics. *Management Science*, 48, 1103-1122.
- GATTIKER, T. F., HUANG, X. & SCHWARZ, J. L. 2007. Negotiation, email, and Internet reverse auctions: How sourcing mechanisms deployed by buyers affect suppliers' trust. *Journal of Operations Management*, 25, 184-202.
- GATTIKER, T. F. & PARENTE, D. H. 2007. Introduction to the special issue on innovative data sources for empirically building and validating theories in Operations Management. *Journal of Operations Management*, 25, 957-961.
- GIBSON, C. B. & BIRKINSHAW, J. 2004. The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47, 209-226.
- GLASER, B. G. & STRAUSS, A. L. 1967. *The Discovery of Grounded Theory: strategies for qualitative research*, New York, Aldine.
- GLOOR, P., PAASIVAARA, M., SCHODER, D. & WILLEMS, P. 2008. Finding collaborative innovation networks through correlating performance with social network structure. *International Journal of Production Research*, 46, 1357-1371.

- GOLD, A. H., MALHOTRA, A. & SEGARS, A. H. 2001. Knowledge Management: An Organizational Capabilities Perspective. *Journal of Management Information Systems*, 18, 185-214.
- GONZÁLEZ, C. S. & BLANCO, F. 2008. Integrating an educational 3D game in Moodle. *Simulation & Gaming*, 39, 399-413.
- GÖTZ, O., LIEHR-GOBBERS, K. & KRAFFT, M. 2010. Evaluation of Structural Equation Models Using the Partial Least Squares (PLS) Approach. In: ESPOSITO VINZI, V., CHIN, W. W., HENSELER, J., WANG, H. & FASSOTT, G. (eds.) *Handbook of Partial Least Squares*. Springer Berlin Heidelberg.
- GOWEN III, C. R., STOCK, G. N. & MCFADDEN, K. L. 2008. Simultaneous implementation of Six Sigma and knowledge management in hospitals. *International Journal of Production Research*, 46, 6781 - 6795.
- GRANOVETTER, M. 1973. The strength of weak ties. *American Journal of Sociology*, 78, 1360-1380.
- GRANT, R. M. 1996. Toward a knowledge-based theory of the firm. *Strategic Management Journal*, 17, 109-128.
- GREEN, P. E. & RAO, V. R. 1970. Rating Scales and Information Recovery. How Many Scales and Response Categories to Use? *Journal of Marketing*, 34, 33-39.
- GUINERY, J. E. 2006. Knowledge integration in production planning, scheduling and control. *PhD Thesis, University of Nottingham*.
- GULATI, R., NOHRIA, N. & ZAHEER, A. 2000. Strategic Networks. *Strategic Management Journal*, 21, 203-215.
- GUNASEKARAN, A. & NGAI, E. W. T. 2007. Knowledge management in 21st century manufacturing. *International Journal of Production Research*, 45, 2391 - 2418.
- HA, B.-C., PARK, Y.-K. & CHO, S. 2011. Suppliers' affective trust and trust in competency in buyers: Its effect on collaboration and logistics efficiency. *International Journal of Operations & Production Management*, 31, 56-77.
- HAAS, M. R. & HANSEN, M. T. 2007. Different knowledge, different benefits: toward a productivity perspective on knowledge sharing in organizations. *Strategic Management Journal*, 28, 1133-1153.
- HAENLEIN, M. & KAPLAN, A. M. 2004. A Beginner's Guide to Partial Least Squares Analysis. *Understanding Statistics*, 3, 283-297.
- HAIR, J. F., BLACK, W. C., BLACK, B. J. & ANDERSON, R. E. 2006. *Multivariate data analysis*, Upper Saddle River, N.J, Pearson/Prentice Hall.
- HAIR, J. F., HULT, G. T. M., RINGLE, C. M. & SARSTEDT, M. 2013. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Thousand Oaks, Sage.
- HAIR, J. F., RINGLE, C. M. & SARSTEDT, M. 2011. PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory & Practice*, 19, 139-152.
- HANSEN, M. T. 1999. The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organization Subunits. *Administrative Science Quarterly*, 44, 82-111.
- HANSEN, M. T. 2002. Knowledge Networks: Explaining Effective Knowledge Sharing in Multiunit Companies. *Organization Science*, 13, 232-248.
- HANSEN, M. T., MORS, M. L. & LØVÅS, B. 2005. Knowledge sharing in organizations: Multiple networks, multiple phases. *Academy of Management Journal*, 48, 776-793.
- HANSEN, M. T. & NOHRIA, N. 2004. How To Build Collaborative Advantage. *MIT Sloan Management Review*, 46, 22-30.
- HANSEN, M. T., NOHRIA, N. & TIERNEY, T. 1999. What's Your Strategy for Managing Knowledge? *Harvard Business Review*, 77, 106-118.

- HARGADON, A. B. & BECHKY, B. A. 2006. When Collections of Creatives Become Creative Collectives: A Field Study of Problem Solving at Work. *Organization Science*, 17, 484-500.
- HE, Z.-L. & WONG, P.-K. 2004. Exploration vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis. *Organization Science*, 15, 481-494.
- HENSELER, J. 2012. PLS-MGA: A Non-Parametric Approach to Partial Least Squares-based Multi-Group Analysis. In: GAUL, W. A., GEYER-SCHULZ, A., SCHMIDT-THIEME, L. & KUNZE, J. (eds.) *Challenges at the Interface of Data Analysis, Computer Science, and Optimization*. Berlin, Heidelberg Springer
- HENSELER, J. & FASSOTT, G. 2010. Testing Moderating Effects in PLS Path Models: An Illustration of Available Procedures. In: ESPOSITO VINZI, V., CHIN, W. W., HENSELER, J., WANG, H. & FASSOTT, G. (eds.) *Handbook of Partial Least Squares*. Berlin, Heidelberg: Springer.
- HENSELER, J., RINGLE, C. M. & SINKOVICS, R. R. 2009. The use of partial least squares path modeling in international marketing. *Advances in international marketing*, 20, 277-319.
- HENSELER, J. R. & CHIN, W. W. 2010. A Comparison of Approaches for the Analysis of Interaction Effects Between Latent Variables Using Partial Least Squares Path Modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, 17, 82-109.
- HERRON, C. & BRAIDEN, P. M. 2006. A methodology for developing sustainable quantifiable productivity improvement in manufacturing companies. *International Journal of Production Economics*, 104, 143-153.
- HINKIN, T. R. 1995. A Review of Scale Development Practices in the Study of Organizations. *Journal of Management*, 21, 967-988.
- HIPKIN, I. 2001. Knowledge and IS implementation: case studies in physical asset management. *International Journal of Operations & Production Management*, 21, 1358-1380.
- HOLSAPPLE, C. W. & JOSHI, K. D. 2002. Knowledge manipulation activities: results of a Delphi study. *Information & Management*, 39, 477-490.
- HOMANS, G. C. 1958. Social Behavior as Exchange. *The American Journal of Sociology*, 63, 597-606.
- HOPP, W. J., IRAVANI, S. M. R. & SHOU, B. 2007. A Diagnostic Tree for Improving Production Line Performance. *Production and Operations Management*, 16, 77-92.
- HORNIK, S., JOHNSON, R. D. & WU, Y. 2007. When Technology Does Not Support Learning: Conflicts Between Epistemological Beliefs and Technology Support in Virtual Learning Environments. *Journal of Organizational and End User Computing*, 19, 23-46.
- HOTH, J. J., BECKER-RITTERSPACH, F. & SAKA-HELMHOUT, A. 2011. Enriching Absorptive Capacity through Social Interaction. *British Journal of Management*, no-no.
- HOUGHTON, S. M., SMITH, A. D. & HOOD, J. N. 2009. The influence of social capital on strategic choice: An examination of the effects of external and internal network relationships on strategic complexity. *Journal of Business Research*, 62, 1255-1261.
- HUANG, T.-T. A., STEWART, R. A. & LE, C. 2010. Identifying key enablers to improve business performance in Taiwanese electronic manufacturing companies. *International Journal of Operations & Production Management*, 30, 155-180.
- HUANG, X., KRISTAL, M. M. & SCHROEDER, R. G. 2008. Linking learning and effective process implementation to mass customization capability. *Journal of Operations Management*, 26, 714-729.
- HUBER, G. P. 1991. Organizational learning: The contributing processes and the literatures. *Organization Science*, 2, 88-115.

- HUGHES, M., HUGHES, P. & MORGAN, R. E. 2007a. Exploitative Learning and Entrepreneurial Orientation Alignment in Emerging Young Firms: Implications for Market and Response Performance. *British Journal of Management*, 18, 359-375.
- HUGHES, M., IRELAND, R. D. & MORGAN, R. E. 2007b. Stimulating Dynamic Value: Social Capital and Business Incubation as a Pathway to Competitive Success. *Long Range Planning*, 40, 154-177.
- HUGHES, M. & PERRONS, R. K. 2011. Shaping and re-shaping social capital in buyer-supplier relationships. *Journal of Business Research*, 64, 164-171.
- HULT, G. T. M., KETCHEN, J. D. J., CAVUSGIL, S. T. & CALANTONE, R. J. 2006. Knowledge as a strategic resource in supply chains. *Journal of Operations Management*, 24, 458-475.
- HUSTON, L. & SAKKAB, N. 2006. Connect and develop: Inside Procter & Gamble's new model for innovation. *Harvard Business Review*, 84, 58-66.
- IMAI, M. 1986. *Kaizen: The key to Japan's Competitive Success*, NY, McGraw-Hill.
- INKPEN, A. & TSANG, E. 2005. Social capital, networks, and knowledge transfer. *Academy of Management Review*, 30, 146-165.
- IRELAND, R. D., COVIN, J. G. & KURATKO, D. F. 2009. Conceptualizing Corporate Entrepreneurship Strategy. *Entrepreneurship Theory and Practice*, 33, 19-46.
- JACK, S. L. 2010. Approaches to studying networks: Implications and outcomes. *Journal of Business Venturing*, 25, 120-137.
- JACOBY, J. & MATELL, M. S. 1971. Three-Point Likert Scales Are Good Enough. *Journal of Marketing Research*, 8, 495-500.
- JANSEN, J. J. P., VAN DEN BOSCH, F. A. J. & VOLBERDA, H. W. 2005. Managing potential and realized absorptive capacity: how do organizational antecedents matter? *Academy of Management Journal*, 48, 999-1015.
- JANSEN, J. J. P., VAN DEN BOSCH, F. A. J. & VOLBERDA, H. W. 2006. Exploratory Innovation, Exploitative Innovation, and Performance: Effects of Organizational Antecedents and Environmental Moderators. *Management Science*, 52, 1661-1674.
- JENSEN, M. B., JOHNSON, B., LORENZ, E. & LUNDVALL, B. Å. 2007. Forms of knowledge and modes of innovation. *Research Policy*, 36, 680-693.
- JICK, T. D. 1979. Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly*, 24, 602-611.
- JOHANNESSEN, J.-A., OLSEN, B. & LUMPKIN, G. T. 2001. Innovation as newness: what is new, how new, and new to whom? *European Journal of Innovation Management*, 4, 20-31.
- JOHNSON, D. & GRAYSON, K. 2005. Cognitive and affective trust in service relationships. *Journal of Business Research*, 58, 500-507.
- JOHNSON, R. B., ONWUEGBUZIE, A. J. & TURNER, L. A. 2007. Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research*, 1, 112-133.
- JONES, O. 2005. Manufacturing regeneration through corporate entrepreneurship: Middle managers and organizational innovation. *International Journal of Operations & Production Management*, 25, 491-511.
- JÖRESKOG, K. G. 1994. Structural Equation Modeling with Ordinal Variables. *Lecture Notes-Monograph Series*, 24, 297-310.
- JÖRESKOG, K. G. & SÖRBOM, D. 1978. *LISREL IV: Analysis of Linear Structural Relationships by the Method of Maximum Likelihood*. Chicago: National Educational Resources, Chicago, National Educational Resources.
- JÖRESKOG, K. G. & SÖRBOM, D. 1982. Recent Developments in Structural Equation Modeling. *Journal of Marketing Research*, 19, 404-416.

- JØRGENSEN, F., BOER, H. & GERTSEN, F. 2003. Jump-starting continuous improvement through self-assessment. *International Journal of Operations & Production Management*, 23, 1260-1278.
- KALE, P. & SINGH, H. 2007. Building firm capabilities through learning: the role of the alliance learning process in alliance capability and firm-level alliance success. *Strategic Management Journal*, 28, 981-1000.
- KAPLAN, D. 2009. Statistical Assumptions Underlying Structural Equation Modeling. *Structural Equation Modeling: Foundations and Extensions, 2nd Ed.* SAGE Research Methods.
- KARAMANOS, A. G. 2003. Complexity, Identity and the Value of Knowledge-intensive Exchanges. *Journal of Management Studies*, 40, 1871-1890.
- KAYNAK, H. 2003. The relationship between total quality management practices and their effects on firm performance. *Journal of Operations Management*, 21, 405-435.
- KENNY, D. A. 2011. Moderator Variables. Accessed 8/1/2013, <http://davidakenny.net/cm/moderation.htm>.
- KERRIN, M. 1999. Continuous improvement capability: assessment within one case study organisation. *international Journal of Operations & Production Management*, 19, 1154-1167.
- KHALIFA, M. & LIU, V. 2008. Semantic network representation of computer-mediated discussions: Conceptual facilitation form and knowledge acquisition. *Omega*, 36, 252-266.
- KIM, L. 1998. Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor. *Organization Science*, 9, 506-521
- KING, W. R., CHUNG, T. R. & HANEY, M. H. 2008. Knowledge Management and Organizational Learning. *Omega*, 36, 167-172.
- KLEIN, R. 2007. Customization and real time information access in integrated eBusiness supply chain relationships. *Journal of Operations Management*, 25, 1366-1381.
- KLINE, R. B. 2010. *Principles and Practice of Structural Equation Modeling*, Guilford Press.
- KNIGHT, G. A. 1997. Cross-cultural reliability and validity of a scale to measure firm entrepreneurial orientation. *Journal of Business Venturing*, 12, 213-225.
- KNOKE, D. & KUKLINSKI, H. 1994. Network Analysis: basic concepts. In: THOMPSON, G., FRANCES, J., LEVACIC, R. & MITCHELL, J. (eds.) *Markets, Hierarchies and Networks: The coordination of social life*. London: SAGE.
- KODAMA, M. 2005. Knowledge creation through networked strategic communities: Case studies on new product development in Japanese companies. *Long Range Planning*, 38, 27-49.
- KOGUT, B. & ZANDER, U. 1992. Knowledge of the Firm, Combinative Capabilities, and the Replicaion of Technology. *Organization Science*, 3, 383-397.
- KOGUT, B. & ZANDER, U. 1993. Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies*, 24, 516-516.
- KOLB, D. 1984. *Experiential learning: experience as the source of learning and development*, Prentice-Hall.
- KOSKINEN, K. U. & VANHARANTA, H. 2002. The role of tacit knowledge in innovation processes of small technology companies. *International Journal of Production Economics*, 80, 57-64.
- KOSTOPOULOS, K., PAPALEXANDRIS, A., PAPACHRONI, M. & IOANNOU, G. 2011. Absorptive capacity, innovation, and financial performance. *Journal of Business Research*, In Press, Corrected Proof.
- KOTABE, M., MARTIN, X. & DOMOTO, H. 2003. Gaining from vertical partnerships: knowledge transfer, relationship duration, and supplier performance improvement in the U.S. and Japanese automotive industries. *Strategic Management Journal*, 24, 293-316.

- KOUFTEROS, X. A., EDWIN CHENG, T. C. & LAI, K.-H. 2007. "Black-box" and "gray-box" supplier integration in product development: Antecedents, consequences and the moderating role of firm size. *Journal of Operations Management*, 25, 847-870.
- KRAUSE, D. R., HANDFIELD, R. B. & TYLER, B. B. 2007. The relationships between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management*, 25, 528-545.
- KREISER, P. M., MARINO, L. D. & WEAVER, K. M. 2002. Assessing the Psychometric Properties of the Entrepreneurial Orientation Scale: A Multi-Country Analysis. *Entrepreneurship: Theory & Practice*, 26.
- KROPP, F., LINDSAY, N. J. & SHOHAM, A. 2008. Entrepreneurial orientation and international entrepreneurial business venture startup. *International Journal of Entrepreneurial Behaviour & Research*, 14, 102-117.
- KYLÄHEIKO, K., JANTUNEN, A., PUUMALAINEN, K. & LUUKKA, P. 2011. Value of knowledge--Technology strategies in different knowledge regimes. *International Journal of Production Economics*, 131, 273-287.
- LAGROSEN, Y., CHEBL, R. & TUESTA, M. R. 2011. Organisational learning and Six Sigma deployment readiness evaluation: a case study. *International Journal of Lean Six Sigma*, 2, 23-40.
- LANE, P. J., KOKA, B. R. & PATHAK, S. 2006. The reification of absorptive capacity: a critical review and rejuvenation of the construct. *Academy of Management Review*, 31, 833-863.
- LAPRÉ, M. A. & VAN WASSENHOVE, L. N. 2001. Creating and Transferring Knowledge for Productivity Improvement in Factories. *Management Science*, 47, 1311-1325.
- LAWSON, B., TYLER, B. B. & COUSINS, P. D. 2008. Antecedents and consequences of social capital on buyer performance improvement. *Journal of Operations Management*, 26, 446-460.
- LECHNER, C. & FLOYD, S. W. 2007. Searching, Processing, Codifying and Practicing- Key Learning Activities in Exploratory Initiatives. *Long Range Planning*, 40, 9-29.
- LEE, J. Y., MACMILLAN, I. C. & CHOE, S. 2010. Technological Knowledge Transfer within Chaebols after the 1997-98 Crisis. *Long Range Planning*, 43, 585-610.
- LEE, J. Y., SWINK, M. & PANDEJPONG, T. 2011. The Roles of Worker Expertise, Information Sharing Quality, and Psychological Safety in Manufacturing Process Innovation: An Intellectual Capital Perspective. *Production and Operations Management*, 20, 556-570.
- LEE, K. T. & CHUAH, K. B. 2001. A SUPER methodology for business process improvement - An industrial case study in Hong Kong/China. *international Journal of Operations & Production Management*, 21, 687-706.
- LEIDNER, D. E. & JARVENPAA, S. L. 1995. The Use of Information Technology to Enhance Management School Education: A Theoretical View. *MIS Quarterly*, 19, 265-291.
- LEJEUNE, M. A. & YAKOVA, N. 2005. On characterizing the 4 C's in supply chain management. *Journal of Operations Management*, 23, 81-100.
- LETTICE, F. & PAREKH, M. 2010. The social innovation process: themes, challenges and implications for practice. *International Journal of Technology Management*, 51, 139-158.
- LEVIN, D. Z. & CROSS, R. 2004. The Strength of Weak Ties You Can Trust: The Mediating Role of Trust in Effective Knowledge Transfer. *Management Science*, 50, 1477-1490.
- LEVITT, B. & MARCH, J. G. 1988. Organizational Learning. *Annual Review of Sociology*, 14, 319-340.
- LI, G. & RAJAGOPALAN, S. 2008. Process Improvement, Learning, and Real Options. *Production and Operations Management*, 17, 61-74.

- LI, J. J., POPPO, L. & ZHOU, K. Z. 2010a. Relational mechanisms, formal contracts, and local knowledge acquisition by international subsidiaries. *Strategic Management Journal*, 31, 349-370.
- LI, S., RAO, S. S., RAGU-NATHAN, T. S. & RAGU-NATHAN, B. 2005. Development and validation of a measurement instrument for studying supply chain management practices. *Journal of Operations Management*, 23, 618-641.
- LI, Y., LIU, Y., LI, M. & WU, H. 2008. Transformational offshore outsourcing: Empirical evidence from alliances in China. *Journal of Operations Management*, 26, 257-274.
- LI, Y., LIU, Y. & LIU, H. 2011. Co-opetition, distributor's entrepreneurial orientation and manufacturer's knowledge acquisition: Evidence from China. *Journal of Operations Management*, 29, 128-142.
- LI, Y., WEI, Z. & LIU, Y. 2010b. Strategic Orientations, Knowledge Acquisition, and Firm Performance: The Perspective of the Vendor in Cross-Border Outsourcing. *Journal of Management Studies*, 47, 1457-1482.
- LIAO, Y., LIAO, K., TU, Q. & VONDEREMBSE, M. 2011. A mechanism for external competence transfer to improve manufacturing system capabilities and market performance. *International Journal of Production Economics*, 132, 68-78.
- LICHTENTHALER, U. 2009. Absorptive capacity, environmental turbulence, and the complementarity of organizational learning processes. *Academy of Management Journal*, 52, 822-846.
- LIEBESKIND, J. P., OLIVER, A. L., ZUCKER, L. & BREWER, M. 1996. Social Networks, Learning, and Flexibility: Sourcing Scientific Knowledge in New Biotechnology Firms. *Organization Science*, 7, 428-443.
- LIN, N. 1999. Building a Network Theory of Social Capital. *Connections*, 22, 28-51.
- LINCOLN, Y. S. & GUBA, E. G. 1985. *Naturalistic inquiry*, London, Sage.
- LINDERMAN, K., SCHROEDER, R. G. & CHOO, A. S. 2006. Six Sigma: The role of goals in improvement teams. *Journal of Operations Management*, 24, 779-790.
- LINDERMAN, K., SCHROEDER, R. G., ZAHEER, S. & CHOO, A. S. 2003. Six Sigma: a goal-theoretic perspective. *Journal of Operations Management*, 21, 193-203.
- LINDERMAN, K., SCHROEDER, R. G., ZAHEER, S., LIEDTKE, C. & CHOO, A. S. 2004. Integrating quality management practices with knowledge creation processes. *Journal of Operations Management*, 22, 589-607.
- LOKNATH, S. & TARUN, G. 1997. An empirical study of just-in-time and total quality management principles implementation in manufacturing firms in the USA. *international Journal of Operations & Production Management*, 17, 1215-1232.
- LOONEY, S. W. 1995. How to Use Tests for Univariate Normality to Assess Multivariate Normality. *The American Statistician*, 49, 64-70.
- LORENZ, E. 1994. Neither friend nor stranger: informal networks of subcontracting in French industry. In: THOMPSON, G., FRANCES, J., LEVACIC, R. & MITCHELL, J. (eds.) *Markets, Hierarchies and Networks: The coordination of social life*. London: SAGE.
- LUMPKIN, G. T., COGLISER, C. C. & SCHNEIDER, D. R. 2009. Understanding and Measuring Autonomy: An Entrepreneurial Orientation Perspective. *Entrepreneurship Theory and Practice*, 33, 47-69.
- LUMPKIN, G. T. & DESS, G. G. 1996. Clarifying the Entrepreneurial Orientation Construct and Linking It to Performance. *Academy of Management Review*, 21, 135-172.
- LUMPKIN, G. T. & DESS, G. G. 2001. Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle. *Journal of Business Venturing*, 16, 429-451.

- MACCALLUM, R. C., BROWNE, M. W. & SUGAWARA, H. M. 1996. Power Analysis and Determination of Sample Size for Covariance Structure Modeling. *Psychological Methods*, 1, p 130-149.
- MACPHERSON, A. & HOLT, R. 2007. Knowledge, learning and small firm growth: A systematic review of the evidence. *Research Policy*, 36, 172-192.
- MARCH, J. G. 1991a. Exploration and exploitation in organizational learning. *Organization Science*, 2, 71-87.
- MARCH, J. G. 1991b. How Decisions Happen in Organizations. *Human-Computer Interaction*, 6, 95-117.
- MARZEC, P. E. & MATTHEWS, R. L. 2012. Refining the Internal-External Learning Model via Knowledge Acquisition and Organizational Learning. *Academy of Management Conference*. Boston MA.
- MARZEC, P. E. & TAN, K. H. 2010. Incorporating Virtual Learning in Operations Management via Second Life. *SAGSET 40th Annual Conference*. Guildford, UK.
- MARZEC, P. E. & TAN, K. H. 2011. A knowledge-based view of process improvement: Examining the role of networks and knowledge acquisition *18th EurOMA Conference*. Cambridge UK.
- MATTHEWS, R. L. & MARZEC, P. E. 2012. Social capital, a theory for operations management: A systematic review of the evidence. *International Journal of Production Research*, 50, 1-19.
- MATTHEWS, R. L., TAN, K. H. & MARZEC, P. E. 2012. Ambidextrous Learning within Process Improvement: An Exploratory Study. (*Working Paper*). Nottingham: Nottingham University Business School.
- MATUSIK, S. F. & HEELEY, M. B. 2005. Absorptive Capacity in the Software Industry: Identifying Dimensions That Affect Knowledge and Knowledge Creation Activities. *Journal of Management*, 31, 549-572.
- MCADAM, R. 2004. Knowledge creation and idea generation: a critical quality perspective. *Technovation*, 24, 697-705.
- MCDERMOTT, R. & ARCHIBALD, D. 2010. Harnessing Your Staff's Informal Networks. *Harvard Business Review*, March, 83-89.
- MCDONALD, M., KHANNA, P. & WESTPHAL, J. 2008. Getting them to think outside the circle: Corporate governance, CEO's external advice networks, and firm performance. *Academy of Management Journal*, 51, 453-475.
- MCDONALD, M. L. & WESTPHAL, J. D. 2003. Getting by with the Advice of Their Friends: CEOs' Advice Networks and Firms' Strategic Responses to Poor Performance. *Administrative Science Quarterly*, 48, 1-32.
- MELLAT-PARAST, M. & DIGMAN, L. A. 2008. Learning: The interface of quality management and strategic alliances. *International Journal of Production Economics*, 114, 820-829.
- MEREDITH, J. 1998. Building operations management theory through case and field research. *Journal of Operations Management*, 16, 441-454.
- MEREDITH, J., RATURI, A., AMOAKO-GYAMPAH, K. & KAPLAN, B. 1989. Alternative research paradigms in operations. *Journal of Operations Management*, 8, 297-326.
- MILLER, D. 1983. The correlates of entrepreneurship in three types of firms. *Management Science*, 29, 770-791.
- MILLER, V. D. & JABLIN, F. M. 1991. Information Seeking during Organizational Entry: Influences, Tactics, and a Model of the Process. *Academy of Management Review*, 16, 92-120.

- MINGERS, J. 2004. Real-izing information systems: critical realism as an underpinning philosophy for information systems *Information & Organization*, 14, p87-103.
- MINTZBERG, H., RAISINGHANI, D. & THÉORÈT, A. 1976. The Structure of 'Unstructured' Decision Processes. *Administrative Science Quarterly*, 21, 246-275.
- MINTZBERG, H. & WATERS, J. 1990. Studying Deciding: An Exchange of Views Between Mintzberg and Waters, Pettigrew, and Butler. *Organization Studies*, 11, 001-6.
- MODELL, S. 2009. In defence of triangulation: A critical realist approach to mixed methods research in management accounting. *Management Accounting Research*, 20, p208-221.
- MÖLLER, K. & SVAHN, S. 2006. Role of Knowledge in Value Creation in Business Nets*. *Journal of Management Studies*, 43, 985-1007.
- MORRIS, M., BESSANT, J. & BARNES, J. 2006. Using learning networks to enable industrial development Case studies from South Africa. *International Journal of Operations & Production Management*, 26, 532-557.
- MORRISON, E. W. & VANCOUVER, J. B. 2000. Within-Person Analysis of Information Seeking: The Effects of Perceived Costs and Benefits. *Journal of Management*, 26, 119-137.
- MORS, M. L. 2010. Innovation in a global consulting firm: when the problem is too much diversity. *Strategic Management Journal*, 31, 841-872.
- MORTARA, L., NAPP, J., SLACIK, I. & MINSHAL, T. 2009. How to implement open innovation: Lessons from studying large multinational companies. *University of Cambridge Institute for Manufacturing*.
- MOWERY, D. C. & OXLEY, J. E. 1995. Inward technology transfer and competitiveness: the role of national innovation systems. *Cambridge Journal of Economics*, 19, 67-93.
- MUKHERJEE, A. S. & LAPRE, M. A. 1998. Knowledge Driven Quality Improvement. *Management Science*, 44, S35-S49.
- NAHAPIET, J. & GHOSHAL, S. 1998. Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review*, 23, 242-266.
- NAMBISAN, S. & BARON, R. A. 2009. Virtual Customer Environments: Testing a Model of Voluntary Participation in Value Co-creation Activities. *Journal of Product Innovation Management*, 26, 388-406.
- NARASIMHAN, R., MAHAPATRA, S. & ARLBJÄRN, J. 2008. Impact of relational norms, supplier development and trust on supplier performance. *Operations Management Research*, 1, 24-30.
- NAYLOR, J. B., GRIFFITHS, J. & NAIM, M. M. 2001. Knowledge-based system for estimating steel plant performance. *International Journal of Operations & Production Management*, 21, 1000-1019.
- NEBUS, J. 2006. Building collegial information networks: a theory of advice network generation. *Academy of Management Review*, 31, 615-637.
- NEMANICH, L. A., KELLER, R. T., VERA, D. & CHIN, W. W. 2010. Absorptive Capacity in R&D Project Teams: A Conceptualization and Empirical Test. *IEEE Transactions on Engineering Management*, 57, 674-688.
- NI, W. & SUN, H. 2009. The relationship among organisational learning, continuous improvement and performance improvement: An evolutionary perspective. *Total Quality Management & Business Excellence*, 20, 1041-1054.
- NIEMI, P., HUISKONEN, J. & KÄRKKÄINEN, H. 2009. Understanding the knowledge accumulation process--Implications for the adoption of inventory management techniques. *International Journal of Production Economics*, 118, 160-167.
- NOHRIA, N. 1992. Is a Network Perspective a useful way of studying organizations? In: NOHRIA, N. & ECCLES, R. (eds.) *Networks and Organisations: Structure, form and action*. Boston: Harvard Business School Press.

- NONAKA, I. 1991. The knowledge-creating company. *Harvard Business Review*, Nov-Dec, 96-104.
- NONAKA, I. 1994. A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5, 14-37.
- NONAKA, I., TOYAMA, R. & KONNO, N. 2000. SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation. *Long Range Planning*, 33, 5-34.
- NUNNALLY, J. 1967. *Psychometric theory*, New York, McGraw-Hill.
- ORMEROD, R. 2006. The history and ideas of pragmatism. *Journal of the Operational Research Society*, 57, p892-909.
- OSTERLOH, M. & FREY, B. S. 2000. Motivation, Knowledge Transfer, and Organizational Forms. *Organization Science*, 11, 538-550
- PADULA, G. 2008. Enhancing the Innovation Performance of Firms by Balancing Cohesiveness and Bridging Ties. *Long Range Planning*, 41, 395-419.
- PAIVA, E. L., ROTH, A. V. & FENSTERSEIFER, J. E. 2008. Organizational knowledge and the manufacturing strategy process: A resource-based view analysis. *Journal of Operations Management*, 26, 115-132.
- PAUL, J. 1996. Between-method triangulation in organisational diagnosis. *International Journal of Organizational Analysis* 4, 135-153.
- PAYNE, A. F., STORBACKA, K. & FROW, P. 2008. Managing the co-creation of value. *Journal of the Academy of Marketing Science*, 36, 83-96.
- PEDROSA, A. D. M. & JASMAND, C. 2012. Absorptive capacity as an individual-level phenomenon? *Academy of Management Conference, Boston, USA*.
- PENG, D. X. & LAI, F. 2012. Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, 30, 467-480.
- PENG, D. X., SCHROEDER, R. G. & SHAH, R. 2008. Linking routines to operations capabilities: A new perspective. *Journal of Operations Management*, 26, 730-748.
- PENROSE, E. 1995. *The Theory of the Growth of the Firm*, Oxford University Press.
- PÉREZ-LUÑO, A., CABELLO MEDINA, C., CARMONA LAVADO, A. & CUEVAS RODRÍGUEZ, G. 2011. How social capital and knowledge affect innovation. *Journal of Business Research*, 64, 1369-1376.
- PERRY-SMITH, J. E. 2006. Social yet creative: The role of social relationships in facilitating individual creativity. *Academy of Management Journal*, 49, 85-101.
- PING, R. A., JR. 1995. A Parsimonious Estimating Technique for Interaction and Quadratic Latent Variables. *Journal of Marketing Research*, 32, 336-347.
- POLANYI, M. 1966. *The Tacit Dimension*, London, Routledge & Kegan.
- POLITO, T., KROS, J. & WATSON, K. 2004. Improving Operations Management Concept Recollection Via the Zarco Experiential Learning Activity. *Journal of Education for Business*, 79, 283-286.
- PRAHALAD, C. K. & RAMASWAMY, V. 2004. Co-creating unique value with customers. *Strategy & Leadership*, 32, 4-9.
- PREACHER, K. J. & COFFMAN, D. L. 2006. Computing power and minimum sample size for RMSEA [Computer software]. Available from <http://www.quantpsy.org/rmsea/rmsea.htm>.
- PREMKUMAR, G. & ROBERTS, M. 1999. Adoption of new information technologies in rural small businesses. *Omega*, 27, 467-484.
- PRUSAK, L. 2006. The World Is Round. *Harvard Business Review*, 84, 18-20.
- RAMASWAMY, V. 2008. Co-creating value through customers' experiences: the Nike case. *Strategy & Leadership*, 36, 9-14.

- RAUCH, A., WIKLUND, J., LUMPKIN, G. T. & FRESE, M. 2009. Entrepreneurial Orientation and Business Performance: An Assessment of Past Research and Suggestions for the Future. *Entrepreneurship Theory and Practice*, 33, 761-787.
- RAYMOND, L. & ST-PIERRE, J. 2010. R&D as a determinant of innovation in manufacturing SMEs: An attempt at empirical clarification. *Technovation*, 30, 48-56.
- REID, S. E. & BRENTANI, U. D. 2004. The Fuzzy Front End of New Product Development for Discontinuous Innovations: A Theoretical Model. *Journal of Product Innovation Management*, 21, 170-184.
- RENZL, B. 2008. Trust in management and knowledge sharing: The mediating effects of fear and knowledge documentation. *Omega*, 36, 206-220.
- RICH, N. & BATEMAN, N. 2003. Companies' perceptions of inhibitors and enablers for process improvement activities. *international Journal of Operations & Production Management*, 23, 185-199.
- RICHTNER, A. & ÅHLSTRÖM, P. 2010. Top management control and knowledge creation in new product development. *International Journal of Operations & Production Management*, 30, 1006-1031.
- RIGDON, E. E. 1994. Calculating degrees of freedom for a structural equation model. *Structural Equation Modeling: A Multidisciplinary Journal*, 1, 274-278.
- RINGLE, C. M. & HENSELER, J. 2011. PLS Path Modelling: Introduction and Application. In: WWW.PLS-SCHOOL.COM (ed.). Nottingham, UK.
- RINGLE, C. M., WENDE, S. & WILL, A. 2005. SmartPLS 2.0 (M3), Hamburg: <http://www.smartpls.de>.
- ROBINSON, C. & SCHUMACKER, R. E. 2009. Interaction Effects: Centering, Variance Inflation Factor, and Interpretation Issues. *Multiple Linear Regression Viewpoints*, 35.
- ROSENKOPF, L. & NERKAR, A. 2001. Beyond local search: boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal*, 22, 287-306.
- ROSENZWEIG, E. D. 2009. A contingent view of e-collaboration and performance in manufacturing. *Journal of Operations Management*, 27, 462-478.
- SAMMARRA, A. & BIGGIERO, L. 2008. Heterogeneity and Specificity of Inter-Firm Knowledge Flows in Innovation Networks. *Journal of Management Studies*, 45, 800-829.
- SARSTEDT, M., HENSELER, J. & RINGLE, C. M. 2011. Multigroup Analysis in Partial Least Squares (PLS) Path Modeling: Alternative Methods and Empirical Results. *Measurement and Research Methods in International Marketing*. Emerald Group Publishing Limited.
- SAUNDERS, M., LEWIS, P. & THORNHILL, A. 2003. *Research methods for business students* Upper Saddle River, FT/Prentice Hall.
- SCHILLING, M. A. & PHELPS, C. C. 2007. Interfirm Collaboration Networks: The Impact of Large-Scale Network Structure on Firm Innovation. *Management Science*, 53, 1113-1126.
- SCHMENNER, R. W., WASSENHOVE, L. V., KETOKIVI, M., HEYL, J. & LUSCH, R. F. 2009. Too much theory, not enough understanding. *Journal of Operations Management*, 27, 339-343.
- SCHROEDER, R. G., BATES, K. A. & JUNTILA, M. A. 2002. A resource-based view of manufacturing strategy and the relationship to manufacturing performance. *Strategic Management Journal*, 23, 105-117.
- SCHROEDER, R. G., LINDERMAN, K., LIEDTKE, C. & CHOO, A. S. 2008. Six Sigma: Definition and underlying theory. *Journal of Operations Management*, 26, 536-554.
- SCHULZ, M. 2001. The uncertain relevance of newness: Organizational learning and knowledge flows. *Academy of Management Journal*, 44, 661-681.

- SCHUMPETER, J. A. 1934. *The Theory of Economic Development*, Cambridge, MA., Harvard University Press.
- SEALE, C. 2007. Quality in qualitative research. In: SEALE, C., GOBO, G., GUBRIUM, J. & SILVERMAN, D. (eds.) *Qualitative research practice*. Concise pbk ed. London: SAGE Publishing.
- SEALE, C., GOBO, G., GUBRIUM, J. & SILVERMAN, D. 2007. *Qualitative research practice*, London, SAGE Publishing.
- SHAH, P. P. 1998. Who are employees' social referents? Using a network perspective to determine referent others. *Academy of Management Journal*, 41, 249-268.
- SHAH, R. & GOLDSTEIN, S. M. 2006. Use of structural equation modeling in operations management research: Looking back and forward. *Journal of Operations Management*, 24, 148-169.
- SHARMA, S., DURAND, R. M. & GUR-ARIESOURCE, O. 1981. Identification and Analysis of Moderator Variables. *Journal of Marketing Research*, 18, 291-300.
- SHENTON, A. K. 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 22, 63-75.
- SHNEIDERMAN, B. 2000. Creating Creativity: User Interfaces for Supporting Innovation. *ACM Transactions on Computer-Human Interaction*, 7, 114-138.
- SIDHU, J. S., VOLBERDA, H. W. & COMMANDEUR, H. R. 2004. Exploring Exploration Orientation and its Determinants: Some Empirical Evidence*. *Journal of Management Studies*, 41, 913-932.
- SIEMSEN, E., ROTH, A. V. & BALASUBRAMANIAN, S. 2008. How motivation, opportunity, and ability drive knowledge sharing: The constraining-factor model. *Journal of Operations Management*, 26, 426-445.
- SIMON, H. 1991. Bounded rationality and Organisational learning. *Organization Science*, 2, 125-134.
- SIMONIN, B. L. 1999. Ambiguity and the process of knowledge transfer in strategic alliances. *Strategic Management Journal*, 20, 595-623.
- SINGHAL, V., FLYNN, B. B., WARD, P. T., ROTH, A. V. & GAUR, V. 2008. Editorial: Empirical elephants—Why multiple methods are essential to quality research in operations and supply chain management. *Journal of Operations Management*, 26, 345-348.
- SKERLAVAJ, M., STEMBERGER, M. I., SKRINJAR, R. & DIMOVSKI, V. 2007. Organizational learning culture--the missing link between business process change and organizational performance. *International Journal of Production Economics*, 106, 346-367.
- SMALL, N. J. H. 1980. Marginal Skewness and Kurtosis in Testing Multivariate Normality. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 29, 85-87.
- SMITH, K. G., COLLINS, C. J. & CLARK, K. D. 2005. Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms. *Academy of Management Journal*, 48, 346-357.
- SOH, P.-H. 2010. Network patterns and competitive advantage before the emergence of a dominant design. *Strategic Management Journal*, 31, 438-461.
- SOROOR, J., TAROKH, M. J. & KESHTGARY, M. 2009. Preventing failure in IT-enabled systems for supply chain management. *International Journal of Production Research*, 47, 6543-6557.
- SPARROWE, R. T., LIDEN, R. C., WAYNE, S. J. & KRAIMER, M. L. 2001. Social networks and the performance of individuals and groups. *Academy of Management Journal*, 44, 316-325.

- SPOHRER, J. & MAGLIO, P. P. 2008. The Emergence of Service Science: Toward Systematic Service Innovations to Accelerate Co-Creation of Value. *Production & Operations Management*, 17, 238-246.
- SRIVASTAVA, M. S. 1984. A measure of skewness and kurtosis and a graphical method for assessing multivariate normality. *Statistics & Probability Letters*, 2, 263-267.
- STUART, I., MCCUTCHEON, D., HANDFIELD, R., MCLACHLIN, R. & SAMSON, D. 2002. Effective case research in operations management: a process perspective. *Journal of Operations Management*, 20, 419-433.
- SULLIVAN, D. M. & MARVEL, M. R. 2011. Knowledge Acquisition, Network Reliance, and Early-Stage Technology Venture Outcomes. *Journal of Management Studies*, no-no.
- SUN, P. Y. T. & ANDERSON, M. H. 2010. An Examination of the Relationship Between Absorptive Capacity and Organizational Learning, and a Proposed Integration. *International Journal of Management Reviews*, 12, 130-150.
- SZULANSKI, G. 1996. Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, 17, 27-43.
- TALLMAN, S. & CHACAR, A. S. 2011. Knowledge Accumulation and Dissemination in MNEs: A Practice-Based Framework. *Journal of Management Studies*, 48, 278-304.
- TALLMAN, S., JENKINS, M., HENRY, N. & PINCH, S. 2004. Knowledge, clusters and competitive advantage. *Academy of Management Review*, 29, 258-271.
- TAN, K. & PLATTS, K. 2003. Linking Objectives to Actions: A Decision Support Approach Based on Cause Effect Linkages. *Decision Sciences*, 34.
- TASHAKKORI, A. & TEDDLIE, C. 1998. *Mixed methodology: combining qualitative and quantitative approaches*, Sage.
- TASHAKKORI, A. & TEDDLIE, C. 2003. *Handbook of mixed methods in social & behavioral research*, SAGE Publications.
- TEECE, D., PISANO, G. & SHUEN, A. 1997. Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18, 509-533.
- TENENHAUS, M., VINZI, V. E., CHATELIN, Y.-M. & LAURO, C. 2005. PLS path modeling. *Computational Statistics & Data Analysis*, 48, 159-205.
- TER WAL, A., CRISCUOLO, P. & SALTER, A. 2011. Absorptive capacity at the individual level: an ambidexterity approach to external engagement. *DRUID 2011- INNOVATION, STRATEGY, and STRUCTURE - Organizations, Institutions, Systems and Regions*. Copenhagen Business School, Denmark.
- TERWIESCH, C. & BOHN, R. 2001. Learning and process improvement during production ramp-up. *International Journal of Production Economics*, 70, 1-19.
- TERZIOVSKI, M. 2010. Innovation practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: a resource-based view. *Strategic Management Journal*, 31, 892-902.
- TERZIOVSKI, M. & SOHAL, A. S. 2000. The adoption of continuous improvement and innovation strategies in Australian manufacturing firms. *Technovation*, 20, 539-550.
- THAWESAENGSKULTHAI, N. & TANNOCK, J. 2008. A decision aid for selecting improvement methodologies. *International Journal of Production Research*, 46, 6721-6737.
- TODOROVA, G. & DURISIN, B. 2007. Absorptive Capacity: Valuing a reconceptualization. *Academy of Management Review*, 32, 774-786.
- TOP-CONSULTANT.COM 2011. Management Consultancy Recruitment Channel Report 2011.
- TORTORIELLO, M. & KRACKHARDT, D. 2010. ACTIVATING CROSS-BOUNDARY KNOWLEDGE: THE ROLE OF SIMMELIAN TIES IN THE GENERATION OF INNOVATIONS. *Academy of Management Journal*, 53, 167-181.

- TRANFIELD, D., DENYER, D. & SMART, P. 2003. Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management*, 14, 207-222.
- TREVILLE, S. D. & ANTONAKIS, J. 2006. Could lean production job design be intrinsically motivating? Contextual, configurational, and levels-of-analysis issues. *Journal of Operations Management*, 24, 99-123.
- TSAI, W. 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, 44, 996-1004.
- TSAI, W. & GHOSHAL, S. 1998. Social Capital and Value Creation: The Role of Intrafirm Networks. *Academy of Management Journal*, 41, 464-476.
- TU, Q., VONDEREMBSE, M. A., RAGU-NATHAN, T. S. & SHARKEY, T. W. 2006. Absorptive capacity: Enhancing the assimilation of time-based manufacturing practices. *Journal of Operations Management*, 24, 692-710.
- TUCKER, C. 2008. Identifying Formal and Informal Influence in Technology Adoption with Network Externalities. *Management Science*, 54, 2024-2038.
- UMBLE, E. J., UMBLE, M. & ARTZ, K. 2008. Enhancing Undergraduates' Capabilities Through Team-Based Competitions: The Edward Jones Challenge. *Decision Sciences Journal of Innovative Education*, 6, 1-27.
- UNIVERSITY OF TWENTE. 2013. *Uncertainty Reduction Theory* [Online]. http://www.utwente.nl/cw/theorieenoverzicht/Theory%20Clusters/Interpersonal%20Communication%20and%20Relations/Uncertainty_Reduction_Theory.doc.
- UPTON, D. M. & KIM, B. 1998. Alternative methods of learning and process improvement in manufacturing. *Journal of Operations Management*, 16, 1-20.
- UZZI, B. & LANCASTER, R. 2003. Relational Embeddedness and Learning: The Case of Bank Loan Managers and Their Clients. *Management Science*, 49, 383-399.
- VAN GRUNDY JR, A. 1997. *Techniques of structured problem solving*, New York, Van Nostrand Reinhold.
- VAN WIJK, R., JANSEN, J. J. P. & LYLES, M. A. 2008. Inter- and Intra-Organizational Knowledge Transfer: A Meta-Analytic Review and Assessment of its Antecedents and Consequences. *Journal of Management Studies*, 45, 830-853.
- VANDENBOSCH, B. & SAATCIOGLU, A. 2006. Idea Management: A Systemic View. *Journal of Management Studies*, 43, 259-288.
- VARGO, S. L. & LUSCH, R. F. 2004. Evolving to a New Dominant Logic for Marketing. *The Journal of Marketing*, 68, 1-17.
- VILLENA, V. H., REVILLA, E. & CHOI, T. Y. 2011. The dark side of buyer-supplier relationships: A social capital perspective. *Journal of Operations Management*, 29, 561-576.
- VOKURKA, R. J., CHOUBINEH, J. & VADI, L. 1996. A prototype expert system for the evaluation and selection of potential suppliers. *International Journal of Operations & Production Management*, 16, 106-127.
- VOLBERDA, H. W., FOSS, N. J. & LYLES, M. A. 2010. Absorbing the Concept of Absorptive Capacity: How to Realize Its Potential in the Organization Field. *Organization Science*, 21, 931-951.
- VON HIPPEL, E. 1994. "Sticky Information" and the Locus of Problem Solving: Implications for Innovation. *Management Science*, 40, 429-439.
- VON KROGH, G., NONAKA, I. & RECHSTEINER, L. 2011. Leadership in Organizational Knowledge Creation: A Review and Framework. *Journal of Management Studies*, no-no.
- WANG, C. L. 2008. Entrepreneurial Orientation, Learning Orientation, and Firm Performance. *Entrepreneurship Theory and Practice*, 32, 635-657.

- WANG, E., KLEIN, G. & JIANG, J. J. 2007. IT support in manufacturing firms for a knowledge management dynamic capability link to performance. *International Journal of Production Research*, 45, 2419-2434.
- WEBER, C. & WEBER, B. 2009. Exploring the antecedents of social liabilities in CVC triads--A dynamic social network perspective. *Journal of Business Venturing*, In Press, Corrected Proof.
- WONG, S.-S. & BOH, W. F. 2010. Leveraging the Ties of Others to Build a Reputation for Trustworthiness Among Peers. *Academy of Management Journal*, 53, 129-148.
- WOOD, N. T., SOLOMON, M. R. & ALLAN, D. 2008. Welcome to The Matrix: E-learning gets a second life. *Marketing Education Review*, 18, 47-53.
- WU, C. F. J. 1986. Jackknife, Bootstrap and Other Resampling Methods in Regression Analysis. *The Annals of Statistics*, 14.
- WU, C. W. & CHEN, C. L. 2006. An integrated structural model toward successful continuous improvement activity. *Technovation*, 26, 697-707.
- YANG, J. 2010. The knowledge management strategy and its effect on firm performance: A contingency analysis. *International Journal of Production Economics*, 125, 215-223.
- YAZICI, H. J. 2004. Student Perceptions of Collaborative Learning in Operations Management Classes. *Journal of Education for Business*, 80, 110-118.
- YIN, R. K. 1994. *Case study research : design and methods*, London, Sage Publications.
- YIN, R. K. 2009. *Case Study Research: Design and Methodology (Applied Social Research Methods)*, Thousand Oaks, CA, Sage Publications Inc.
- YLI-RENKO, H., AUTIO, E. & SAPIENZA, H. J. 2001. Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic Management Journal*, 22, 587-613.
- ZACHARIA, Z. G., NIX, N. W. & LUSCH, R. F. 2011. Capabilities that enhance outcomes of an episodic supply chain collaboration. *Journal of Operations Management*, 29, 591-603.
- ZAHRA, S. A. & GEORGE, G. 2002. Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review*, 27, 185-203.
- ZHANG, X. & CHEN, R. 2008. Examining the mechanism of the value co-creation with customers. *International Journal of Production Economics*, 116, 242-250.
- ZHAO, H. & SEIBERT, S. E. 2006. The Big Five personality dimensions and entrepreneurial status: A meta-analytical review. *Journal of Applied Psychology*, 91, 259-271.
- ZHAO, J. & ANAND, J. 2009. A multilevel perspective on knowledge transfer: evidence from the Chinese automotive industry. *Strategic Management Journal*, 30, 959-983.
- ZHAO, Z., ANAND, J. & MITCHELL, W. 2005. A Dual Networks Perspective on Inter-Organizational Transfer of R&D Capabilities: International Joint Ventures in the Chinese Automotive Industry*. *Journal of Management Studies*, 42, 127-160.
- ZOLLO, M. & WINTER, S. 2002. Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, 13, 339-351.