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**Trust In Innovation Networks**

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**Abstract**

Recent research (Casciaro & Lobo, 2005, 2008; Ohly et al., 2010) suggested that there is complex interaction between trust and network formation in innovation. Interestingly, psychometrically-valid measures of trust and its antecedents have rarely been utilised in network research (McEvily & Tortoriello, 2011). To my knowledge, there have been no previous attempts to characterise the stages of the innovation process using individual dimensions of trust and trustworthiness (Clegg et al., 2002; van de Bunt et al., 2005) that binds the networks together. Researchers have instead depended on the measure of *tie strength* that captures the diffusion of influence and information (Granovetter 1973). Even when trust was implicated in the literature, (Buskens et al., 2010; Gilstrap & Collins, 2012; Wong & Boh, 2010), researchers did not take into account the latest development of trust in the psychology literature (Gillespie, 2003, 2012; Tomlinson & Mayer, 2009) save Ferrin et al. (2006) and Yakovleva et al. (2010).

Furthermore, it has been suggested that certain network structures support the development of trust (Ferrin et al., 2003; Ferrin et al., 2006; Lusher et al., 2012b; Robins et al., 2009). Tortoriello and Krackhardt (2010) pointed out that Simmelian ties, a special type of closed triadic network structure suggested by Simmel (1950) provides unique advantages to innovation by facilitating novel knowledge transmission (Tortoriello & Krackhardt, 2010, p. 168). Additionally, the embeddedness and transparency that such structures allow enables the actors involved to facilitate common understanding and norms, reduce miscommunication and carry out coordinated action to tackle tasks. The open communication channels allow for the development of trust within such networks, making Simmelian ties very effective at knowledge transfer, boundary spanning, creativity and innovation (Tortoriello & Krackhardt, 2010). But while this has been conceptually proposed, no previous research has provided empirical support utilising the aforementioned valid trust measures.

This study has two main aims: (1) to improve our understanding of the role of trust and perceived trustworthiness in the development of social networks at different stages of the innovation process; and (2) to ascertain whether there is a network structure (namely Simmelian ties) which promotes trust development. Here, the latest conceptual advances in trust, social networks and innovation literature are brought together to explore the intra-organisational association between trust and network attributes at two stages of the innovation process: idea generation (IG) and idea realisation (IR). Specifically, it examines how each element of trustworthiness (Ability, Benevolence and Integrity) influences choices that employees make in forming ties within these networks. Cross-sectional social network and attribute data collected from two firms was analysed to address these questions. In addition, there is a secondary objective of identifying the links between certain personality level and team level variables that influence tie formation choices in innovation.

The study uses the software UCINET to simulate the statistical distribution of networks and correlate that with levels of trust and trustworthiness. Drawing on data from 153 employees working at two firms, various dimensions of trust were found to influence tie formation across two stages of the innovation process. Specifically, all three dimensions of perceived trustworthiness (Ability, Benevolence and Integrity) predict tie formation for both idea generation and idea realisation. Moderation analyses revealed that perceived Ability only predicts idea generation and idea realisation tie formation when the alter is perceived to be benevolent. Additionally, alters who are perceived to have high Ability but low Integrity are avoided. The moderation effect of Integrity on the relationship between Ability and tie formation was only found in idea realisation. Additionally, self-monitoring was found to predict tie formation for idea realisation, but not idea generation. The analysis also showed that Simmelian ties are strongly associated with trustworthiness, supporting the idea that these special triadic structures promote trust development. These results suggest demonstrating benevolence, that is, collegial behaviour and concern for others, is central to unlocking ties that brings resources essential for innovation into project teams. They also suggest that in risky scenarios, Simmelian ties can be induced to support the development of trust.

**<u>Declaration by author</u>**

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my research higher degree candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

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Associate Prof Dr John Steen

Supervisor, editor, conception of topic, research design, data access

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**Statement of parts of the thesis submitted to qualify for the award of another degree**

None

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## List of Abbreviations

This thesis adopts abbreviations that are consistent with their use in academia in order to increase clarity while reducing the overall bulk of the text. The following list of abbreviations and their meaning are arranged in alphabetical order.

1. BTI      Behavioural Trust Inventory
2. IG      Idea generation
3. IR      Idea realisation
4. LRQAP    Longitudinal Regression Quadratic Assignment Procedure
5. MRQAP    Multiple Regression Quadratic Assignment Procedure
6. OECD    Organisation for Economic and Co-operation Development
7. RQ1      Research Question 1
8. RQ2      Research Question 2
9. RQ3      Research Question 3
10. SH      Structural holes
11. SMA      Acquisitive self-monitoring
12. SMP      Protective self-monitoring
13. SWT      Strength of Weak Ties

# CHAPTER 1   Overview

## 1.1   Trust as a predictor of social networks for innovation

Innovation is known to spur growth and sustain the competitive edge of firms (Amabile & Cheek, 1988; Axtell et al., 2000; Barney, 1991; Choi & Chang, 2009; Doz et al., 2001; Henderson & Cockburn, 1994; Katz, 1964; Peteraf, 1993; Smith, 2005; Unsworth & Clegg, 2010; Wernerfelt, 1984). Researchers have contended that innovation can be sourced through informal networks of cooperation (von Hippel, 1988), that share novel and idiosyncratic knowledge (Kastelle & Steen, 2013). These networks are a source of *social capital* which employees can leverage to help them innovate (Nahapiet & Ghoshal, 1998).

Social capital is defined as the value brought about through the structure and attributes of social relations (Coleman, 1988; Nahapiet & Ghoshal, 1997) and is a contextual complement to human capital. In contrast to human capital, social capital exists through the *ties* among persons (Coleman, 1988), the characteristics of that network and how those characteristics affect performance (Burt, 2000; Putnam, 1993). Social capital consists of three dimensions: 1) positions that human actors take in a social network of an organisation or *structures* (Coleman, 1988); 2) the features of the network *relations* such as trust and norms; and 3) *cognitive* abilities and systems which represent shared understanding and interpretations, such as language, codes and narratives (Nahapiet & Ghoshal, 1997). By having the right human capital, and leveraging their social networks, actors have more social capital and consequently are able to perform better (Bourdieu & Wacquant, 1992; Coleman, 1990; Portes, 1998; Putnam, 1993).

This thesis concentrates on the interplay between two elements of social capital – the network structures (structural elements) and trust (relational elements) in facilitating and enabling innovation. The core contribution of this thesis is in examining how the elements of trust influence tie formation for innovation. The thesis integrates the latest conceptual advances in trust research and analytic developments in the social networks literature to explore the assumption that trust is central to social network formation, and to better understand which elements of trust, if any, are most crucial. Understanding this interplay will help refine firms' innovation facilitation responses

in managing the innovation process. The roles of structural and relational elements will be outlined in the following sections.

### 1.1.1 The Structural and Relational Elements of Social Capital

A social network structure is an example of the *structural* dimension of social capital. The basic unit in these networks is the dyad, formed when a focal actor (or the *ego*) forms a tie with another actor (from now on also referred to as the *alter*). *Social networks* describe the overall configuration of such ties within a community. People who are rich in contacts probably have access to useful information (Ahuja, 2000; Dhanasai & Parkhe, 2006; Kleinbaum & Tushman, 2007), and those who bridge different groups or clusters can become reliable conduits of data to facilitate the transmission of novel information (Kleinbaum & Tushman, 2007). These benefits make network structures effective enablers of creativity and novelty (Somech & Drach-Zahavy, 2011; Tortoriello & Krackhardt, 2010).

Trust is an example of the *relational* dimension of social capital. It encapsulates affective and cognitive elements such as information, emotions and expectations that flow through social ties, linking one person to another. Relations can be transferred from domain to domain; this makes relations potentially influential in determining network configurations (Burt, 2005; Nahapiet & Ghoshal, 1997). In this manner, relational elements can open up the network to receive benefits from another network established for different purposes.

Trust is said to be a fundamental driver in the formation of network ties (Burt, 2005, Chapters 3-4; Granovetter, 1973; Granovetter, 1983). It was suggested that people will choose to form ties with others identified to have desired resources, and when interaction with those chosen is perceived to bring benefits (Mayer et al., 1995; Rousseau et al., 1998). Yet research in social networks rarely examines this claim (McEvily & Tortoriello, 2011; Yakovleva et al., 2010). Furthermore, the trust literature established that trust is a multidimensional construct made up of several elements (Gillespie, 2003; Mayer et al., 1995). This multiplexity makes it far more difficult to ascertain the impact of these separate elements on tie formation and the resultant network structures.

### 1.1.2 Stages of innovation

Innovation can be conceptualised as a multistage process characterised by *creativity-oriented behaviour* and *implementation-oriented behaviour* (de Jong & Hartog, 2007;

Garud et al., 2013; Janssen et al., 1997). These phases are collectively known as Innovative Work Behaviour or IWB (de Jong & Hartog, 2008). Creativity is exhibited in the first stage of innovation where novel and useful ideas are generated (Amabile et al., 1996; Scott & Bruce, 1994), while idea realisation or implementation refers to the process of converting the novel ideas generated into new and improved products, services or ways of doing things (West, 2002; Yuan & Woodman, 2010). The phases themselves can be linked as a chain of processes, with each phase's output feeding into the other.

Creativity and innovation requires the alignment and integration of various cognitive, structural and social elements residing in different domains (Amabile, 1988; Hargadon, 2002). Coordination of these resources allows organisations to deal with the challenges of stages of the innovation process, including the generation and refinement of ideas (Hargadon, 2002; Hargadon & Douglas, 2001), production (Axtell et al., 2006), coordination across organisations (Axtell et al., 2000), minimising risks (Berardo & Scholz, 2010) and initiating market uptake. This synchronization can be enabled through the interplay between the elements of social capital.

### 1.1.3 The challenge in optimising innovation outcomes

Distinctively different employee activities, behaviours, and characteristics are associated with the phases of the innovation process that generates and implements novel ideas (Amabile & Cheek, 1988; Basadur, 2004). But appreciating the work behaviour differences within these phases alone is not sufficient to optimise employees' creativity. There is a need to understand the characteristics of the stage the project is in, how each employee's strengths can contribute, and the network structures that facilitate these contributions. During the generation of ideas, knowledge of how creativity and innovation are hatched, generated, developed, promoted and implemented is essential for the successful implementation or realisation of those ideas (Dodgson & Hinze, 2000). In the implementation stage, it is important to have a clear picture of who can deliver, who has the right kind of networks to build support for the ideas, and who has the resources to rectify issues that surfaces.

Further, recent research has implied that there is complex interaction between trust and its elements in innovation. The collective research of Casciaro and Lobo (2005, 2008) showed that affect moderates the impact of cognition on task-related ties.

Casciaro and Lobo (2005, 2008) also suggested that general affect is different to perceived trustworthiness. I suggest that in a similar manner to affect, the trustworthiness dimensions of Benevolence and Integrity can separately override the cognitive needs of a working relationship especially skill-seeking, and skew the chances of success.

Despite the importance of trust, conceptualisations of trust and its antecedents have rarely been utilised in network research (McEvily & Tortoriello, 2011). Instead of using psychometrically-valid measures of trust, researchers used other measures (e.g., Bijlsma-Frankema et al., 2008; Lusher et al., 2012b; Robins et al., 2009; van de Bunt et al., 2005) with the recent exception of Ferrin et al. (2006) and Yakovleva et al. (2010). To the author's knowledge, there have been no previous attempts to characterise stages of the innovation process using individual dimensions of trust and trustworthiness within stage specific networks.

There are also questions surrounding network structures that support trust development. Traditional network literature on innovation has supported the idea that bridging ties between different domains is central to innovation (Elsbach et al., 2005; Hargadon, 2002), and the differences between domains creates barriers that brokers need to overcome (Tushman & Scanlan, 1981a; Tushman & Scanlan, 1981b). Tortoriello and Krackhardt (2010) suggested that the presence of third parties around such bridging ties qualitatively changes the nature of the tie's relationship. Presence of a third actor or the *tertius iuengens* (Obstfeld, 2005) who has strong reciprocal ties with the actors in the bridging tie brings into play trust-development mechanisms that facilitate risk suppression. However, no current empirical study that verifies this proposition exists.

Notwithstanding the above, there is little understanding about how trust operates within networks, how networks influence trust, and the effects this has on innovation. This current research suggests that an employee in an innovative project team needs to perceive that a potential work partner is trustworthy before seeking out the task resources that resides in that partner. This leads to important yet largely unaddressed questions: how does trust and its related elements affect the formation of social network ties in the innovation processes (Ferrin et al., 2006), and is there a network structure that is linked to trust? This study addresses the interplay between network structure and trust within the innovation process boundaries using survey tools. The

next section describes the research question of this work in order to help address this conundrum.

## 1.2 Research Statement: Relationship between Trust and Network Structures in Innovation

This research joins recent and emerging research (Levin & Cross, 2004; Marks et al., 2001; Schulte et al., 2010) to argue that trust is the over-arching attitudinal construct that drives tie formation in social networks. Since innovation is viewed as a process with distinct phases that fulfil different objectives (Janssen et al., 1997), this research argues that trust will play context-specific roles within the creative, idea generation (IG) stage and the executive, idea realisation (IR) stage. The research questions guiding this research are:

RQ1. How does the perceived trustworthiness of other actors influence employee choice of ties in IG and IR networks?

RQ2. Is there a network structure in innovation that is linked to trust?

RQ3. How do other personal variables influence employee choice of ties in IG and IR networks?

The primary research objective of this thesis aims to clarify how trust and its elements influence social network formation in different stages of the innovation process, and how certain network structures can influence trust levels. Research question 1 (RQ1) analyses the network structure at the individual and dyadic levels. Research question 2 (RQ2) analyses the structure at the dyadic and triadic levels. RQ3 addresses the secondary research objective linking various personality variables with IG and IR tie formation.

This research is a cross-sectional study of the social networks of innovation project teams of two high-tech firms. The network boundaries are based on the innovative work behaviour exhibited by the employees within the networks. Social theories of network establishment will be used as the basis for the hypotheses to be formulated and tested via survey tools. The results of this research will further inform the literature on trust and social networks, particularly in the context of innovation.

## 1.3 Contributions

Overall, this research aims to develop our knowledge of the interplay between social networks, trustworthiness, and innovation by advancing our understanding of the role of trust in the development of social networks at different stages of the innovation

process. The research explores the intra-organisational links between trust and network attributes at two stages of the innovation process: idea generation (IG) and idea realisation (IR). Specifically, it examines how each element of trustworthiness (Ability, Benevolence and Integrity) influences the choices that employees make in forming ties within these networks. It also examines the interplay between the trustworthiness dimensions, specifically the moderation impact of Benevolence and Integrity on the impact of Ability on tie formation. In addition, it also has a secondary aim of uncovering any links between personality and team level variables (namely, Self-monitoring, Locus of Control, Proactivity, the Five Factor Inventory, and Team Climate for Innovation) and tie formation choices.

This study aims to make two main contributions. Restating, it joins recent and emerging research (Levin & Cross, 2004; Marks et al., 2001; Schulte et al., 2010) to argue that trust is the over-arching attitudinal construct that drives tie formation in social networks. Trust will play roles within the idea generation (IG) and idea realisation (IR) stages. To examine how trust and its elements influence network formation during the two identified stages, the latest theoretical advances in the concept of trust and innovation are brought together. Capturing this interplay helps clarify roles of trust in unlocking ties in support for innovation. It assists employees in innovation projects to create more resilient innovation networks that suit the situation and meet constraints (Kijkuit & van den Ende, 2010). This balance is essential in innovation where novel, risky ideas can be found (Clegg et al., 2002).

A second contribution is a deeper understanding of how network structures can influence trust levels. Identifying these structures will aid in our theoretical understanding of how trust can be reinforced in scenarios that require solidarity, coherence and coordination. This is critical in idea generation that requires input from employees from diverse backgrounds and different domains, where these differences that can lead to novelty can also cause friction and disagreement. Similarly, this is also critical in idea realisation where trusting the right people can mean the difference between a successful innovation project and one that fails.

## 1.4   Overview of Thesis

In Chapter 1, I have reviewed the literature on structural and relational attributes of innovation networks. Here I outline the current issues with our comprehension of trust within networks, and identify the tension within the literature between sparse and dense networks. The assumption is that the latter is associated with high trust, but this

has never been empirically shown. Additionally, I highlight the lack of data to support our belief in how trust operates within networks, and how different dimensions of trust are linked to the different stages of the innovation process.

Chapters 2 and 3 review the relevant literature on networks, innovation, and trust, respectively. The review encapsulates discussion on innovation, characteristics of the stages within the process, social network analysis, and theories that link networks, innovation and trust. The review highlights dimensions of trust, including its antecedents, the positive and negative consequences of trust, and how they are associated to innovation. These associations underscore the expected hypotheses and dictate the type of methodology suited to the task.

All aspects related to the methodology employed are addressed in Chapter 4. The chapter details the rationale behind the strategy adopted, the related data collection techniques using interviews and surveys, as well as the unique analytical procedures used. These procedures are shown to allow for significance testing of the observed networks versus randomly-generated ones in order to test for the hypotheses posited in Chapter 5.

Chapter 5 details the hypotheses and analytical results to answer the primary research question, that is, how perceived trustworthiness influences employees' choice of IG and IR ties. The hypotheses put forward are based on both existing literature and my own nuanced understanding of the IG and IR-specific trust-structure interplay. The impact of trust elements on tie formation in stages of the innovation process is unpacked and elaborated. I also discuss the moderating effect of Benevolence and Integrity on the link between Ability and tie formation. In addition, I unpack the effect of Self-monitoring on tie formation in response to the secondary research question. The other variables were omitted from the main report for reasons that will be explained, but included in Appendix C for a complete overview.

Chapter 6 focuses on a special type of network structure posited to be related to trust: Simmelian ties. No prior empirical work has been carried out to verify the suggested relationship. This research will clarify this issue and contribute to our understanding of what constitutes an observable network measure of trust. Additionally, it also presents Simmelian ties as a network structure that can boost trust levels between employees. Finally, Chapter 7 integrates the findings from the previous chapters to frame the discussion regarding the contribution of the research to the body of knowledge on the links between innovation, trust and social networks, as well as the

managerial implications of the findings. This chapter further addresses the specific conclusions from this research and the implications for theory, future research and management practice.

# CHAPTER 2  Innovation

In developing innovations, access to diverse networks or knowledge domains is merely the antecedent for the generation of ideas (Ahuja, 2000), not a guarantee. Hence, having awareness of a resource does not guarantee that action will be taken to acquire it. Likewise, the generation of ideas does not determine their implementation, and perceiving an alter to be trustworthy does not mean that that person is trusted. Furthermore, innovation phases are separated by different cognitive processes that allow for the sharing and integration of knowledge (Dougherty, 1992; Tushman & Scanlan, 1981b). These processes pose challenges. West and Farr (1990) pointed out one of the major challenges of innovation at work is that of successfully bringing new ideas into an existing marketplace or workplace.

This chapter outlines the current understanding of the concept and processes of innovation. It describes the stages of the innovation process focusing on two specific phases: Idea Generation and Idea Realisation. Since innovation is generated through the agglomeration of ideas from various quarters, idea generation networks need to bring in new knowledge to stand a better chance of hatching truly novel solutions (Kastelle & Steen, 2013). Idea realisation networks on the other hand need to navigate the social-political landscape (Yuan & Woodman, 2010) and gather resources that allow the execution of ideas developed from the idea generation stage (Kastelle & Steen, 2010). Relevant literature on social networks, innovation and the factors facilitating them is outlined. This includes the most pertinent theories and relevant prior empirical research.

## 2.1   Definition

While numerous definitions of innovation abound, this research requires one which captures both network and relational elements, for example, network and psychological measures of trust (Nahapiet & Ghoshal, 1998). For this reason, the definition outlined in the Oslo Manual jointly published by the OECD and Eurostat (2005) is adopted. Innovation is defined as "the realisation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (OECD & Eurostat, 2005, p. 46). Such a broad definition allows a wide

range of outputs that the public identifies as being innovation, while implicitly acknowledging the elements of individual creativity, and human and social capital.

## 2.2    Innovation as a multiphase process

Innovation is a process made up of divergent and convergent phases which includes research and development and its associated activities (see review by Garud et al., 2013; OECD & Eurostat, 2005). Several models of the innovation process exist, and a review of these models suggest two dominant stages (Garud et al., 2013): idea generation (IG) and idea implementation or realisation (IR). Figure 2-1 illustrates these stages, the links between them, and the associated behaviours that characterise these stages. These behaviours are collectively known as Innovative Work Behaviour or IWB (de Jong & Hartog, 2007; Ramamoorthy et al., 2005) which captures the distinct behaviours and activities at each stage of the innovation process, namely either *creativity-oriented behaviour* or *implementation-oriented behaviour* (de Jong & Hartog, 2008; Janssen et al., 1997; Unsworth, 2001). Creativity is exhibited in the first stage of innovation, defined as the production of novel and useful ideas (Amabile, 1988; Amabile et al., 1996; Oldham & Cummings, 1996; Scott & Bruce, 1994), while implementation refers to the process of gaining targeted groups' appropriate and committed use of an innovation (Klein & Sorra, 1996).
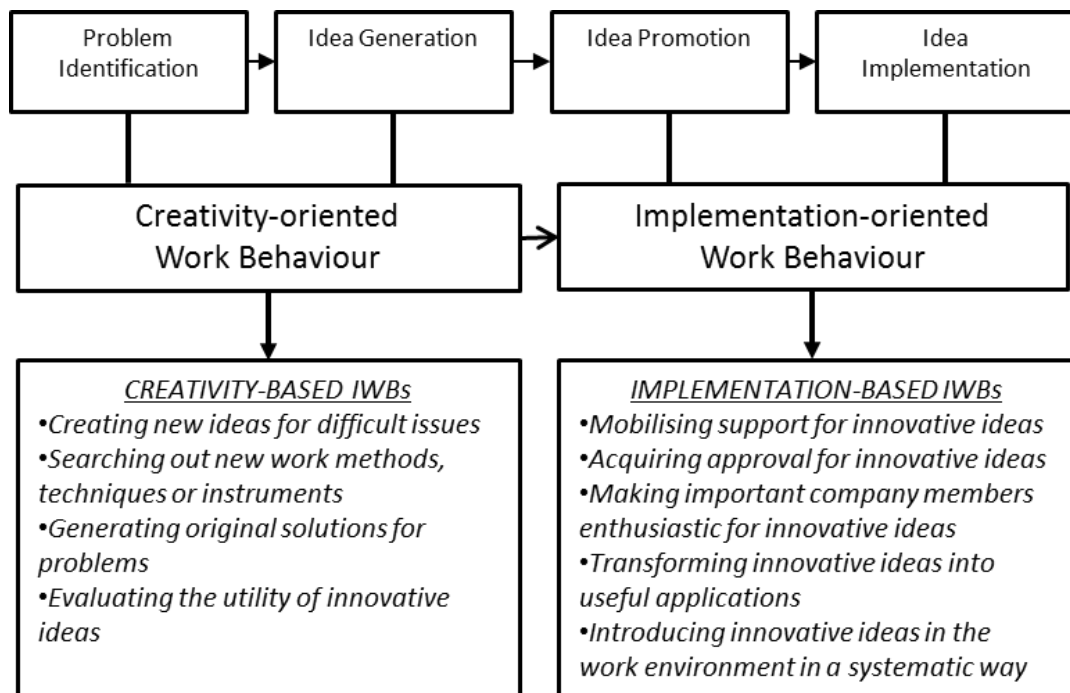


Figure 2-1: The four stages of the innovation process (based on Janssen et al., 1997) with associated Innovative Work Behaviours (Ramamoorthy et al., 2005).

Curiously, one of the deficiencies in our understanding of innovation is the limited research that differentiated between these two major stages of innovation (Baer, 2012; George, 2007; Kastelle & Steen, 2011; Ohly et al., 2010; Somech & Drach-Zahavy, 2011). To rectify this shortfall, this current study focuses on the IG and the IR stages. These associated networks are selected as they represent the tail-end of the two major innovation process phases separating the creative-based stages (i.e., idea generation) and the implementation-based stages (i.e., idea realisation) (Ramamoorthy et al., 2005). They have clear objectives and associated challenges, making behaviour-determination and hence network generation more distinct than otherwise. Selecting these stages allows for unique association and measurement of the trust-related variables to support further analyses and hypothesis testing.

Since the innovation process can be separated into several distinct phases, each of which is defined by its own set of cognitive and social processes and associated behaviours (Janssen, 2000; Janssen et al., 1997; Roper & Arvanitis, 2012; Roper et al., 2008), it is reasonable to expect that the different phases will have idiosyncratic characteristics. Organisational characteristics facilitating the initiation and the implementation of innovation are indeed unique (Baer, 2012; Unsworth et al., 2000). The generation of ideas is supported by high structural complexity, low formalisation and decentralisation, while the inverse situation supports its realisation, or as Duncan (1976, p. 179) calls it the 'ambidextrous model' of innovation. O'Reilly and Tushman (2004) further refined this and proposed that for organisations to carry out successful innovations, they need to have diverse and differentiated task structures to initiate more innovations, as well as have formal and centralised structures to implement more innovations.

Research in this vein has teased out some unique characteristics of the different phases of innovation (Hansen & Levine, 2009; Ohly et al., 2010; Somech & Drach-Zahavy, 2011) and focused on characterising them (Baer, 2012). The levels of diversity of each actor's social interaction is known to bring about novel ideas (Brown & Duguid, 1991; Hargadon, 2003; Henderson & Clark, 1990) and innovations, if this diversity is properly harnessed, managed and developed. However, the way that the support networks associated with the different phases unfold is driven by various factors. This includes choices that employees make in establishing their social networks, and the network structures formed, be it with experienced employees, project leaders, management or their peers (Amabile, 1988; Amabile, 1993a, 1997; Conti et al., 1996;

King & Anderson, 1990; Uzzi & Spiro, 2006). Choosing the right personnel with creative ideas and advocacy to push the ideas to completion are all part of successful innovation processes. These choices in turn are connected with the behaviours exhibited towards others. These behaviours form the basis for the concept of Innovative Work Behaviour (IWB).

### 2.2.1 Innovative Work Behaviour

Innovative Work Behaviour (IWB) can be defined as the intentional creation, introduction and application of new work ideas within work roles, groups or organisations in order to benefit role performance, the group or organisation (West & Farr, 1989) that are *extra-role* and *not* part of the formally recognised employee reward system (Janssen, 2000; Organ, 1988; Ramamoorthy et al., 2005; Scott & Bruce, 1994). This is an important distinction as most firms evaluate and reward their employees based on performance indicators, with little emphasis on the supporting processes. Behaviours associated with these processes can be categorised as either *creativity* related behaviour or *implementation* related behaviour (de Jong & Hartog, 2008). By providing new options for the further development of similar novel behaviours, IWB is thought to give rise to innovations. Creativity is then linked to IWB in a similar fashion to the way it is linked to innovation (West, 2002), in that actors engage in IWB to bring ideas together in a new way. This leads to new knowledge that is then implemented.

Idea generation in some sense depends on the ability of knowledge brokers to identify novel ideas and the domains that these ideas reside in. In attempting to access these domains, some level of social exchange is expected. Working on the assumption that information is not given up freely, some form of motivation is needed as a measure of returns to the brokers, intrinsic or extrinsic. This is in line with the intrinsic drivers of creativity mentioned by Amabile (1983).

IWB is not only about exploration of opportunities to generate new ideas, but also about including behaviours that improve performance through the stages of *implementation*, *application of new discoveries* or *process improvements* (Fagerberg, 2005; King, 2002). Research in a similar vein looking at project teams in firms (Kleinbaum & Tushman, 2007; Somech & Drach-Zahavy, 2011) highlights the different roles that networks of innovation teams fulfil through the *emergence* and *implementation* of ideas. Such a framework further supports the idea that the innovation process has stages with different risks. Uncertainties and risks may take

the form of opportunistic behaviours, failure of technology, unforeseen organizational hurdles and financial concerns. Taken together, to achieve success, the different stages with different objectives must be supported by appropriately tailored behaviours.

## 2.3    Creativity-oriented stage: Idea Generation

Research into creativity has taken various perspectives. These include creativity in organisations (Oldham & Cummings, 1996; Scott & Bruce, 1994; Scott & Bruce, 1998), personality accounts (Barron, 1968), interactionist accounts (Woodman et al., 1993) and social psychology (Amabile et al., 1996; Kurtzberg & Amabile, 2001). This long and recognised history has been based on the assumption that creativity is a unidimensional construct, but there have been efforts to further dissect it (Unsworth, 2001). Since innovations supposedly originate from creativity that in turn is embedded in individual and social psychology (Amabile, 1983), this research argues that dynamic social-psychological interactions that generate creativity must be included in the general framework of innovation (Perry-Smith & Shalley, 2003; Unsworth, 2001). Creativity is defined by DeGraff and Lawrence (2002, p. 4) as "a purposeful activity (or set of activities) that produces valuable products, services, processes or ideas that are better or new". Other definitions of creativity all point to two similar developmental characteristics. First, it specifies the need for novelty or originality (Bruner, 1962; Eysenck, 1993; Newell et al., 1962; Stein, 1974), and second, creativity must be consensually evaluated by consumers (Amabile, 1982). Collectively, these imply that creativity is an individual-level capability that is projected outward as an output that consumers find novel and appealing. This distinction is important because without appealing to others, novel ideas are not considered worth pursuing.

Creativity is proposed to be made up of three elements (Amabile, 1983): (a) domain-relevant skills such as knowledge, technical skills and talents available in a domain; (b) creativity-relevant skills as cognitive and personality working styles that allows one to use domain-relevant skills in a way that produces novel ideas; and (c) intrinsic motivation as the motivation to execute a task primarily because it is personally challenging or satisfying (Amabile, 1982; Amabile et al., 1996). Based on these elements, it is easy to see the link between creativity and innovation. Whilst creativity involves the generation of useful ideas, innovation involves both the generation and the realisation of that idea for utilisation and consumption (Dodgson & Hinze, 2000;

Kanter, 1988; Unsworth, 2001; West & Farr, 1990). Creativity is thus part and parcel of the innovation process, and is treated as such throughout this thesis. Accordingly, there is a need to understand the genesis of creativity in order to comprehend the idea generation process, and the innovation process as a whole.

The multistage process of innovation (Axtell et al., 2000; Janssen et al., 1997; Scott & Bruce, 1994) starts with Problem Identification. Here, a specific problem faced by an organisation or consumers is recognised and given scope (Kanter, 1988). Idea Generation (IG) follows, characterised by the production of novel and useful ideas to tackle the problem (Scott & Bruce, 1994). Within this stage, novelty is rarely the case within a closed group, since what one person knows is probably redundant information to colleagues. Accordingly, knowledge and creativity outside of a domain is often critical to the creativity and innovation process, be it at the inter-unit level (Mansfield, 1968), organisational level (March & Simon, 1958), industry level (Brock, 1975; Peck, 1962), or national level (Mansfield, 1988; Westney & Sakakibara, 1986). A lot of this knowledge and creativity is based on the borrowing of ideas, which is supported by extensive research on sources of innovation (Amabile, 1993b; von Hippel, 1988, 2005).

Accurate problem solving, then, plays an important role in IG. Here, actors need to develop novel ideas beyond the fundamental concepts that they individually have, that is, to look for rule schemas beyond their knowledge domain. The search for different perspectives will then lead them to talk to others who are perceived to have the skills and knowledge in the associated domain of novelty. An example would be students seeking out a professor of chemical engineering to assist them in developing a new concept for an environmentally friendly plastic. However, while the expertise of the professor may help the students identify approaches that will and will not work, it may hinder their search for possible solutions due to rule schemas or cognitive barriers within the Cognition domain of the professor. This comes about because shared codes and knowledge within a cognitive boundary, while useful in efficient communications and actions, may prevent effective identification of knowledge schemas that exist in other domains. Hence, there are no guarantees that "the relevant knowledge will be available at the right time: to the right people" (Hargadon, 1999, p. 142). Talking to others in different units or fields of expertise can yield other avenues that have not been pursued. An intellectual property lawyer may be able to assist a student in identifying other possible patented methods that have been tried or tested, but have

failed due to immature support technology at the time of patenting. An electrical engineer may point out that an existing technology might make a previously unavailable polymer useful for the application. This underscores one of the main challenges faced by people tasked with IG in identifying a useful knowledge repository (MacAulay, 2009).

### 2.3.1    Social networks as sources of creativity

To generate novel ideas and turn them into innovations, the source of creativity needs to be identified. Following Schumpeter (1947), Moran and Ghoshal (1997) argue that two generic processes generate intellectual capital: combination and exchange. Combination is the act of bringing together previously unconnected elements. When these elements are held by different parties or sit in different domains, exchange needs to precede combination. In organisations, exchange can be accomplished if various cognitive, structural and social activities are aligned and brought together by agents. This is referred to as *knowledge brokering*, with the agents known as *knowledge brokers* (Hargadon, 2002) or *boundary spanners* (Tortoriello & Krackhardt, 2010; Tushman & Scanlan, 1981a; Tushman & Scanlan, 1981b).

Knowledge brokering is a strategy pursued to exploit weak ties that exist across multiple domains (Carmen Cabello et al., 2005; Elsbach & Hargadon, 2006; Hargadon, 2002; Hargadon & Bechky, 2006). It is not merely the transfer of ideas, but a *whole suite of strategies* that enables ideas to be transferred in a unique way that hatches new and useful information. Knowledge brokering brings together ideas from multiple levels of social structures to organisational practices and individual cognition (Hargadon, 2002). Brokers face the challenge of overcoming the structural isolation that exists between clusters or 'boxes' in which knowledge resides. Additionally, to allow information flow, cognitive understanding that exists in the domain from where the knowledge originates as well as in the domain where it is to be applied needs to be remodelled. *Analogical reasoning* is one such remodelling technique, where knowledge from one domain is applied to another to see if any similarities can be observed and deployed in the relevant context. If it does, ideas can then begin their cross-border journey in stages as identified by Hargadon (2002). These are outlined and shown diagrammatically in Figure 2-2.
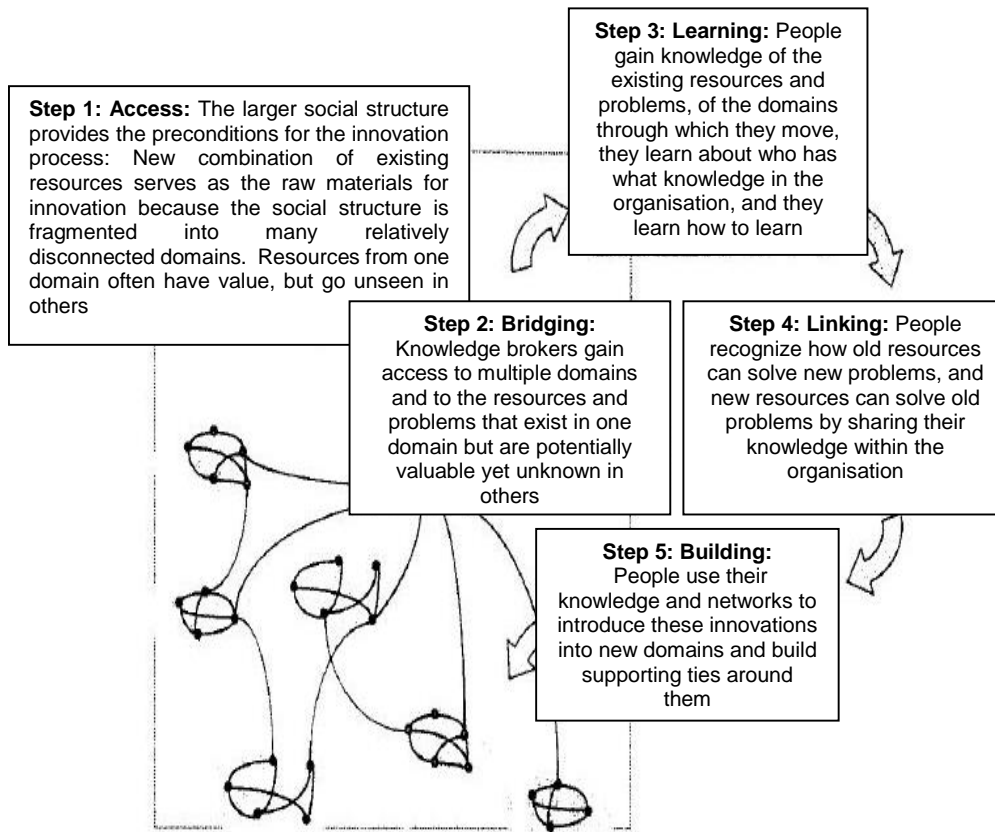
Figure 2-2: The mechanisms of knowledge brokering that support innovation (adapted from Hargadon, 2002)

The steps in the figure above are described as follows:

Step 1: **Access** is gaining entry into the domains of the larger social structure. The opportunity to make the combination must first exist.

Step 2: **Bridging** describes *analogical reasoning,* where new but unvalued knowledge could potentially be applied in another domain.

Step 3: **Learning** is the action of obtaining the new and unvalued knowledge from the respective domains.

Step 4: **Linking** identifies how people recognise that old resources can be used to solve new problems by sharing their knowledge within the organisation, or perhaps across organisations. This step is essential as Cohen and Levinthal (1990) argued that firms need to have the ability to recognise value of new information and apply it to commercial ends. Lacking the ability to link this new knowledge together implies that the organisation fails to generate innovations based on existing knowledge. An example could be a parking system based on the concept of computer data storage in random-access memory.

Step 5: **Building** introduces the new knowledge through their networks, and builds support structures to stabilise their operationalisation.

Network bridging by knowledge brokers is thus central in the innovation process. Brokers are expected to bridge gaps between groups in organisations, having had experience perhaps in different domains or roles (Tushman & Scanlan, 1981a), have other personality traits that make them able to adapt to different scenarios, and take active steps in establishing ties. This by no means understates the roles of other, non-brokering actors, since the latter need to refine the knowledge being developed within domains. When these resources move across boundaries, they become new and/or novel for other industries, and may become valuable for their perceived novelty. These translations are concrete and can be seen as part of strategies and actions of individuals and organisations (Hargadon, 2002). If the application of analogical reasoning works, then the new knowledge can successfully reside beyond the boundaries of the original organisation. A firm that is able to extract new knowledge from an external domain and internalise it is said to have *absorptive capacity* (Cohen & Levinthal, 1990). Knowledge and idea sharing becomes a social artefact of interactions between these actors (Nahapiet & Ghoshal, 1998: pg. 253). The next section describes the challenges in IG and IR where this absorbed knowledge is further developed into novel applications.

### 2.3.2    Key Challenges in IG

In innovation, there are unique risks associated with developing novel ideas and implementing them. Three main challenges are outlined here: (a) access to different domains; (b) resistance to novel ideas; and (c) idea security.

Gaining access to different domains in itself is a challenge, because each domain is represented by its own sets of shared schemas and codes (Cicourel, 1973; Orr, 1990). Knowledge brokers attempting to access these groups must learn these schemas and codes if they are to make sense of the information that circulates within (Olson et al., 2007). Those barriers may not only be present due to lack of commonality, but also due to the existence of arduous relationships between the source and the recipient of the knowledge as pointed out by Szulanski (1996). If parties cannot gain access to knowledge sources, cannot perceive positive outcomes from the interaction, or do not have the motivation to engage in activities such as acquisition of language and codes that require additional investment of resources, this deters the necessary combination

and exchange from happening. The creativity, novelty and hence value of information can only be ascertained *after* access is gained. Without access provided by ties, novel ideas cannot be extracted.

Novel ideas, as opposed to more incremental ideas, tend to challenge the status quo. At times they can be 'out there' and totally ungrounded in existing understanding. Additional effort, input and ideas are then required to refine these ideas, so as to 'create the box' for the eventual implementation and realisation. Those responsible for allocating resources need to make prudent decisions on which novel ideas are to be developed. The associated resource diversion means there are fewer resources available to deal with current tasks. Some employees are not keen to divert these resources, preferring instead to focus on existing tasks (Furnham, 2005b). These include employees who have vested interests, overly rational thinkers who focus on routines rather than new approaches, and bureaucrats who emphasise rules and operational efficiency. They have been observed in industry to eschew innovative ideas for more proven technologies or methods that will not derail firm activity in pursuit of disruptive technologies (Furnham, 2005b, p. 553). This pursuit leads to resistance in the organisation, especially in terms of sourcing the right people who can help develop and further refine the ideas, and gaining support for and sourcing resources to implement the ideas (Damanpour, 1988). The more radical the idea, the more resistance is expected. Typically this stems from the assumption such ideas, if implemented, will change the fundamentals of operations, requiring additional resources to internalise. Such resistance in turn increases the probability of innovation failure, leading to waste and possibly reduction in performance (p. 556) and loss of opportunities, reducing its appeal.

The second challenge in IG is resistance to risky, novel ideas and the conflict it elicits through creative friction (Janssen, 2003; Tsing, 2011). Creative friction is defined as the imperfect connectivity between people of dissimilar cultures, who have diverse task-orientations and operate at different levels (Tsing, 2011). When people of these groups interact, creative friction can initially cause discrepancies in the perception of ideas, because something that is practised in one domain might be totally new and untrusted in the other. But if these ideas are embraced, they can lead to the formation of novel ideas. Creative friction here acts as the bridge that helps refine ideas so that they can be accepted into other domains. So it acts as a double-edged sword that needs to be wielded carefully for optimal innovation process output.

The third challenge faced in IG is idea security. Novel ideas that are perceived to offer superior benefits attract a lot of attention. An opportunistic person might steal the idea, claiming it as their own in order to claim rewards. Such people will probably exploit trust at every opportunity, especially in one-off transactions where there are clear exit strategies (Burt, 1999). It has been suggested that in a start-up company, idea theft can effectively wipe out any incentives an entrepreneur has in expending effort, reducing the chances of innovative solutions to permeate, and causing the value of the firm to plummet (Bachmann & Schindele, 2006). While the threat of sanctions on the offending party, if discovered, can reduce the possibility of idea theft, this threat is insufficient, particularly in the face of potentially large profits or an easier development path. Ueda (2004) found that idea-specific support and expertise, low collaterals, high growth potential and returns promised by VCs to innovative start-ups trumps the risks of expropriation to the entrepreneurs. Yet, idea theft in these scenarios is a common occurrence (Bachmann & Schindele, 2006). The same idea is extended to employees in an organisation, but because employees can self-select, they are expected to use this freedom to choose alters perceived to be non-opportunistic.

Taken together, this suggests that as employees try to generate new ideas to tackle an issue, they will seek people with fresh perspectives and different outlooks in different domains. The same idea is extended to employees within an organisation. Because employees can self-select, they are expected to use this freedom to choose trustworthy alters willing to be 'sounding boards' or provide support. This leads to a proposition that links employees' IG tie formation choices with the trustworthiness of alters.

*Proposition 1: Employees will choose to form ties with alters perceived to be trustworthy to share and generate novel ideas.*

## 2.4 Implementation-oriented stage: Idea Realisation

The main objective of the IR stage is getting parties to accept and adopt a new idea (Klein & Sorra, 1996), and to successfully implement it. This is the stage where an idea is completed by the production of, 'a prototype or model of the innovation…that can be touched or experienced, that can now be diffused, mass-produced, turned to productive use, or institutionalized" (Kanter, 1988). Hence, one way to support idea implementation is to showcase the idea's benefits. This can be facilitated by networks (Farr & Ford, 1990) through social contagion (Burt, 1980, 1982, 1987; Contractor & Eisenberg, 1990), which increases the likelihood of actors adopting similar IWBs.

This is the definition of what is referred to as the *convergence* model of communication (Rogers & Kincaid, 1981), in that convergence standardises the behaviour of all the actors in the same network.

The implementation stage of innovation is found to be very much a social-political process (Van de Ven, 1986; Yuan & Woodman, 2010). The availability of support as well as financial, human and technical knowledge increases the possibility of innovation success (Klein & Knight, 2005). Successful innovations are characterised by employees who have good influencing skills, have a clear picture of those firm-specific social-political channels, and of how they operate. Employees should personally have the propensity to carry out these behaviours (Baer, 2012) and also to leverage on the firm environment. Baer and Frese (2003) suggested that on top of firm climate for innovation and psychological safety, personal traits and perceptions of alter trustworthiness should also be strong determinants of IR success.

In seeking resources for an idea, an innovative individual seeks support, perhaps from a prominent person at the organisation who has some clout, and from that point on builds momentum. Here, one objective is "issue-selling", where these individuals make certain issues or cases known to top management (Dutton & Ashford, 1993; Dutton et al., 2002; Dutton et al., 1997; Dutton et al., 2001). Recent work by Baer (2012) that examined the relation between creativity and idea implementation found that the belief that positive outcomes will come from implementation efforts, is called *implementation instrumentality* and is linked to the intrinsic motivation to be creative. Additionally, Baer's research found that being skilled at forming buy-in ties links idea generation and idea realisation. Buy-in ties form when an employee successfully lobbies for support from an influential person who controls the necessary resources to execute an innovative idea.

### 2.4.1    Key Challenges in IR

There are several challenges in getting the buy-in of those perceived to have the resources (Duncan, 1976) through 'issue-selling', the managing of unexpected problems, and coordinating multiple efforts in executing the innovation. Powerful actors with resources could be either within or beyond an organisation, which parallels the earlier finding by Dutton et al. (2002). However, during these implementation activities of novel ideas, several challenges crop up. They are (a) resistance to novel ideas; (b) managing unanticipated problems; and (c) coordinating different divisions' activities.

The first challenge is overcoming opposition to change brought by innovations. Similar to IG, the implementation of creative ideas may draw resistance. In IR networks, this causes resistance in the organisation against support and sourcing of resources to implement the ideas (Klein & Knight, 2005). As mentioned earlier, the decision to provide resources and support is very much political. Multiple superiors potentially oversee the whole innovation channel, and they may have differing ideas of the value of the idea. Different perceptions on novel ideas that offer ambiguous benefits lead to social-political manoeuvring, and advocacy and championing are mechanisms that influences these resource decisions (Green et al., 2003). This is succinctly put by Kanter (1988, p.186): "The features of successful ideas have more to do with the likelihood of gathering political support than with the likelihood of the idea to produce results".

The second challenge is managing unanticipated problems. Strategies that firms employ in innovation include the establishment of long-term research programs where recursive learning takes place between practitioners and on-site data gathering. The conflicting requirements of various task personnel mean that technical, legal and political objectives will pull projects in various directions, requiring managers to sustain support for the innovation even when faced with serious hurdles. This implies the formation of cooperative networks among all involved, which can include practitioners, technical professionals, researchers and management (Berardo & Scholz, 2010; van den Daele & Krohn, 1998).

Coordination is the third challenge to be overcome. Organisations have realised that teams are the fundamental units that can successfully execute IR, as projects become ever more complicated due to the multitude of inputs required (van der Vegt et al., 2010). These teams respond to various external demands (Jones, 1996; Powell et al., 1996) through the dynamic relationships within (van der Vegt et al., 2010) and beyond their boundaries. While most of these teams are probably built along formal lines within the organisation to build legitimacy, some of them can also be embedded in the organisation's informal structure (Oh et al., 2006). But the building blocks of these teams are individuals, each with their own idiosyncrasies that potentially can complicate coordination efforts. For risky, novel innovations, riddled with even far more uncertainties, poor coordination will cause underperformance or even project failure.

Consequently, the successful implementation of novel ideas is dependent on the ability of individuals to establish ties and gain trust from key figures, idea champions and the implementation team as a whole (Mullins et al., 2008). Getting buy-in and securing trust of key figures who hold positions and power to influence decisions on resource allocation allows employees to obtain the resources needed to improve the chances of their ideas being realised (Damanpour, 1988; Garud et al., 2013).

Gaining access and trust also allows employees to obtain essential and pertinent information to deal with unexpected problems. In their study of waste-disposal and commercialisation of molecular biotechnology, van den Daele and Krohn (1998) studied how researchers carried out practical experimentation on-site to generate data and validate methods to tackle these problems. The researchers formed research clusters and worked closely with those in development and application of solutions to emergent issues. Such research clusters facilitate recursive learning as demonstrated by research within the Korean Government (Choi & Chang, 2009), in mid-sized German firms (Baer & Frese, 2003), and in the implementation of TQM (Victor et al., 2000). Such strategies alleviate the potential loss of support by building solidarity within the research team.

Taken together, this suggests that as employees attempt to implement novel ideas, they will seek people with the relevant resources who are *trustworthy*. This leads to a proposition that links employees' IR tie formation choices with the trustworthiness of alters.

*Proposition 2: Employees will choose to form ties with alters perceived to be trustworthy to obtain resources and coordinate the implementation of novel ideas.*

## 2.5 Summary

This chapter presented an overview of what constitutes innovation. The definition of innovation was outlined, and innovation was shown to be a multiphase process. The research focuses on two key stages of innovation, specifically Idea Generation (IG) and Idea Realisation (IR). The main challenges of these two stages were reviewed, and I argue that networks and trust are central to address these challenges. The next section discusses social networks and trust, and how they are pertinent to the innovation process.

# CHAPTER 3   Social Networks and Trust

The previous chapter alludes to the importance of social networks and trust in supporting the innovation process. This research will make use of social network analytical approaches to examine how trust predicts tie formation and structures in social networks formed for innovation.

## 3.1    Social Networks: Structures of Communications

The study of relationships within an organisation or the social networks looks at the way people are linked to one another, the nature of the network they are in, the human capital related to these networks and the type of information being transferred (Monge & Contractor, 2003). Such networks can function on many levels, contributing to the way decisions are made, firms operate, and the level of success teams have in achieving their goals. Burt's research into social capital (2000) highlights the framework which relates social network to social capital. This includes how the relational dimension of trust can be built, an important consideration when dealing with the uncertainties brought about by the innovation process. The network can be a measure of social capital in itself (i.e., the value people get from the social network), or seen as the mechanism through which social capital value accrues or is erased.

Social networks explain how certain network structures of project teams bring advantages to the project.  Networks can facilitate not only cooperation to pursue opportunities (Podolny & Baron, 1997) but also the transmission of a person's trustworthiness and the corroboration of that reputation within the network (Ferrin et al., 2012). Through network relationships, opportunities are created for information sharing and coordinated action to mutually reinforce and accumulate over time (Burt, 1997). Trust is particularly salient for the innovation process, due to the risks and uncertainties inherent in creating and implementing novel ideas. Trust allows actors involved in innovation to share information and collectively solve problems to better evolve and manage these risks. Trust that can be facilitated through networks (Nahapiet & Ghoshal, 1997) is a key lever for the management of such risks. This chapter details the relevant essentials of social network analysis, followed by those essential for trust.

### 3.1.1    The basics

Organisations can be considered as social groups where communications and exchanges that support the main objectives take place (Katz, 1964). Social network analysis is a coherent

framework that allows analysis of these communication processes, both current and emergent (Tichy et al., 1979). This framework has developed to the point of allowing empirical data collection as well as analysis of significant organisational processes that takes place at different levels of analysis (p. 507). This is achieved through theorizing the models supporting the framework and testing the hypothesized links between multilevel variables of organisation behaviour (Borgatti & Halgin, 2011).

Borgatti and Halgin (2011) described model-based theorising, outlined the models most pertinent in social network studies, and how they help us describe unseen processes that shape outcomes. Theories guide the formation of models, which explains the relationship between conditions and variables that influence the behaviour of the observed phenomena. These form the basis of testable hypotheses. In social network analysis, the models are based on the interaction between the networks observed, the selected variables, and outcomes.

A network typically consists of a set of nodes and ties that link them. These ties are identified based on name-generator questions that define the link between the nodes, generating the research boundary. Nodes can be directly connected through the ties, which in turn form network structures that can be analysed visually as well as mathematically. Analysing these networks allows for the measurement and correlation of variables (Ahuja, 2000; Drach-Zahavy & Somech, 2001). Meaningful interpretations can be gleaned from the resultant analysis. Altogether, social network analysis essentially quantifies the social capital associated with the ties and structures that actors establish with other actors (Burt, 2005).

Figure 3-1 depicts a typical social network graph. The nodes represent the actors, and the lines signify set of defined connection between actors. The name-generator question that frames this specific example is "Whom do you publish with?". The nodes in Figure 3-1 represent researchers, and the lines represent who co-published with a central author. Notice that there is very strong clustering that creates silos of co-authors. This clustering can be ascribed to the tendency of these authors to keep to cliques. Other variables, such as the characteristic of the members in these cliques to describe the affinity that drives such structures, can be hypothesised and tested. It could be that some of these variables exhibit stronger effects than others, and surface as the more important driver of these relationships.

The network diagram also indicates some characteristics of the connectivity of people. In this figure, the graphs are disconnected, so those in one cluster cannot or do not reach out to other clusters. These clusters are defined as components of a network.
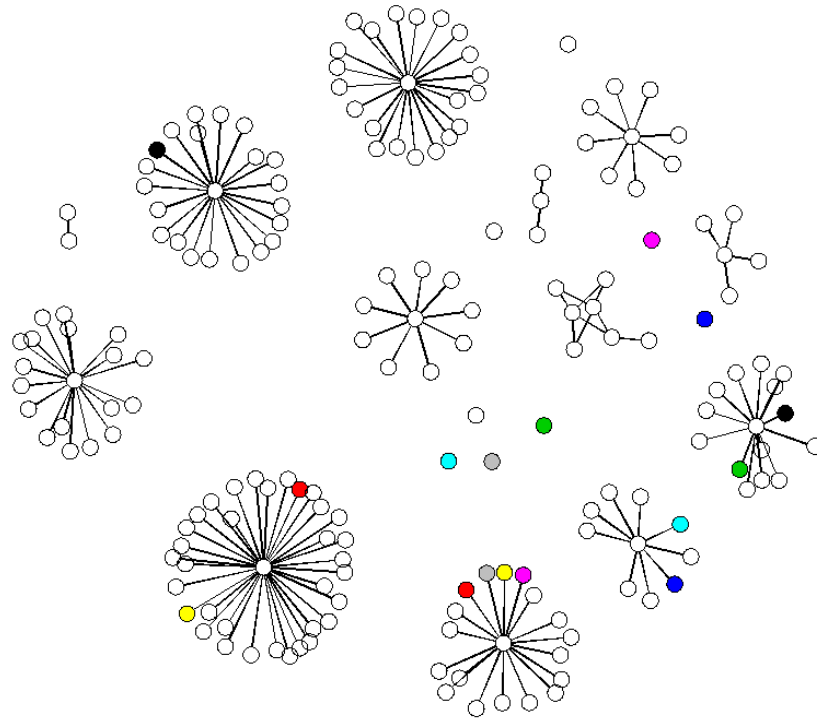
Figure 3-1: A network graph of a co-authorship network

Some of the basic terms used in social network analysis are described below.

1.  The people or organisations that constitute the network membership that make up the 'nodes' of the network are known as **actors** (Knoke & Kuklinski, 1991). The actor at the centre of a particular refined study is referred to as the **ego**, and the persons linked to the ego are known as **alters**.

2.  **Ties** are the links that connect actors together, and usually differ in strength and direction. Ties can be classified as either reciprocated (e.g., if person A lists person B as a friend, and person B also lists person A as a friend) or non-reciprocated (e.g., if person A lists person B as a friend, and person B does not list person A as a friend) (Knoke & Kuklinski, 1991).

3.  A **dyad** defines two actors A and B and the possible ties between them.

4.  A **triad** defines three actors A, B, and C and the possible ties between them.

5.  **Reciprocity** describes the occurrence of a tie from A to B matched by a tie from B to A, with both ties fulfilling the same function defined by the name-generator question. Identifying the underlying reasons behind reciprocity can yield useful insight.

6.  **Centrality** measures the degree of connectivity a person or node endows the network (Freeman, 1978; Monge & Contractor, 2003). A person connected with the most number of other nodes in the network is said to have the highest centrality.

7.   **Betweenness centrality** considers the extent to which one node controls the access of other nodes to other actors within the network (Borgatti & Everett, 2006; Freeman, 1978). These nodes bridge gaps between isolated sub networks or clusters within the larger network. The implication is then that these actors have high leverage and thus hold high positional power due to their ability to broker knowledge and exchange resources. They are the *knowledge brokers*.

## 3.2   Relevant Network Theories on Innovation

Organisational innovation and creativity are facilitated by new and existing social connections between people. These connections enable ideas and resources to flow from one another to generate the products or achieve objectives (Obstfeld, 2005). Research has identified innovation as emerging from the combination and recombination of people, knowledge and resources through the aforementioned links (Henderson & Clark, 1990). However, our understanding of the mechanics of this combination and recombination process is still incomplete (Obstfeld, 2005, p. 100).

Numerous benefits of social networks to a person's creativity and subsequently a firm's innovation output have been uncovered. Freeman (1991) found that a firm's external as well as internal networks are sources of information for successful innovation. The research by Powell et al. (1996) suggests the same happens in the biotechnology industry, where interorganisational networks of learning play a more important role in providing firms with access to novel knowledge. Within R&D firms, Reagans and Zuckerman (2001) found that network heterogeneity offers enhanced learning capability through access into different but salient demographic boundaries. Dhanasai and Parkhe (2006) showed that network heterogeneity occurs as a result of the actors orchestrating activities within in order to optimise output, even in the face of constraining factors such as hierarchies. This implies there are socio-psychological elements at play that influence network formation and evolution. The types of network structure that the actors form to support innovation also varies depending on the objectives (Simon & Tellier, 2011). When firms aim to validate an idea, successful innovation projects are characterised by a local increase in the number of ties within a group. When the objective is to educate team members about an innovation, ties are formed with redundant contacts to lobby and secure resources.

Typically, team effort and social coordination are required to turn novel ideas into innovations (Anderson & West, 1998; Drach-Zahavy & Somech, 2001; Somech & Drach-Zahavy, 2011). Prior research has proposed that both homogeneous and heterogeneous teams facilitate innovation, but in different ways. Homogeneous teams benefit from structural cohesiveness,

commitment and member satisfaction (Carron & Brawley, 2000; Hinds et al., 2000; Oh et al., 2006) that allow faster and more efficient communication. Heterogeneous teams benefit from creative output due to creative friction between different cognitive groups (Tsing, 2011) that can lead to novel ideas (Tsui et al., 1992) and subsequently positive innovation performance (Casey-Campbell & Martens, 2009; Mathieu et al., 2008).

Homogeneity and heterogeneity between team members are assumed to lead to the formation of sparse and dense networks, respectively. Recent work by Mors (2010) has supported the idea that in creating new knowledge, different network densities bring different benefits. Sparse networks have been found to consist of relatively weak ties (Granovetter, 1983; Hansen, 1999; Podolny & Baron, 1997) that facilitate the brokerage of novel information from one domain to another (Burt, 2005; Mors, 2010). A benefit of weak ties is that they are less resource-intensive, allowing actors to have large but relatively sparse networks. They also generate creativity (Burt, 2004; Burt et al., 2013; Perry-Smith & Shalley, 2003) and enable contingencies (Mizruchi & Stearns, 2001), based on the assumption that weak ties link heterogeneous actors together; they hold non-redundant information and hence can provide diverse knowledge.

However, some scholars have argued that dense networks facilitate effective knowledge transfer critical for innovation (Cross & Borgatti, 2000; Ibarra, 1995; Krackhardt, 1992; Obstfeld, 2005) because it generates an environment where trust and safety are nurtured (Barker, 1993; Coleman, 1988; Edmondson, 1999; Uzzi, 1997). Additionally, dense ties and closed network structures are said to facilitate coordination, provide work support, and produce trust and reputation (Burt, 2005; Burt et al., 2013; Coleman, 1988; Reagans & McEvily, 2003). This dichotomy between homogeneous and heterogeneous teams leads to a recurring tension in innovation research: the finding that both dense and sparse networks are relevant to innovation (Burt, 2005; Obstfeld, 2005; Perry-Smith & Shalley, 2003). It also leads to the assumption that trust is higher in dense networks compared to sparse networks (Edmondson, 1999; Granovetter, 2005; Uzzi, 1997). Unfortunately, most of this research has neglected the antecedents of these network structures (Burt, 2004). This thesis addresses this gap by examining how trust predicts tie formation, which subsequently gives rise to multi-faceted communications that bring about fresh or different perspectives on the development of innovation.

The most useful theories of social networks pertaining to trust and innovation are Granovetter's (1973) strength of weak ties theory (SWT), Burt's (1992) structural holes (SH) theory, and Aral and Alystyne's (2011) bandwidth theory. Each of these theories explains how network structures can influence the innovation processes through bridging different domains of knowledge, bringing in large volumes of information to allow for novel knowledge flow and

recombination, or reinforcing the existing relationship further in support of implementation. The strength of weak ties theory suggests that weak ties are a source of novel ideas because it bridges different domains. A bridging tie is defined as one that ties an actor to another who is not connected to his or her friends (Borgatti & Halgin, 2011). This increases the possibility that any information a person receives through this tie will be new and not available from his or her current contacts (Granovetter, 1973). On the other hand, Burt's (1992) SH theory focuses on the nodes that surround, and the resultant structure of the ties emanating from, a focal actor. *Ceteris paribus*, Burt suggested that the actor who has access to more separate clusters or domains will receive novel information that probably does not exist in the other clusters that the actor is connected to. However, novel information can also come from within groups if certain conditions exist. Aral and Alstyne (2011) found that higher communication bandwidth or volume brings greater amounts of information over time, thus creating "countervailing effects on access to novel information" (p. 91).

Recapping, the network literature has found that network diversity and bandwidth of information exchange both influence the probability of novel idea formation. These will guide the discussions into how network structures influences the types and levels of trust exhibited in organisations that are tackling idea generation and idea realisation.

### 3.2.1   Network as IG enabler

The idea generation stage can be supported by having the right network structure that brings novel information to employees. SWT describes the expected characteristics of bridging ties that bring about novel ideas. These ties will be relatively weak, that is, actors in the dyadic bridging tie will report low contact frequency, low affinity, little historical connection and little reciprocal services between them (Granovetter, 1973). Such characteristics make them better at supporting idea generation. SH theory on the other hand, places importance on the structure of the networks and how it brings advantages to a focal actor, and ignores non-structural effects such as trust. The diversity-bandwidth concept though takes into account volume flow through ties which were shown to be more significant in supporting innovation. All three have something in common: they allow access to novel knowledge (Hargadon, 2002).

To reach into different domains for novel ideas, idea generation requires a sparse and far-reaching network structure that supports the seizing, retention of, and development of ideas. This is critical to deal with today's multidimensional business environment (Davis et al., 2009) where new opportunities emerge at a rapid pace, along with ambiguity of ideas, unpredictability and complexity. For example, in complex environments, employees need to make difficult decisions across multiple areas in parallel (e.g., technical, financial, human resource and

marketing). Poor coordination will lead to waste of resources that could have been directed at other ventures. A sparse structure supports such an approach by giving access to various different functional groups to the focal employee.

Sparse and far-reaching networks also bring added benefits to IG. There is greater degree of freedom, with respect to options, leading to better opportunities for the recombination of ideas and resources into new solutions (Miner et al., 2001). Managers can bring into the fold more skilled players who can deal with simultaneous multiple inputs, increasing the potential novelty of the innovation. To implement these novel ideas in turn, a firm needs IR networks.

### 3.2.2    Network as IR enabler

Idea realisation requires a structure that improves the efficiency of implementation and supports the associated social-political process (Wolfe, 1994; Yuan & Woodman, 2010). The former is achieved through clear definition of employees' roles and tasks based on rules, reporting links and hierarchical levels (Siggelkow & Rivkin, 2006). These allow the employees to focus on certain tasks, tailoring their output to specific portions of the IR process.

Efficient implementation of novel ideas can be achieved through coordination. While the catchphrase 'think outside the box' is used, or perhaps even over-used, to describe innovation, the uptake of those ideas by users can only happen if they are turned *into* 'boxes', that is, operationalised by giving it a structure and framework. This includes the creation of a domain within which a system converts ideas into procedures, operates devices to support processes, and creates codes and symbology to increase the speed at which information is transferred. Tight, dense network structures made up of strong ties support the formation and operation of such a system (Baer, 2012; Obstfeld, 2005). This level of coordination can be further reinforced through strict adherence to guidelines that consist of shared codes and meanings (Dougherty, 1992; Tushman & Scanlan, 1981a) *within* and *between* functional task groups.    Effective communication can be further reinforced if there is shared understanding of the knowledge, experiences and symbols among group members. An example of this efficacy of shared understanding is hand gestures used by army platoons during ground operations to transmit instructions. Cognition here allows the transmission of ideas across a community through the commonality it generates.

Idea realisation also requires focus on required tasks. Focus reduces the required resources investment, be it in time, money or human capital, and also the decision-making that managers need to make due to increased certainty in the processes (Miner et al., 2001). Brown and Eisenhardt (1997, p. 15) described a high-tech firm with little focus, few rules, priorities, and

structures that "revelled in the excitement of panicked product development" but engendered "enormous time wasting" and errors. Ultimately, this firm created too many ineffective products that were behind schedule. Focus is thus the additional factor that qualitatively establishes the lower threshold of trade-off between novelty and proven ideas.

The social-political exchanges that take place in IR relationships are also characterised by power play (Yuan & Woodman, 2010), and one way to obtain power is to position oneself in specific network positions. Experimental work on power in exchange networks found that dependence on others fundamentally determines network positions (Skvoretz & Willer, 1993). Insecure trustors look for protection and risk reduction, and will tend to form ties to alters who are *available* and dependable (Granovetter, 1983, pp. 207-209). However, Cook et al. (1983) stated that network positions such as centrality cannot explain power in all networks, and affects its generalisability. Simply put, in power exchanges, "being connected to weak others makes one powerful, and being connected to powerful others makes one weak" (Borgatti & Halgin, 2011, p. 6). This suggests that network position alone cannot describe the expected advantages that can accrue to, or disadvantages that can befall an actor. The overall network structure, its antecedents and attributes, which include actor trustworthiness, necessarily play additional roles.

Taken together, these findings paint a picture of how IG and IR networks operate. In IG, the focus is on the behaviour that supports the generation and selection of ideas that will bring most benefit to innovation. The generation of ideas will be dependent on the ability of a person to access alters who are in different domains (Burt, 1992), and alters who offer high bandwidth transfer of information (Aral & Alstyne, 2011). These alters help generate creative insights not possible from a purely individual contribution. For example, Hargadon and Bechky (2006) suggested that a creativity focus shift from an individual to the collective can only occur if there is trust between an individual and the alters who can provide diverse and novel knowledge. This trust in turn can only come about if the alters are perceived as trustworthy.

In contrast, IR networks support the securing of backing from those who can allow the pursuit of novel ideas within their organisation (Podolny & Baron, 1997) as well as the coordination of multiple tasks in pursuing the aforementioned ideas. These ties link to 'idea champions' who provide sponsorship and advocacy to the individual pushing for the novel ideas, and are usually strong ties (Perry-Smith & Shalley, 2003). In return, these alters usually require non-tangible exchanges such as support in the future (Kanter, 1988). Such implicit agreements require mutual trust to exist (Baer, 2012), something that is more likely to develop when the alters are perceived to be trustworthy.

These arguments suggest that chances of an innovation to succeed improve if the respective IG and IR networks are supported by trust. Thus, when a focal actor in an innovation team perceives an alter to be trustworthy, a tie will form between them. This research will investigate which dimensions of trustworthiness will be the key drivers in IG and IR tie formation.

## 3.3    Trust in Innovation

In the quest to develop and implement innovations, no individual or organisation is truly independent. The implied interdependency underscores the fact that risk is ever-present in cooperative relationships. Concurrently, trust is one mechanism that can be utilised to manage these associated risks, which include questions like these: Will it be adapted by the users? Will it be embraced or rejected? Will existing support systems be able to sustain the innovation, or will it need new systems? The novel idea will only be adopted if it is perceived to be capable of delivering promised benefits, able to deliver it reliably, and do so without damaging the user. Users thus develop a pseudo-relationship with the innovation platform, which includes the technology and associated support systems and its people. The presence of the aforementioned risks makes trustworthiness of people involved in innovation very pertinent and important (Clegg et al., 2002; Ellonen et al., 2008; Madjar & Ortiz-Walters, 2009; McEvily & Tortoriello, 2011).

The next sections review concepts related to trust and innovation. It summarises the theoretical underpinnings and developments in trust that are relevant to the current study. Focus is on the role of trust in the structural evolution of supporting social networks. It is concluded that under this lens, an integrated socio-psychological approach to interpersonal trust is most apt to study the links between networks and trust in innovation.

### 3.3.1 Positive Consequences of Trust for Innovation

Trust is important for achieving positive consequences in innovation by offering several benefits to social networks and innovation. These benefits are: (a) improved employee attitude (Dirks & Ferrin, 2001, 2002); (b) cooperation between employees (Berardo & Scholz, 2010; Costa et al., 2001); and (c) knowledge sharing (Collins & Smith, 2006; Gilstrap & Collins, 2012; Mooradian et al., 2006). These are presented as a general model in Figure 3-2.
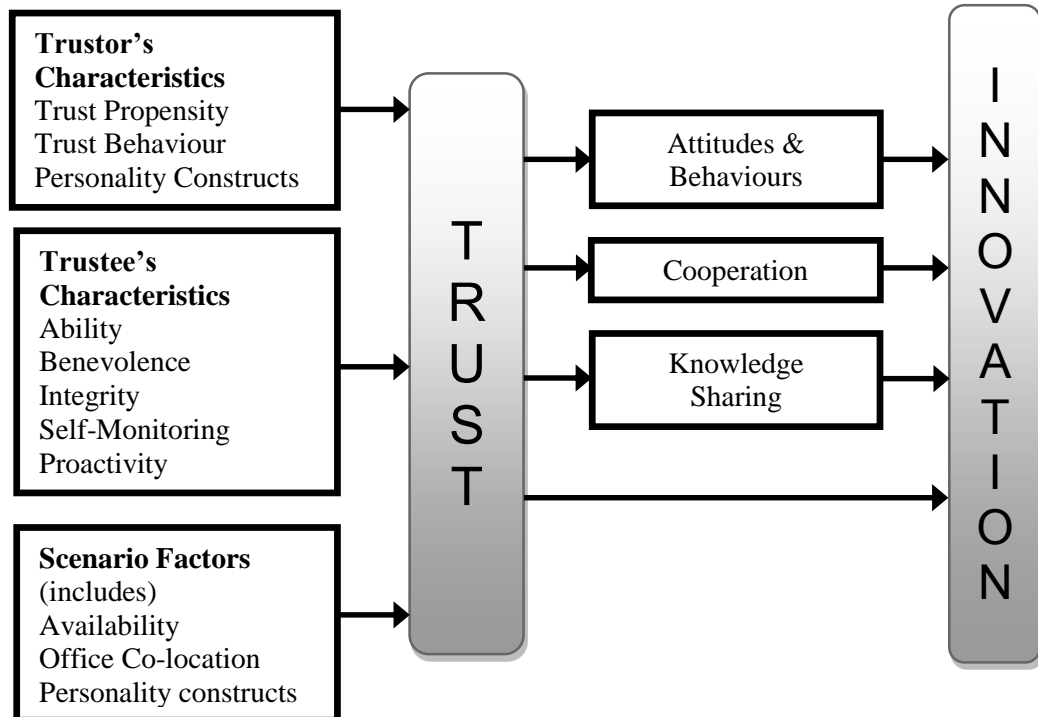
Figure 3-2: A general model of antecedents and consequences of trust in support of innovation.

In contributing to a more creative workplace atmosphere and improved employee attitude, trust provides greater organisational commitment, enhanced job satisfaction and lower job turnover (Dirks & Ferrin, 2001, 2002). Trusting one's manager has positive effects on employees' job satisfaction, because the multitude of roles that managers carry out has a great impact on employees' future. If the employee trusts that the manager will carry out those tasks fairly, such as employee evaluation, task delegation and rewards, the employees' level of job satisfaction and organisational commitment will increase. This can spill over into relationships among team members leading to a cooperative work environment. Trust supports cooperation by initiating social processes that includes putting team priorities first, flexibility in task definition and execution as well as high commitment and intense socialisation. These contribute to superior performance through task coordination and extra-role behaviours (Berardo & Scholz, 2010; Costa et al., 2001).

Trust also helps facilitate the sharing of knowledge and ideas within organisations (Collins & Smith, 2006; Gilstrap & Collins, 2012; Mooradian et al., 2006). The sharing of knowledge and ideas is challenging, especially when tacit knowledge is involved (Szulanski, 1996, 2003). According to Mooradian et al. (2006), the person trusted with such information must be perceived to be trustworthy. Trust is also expected to assist in information sharing as the trustor can expect reciprocal action in the future (Berardo & Scholz, 2010; Collins & Smith, 2006).

Thus, the atmosphere created when individuals seek and offer assistance will recursively stimulate knowledge sharing and exchange of ideas (Jones & George, 1998), including novel ideas that support the innovation process (Kleinbaum & Tushman, 2007; Ohly et al., 2010).

## 3.4    Defining and Conceptualising Trust

### 3.4.1 Definition

The most widely cited definition of trust is, "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control the other party" (Mayer et al., 1995, p. 712). Rousseau et al. (1998) made a similar observation that, "trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another" (p. 395). These definitions share two common characteristics of trust: the positive expectations of the trustor, and a willingness to be vulnerable (Lewicki et al., 2006). The former is confidence in that the trustee will behave benevolently, and with competence and Integrity. The latter refers to the willingness of the trustor to be vulnerable to the actions of the trustee, placing their interests in the hands of the trustee. In interpersonal relationships, opportunities for trust arise when the trustor is unable to cognitively ascertain the behavioural characteristics of the trustee. A level of uncertainty exists, and the trustor is now reliant on the trustee to carry out actions that will be beneficial to the trustor. Interdependence is thus established, and trust can be measured as the level of interdependency.

### 3.4.2 Integrative Trust Model: Propensity, Antecedents, Trust

Literature development of trust has taken several trajectories over the last few decades. To model trust, three different approaches have been proposed: the personality trust dispositions approach (Rotter, 1967, 1980); the behavioural approach (Axelrod, 1984; Burt & Knez, 1995; Deutsch, 1958); and the psychological approach (Kramer, 1999; for a complete review, see Lewicki et al., 2006). Additionally, trust is seen as either a unidimensional or a multidimensional construct. Rousseau et al. (1998) contended that these approaches are fundamentally quite similar, which highlight two essential characteristics of trust: The positive expectations of the trustor or ego, and a willingness to be vulnerable to the actions of the trustee or alter (Lewicki et al., 2006). These characteristics reflect three arguments. First is the argument that trust in another is supported by the belief of the trustor that the trustee will be benevolent. Second is the argument that trust in the trustee requires some level of dependency

on the part of the trustor, and this implies that that the interests of one party cannot be fulfilled without reliance on the other, that is, interdependency. The third argument is that trust in the trustee means that the trustor cannot control or force the trustee to fulfil the agreement, which clearly implies that there is the risk of failure to satisfy the trustor's expectations.

Studying the trusting behaviours of potential trustees within a specific domain enables trustors to make inferences about the former's level of trustworthiness. Exhibited behaviours such as information sharing, discussion on ideas and an inventor's reliance on his or her investor to market the inventions are observable, unlike trustworthiness which essentially exists as a perception in the minds of people. Serva et al. (2005) point out that this clear evidence can prove beneficial in the evaluation of the relevant actor's trustworthiness, thus linking it to trusting behaviour. Mayer et al. (1995) proposed an integrative model of trust depicted in Figure 3-3 that consolidates all of these developments and is duly adopted in this research.
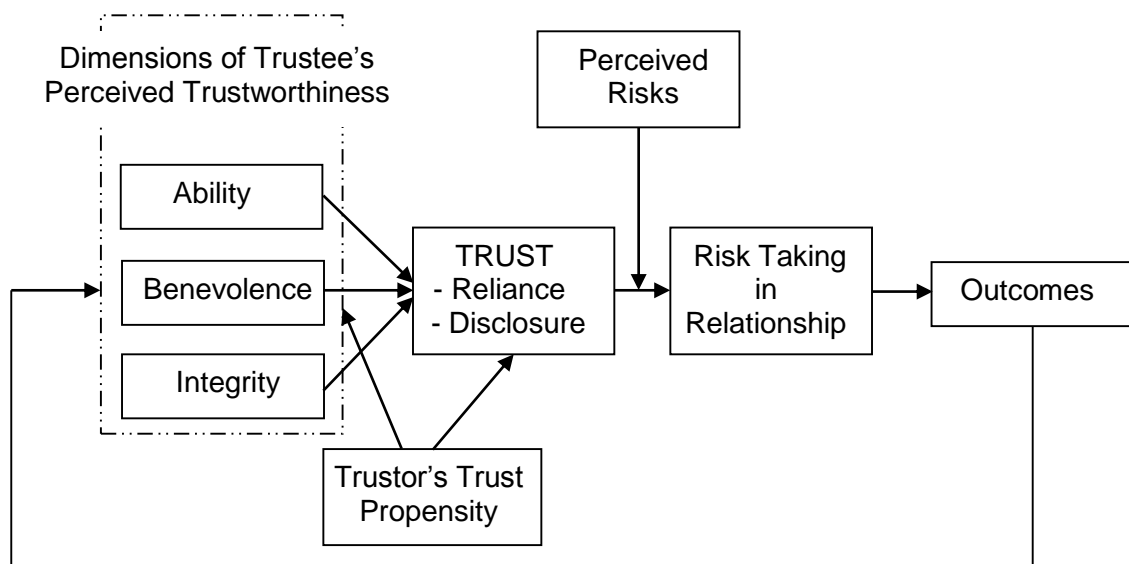


Figure 3-3: Integrative model of trust which captures the trustor's and trustee's psychological states (adapted from Mayer et al., 1995).

The multidimensional trust model by Mayer et al. (1995) suggests that there is a flow to the development of trust, with antecedents, trustor's propensity, elements of risk, positive expectations of the trustor towards the trustee, and actual risk-taking behaviour all leading to the final outcome of the trust. The strength of this model is that it distinguishes between trustworthiness, trust, and trusting behaviour. The presence of dimensions of trustworthiness allows for the reconciliation between the ideas of personality trust dispositions and trustworthiness both influencing the final trust decision. Both of these perceptions are very much psychological in nature. Antecedents of trust, that is, Ability, Benevolence and Integrity identify the *trustor's perception* of the *trustee's* trustworthiness. Mayer et al. (1995) defined trust as the *trustor's* willingness to take risk, and trusting behaviour is the actual act of the trustor placing trust. Taken together, these findings set the stage for general acceptance of trust as a combined psycho-cognitive state.

### 3.4.3 Trust Propensity

Rotter (1967, p. 651) defined trust as 'a generalised expectance held by an individual that the promise, oral or written statement of another individual or group can be relied on". This generalised expectance is related to the construct now known as *trust propensity*. Trust propensity is a relatively stable personality trait (Rotter, 1980), reflecting a general *propensity* for a person to trust or distrust a person or a group that is relatively new to them. Mayer et al. (1995) labelled this as trust propensity and refers to it as the "general willingness to trust others" (p. 715). Mooradian et al. (2006) concluded that trust propensity is "neither focused on specific others, nor dependent on specific contexts and it is not only related to lifetime experiences but also to temperament, and thereby to genetics and bio-physiological structure", (p. 525). They also found that individuals with a high propensity to trust believe that people are generally sincere, fair and have good intentions, while low trust propensity is associated with the tendency to see others as self-centred, conniving and potentially dangerous.

## 3.5    Dimensions of Perceived Trustworthiness

### 3.5.1    Ability

Ability refers to an individual's capability and expertise to carry out a specific set of tasks in a defined field or domain (Costa et al., 2001; Mayer et al., 1995; Mishra & Mishra, 2008). With respect to innovation, ability can include skills or characteristics such as intelligence, clarity of thinking, competence in communicating thoughts, and focus on tasks at hand. This field-

specificity of Ability enables a party to have significant sway in a specific domain, allowing a skilled person to earn trust pertaining to domain-related tasks, but not necessarily beyond. Ability is essential in relationships embedded in the innovation process. Team members are more likely to coordinate their actions with a focal actor if they believe the latter has the necessary skills to make sound decisions in developing novel ideas, to achieve the organisation's vision (Bartram & Casimir, 2007), and deliver the novelty.

### 3.5.2    Benevolence

Benevolence is the perception of a positive orientation of the trustee toward the trustor (Mayer et al., 1995), and that the trustee has genuine care and concern for the trustor. The trustee should be perceived to be benevolent towards the trustor, that is, to have a vested emotional interest in helping the trustor. Benevolence suggests that the trustee is somehow *affectively* attached to the trustor, and has the trustor's interests at heart thus will be motivated to assist in such a way that success will be achieved. An example of such a scenario would be an inventor who has a prototype of a novel product and requires assistance to manufacture and market it. This person will seek a venture capitalist perceived to be benevolent and will support the commercialisation of the prototype for the benefit of the inventor as well as other parties. In this case, Benevolence is the trustor's perception of positive feelings towards the trustee.

### 3.5.3    Integrity

McFall (1987) associated the word 'integrity' with the *adherence* to a set of principles, and *acceptability* of those principles to parties involved. Both aspects are essential to the concept of Integrity. A trustee is said to have Integrity if he or she behaves according to a set of principles that is acceptable to the trustor, independent of other's perspectives. Consistency and congruency of the trustee's past actions (Sitkin & Roth, 1993), and feedback from other parties within the network all influence a trustor's perception of a trustee's level of Integrity. Such a definition allows for the explanation of trust in workplaces where people fulfil promises and meet their targets, even in the presence of interpersonal conflict.

## 3.6    Dimensions of Trust: Reliance and Disclosure

The discussion on antecedents of trust is completed by detailing the resultant of trustworthiness: trust. One of the major hurdles in trust research is the inconsistency in how trust has been defined and measured (Gillespie, 2003, 2012).  Any scale to measure trust must take into account (a) the belief that a specific trustee is trustworthy, and (b) the willingness to take risk by trusting that trustee. Mayer et al. (1995) concedes that "because trust is a willingness to be vulnerable, a measure that assesses that willingness is needed" (p. 729).

A review by McEvily and Tortoriello (2011) suggested that the Behavioural Trust Inventory (BTI) scale developed by Gillespie (2003) is one of the most well validated measures of trust. Gillespie (2003) developed the 10-item BTI scale that measures willingness to engage in two types of trusting behaviour between team members and in the team leader: (a) *reliance* and (b) *disclosure*. These measures were developed and validated on R&D staff whose primary function was to generate and realise innovations. Reliance refers to the act of relying on another's skills and knowledge as well as delegating tasks and responsibilities. Disclosure deals with the act of sharing sensitive information, be it task-based on affective-based, to one's supervisor or project team members. One study that made use of this is Gillespie and Mann (2004) which measured team members' trust in their project leader within an R&D landscape. For trust to exist, parties in that relationship must be interdependent and experience risk (Bigley & Pearce, 1998; Hosmer, 1995; Mishra, 1996; Rousseau et al., 1998). This is relevant in innovation projects, where team members are *reliant* on other members for support, idea development and implementation. The act of relying on another is *reliance. Disclosure* is defined as the act of sharing sensitive or personal information that may bring detrimental effects to the focal actor. The risk is that the trust given might be misplaced: consequently the trustee betrays that trust and acts opportunistically – causing harm to the trustor. Items that capture Disclosure include the willingness to discuss personal feelings, confiding in personal matters, being open about negative feelings, and sharing personal beliefs (Gillespie, 2003, p. 41). Trustors who partake in this action essentially feel sufficient trust in the trustee to feel safe to openly express their real and honest beliefs, feelings and concern, either for themselves or another. Such concerns are pertinent in innovation. There is a level of vulnerability attached to this behaviour, as those who express it put themselves at risk of having their emotions or intuitions ridiculed or taken advantage of. Risk inherent in this action makes Disclosure a good measure of trust in innovation projects.

## 3.7    Trust Operationalisation

Mayer et al. (1995) suggested that in any dyadic trusting relationship between a trustor and a trustee, the traits of the trustor and the trustee play specific roles. Trust propensity of the trustor influences the trustor's perception of the trustee's Ability, Benevolence and Integrity, especially during the initial contact between actors. Through interactions, the trustor can develop first-hand, or in the case of indirect ties, second-hand knowledge of the potential trustee's skills and Abilities, their levels of Benevolence towards the trustor, and their Integrity in keeping to their word (Obstfeld, 2005; Wong & Boh, 2010; Yakovleva et al., 2010).

Based on the interaction between the trustor and the trustee, the trustor can then take into consideration the trustee's trustworthiness and the scenario before making the decision of whether to trust the trustee. This is where the domain-specific psychological-cognitive interplay occurs within the trust process (Costa et al., 2001). This research operationalises the action of giving trust within the innovation networks as a focal actor's choice of tie formation. For example, in the development of a new method for coal drilling, an employee who is in the development team may need to identify others who can assist in refining the idea, but will not claim it for themselves. The employee, now the trustor, will engage in interactions with team members to ascertain who has the necessary skills, is benevolent, and has Integrity. The trustor's trust propensity and the risks in the scenario will influence his or her perceptions of the alters' trustworthiness. The lower the level of trust propensity, and the higher the risks faced, the higher will be the threshold levels of trustworthiness that alters need to have before the trustor will make the decision to place trust.

The decision to place trust will lead to risk-taking behaviour. Depending on the scenario, this can range from accepting a leader's word thus placing oneself under the influence of another (Zand, 1972), to trusting a team member with work-related or personal information in the belief that that team member will not behave opportunistically with that information. Gillespie (2003) found that the respondents associated trusting behaviour with the willingness to be vulnerable in situations which required "relying on another's skills, knowledge, judgments or actions, including delegating and giving autonomy", and disclosing "work-related or personal information of a sensitive nature" (p. 10). These form the basis for the BTI.

Taking the literature further, Dietz and Den Hartog (2006) also adopted the belief and behavioural aspects of trust. Specifically, they proposed that trust can take three forms, which are belief, decision and action. Belief here represents a trustor's assessment of the trustee's level of trustworthiness. This assessment is based on the personal characteristics and actions of the trustee (Costa et al., 2001), which collectively can be considered the trustee's reputation. However, it should be noted that while these are major drivers for the development of trust of a trustor in a person (Mayer et al., 1995), this does not mean that the trustor will actually place trust to the potential trustee (Dietz & Den Hartog, 2006).

To complete the process of trust, the trustor must actually engage in trusting behaviour with the trustee (Dietz & Den Hartog, 2006). Trust and trusting behaviour are distinct from each other in that the former outlines the general intention to engage in risk-taking behaviour, while trusting behaviour involves actually taking risks. Taken together, this means that risk-taking

behaviour only happens when the employee actually discusses that idea with an alter. Until that happens, no risk is taken.

### 3.7.1 Characteristics of Disclosure and Reliance in Innovation

The way people give and withhold trust in innovation implies an interplay between the components of the trust construct and trustworthiness (Clark & Payne, 1987; Cummings & Bromily, 1996). This interplay is due to difference between the professional nature of Reliance versus the more personal nature of Disclosure, each dimension relevant to different stages of innovation. In contrast to Reliance which is cognitive in nature, Disclosure has a stronger emotive, affective element to it (Gillespie, 2003, p. 35). During the IG stage of innovation when one discloses ideas that are novel to an alter, they take on risks hoping that the alter will show interpersonal attachment or affect and care, that is, being benevolent towards them. On the other hand, Reliance is more dependent on perceived skills or reliability of the alter in implementing novel ideas, and consequently is more relevant during the IR stage of innovation.

### 3.7.2 Boundaries of trust

Many researchers have highlighted that "most inter-personal relationships are complex and have a broad bandwidth" (Lewicki et al., 2006, p. 1002). Consequently, the answer to a general trust question "Do you trust person A?" should not be a simple "Yes" or "No" but rather "to do what?" (Chugthai, 2010, p. 77). The domain in which these relationships are embedded then plays a critical role in determining whether trust will be extended. For example, an electrical engineer may be trusted by a project team leader to lead the development of an electrical sub-component, but not to lead the development of a funding model. In this scenario, the engineer (trustee) may be perceived by his leader (trustor) to be competent in the field of electrical engineering and will be able to deliver the sub-component, but does not perceive the engineer to be competent enough to know the necessary details for funding. The multidimensional model chosen alludes to the identification of deficiencies in the trust relationship, allowing for the right trust decision to be made (Smith & Barclay, 1997). The next sections unpack the interdependence that underpins trust formation in a relationship.

### 3.7.3 Trust dynamics

Trust is a dynamic phenomenon, which implies that it takes on different characteristics at various stages of a relationship. There are scenarios in which trust swiftly develops (Meyerson et al., 1996) or develops over time (Rousseau et al., 1998). Lewicki and Bunker (1996)

suggested that there are three main stages of the forward development of trust, which Rousseau et al. (1998) posited can characterise the level of a relationship.

Trust can start in a dyadic relationship if a trustor perceives a trustee to be trustworthy. Obtaining this information is a necessary step for an accurate evaluation of the suitability of the alter to be trusted for specific tasks or relationships. Networking is one method by which trust can develop. Whitener et al. (1998) used the social exchange and the agency theory approach to examine this problem in managerial situations. Their approach suggested that a manager can learn about a subordinate's trustworthiness by first placing trust in them. Such an initiative aims at indicating not only to the subordinate but to others that the manager is willing to engage in trust and responsibility sharing. From a network perspective, a focal actor needs to first give trust to the trustee to learn about the trustee's trustworthiness. A feedback loop is created (Mayer et al., 1995) through which the focal actor can then decide whether to build upon, or withhold trust. Multiple interactions enable a trustor to glean more information and more opportunity to evaluate different aspects of the potential trustee (Findlay & Lumsden, 1988) that can lead to a more optimal decision. To continue building upon that trust, actors need motivation to engender trust over what has been established.

### 3.7.4    Engendering trust

Several mechanisms have been theorised to engender trust within networks (Burt, 2005). They can be grouped into two categories, based on the motivations behind the initiation of the trusting relationship (van de Bunt et al., 2005). They are (a) *instrumental*, and (b) *expressive*. Instrumental motives comes about from the "result of strategic interaction and the deliberate effort of individual actors to control their environment in order to improve their personal well-being" (van de Bunt et al., 2005, p. 342). These motives can be realised either formally or informally, and operationalised voluntarily or through controls. Focal actors will thus establish relationships to achieve certain material objectives or to avoid material losses. Tie formation or dissolution brings about or avoids the loss of *tangible* value. Examples of instrumental trust development mechanisms include *signalling* that is enacted through formally legitimised hierarchical structures, within which authority in selecting ideas is exercised (Lindenberg, 2000), *sharing group effect* where interdependent innovation tasks require coordination (Costa, 2003), and *structural holes effect* (Burt, 2004, 1992) where actors establish more efficient novel-idea generation networks.

Expressive motives are associated with affective value embedded in relationships. The formation of ties is then based on how the tie will provide support to the social wellness of the focal actor. This can lead to a sense of belonging or solidarity. From this perspective, formation

and dissolution of such ties bring about or prevents the loss of *intangible* value. Some examples of expressive trust development mechanisms include *homophily*, that is, trust ties between people with similar characteristics (McPherson et al., 2001), *balance*, that is, trust ties with others who have common trusted contacts, and *gossip* i.e. sharing negative thoughts and ideas about a third party with an alter.

These mechanisms are important because they are *choice* behaviours (Hardin, 2004; van de Bunt et al., 2005). Actors in innovation networks may not be able to select their team members, but they do get to choose who they will approach to be included in their IG and IR networks. This choice is driven not only the focal actor's motives for trust, but also the perceived trustworthiness of the potential alters around them.

For trust to build, not only does it require initiative, but it takes time and numerous interactions to provide information on trustee's trustworthiness (Lewicki et al., 1998; Lewicki et al., 2006). To illustrate, in running a cow farm, the owner might trust his son's friend and allow the use of a novel cattle feed which is said to absorb toxins from the cattle, leading to improved meat and dairy output. The owner has a sense of benevolence towards the son's friend at the start, but also pays heed to what the latter does in administering the feed. Through numerous interactions, the owner can ascertain whether the son's friend has the necessary skills to manage the introduction of the new product, and whether the latter carries out the task with Integrity. Based on these, the owner can then decide whether to continue giving trust.

### 3.8   The Dark Side of Trust

It is important to note there is a dark side to trust (Babcock-Lumish, 2010; Kramer, 1996; Portes, 1998). Recent research (Bidault & Castello, 2010) has suggested that there is a threshold past which trust results in negative consequences, such as a reduction in benefits for the individual as well as the organisation.

Several scholars have suggested that high levels of trust can cause a general 'blindness' that could lead to abuse and exploitation of trustors at the hand of trustees (Kramer, 1996). Research by Babcock-Lumish (2010) on nascent business deals has shown the presence of over-reliance on trust to hatch and maintain operations. This is called 'trust network sclerosis', whereby many parties mention that shared identity and experiences were considered to be proxies for trust, with trust in turn being considered a proxy for due diligence. The danger exists when the trustor mistakenly perceives that the trustee is trustworthy based on homophily or other similarities, when in actual fact the trustee is not.

Another negative aspect of trust in idea generation is the barring of others from gaining access (Portes, 1998). Reciprocal, cooperative and embedded networks where there is trust are advantageous, self-enhancing and supportive of a culture of trust (Babcock-Lumish, 2010). However, closed-off communities also creates factions, hence, they can be counterproductive (McPherson et al., 2001; Sztompka, 1999). Arthur's work (1994) has shown that technological lock-in and suboptimal outcomes can occur due to extreme homophily in networks. Such networks that consist of similar-minded people tend to hang on to the status quo since everyone has similar thinking, beliefs and experiences. Trust through homophily thus creates powerful divisions and over embeddedness that isolates the members from external thinking that exists beyond their networks (Uzzi, 1997). This reduces the possibility of the group accessing new and novel solutions and thus impede idea generation (Hargadon, 2002).

Trust can also lead to poor innovation performance (Chen et al., 2007). In a meta-analysis of team-level predictors of innovation at work, Hülsheger et al. (2009) showed that participative team safety (which incorporated trust) had a very low correlation with performance. They suggested that this could be due to the intragroup safety component of participative safety, and that, "if team members are highly committed to maintaining a nonthreatening atmosphere and a positive affective tone, they might be afraid of conflict and shy away from criticising each other's ideas" (p. 1139). This could result in unwillingness to question or criticise poor ideas, and erase any creative friction (Barker, 1993) required to refine novel ideas. The absence of tension that forces people to challenge each other's ideas also leads to very soft and accommodating teamwork behaviour. Bidault and Castello (2010) ascribed the failure of the Sevelnord car joint-venture between Fiat and Peugeot to the low level of creative tension that existed between the firms when there is excessive trust. The high level of mutual trust between them resulted in an unchallenging, unstimulating environment (Bidault & Schweinberg, 1996) – the exact opposite of what is needed to devise novel solutions.

Another drawback of excessive trust is misplaced trust. Over embedded actors send and receive powerful signals, due to the network behaving like a multichannel system. This overspill of influence-sharing can include trust. A natural 'halo' effect occurs (Cook et al., 2003) when subjective judgment is made that is influenced by factors not relevant to the domain in question, including excessive trust in the person putting forth a novel idea. If this happens during the evaluation of the idea, it leads to a non-objective evaluation. Conversely, the 'devil' effect can also play a role in demonising an idea during a supposedly objective evaluation. Similarly, during the implementation of ideas, someone who is trusted for an unrelated matter may be

expected to successfully implement a project with little or no supervision. This could lead to project failure should the person turn out to be incapable of fulfilling his or her promises.

Taken together, the literature advocates that organisations need to make their employees aware of how trust can be used to optimise IG and IR. To accomplish this, organisations need to measure or have a general understanding of the levels of trust that is present in their IG and IR networks.

### 3.9 Predictors of Innovation

Numerous works have identified various antecedents of innovation. Katz (1964) outlined the categories these antecedents fall under: behaviours, incentives, and penalties. Among the constructs found to have an impact on innovation are creativity (Baer, 2012; Unsworth & Clegg, 2010; Zhou et al., 2009), team member identity (Glynn et al., 2010) self-efficacy (Parker, 1998; West & Farr, 1990) and various team variables (review by Hülsheger et al., 2009). What these existing literature have not ascertained is whether the measured variables will exert different influences over the two innovation phases in focus.

The significance of personality attributes and its association with networks and innovation have been well-established (Burt et al., 2013; Tortoriello & Krackhardt, 2010). King (1990) cites a large body of literature that looks at personality traits as antecedents of individual creativity performance. The literature also supports the idea that personality characteristics of team members are relevant to the formation of ties within the innovation process (Stoker et al., 2001; Zhou et al., 2009). Among the constructs found to have an impact on innovation are creativity (Baer, 2012; Unsworth & Clegg, 2010; Zhou et al., 2009), team member identity (Glynn et al., 2010) self-efficacy (Parker, 1998; West & Farr, 1990) and various team variables (review by Hülsheger et al., 2009) and self-monitoring (Gangestad & Snyder, 2000; Sasovova et al., 2010). In the next section, I discuss some individual-level constructs and one team-level variable that are expected to play different roles in the IG and IR networks.

### *3.9.1 Self-Monitoring: Link to Networks*

An effective tool for engendering and managing interpersonal trust is self-monitoring, which is an element of impression management. Impression management focuses on "what organisations can do to initiate and manage trustworthy behaviour and to engender and support trusting relationships that are self-perpetuating and sustainable" (Whitener et al., 1998, p. 525). Self-monitoring is the idea that individuals can monitor, that is, observe and control their self-presentation and expressive behaviours (Snyder, 1974). They are aware that their affective experiences and expressions are either socially inappropriate, or lacking. Self-monitoring

stands out for three reasons (Mehra et al., 2001): it links individual differences in self-monitoring to numerous job outcomes; makes clear predictions on how individuals shape their social worlds; and predicts patterns of variability across multiple social situations that are of interest to social network researchers. In this current research, focus is on self-monitoring as a personality trait that influences an employee's tie choices for IG and IR.

Prior research on self-monitoring has shown that high and low self-monitors tend to inhabit different social clusters or cliques (Snyder & Gangstead, 1986). Related work on impression management (Costa, 2003; Wolfe et al., 1986) has linked it to innovation behaviour and performance. However, previous research has yet to discern the impact self-monitoring may have on phases of innovation. Clear distinction between managing image risks versus improving image (Costa, 2003) suggests how these mechanisms might operate in an innovation landscape.

Self-monitoring is categorised as a method of *impression management* (Arkin, 1981; Tetlock & Manstead, 1985). It can help circumvent the problems mentioned above by adjusting one's expressive behaviours based on situational cues in order to be socially appropriate and match the social environment (Snyder, 1974, 1979). This is also done for the purpose of resource acquisition (money, power, status etc.) and for protection from loss of said items (Lennox, 1988). This definition implies that social interaction is the driver of self-monitoring behaviour, regardless of whether it tallies with the person's own emotions or not. Varying levels of performance can be expected, and indeed this has been observed in many scenarios whereby high self-monitors tend to occupy positions that span social divisions deemed strategically important positions in social networks, leading to faster promotions (Burt, 2000, 2004) and higher performance ratings (Mehra et al., 2001). An emergent model shown in Figure 3-4 was proposed by Mehra et al. (2001) to capture the fact that high self-monitors position themselves advantageously within a network, giving them access to more people to accomplish their tasks.
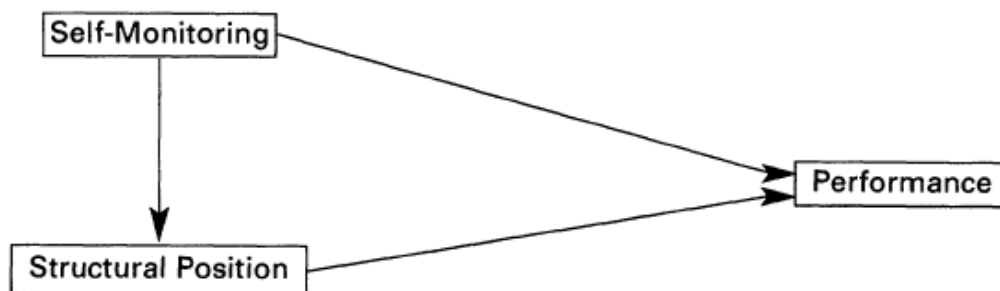


Figure 3-4: Emergent model on self-monitoring and structural position effects on individuals' work performance (Mehra et al., 2001).

To sustain innovation, one way of improving coordination within and between domains is the development of standards. This manifests in terms, languages and symbols. It also involves non-language behaviours, such as voice quality and body motion, which are cues that are often used to communicate affective state and attitudes. Through this similarity, trust can be cultivated between domain members. According to Thomas (1984), those who share these behaviours enjoy efficient communication, are able to transmit relatively large amounts of information with relatively few specialised symbols and with minimal misinterpretation (Dearborn & Simon, 1958). Without this shared coding scheme and technical language, work-related communication would be more costly due to additional resources needed to decipher and authenticate the information. This can be brought about by different standards, lack of common understandings (Bechky, 2003) and coordination issues (Mors, 2010). The development of such coding schemes, however, often acts as a double-edged sword: the same specialised coding increases efficiency, but also creates silos. Outsiders who can emulate the expected coding and expression will be trusted and subsequently obtain access to information in these silos.

### 3.9.2   Acquisitive and Protective Self-monitoring

To conceptually account for the IG and IR networks in which selected alters exhibit different relevant behaviours, the *distal* variable approach can be adopted. One issue with using direct proximal measures of innovation behaviours (e.g., trust) is that a person's displayed behaviour may be different from that person's perception and thoughts (Fletcher & Fitness, 1990). As mentioned earlier, a focal person may exhibit self-monitoring behaviour for social interaction, even if it does not match the focal person's own emotions. Applying the integrative model of behaviour developed by Fishbein (2000) to innovation suggests that, overall, employees will seek others for innovation when they have formed the intention to do so. The model suggests that a distal variable indirectly effects intention. Distal variables include stable dispositional constructs that precede the immediate proximal context, including personality traits such as self-monitoring. A distal variable may be correlated with behaviour, but, "this must mean that the distal variable is related *to* one or more of the proximal model variables as well" (Yzer et al., 2004, p. 1231). Therefore relating between self-monitoring as the distal variable and trustworthiness perceptions as the proximal variable is important because (1) it bridges the gap between self-monitoring and trustworthiness, and (2) it also explains the differences between employees' perceptions of alter's trustworthiness.

Self-monitoring is strongly related to status-oriented impression management motives, which include the management of trust perceptions (Gangestad & Snyder, 2000). Work by Snyder and Gangstead (1986) and Gangestad and Snyder (2000) indicated that high self-monitors are more likely to rely on their adaptability to manage the perception of status and reputation within dyads, including their trustworthiness. Costa (2003) further showed that in innovation, employees actively cultivate public images that are associated with social status and create social circles that further enhance that status (for review see Gangestad & Snyder, 2000; Tajfel, 1982). Additionally, Sasovova et al. (2010) showed that high self-monitors tend to attract relative strangers who were also previously unconnected. This "efficiently increased the number of structural holes in the resultant network" (p. 639), boosting the possibility of the creation of novel knowledge that can lead to innovation. Taken together, high self-monitors facilitate innovation by reaching across different domains and linking unconnected others by *acquiring* a positive image, and *protecting* the established image. The former is triggered by "self-enhancing motives activated by perceived opportunities for creating favourable impressions on others" (Tetlock & Manstead, 1985, p. 61). The latter is driven by the desire to avoid negative affective states, such as embarrassment. These constructs are in line with the two different affective states and individual motives outlined in the research works by Lennox and Wolfe (1984), and Wolfe et al. (1986). These works showed that self-monitoring consists of two main components: (A) the ability to gain acceptance, approval and popularity or "getting along", and (B) the ability to acquire power, control and status, or "getting ahead". They are better known as the two styles of self-presentation, *protective* and *acquisitive,* respectively. I refer to the former as SMP and the latter as SMA.

The SMA style aims to improve expected treatment in uncertain future scenarios via social approval (Arkin, 1981). This is achieved through the ability to modify self-presentation in order to appear congruent and appropriate to the surrounding (Wolfe et al., 1986). SMA is characterised by actors giving off a desired impression with continuing effort in order to achieve goals through social approval. This style aims to improve the chances of being treated favourably in undefined future scenarios (Arkin, 1981). SMP focuses on an actor's ability to read the emotions of others and have concern for the impact they have on the emotions of others (Lennox & Wolfe, 1984; Wolfe et al., 1986) by avoiding disapproval through social anxiety reduction, reticence and conformity. Taken together, actors carry out SMP-related actions to defend their current social image (Tetlock & Manstead, 1985).

These definitions show the contrast between SMP and SMA. In order to get along, in most situations, one would only need to avoid disapproval and conform to the expectations of others,

hence SMP is activated. But to get ahead, an individual will have to be more active, manipulative and skilled in the forms of self-monitoring to project a favourable impression on others. This entails a higher level of risk but also potentially greater rewards (Arkin, 1981; Lennox, 1988; Weisz et al., 1984), hence SMA is activated. The two styles are driven by totally different motives, and the affective responses to these styles are also dissimilar (Wolfe et al., 1986). This makes the two styles incompatible, and interpersonal relationships inherently problematic (Hogan et al., 1985). Nevertheless, high SMA/SMP alters are perceived to be trustworthy, since others perceive their ideas to be meaningful and significant (Zhou & Woodman, 2003), leading them to be more popular for IG and IR. Additionally, they expect less risk to their status in the case of innovation failure due to their supervisors being less likely to hold them responsible (Regan & Totten, 1975). Overall, high self-monitors manage interpersonal trust by projecting a cohesive, trustworthy representation that *protects* their image through solidarity. In this manner I suggest that both SMA and SMP (as distal variables) supports trust as critical contingencies for advantages that network brokerage brings (Burt et al., 2013) when dealing with risks in innovation.

This research aims to clarify the link between self-monitoring and trust in innovation. Currently, it is not clear how SMP and SMA influence the innovation process. Furnham (2005a) found that, at work, high SMA employees try to *get ahead* with others in a bid to gain mastery, while high SMP employees try to *get along* with others. This leads to the third proposition that links self-monitoring as a distal antecedent to tie formation:

*Proposition 3: Employees will be inclined to choose to form ties with alters who are high self-monitors to assist with generating and implementing novel ideas.*

A caveat on self-monitoring is the fact that on face value, the construct may be misconstrued as a form of deception. Incongruence between projected image and actual behaviour and thoughts of a focal person brought about by self-monitoring might lead to that person being perceived to be 'putting on an act', and subsequently judged to be untrustworthy. This judgment may be unfair when he or she was essentially actively executing impression management. The research by Lennox and Wolfe (1984) showed how items for self-monitoring loaded onto two separate factors of *acting ability* and *ability to modify self-presentation*. This empirical evidence supported the idea that acting as in the theatrical sense requires different sets of skills from those required to regulate one's self-presentation (Briggs et al., 1980; Lennox & Wolfe, 1984). Self-monitoring, therefore, is a legitimate form of impression management, while acting is a form of role-play that is distinct and separate.

### 3.9.3 Locus of Control (LOC)

The novelty and creativity of innovation makes it similar to new venture creation (Dunkleberg & Cooper, 1982; McClelland, 1961; Solomon & Winslow, 1988; Timmons, 1978; Winslow & Solomon, 1989) in that they are both characterised by agents with entrepreneurial skills and willingness to reform or exploiting business by bringing innovations to the market, be it technical or non-technical. Social networks must exist because by definition, ventures are characterised by the presence of ties between the agents. When these agents are individuals, their personalities are expected to have an impact on the networks.

Psychology have looked at personality traits related to perceived control and its impact on human behaviour in various scenarios (Strickland, 1989). A significant contribution to our understanding of personality traits was made by Rotter (1966) through the introduction of the concept of "locus of control" (LOC). This construct is defined as the belief that events that happen are either within or beyond his or her personal control and understanding. People with an internal locus of control tend to have more success at achieving their academic goals (Findley & Cooper, 1983), tend to be more pro-active in controlling their environment (Rotter, 1966), and attempt to position themselves in social locations which increase chances of success (Burt, 2000, 2004; Moore, 2006). On the other hand, "externals" believe that the outcomes are controlled by forces beyond the control of the individual, and hence are more passive in their dealings (Rotter, 1966).

The realization that locus of control can affect entrepreneurial and innovative behaviour (Miller et al., 1982) has spurred on numerous empirical studies. Some of these studies (Brockhaus, 1975; Durand & Shea, 1974; Jennings & Zeithaml, 1983; Pandey & Tewary, 1979; Shapero, 1975) showed people who have entrepreneurial intentions or are exhibiting entrepreneurial behaviours have a higher internal locus of control. Work using multidimensional measures of locus of control (Bonnett & Furnham, 1991; Levin & Leginsky, 1990) generally supports the idea that entrepreneurs are more internal than non-entrepreneurs. This implies that internals will more likely take initiatives necessary to innovate, including forming network ties. For this reason, LOC is one of the personality variables thought to impact on tie formation for innovation. Accordingly it was adopted as a firm B-specific variable.

### 3.9.4 Proactivity

People are observed to behave differently even if they were tasked with the same roles. Some directors will take initiatives and launch new ideas, while others conform to the status quo. Employees can also be similarly seen to undertake new ventures, while others are content with

existing scenarios. These people are labelled either as 'proactive' or 'passive' (Bateman & Crant, 1993).

Similar to the LOC-internals, the proactive behaviour is embedded in people's perceptions that they control their destiny. Proactivity takes it further and captures actual behaviour to control one's environment. Bandura (1986) stated that proactive people "create environments and set them in motion as well as rebut them. People are foreactive, not simply counteractive" (p. 22). Aligned with that argument, Bateman and Crant (1993) conceives proactive behaviour as a foreactive as opposed to counteractive process, transcendent more than acquiescent, manipulating rather than accommodating, and agency more than passivity (p. 105).

Research into proactivity's impact on creative behaviour reveals links with innovation. Unsworth and Clegg (2010) teased out the importance of proactivity in eliciting creative and innovative behaviours from employees. Their interviews indicated that proactivity initiates the thinking cascade and suggest that employees rely on two mechanisms to make the decision to engage in creative action, namely expectancy and instrumentality. To actually evaluate the value of an idea whether the effort is worthwhile (expectancy) requires resources to be spent i.e. time and communication. Additionally it was found that employees need to dedicate some time and thought to then determine the positive and negative consequences from engaging in the creative action (instrumentality). Without proactivity, this engagement of the mind will not even occur. Parker et al. (2006) showed that themes such as role perceptions, support and autonomy is part of people's perception of creative behaviour. Similar themes such as problem recognition, idea generation, idea promotion and idea realization requires the application of roles, support for emerging ideas and freedom to carry out extra-role activities and develop those ideas (Von Hippel et al., 1999) in a framework that is defined by IWB (Ramamoorthy et al., 2005). These associations lead me to believe proactivity is a salient concept in the formation of idea generation and idea implementation networks.

While LOC defines how people perceive the level of control they have over their lives, it does not really capture the motivations behind their actions. Unlike LOC, proactivity is an artefact of interactionism that suggests behaviour to be internally and externally controlled (Shinder & Cross, 2008). Interactionism suggests that there is a recursive relationship between people and their surrounding environment (Robert et al., 2009), whereby people, environment and behaviours influence each other (Bandura, 1986). For this reason, Proactivity is seen as a stronger predictor of innovation than LOC.

### *3.9.5    Personality Traits: The Five Factors Inventory (FFI)*

In organizations, staffing is organized by management around the requirement to provide the organization with highly-talented people (Furnham, 2005b) who each bring with them their own personalities and idiosyncrasies. Even in such highly structured organizations, self-selection of task partners occurs. Under such circumstances, it is reasonable to assume that psychological predispositions will influence employees' choices of who will be in their network (Kalish & Robins, 2006). Any study into innovation and hence creativity thus must take into account the psychological predispositions of those being studied. But considering the large number of possible traits to focus on, deciding which to study is no easy task. To aid the discussion, I turn to psychological personality theory.

Psychological personality theory assumes that people's behaviour can be explained to some extent in terms of underlying personality constructs (Kalish & Robins, 2006). These two constructs include state characteristics, assumed to be more contextual and refer to "a temporary adoption of a personality characteristic induced by current circumstances" (Allport, 1962). Trait characteristics meanwhile are assumed to be relatively permanent individual characteristics that are stable over time. The current theoretical and empirical research suggests that the possibility of these characteristics to change over time is negligible. To the extent that the personality traits are indeed stable, they cannot be the outcomes of changing social network structures as individuals attempt to shape their social worlds. So while the predispositions can drive network formation, they are not expected to be recursively influenced.

Overall research on personality has found that most of the variability across individuals can be measured using five different constructs known as the "Big Five"): Neuroticism, Extraversion, Openness to Experience, Conscientiousness and Agreeableness (N, E, O,C, A)(for a full explanation, see Costa & McCrae, 1992a). Taken together, there is enough empirical evidence to suggest that some psychological traits influence network structure formation (Burt et al., 1998; Kalish & Robins, 2006; Klein et al., 2004; Mehra et al., 2001).

Research using generalized "social interaction" instruments such as the semi-structured interview has found that some of the FFI constructs are linked to perceptions of social support. Among others, is found that people high in neuroticism tend to have a smaller number of alters they approach for social support (Furukawa et al., 1998). Neurotics tended to adopt a more negative view of people around them, and in turn be negatively viewed by them (Henderson, 1977) and consequently have smaller networks (Klein et al., 2004). People high in neuroticism tend to experience negative emotions such as anxiety, depression and anger. Neuroticism is often considered to be an overall anxiety measure or "psychological strain".

Extraverts tend to be energetic, cheerful, gregarious, and sociable. They prefer large group gatherings; tend to be more confident, active and chatty. They have larger numbers of social support alters (Furukawa et al., 1998; Henderson, 1977) who tend to be more diverse (Cohen & Hoberman, 1983). For Extraverts, two opposing social processes are thought to affect their personal networks. First, it seems likely that people who are high on extraversion may prefer not to keep their close network partners separate, and may actively seek to introduce them to one another at social gatherings. Simply because they are more socially active, they may create more opportunities for such interactions. Hallinan and Kubitschek (1988) found that "friendly" students (defined as students with a high in-degree centrality) had a lower tolerance for intransitive triads i.e. networks where their close friends don't know each other, and would thus tend to introduce them to each other over time.

However, it is important to recognise the possibility of an opposing effect. Extraverts may have too such large networks that the net effect is its impossible for them to introduce their close friends to each other. This is reflected in the well-known knowledge that for two networks with same average degree, the larger network has lower density (Kalish & Robins, 2006). On top of that, the diverse set of partners will cause homophily-tension, leading to alters in their network shying away from each other.

Openness can be defined as being imaginative and sensitive to art and beauty while being curious and behaviourally flexible. Actors who are Open have a complex emotional life, nondogmatic in their attitudes and values (McCrae & Sutin, 2009). Openness to experience was found to result in creative behaviour (George & Zhou, 2001) especially when put into a heuristic task environment where creativity was allowed. Similarly, the experience and challenge of rigidly implementing set tasks might also suit Open individuals. Taken together, this implies that FFI variables will play roles in innovation stages.

### 3.9.6    *Team-Level Variable: Team Climate for Innovation*

While most of the predictors here are psychological variables, scholars have emphasized that surrounding environmental support plays an important role in the success of project teams (Amabile, 1997; Anderson & West, 1998; Conti et al., 1996). Teams aiming to innovate are required not only to generate ideas, but align team members for IR (Somech & Drach-Zahavy, 2011). While optimizing the conditions to foster creativity requires reaching out to various domains to gather diverse sets of knowledge, realising ideas requires convergence in teams along the lines of shared cognition (Bledow et al., 2009). Research have shown that team climate for innovation, will interact with team creativity and be critical in enhancing the

implementation of innovations (Somech & Drach-Zahavy, 2011). For that reason, this research includes this team-level concept as a variable.

Anderson and West's research (1998) identifies four main factors that they ascribe to as Team Climate for Innovation: (a) Vision ; (b) Participative Safety; (c) Support for innovation and (d) Task orientation. The following describes what these factors represent:

Vision: Idea of a valued outcome, representing a higher order goal and motivation at work (West & Farr, 1990). If vision is high, team and organizational goals are clear, objectives are feasible and team members are committed (Hülsheger et al., 2009). Teams with high vision will be more likely to implement their creative ideas than teams with vague and abstract vision, who might find implementing their ideas to be daunting.

Participative safety: This consists of two components. One is participation in decision-making, and the other is intrateam safety. The latter refers to perceived psychological safety (Edmondson, 1999; Schulte et al., 2010) in the team, complete with support and trust. Problems expected to crop up during the implementation will drive team members towards tighter collaboration (Parker & Wall, 1996) and hence correspondingly tighter-knit networks. For intrateam participative safety, a climate rich in this will see its members speak up and take risks, expected during the implementation of risky, novel ideas. In contrast, low level of participative safety implies helplessness and feeling victimized by the innovation, and people may chose to ignore problems (Baer & Frese, 2003). There is recent empirical evidence to suggest that participative safety and network structures co-evolve (Schulte et al., 2010), which is known to be conducive to disclosing ideas (Collins & Miller, 1994).

Task orientation: Task orientation means team members sharing concern for achieving a good standard of performance. This includes task performance excellence, measured with evaluations, modifications, control systems, and critical appraisals (Anderson & West, 1998; West & Farr, 1990). High levels of team task orientation leads to members willing to work harder and overcome obstacles during implementation to turn the risky creative ideas into products and processes. Low task orientation implies lack of concern with excellence, leading to less likelihood of creative ideas turned into innovative outcomes.

Support for innovation: This factor means the expectation, approval and practical support for attempts to introduce new and improved ways of doing things (West & Farr, 1990). These must be articulated through documents, policies, word of mouth and enacted by active promotion of innovative behaviour. This includes the provision of adequate resources, such as time to produce novel work as well as availability of training or funding. Perceptions of adequacy of resources provided can affect psychological perspectives of team members leading to beliefs

on the intrinsic value of the projects they pursue (Amabile et al., 1996) which in turn impacts on their willingness to dedicate their own resources i.e. time, knowledge, skills etc. in implementing the creative ideas (Eisenbeiss et al., 2008). Teams that lack this support less likely convert their ideas into tangible innovative outcomes.

## 3.10  Network Structures Related to Trust

There are several types of structures and network attributes that support innovation, such as homophily (McPherson et al., 2001; Singh et al., 2010) and structural holes (Burt, 2004; Hargadon, 2002). The current study focuses on a specific category and a subset of it that is suggested to be strongly linked to trust, but has not been empirically proven. That category is transitivity, and the subset is Simmelian ties. The following section describes what some of these structures might look like, and how they imbue the network with the functionality to deliver a particular stage's output.

### 3.10.1  Transitivity Effects

Transitive ties or triads are basic network structure made up of three actors, as opposed to two in dyads. Transitive ties are created when a third party, described as the *tertius iungens* or 'the third who joins' (Obstfeld, 2005), connects otherwise disconnected parties. Simmel (1950) suggested that the introduction of the third person changes the dynamics of dyadic connections. In a dealing between parties A and C, the third party B can play the role of an advocate (Burt & Knez, 1995; Ferrin et al., 2006; Uzzi, 1996), vouching for the trustworthiness of A to C. The heterogeneity, overlaps and density of networks of the third party in transitive ties have been shown to increase a manager's reputation measured with variables that approximate Integrity (i.e., fairness and fulfilling promises) within embedded networks (Wong & Boh, 2010). This implies that aspects of embeddedness can influence how levels of trust develop. But before anything else, one needs to understand the fundamental differences between triads and dyads. The presence of the transitive ties brings about fundamental differences between dyads and triads due to changes in social behaviour. Figure 3-5 illustrates this with an example of how a dyad ST changes into a triad STU with the presence of ties to actor U. A change in social behaviour may require redundant exposure from multiple contacts providing the reinforcement necessary to promote adoption. In an internet experimental study, Centola (2010) found that adoption was more likely when participants received "redundant" encouragement from multiple ties. In addition to fostering behavioural change, redundant ties also provide credibility or verification of information and makes one less dependent on single sources of such information

or other resource (Brass & Halgin, 2012). Brass and Halgin (2012) proposed a focus on redundant content or what flows through the connections in place of, or in addition to redundant positions in the network. For example, while everyone needs to know a doctor, having a redundant backup doctor provides a second opinion that is often useful. Redundant contacts may then represent an additional source of confirmation of knowledge.
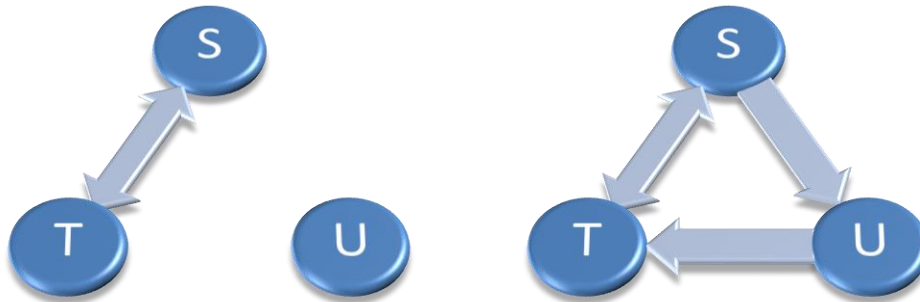


Figure 3-5: Differences between the original dyad S-T (left) and the addition of actor U into the network structure (right).

The act of delivering information in a triad creates a multiple channel system, much like an echo chamber or broadcast. This allows a cross-evaluation of possible alternative ideas, known as *sensemaking* (Elsbach et al., 2005). This complicated multichannel method looks at various inputs to the cognition process in order to decide which option or explanation is most suited to a particular event or scenario. This multiple confirmation channel helps reaffirm the earlier content's veracity, and increases the level of trustworthiness of all actors within this functional group.

Another aspect related to triads that can influence trust is information symmetry. This feature is centred around the information that others can obtain about others in the triad (Wong & Boh, 2010). The multiple information channel in triadic structures reduces any information asymmetry that may exist in the relationship (Colquitt et al., 2012), reducing uncertainty and thus risk. This in turn can impact on an alter's trustworthiness. Referring again to Figure 3-5, actor U can potentially receive not only information about T through their direct interpersonal communication, but also *others' interpretation* of U, in this case from S. The multiple channels allow person U to build up a perspective about T. The more congruent or incongruent news or stories U hears about T, the more opportunities U has to perceive that T's trustworthiness is of a certain nature. So while redundancy may not be a very efficient way of communicating information, it certainly helps improve perception efficacy especially based on reputation (Burt,

2005; Burt & Knez, 1995; Ferrin et al., 2006; Gulati, 1995). This improvement in perception feeds back into an alter's perceived trustworthiness, allowing a focal actor to glean a more accurate picture of a potential alter. The effect of the third party is explored further in Chapter 7 which focuses on a special type of triadic structure posited to be strongly related to trust: Simmelian ties.

## 3.11 Summary

This chapter outlined the background of the key elements and dimensions of social networks and trust, and unpacked some of the relevant issues. It started by outlining some basics of networks, and related some relevant theories that influence IG and IR. It also described transitivity as a network structure that is generally linked to trust. The chapter then outlined trust, before presenting the overall trust framework, by focusing on the antecedents and actual trust behaviour. Measures developed by Mayer et al. (1995) and elements in the BTI (Gillespie, 2003) were described and unpacked to answer the research questions.

Upon this foundation and on the basis of existing conceptual and empirical work, it is argued that trust (Bidault & Castello, 2010; Gulati, 1995) and social network structure (Burt, 2005; Burt et al., 2013; Ohly et al., 2010) are the central constructs in innovation. The argument is as follows: social networks allow an employee in innovation teams to seek out information about potential alters. The networks provide this information, enabling focal actors or egos to ascertain their levels of trustworthiness. Egos can then decide whether to trust these alters for IG and IR.

Via survey tools, this research answers the questions of how trust influences the choices employees make on who to seek for IG and IR, and whether there is a special network structure that is strongly linked to trust. To do this, the global IG and IR networks within three high tech firms were captured, and the levels of perceived trustworthiness of alters in the ties within these networks were measured along with supporting variables such as trust and self-reported levels of self-monitoring. By carrying out analysis between the tie formation behaviour and these variables, a better understanding of how trust elements influence the formation of IG and IR ties was obtained. Specifically, this study aims to determine whether Ability, Benevolence and Integrity play roles in IG as well as IR, and whether the egos' self-monitoring levels impact these decisions. Furthermore, Simmelian ties within the captured networks (a special form of transitivity) were analysed to establish whether the structure was strongly linked to levels of trust between embedded employees. The next chapter will explain the methodology employed in this research to answer these research questions.

# CHAPTER 4   Methodology

The focus of this chapter is to describe and justify the research design adopted to test the principal aim of the study: how trust influences the social ties of employees formed for the generation and realisation of innovation.

This chapter consists of six sections, leading with a description of the organisations where the surveys were administered. The chapter then outlines the survey design, mainly how the questions and variables were selected and refined. Following this, network-related questions are elaborated on, and definitions provided of the dyadic and team-level variables used. The methods for data analysis are then discussed, including procedures and software used, data handling, and issues with data handling as well as limitations.

## 4.1   Data collection

Data were obtained from three companies: 1) Firm A which is a world-leading high tech mining equipment producer; 2) employees tasked with execution of oil and gas projects at firm B, a multinational firm; and 3) researchers at firm C, a large scientific organisation. Employees at firm A operate in project teams tackling development of new products or new internal systems. It manufactures high-tech equipment in Brisbane with sales and service employees in the Americas, South Africa and parts of Asia. Firm B is a multinational firm with global reach into multiple industries, with two offices in Australia. Employees work in teams that carry out multiple projects supplying technical and production knowhow to the oil and gas industry. In contrast with firm A, firm B's activities are less focused on idea generation, and more focused on idea realisation. Employees at firm C work together across multiple sites, project teams, and divisions in developing new technology, publishing research papers with local and foreign organisations, and advising external organisations about technology applications. All firms selected leverage on either leading edge, or current state-of-the-art technology to deliver products or services, in which the firms are either a producer of the technology, or fast-followers. This manifests in end-products or services provided to customers. The use or adoption of the technology thus requires significant organisational and team understanding of its impact especially on resource allocation and operations. As with any research involving human respondents, ethical clearance for interviews and surveys was obtained from UQ Business School's Ethical Review Committee.

### 4.1.1 Pilot testing: Study 1

The survey for study 1 was rolled out as part of a network study of firm A. It had just over 160 employees, with around 70 in the four main project teams. I rolled out the survey at firm A to pilot test the items. The information and feedback gathered was used to further refine the survey that was deployed at firms B and C.

### 4.1.2 Study 2

Study 2 consisted of two samples. Sample 2 was a division of firm B. This division had about 60 employees in the relevant project teams. Sample 3 was a division at firm C that was a product of a merger between two divisions. Focus of this research is on the 550 or so employees who deal with information systems, robotics, and mathematical modelling.

### 4.1.3 Interviews to guide survey development

Prior to survey development, I interviewed eight employees from firm A, two senior managers from firm B, and five employees from firm C. The interviews were carried out to understand the general environment at the firms and the culture of the firm they belong to (van Erde & Thierry, 1996). Participants were selected by the firms' management to represent a cross-section of the employee population. The qualitative data provided rich observations supporting the survey data as well as alternative explanations should certain finding appear to be contradictory to expected outcomes, hence enable data triangulation. The interviews were semi-structured, with questions revolving around the participants' beliefs and opinions on what constitutes innovation, idea generation, idea realisation, and what factors supports or retards them, that is, self-monitoring, trust, and trustworthiness. This approach is similar to that carried out by Uzzi (1997). The interviews were recorded, but not transcribed. The insights from these interviews were used to refine the questions used in the survey.

Although project team memberships are determined by management, employees can self-select who they choose to work with for IG and to a certain extent IR. Our interviews found that outsiders, including suppliers, customers and consultants were also approached for IG and IR. However, they comprised only about 10% of dyads, and hence were dropped from this analysis since their presence did not help address the research question.

## 4.2 Survey Procedure

### 4.2.1 Data handling

The survey was administered online. As such, it was custom-designed to collect network and associated data online. Prior to its roll-out, endorsement of the survey from each participating

firm's management was obtained. Emails were sent to target employees that explained the background and reasons for the survey, provided a link to the survey, and were accompanied by an email from firm management stating their support to increase the survey's legitimacy. To improve participation rate further, the email stated clearly that participation is purely voluntary, that all responses will be kept anonymous, and that data will be kept securely to maintain confidentiality. It also stated that participants can choose to not answer any question and that there will be no penalties associated with non-response. A reminder was sent three weeks later to thank those who have participated, and to request those who have not participated to do so. Data from respondents was captured in the form of textual input that can be converted into .csv files that can then be processed. The data include the name of the respondent, the name of nominated alters, and the alter's item scores. Microsoft Excel was used to convert the data file into a typical Excel file, with the data in columns. These Excel files were used as the main method of data input in the analytical software UCINET (more on this software later). To analyse the effect of each variable on network formation, an NxN matrix that represents that variable's relationship between actor $i$ and $j$ was generated (where N represents the number of actors within the IG or IR network). The approaches used to form the variable matrices will be described in each variable's section.

For study 1, the survey was administered to 70 employees directly involved in the project teams. Feedback from firm A was used to refine the survey further for firms B and C. For study 2, the survey was administered to all 59 employees of the focal division of firm B. The refinements include the substitution of one variable for another, the reduction in survey items, and the merging of the two surveys into one. At firm C, approximately 550 employees received the emails with links to the survey. Items for study 1 are provided in Appendix A, while the items for study 2 are in Appendix B.

The survey was divided into parts A and B for clarity. Part A is the network survey, which aimed to capture the social networks bounded by IG and IR behaviours and the associated dyadic attributes. Part A aimed to elicit data on the IG and IR ties of respondents and the attributes of the dyads based on items that correspond to variables to be measured. Part B captured the personality attributes and team-level variables from the respondents. The separation assisted the respondents to focus their responses as well as simplify data capture and analysis. The hypotheses, corresponding results and analysis from these studies are discussed in chapters 5 and 6.

*4.2.2 Part A: Tracing people's ties and social structure*

In this research, the global network approach is adopted to analyse the data. This means all of the actors in the organisation designated by the respondents in the survey are indicated in the network graph, and all of the identified ties are mapped.

For study 1 and study 2 at firm B, Part A of the survey asked respondents to identify their project team. Their project team was defined as the primary permanent or semi-permanent project team to which the employees were assigned or identified with, and with whom they meet regularly to perform project-related tasks. In study 2 at firm C, employees were not allocated to specific projects; the employees are organised around Programs to reflect upon the service-oriented nature of firm C. Additionally, this approach provides a level of flexibility that is beneficial for its operations. For all intents and purposes, the Programs are identical to Project Teams. Data on their program memberships were provided by HR.

To generate the global network of IG and IR ties between individuals within the firms, respondents were asked to identify who they approach for IG and IR respectively. The general name-generator questions are, "Who do you go to for generating ideas?" and, "Who do you go to for support in implementing ideas?". Respondents were also asked to identify up to eight contacts for each network. Definitions of IG or IR based upon IWBs (Janssen, 2000, 2003; Janssen et al., 1997; OECD & Eurostat, 2005) were provided to ensure all respondents had a clear and common understanding. Hence, behaviours such as "creating new ideas to tackle new problems" were used to define IG contacts. Examples of IR behaviours include "making important company members enthusiastic for innovative ideas". Full survey items are in Appendix A, and shows clear distinctions between IG and IR behaviours. The survey then asked respondents to score on a scale of 1 to 7 their perceptions of the identified alters' Perceived Trustworthiness, Trust, Availability, and Closeness. The last variable is one of the dimensions of Tie Strength developed by Granovetter (1973) to characterise the ties in networks (Granovetter, 1983). Contact Frequency was later discarded from the measures since it is directly aligned with tie formation and does not add much value to the analyses. For comprehensiveness, it is discussed here.

*4.2.3 Part B: Personality traits*

In Part B, respondents answer questions assessing their personality traits and team climate variables that were predicted to relate to innovation (though the latter were omitted from analysis). The full survey items are included in Appendix B. Measures are: Team Climate for Innovation, Five-Factor personality Inventory, Proactivity, Locus of Control and Self-

Monitoring (Baer & Frese, 2003; de Jong et al., 2011; Eisenbeiss et al., 2008; Gong et al., 2012; Kim et al., 2009; Moore, 2006; Ogawa, 1998; Ohly & Fritz, 2007; Sasovova et al., 2010; Somech & Drach-Zahavy, 2011; Zhou, 2003).

In the subsequent analysis, it was found that only Self-Monitoring was found to be significant across firms; hence, the others were duly omitted from the main study. For a more complete overview, these results are presented in Appendix C. The following sections describe the core variables measured. The variables were adapted from pre-existing scales in the literature and are described in the following sections. The scales selected for use here have been found to be reliable in prior research. This minimises any issues with item reliability and validity.

## 4.3    Measures

### 4.3.1 Perceived Trustworthiness

The three theorised dimensions of perceived trustworthiness (Mayer et al., 1995) were assessed, namely Ability, Benevolence and Integrity. Ability is defined as "skills, competencies and characteristics that enable a party to have influence within some specific domain" (p. 717). Benevolence of a trustee is a trustor's belief that a potential trustee wants to do good by the trustor, and have the trustor's interests at heart. It implies some level of emotional attachment to the trustor (p. 718). Integrity refers to the trustor's perception that the trustee adheres to a set of guidelines and principles that is mutually acceptable (p. 720).

The survey asked respondents about the competency level of their contacts in carrying out general work-related tasks (Ability), their Benevolence (caring, openness) and Integrity (honouring promises). Items were adapted from Mayer and Davis (1999) using a seven-point Likert scale (1=strongly disagree, 7=strongly agree). Example items include "I believe this person has much expert knowledge in the field I need advice in" (Ability), "I feel this person cares about what happens to me" (Benevolence), and "I never have to wonder if this person will stick to their word" (Integrity).

It was mentioned earlier that to analyse the impact of variables on tie formation, the variable scores needed to be converted into NxN matrices. The NxN matrices for Ability, Benevolence and Integrity are shaped by inserting actor $i$'s scores for actor $j$'s perceived Ability, Benevolence, or Integrity in cell $(i,j)$. The matrices thus formed represents actor $j$'s corresponding Ability, Benevolence or Integrity as perceived by actor $i$.

### 4.3.2 Trust Behaviour: Reliance and Disclosure

Items for Trust are taken from the BTI developed by Gillespie (2003). Meta-analysis work on trust (Colquitt et al., 2007; Hülsheger et al., 2009) has indicated that behavioural estimation

items are strongly predictive of actual behaviour across a wide range of settings and behaviours. Thus, measuring the willingness to be vulnerable and engage in risk-taking behaviour enables the prediction of trusting behaviour in the complex and highly dependent relationships observed in IG and IR. To do that, the BTI items used in this research are made up of two items, one each for Disclosure and Reliance.

Items adopted for this research captures the act of disclosing feelings to the nominated alters, and relying on these alters for their skills. These behaviours can make the respondent feel vulnerable to the alter, which is pertinent to capture actual trusting behaviour within a dyad. Items include "I rely on this person's task-related skills and abilities" and "I share personal feelings with this person", to measure Reliance and Disclosure respectively. Respondents answered these questions on a seven-point Likert scale (1=strongly disagree, 7=strongly agree). The NxN matrices for Reliance or Disclosure were formed in a similar way to matrices for perceived trustworthiness dimensions, and represents actor $i$'s level of Reliance and Disclosure towards actor $j$.

### 4.3.3 Self-monitoring

While several scales for self-monitoring are available, the one developed by Lennox and Wolfe (1984) was chosen for its suitability for capturing innovation-related behaviours. It measures both *protective* (SMP) and *acquisitive* (SMA) styles of self-monitoring.

To measure self-monitoring, six items from the scale developed by Lennox and Wolfe (1984) were used, three representing SMA and SMP measured on a seven-point Likert scale. Sample items include "Once I know what the situation calls for, it's easy for me to regulate my actions accordingly", which measures SMA, and "I can usually tell when I've said something inappropriate by reading it in the listener's eyes", which measures SMP. The NxN matrices for SMA or SMP are formed by applying the actor $i$'s average self-scores of SMA or SMP across all the columns, representing a sender (ego) effect. When regressed against IG or IR networks as the DV, this represents ego's SMA or SMP effect on tie formation.

### 4.3.4 Control Variables

Control variables help to rule out alternative explanations for tie formation. In many instances, ties are formed involuntarily due to formal positions of hierarchy (Adler & Kwon, 2002; Podolny & Baron, 1997), and work co-location and team membership (Levin & Cross, 2004). For this research, demographic variables such as the alters' physical work proximity, project or program membership, seniority, availability and tenure were controlled for. Physical proximity

was based on the respondent's office location. Similarly, project or program memberships were recorded to determine the task–oriented groups in which employees were co-members.

I used employee Project Team or Program membership (Project Team), office Co-Location (Location), Seniority, Tenure, Availability, Closeness, and Trust Propensity as control variables at the individual level. These reflect seven effects that influence an employee's choices for IG/IR tie formation choices. Project Team and office co-Location relationship matrices are similar, in that they represent co-categorical memberships that hypothetically influence tie formation probability. The relationship matrices were determined using Boolean operators. If the ego and alter worked in the same office or in the same team, then the matrix was scored as a dummy value 1, 0 if otherwise. Typically this produced NxN relationship matrices. A mathematical version of this definition is given as follows:

$$R_{i,j} = \begin{cases} 1 & if\ V_i = V_j \\ 0 & \text{otherwise} \end{cases}$$

Seniority hypothetically influence tie formation probability. The more senior an employee is, the higher the likelihood of the actor receiving a tie. In social network parlance, the focal actor popularity increases with his or her seniority. Seniority was measured as the respondent's position in the firm. Employees' seniority were coded between 0 to 5, with 0 representing technicians and non-executives, 1 representing executives, 2 representing managers, 3 representing senior managers, 4 representing directors and 5 representing the CEO. The NxN matrix was formed by applying the actor $i$'s Seniority scores across all the columns in the matrix. This represents an ego's Seniority effect as the receiver of ties in tie formation. Tenure is a sample 3-specific measure, based on service length, which in turn was coded from 1 to 9, with 1 representing employees who had served less than 1 year, to 9 representing those who had been with the organisation more than 31 years. Tenure hypothetically influence tie formation probability, in which a focal employee will be inclined to form more ties the longer they serve in the firm. This is on the basis that a longer-serving employee will know more people, have more time to cultivate friendships, and hence have more people to choose from for IG or IR. The NxN matrix was formed by applying the actor $i$'s scores across all the columns. This represented the ego's Tenure effect as the sender in tie formation.

Another facet to control for was the Availability of the alter. Granovetter (1983, p. 209) stated that "strong ties have greater motivation to be of assistance and are typically more easily available". This suggests that an employee approaches a person primarily due to the other person's availability, beyond other factors. To account for this different explanation for tie formation, one general item was adapted from Levin and Cross (2004): "This person is available

when I need him/her". A seven-point Likert scale was utilised here (1=strongly disagree, 7=strongly agree). The NxN matrix was formed by applying the actor $i$'s scores for actor $j$'s perceived closeness in cell ($i,j$). This represented actor $j$'s Availability as perceived by actor $i$. Closeness is one of the four original dimensions of Tie Strength (Granovetter, 1973; Granovetter, 1983). I used Closeness in this research to identify the tendency of a focal employee to form ties with an alter who is perceived to be emotionally close. It was measured by asking respondents to respond to one item taken from Hansen (1999). Closeness captured the quality of the tie, a proxy for the type of information shared, and the affective element of the tie through the question, "How close is your working relationship with this person?". This was scored on a 7-point Likert scale, with 1 being a distant relationship, and 7 denoting a very close relationship. The NxN matrix for perceived Closeness was formed by applying actor $i$'s scores for actor $j$'s perceived Closeness.

Trust propensity was measured using two out of the eight-facet items from the NEO Personality Inventory Revised (NEO PI-R,Costa & McCrae, 1992b). These two items were selected based on best face validity, with the added advantage of the second being able to capture the reverse of trust propensity, specifically cynicism and scepticism. A seven-point scale was used (1=strongly disagree, 7=strongly agree). The NxN matrix was formed by applying the actor $i$'s averaged scores of Trust Propensity across all columns that represented the focal actor's Trust Propensity effect on tie formation.

These survey items are included in parts A and B. Figure 4-1 depicts the sequence of the survey tool and how the measures are distributed.
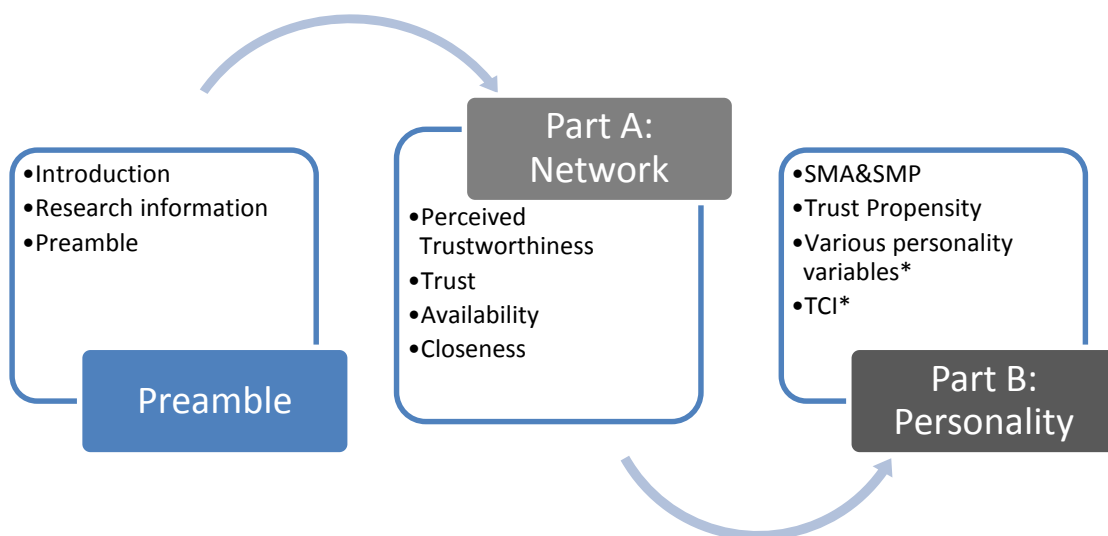


Figure 4-1: Diagram outlining components of the survey and the sequence.

(N.B. * denotes variables omitted from main study)

## 4.4    Analytical Method

Analysing network data poses a unique set of challenges. The most obvious is that the observed data and the variables are not statistically independent. One of the typical assumptions in network research is that "network structures are exogenous, with actors randomly assigned to network positions....clearly the assumption that network positions are exogenous.... is, at best questionable and, at worst, violated in the majority of cases" (Stuart & Sorenson, 2007, p. 217). In a nutshell, much research that utilises typical regression methods has ignored the need for the variables to be independent. In network analysis, that is certainly not the case.

To illustrate this, imagine an adjacency matrix where a row represents the connections one actor has with others in the network. The characteristics or attributes of this one actor will influence the tie formation behaviour reflected in the cells of the row. This lack of independence means the assumptions of traditional regression and statistical inferential tests do not hold. Consequently, standard statistical packages such as SPSS or Stata should not be utilised to analyse the data (although at times they are unfortunately used). Furthermore, traditional statistical tests assume that the data is extracted from a population that has a particular distribution. However, network data distribution sometimes is not known (Borgatti et al., 2013). And it could be that the network is not just a sample of the distribution, but **is** the whole population.

To deal with these interdependencies in the dataset and ensure that the mechanisms that influence the evolution of the network are also modelled, Borgatti and Cross (2003) developed a special procedure called the Multiple Regression Quadratic Assignment Procedure (MRQAP) as part of the software UCINET (Borgatti et al., 2002; Hubert & Schultz, 1976; Krackardt, 1987). This is the method used to run the correlations and multiple variable regressions in this research, and is further explained in Section 4.4.2. The ability of QAP to tackle the endogeneity in networks makes it a suitable approach, but there are other methods and software available, such as rSIENA (Ripley & Snijders, 2011) and ERGM (Lusher et al., 2012a). However, the interface for both rSIENA and ERGM are complicated, and inserting models requires a good grasp of computer languages. In comparison, UCINET is easier to use due to its GUI, while its models are reasonably accurate for the purpose of this study. The next section describes how data for this research is handled and fed into QAP.

### 4.4.1  Handling Missing Data

One issue that crops up often in network analysis is missing data. Missing data can occur due to: (a) the boundary specification problem because ties beyond the organisations in focus were ignored; (b) survey non-response, where the respondent chooses not to fill out some questions;

and (c) fixed choice effects, caused by right-censoring the vertex degree of actors through specifying limits to the number of alters that can be designated (Kossinets, 2006). This current research was bounded by the research question focusing on the ties within the firms. Thus, the boundary specification problem is not pertinent here. The survey non-response and fixed choice effect issues however, are of concern.

Survey non-response occurs when respondents refuse to answer the network or dyadic or personal attribute questions. Some of them, however may have been nominated as alters by others, so inherently they are present in the networks. Examples in this research include respondents refusing to specify the level of perceived trustworthiness of an IG contact. This poses a survey non-response problem, since the research question hypothesizes the link between ties formation with the perceived trustworthiness of the alter.

To deal with missing tie data, UCINET utilises standard imputation methods suggested by Ward et al. (2003). This approach uses latent space estimates that gauge whether a link that does not exist may actually be missing. Imputation values are based on the idea that missing values often lead to dependencies in the sociomatrix. The estimates are based on a logistic regression model that calculates the probability that actors $i$ and $j$ are situated on similar locations on a latent space. This space is visualised as a sphere with a radius $k$ that is associated with a selected covariate of the focal actor $i$. If actors $i$ and $j$ are found to be co-located in this latent space, then a tie actually exists between the two. The missing value is then calculated by finding the maximum of a function which relates the log probability of the general sociomatrix measured and a function of the related covariates (Ward et al., 2003, p. 6). This approach has been adopted by users of social network analytical algorithms (Freeman & Gill, 2010; Gill & Freeman, 2013; Huisman, 2009; Mullins et al., 2008; Sasovova et al., 2010). Missing attribute data was treated by replacing the values with the value 999, and the internal UCINET subroutines deal with these missing values.

Other network researchers might query the absence of questions that ask the respondents to nominate alters who approach *them* for support for IG or IR. Two interlinked reasons exist for the decision in this current research not to include such questions. First, the research question aims to identify how the network ties and the perceived trustworthiness of alters are related. Asking who the respondent gives advice to would require the nominated employees to tell us their perception of the respondent's trustworthiness, strictly speaking. Tracking this would not only have increased workload, but would have violated the confidentiality clause outlined in the research. Second, the respondent burden would also have increased significantly, which can adversely impact on the survey response rate. To illustrate, respondents could nominate a total

of 16 alters. There were a minimum of 12 dyadic attributes per respondent, a total of 192 response items. Inclusion of the alters the respondent gives advice *to* would have doubled this number, making recall very tedious. For these reasons, respondents were not asked this question.

On fixed choice effects, limitation on the number of nominated alters is a reality that researchers face. Respondents have a limited ability to recall contacts, and not putting a cap on the number of nominated alters may increase a respondent's burden, adversely affecting response. This is compounded by other inputs required of the respondent, so striking a balance is crucial. Typical social network research (Marsden & Campbell, 1984; McPherson et al., 2001; Tichy et al., 1979) has asked respondents to name between three to six contacts within their network. In this research, nominations were limited to eight contacts, which may lead to some ties being censored out of the dataset. However, as pointed out by Kossinets (2006), such a fixed choice design is not a serious issue, and that even at a cut-off of twice the average number of contacts, fixed-choice errors are virtually non-existent (p. 263). Overall, this will reduce over specifying the number of contacts per respondent, and help make the data more manageable.

### 4.4.2 Quadratic assignment procedures (QAP)

MRQAP and LRQAP are two of the many analytical procedures that fall under the quadratic analytical procedure (QAP) family available in the network analytical software UCINET (Borgatti et al., 2002) distributed by Analytic Technologies. UCINET is continuously being developed, with the current version used to analyse the data at the time this was written being version 6.491.

Quadratic assignment procedures (QAP) allows for the determination of significant DVs for variables that are not independent of each other, as in network analysis. The main characteristic of QAP is the generation of the random pairs of matrices that are similar to the observed ones. Rows and corresponding columns in the observed matrices are randomly permutated, creating new matrices that are independent of the original data matrix, yet retain its characteristics. These include the mean, the total number of ties, average density, etc. Comparisons between these matrices' correlations and the observed correlation are consequently valid for statistical purposes.

When presented with two matrices, analysis software reforms them into two long columns and then calculates an ordinary statistical correlation measure, such as Pearson's *r*, between the two matrices. This is called the "observed" correlation (Borgatti et al., 2013, p. 128). To determine the significance of this observed correlation, QAP compares this correlation to the correlation obtained between random pairs of matrices that are similar to the observed matrices, yet are

known to be independent of each other. The *p*-value is simply the proportion of the correlations between the random pairs that is as large as the observed correlation. If the proportion of correlations drops below a certain threshold, typically 5%, then there is a good chance that the two observed matrices are related, supporting the hypothesis tested. Fundamentally, the procedure is similar to the non-network procedures, especially in the estimation of parameters. It differs in that it carries out random permutations of the rows and corresponding columns of the data matrix. This essentially creates the sample space of similar matrices, and studies the significance of the observed matrix in comparison to this generated data set. A double semi-partialing approach recommended by Dekker et al. (2007) was used to calculate the significance levels based on the proportions of chance permutations out of 2000 random permutations that generated values as great as that in the observed statistic. The number of random permutations is arrived at after evaluating the stability criterion of the residuals. Any increase beyond this value increases the computation time with no significant improvement in the results.

A caveat for using MRQAP is the fact that only the reported statistical significance is meaningful (Borgatti et al., 2013), and is adequate for correlation analyses. The beta weights as reported by MRQAP do not hold the same meaning as beta weights defined through normal regression or OLS methods (Borgatti et al., 2013, p. 134). Therefore, comparisons of variable effect sizes using the beta weights in this manner must be taken with a little bit of scepticism. To obtain accurate regression estimates, the similar *logistic regression quadratic assignment procedure* (LRQAP) was utilised.

To test for the Simmelian tie hypotheses, a similar approach was required, consisting of three main steps. (Borgatti et al., 2013, p. 252). First, merging the IG and IR networks of Firms B and C into two firm networks, respectively, captured all innovation-linked ties within the dataset. Two reasons lie behind this merging: it increases the statistical power of the analysis by increasing the number of ties, and it captures all the dimensions of perceived trustworthiness related to the innovation process, in line with the justifications presented in the hypotheses section. The second step (Borgatti et al., 2013, p. 252) was to decompose the two merged networks into three matrices containing the separate dyadic components of the triads: (a) a non-symmetrical network matrix; (b) a sole-symmetric network matrix; and (c) a Simmelian network matrix. The next step was to compare the regressions coefficients of these networks in respect to perceived trustworthiness dimensions, controlling for Trust Propensity using logistic regression QAP or LRQAP.

LRQAP in many ways is similar to MRQAP. The major difference is that LRQAP is built on the basis of a binomial logistic regression which aims to determine the binary response based

on one or more predictor variables. These variables can be continuous, as in this research. Similar to MRQAP, it generates randomised matrices based on the observed network matrix. However, it utilises the logistic function *F(t)* that varies between 0 and 1 as shown in Equation 4.1:

$$F(t) = \frac{e^t}{e^t+1} = \frac{1}{1+e^{-t}} \qquad (4.1)$$

where t is a linear function of the explanatory variable being studied. By equating this linear function with coefficients related to the explanatory variable as shown in Equation 4.2:

$$t = \alpha + \beta x \qquad (4.2)$$

where α and β are the linear coefficients of the explanatory variable, the logit function can be linked to the explanatory variable's coefficients and values. The inverse of the logistic function or the logit can be manipulated as shown in Equation 4.3:

$$\frac{\pi(x)}{1-\pi(x)} = e^{\alpha+\beta x} \qquad (4.3)$$

The main advantage of this approach is that while the explanatory variable can take values from negative to positive infinity, the output is bounded by values 0 to 1, which can be interpreted as tie formation probability. The values of α and β can then be interpreted as linear effect size as defined by the above equation. This can then be compared for different variables, making evaluation much easier and clearer. To simplify effect size comparison of the explanatory variables intuitively, LRQAP also calculates odds ratios for all of the variables.

### 4.5    Summary

In this chapter, the research design, methodology, and analytical methods employed in this study were described and discussed. The sample firms from which participants were drawn were briefly described in terms of their industry identity, and their similarities to and differences from each other with respect to innovation. The survey design steps and the variables central to the analysis, which includes dimensions of Perceived Trustworthiness and Self-Monitoring, were also described along with control variables. In addition, this chapter outlined the main statistical tools and approaches employed in this study, and described how the captured data were handled and modelled.

In the next chapter, I move on to explaining how the research questions were tackled. I discuss the hypotheses, sample, the results obtained and the analysis from datasets. Chapter 5 goes on to present the hypotheses and analytical results to answer the first primary research question,

that is, how perceived trustworthiness influences employees' choice of IG and IR ties (RQ1). It also includes a discussion revolving around the secondary research question (RQ3) of how personality variables, specifically self-monitoring influences IG and IR tie formation. Following this, the impacts of trust elements on tie formation in stages of the innovation process are discussed. Chapter 6 then answers the second primary research question, if there is a network structure in innovation that is linked to trust, by focusing on a special type of network structure posited to be related to trust: Simmelian ties (RQ2). Additionally, it also presents Simmelian ties as a network structure that can boost trust levels among employees.

# CHAPTER 5    Predictors of Tie Formation in IG and IR Networks

This chapter outlines the results related to the primary and secondary research questions (RQ1 and RQ3): How trustworthiness, and certain personality variables, influence employees' tie formation decisions for idea generation and idea realisation. The hypotheses and their justification are outlined; this is followed by the results of analyses and a discussion on their significance and contribution to theory and practice.

## 5.1    Hypotheses

### 5.1.1 Trustworthiness in IG and IR relations

As discussed in Chapter 3, there are unique challenges faced during the IG and IR stages of innovation. For IG, they are (a) accessing different domains, (b) resistance to novel ideas, and (c) idea security. For IR, to gain the resources from management and deploy them effectively, the challenges include (a) managing resistance to novel ideas, (b) managing unanticipated problems, and (c) coordination.  Figure 5-1 presents this diagrammatically.



- Access different domains
- Resistance to novel ideas
- Idea security

IG

- Resistance to novel ideas
- Unanticipated problems
- Coordination

IR
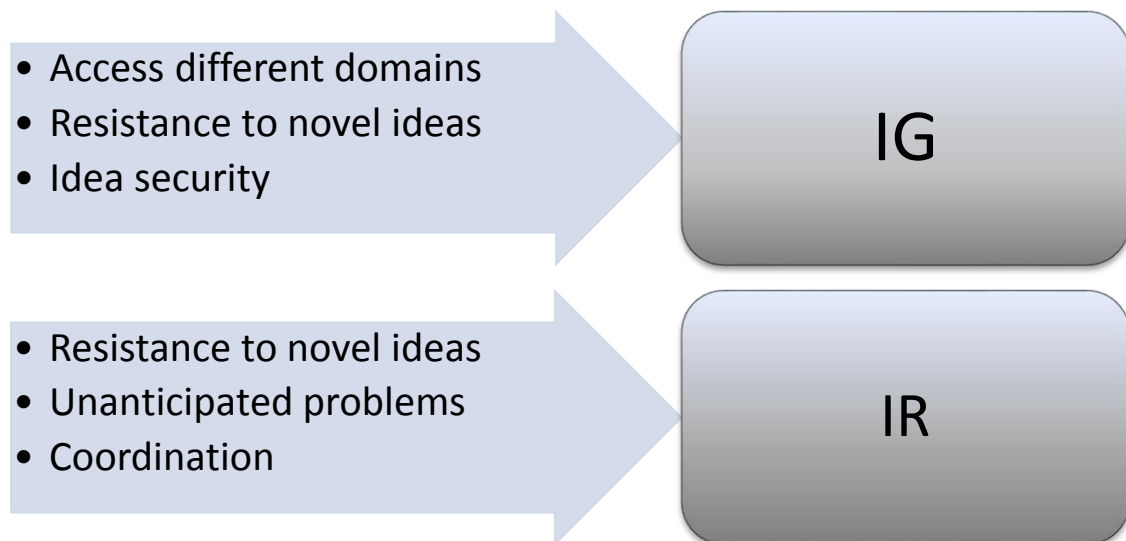
Figure 5-1: The unique challenges in IG and IR.

In IG, a common theme linking the challenges outlined is resistance. This imply the possibility of conflict. Bringing together people from different backgrounds means working across demographically diverse sets of people. Such diversity increases possibility of disagreements,

reduces cohesion, retards internal communications and prevents effective internal coordination within teams (Dougherty, 1992). The group literature has further suggested that conflict is caused by the difficulty of merging different cognitive styles, attitudes, and values (Barker, 1993; Bettenhausen & Murnighan, 1985; Bettenhausen, 1991) such as those found in teams with diverse members and norms. If not managed effectively, this diversity can create internal processes that slow decision making and prevent members from concentrating on the task. Conversely, managed properly, conflict can allow the best solutions to filter through, which leads to good performance. While conflict can be detrimental to teams carrying out routine work, it can be beneficial if they are carrying out non-routine work instead (Jehn, 1995). Conflict in non-routine tasks provides an avenue for people embedded in the tasks to explore different options and pathways to deal with the emerging issues. This is more so if the level of variety for tasks matches the level of diversity and differing opinions of people working on the innovation (Tushman & Nadler, 1978). Maximum benefits from these diverse perspectives can be obtained from the information channelled within and beyond the networks. This is where trust elements play their central role.

Choosing alters who are perceived to be trustworthy will help actors tackle the problems in IG and IR, including conflict. Perceptions of Ability, Benevolence, and Integrity helps manage conflict by allowing employees to identify which alters have the skills to refine the ideas, are benevolent towards the focal person and have the Integrity to uphold promises (Bledow et al., 2009; Curşeu & Schruijer, 2010; Deutsch et al., 2011; Gillespie, 2012). Perceptions of alters' trustworthiness help focal actors decide who is worth sending ties to based on these criteria: (a) who has the necessary skills to help refine the ideas or convince gatekeepers to buy into the idea; (b) who cares enough about the focal person to help refine the ideas further to make it more practical and appealing to funding parties; and (c) who is least likely to act opportunistically and steal the ideas. The accrued expected benefits that relates to creativity, idea generation, sifting and refinement can lead to novel, useful and ground-breaking offerings that can provide the competitive edge that companies seek.

Alters perceived to have Ability will help employees gain essential technical resources and information. Firms usually divide their workforce according to skill domains, governed by hierarchies, with managers at the top rung. Within these 'thought worlds' (Dougherty, 1992), members are focused on their tasks to the point this can prevent them from recognising and sharing novel ideas and useful knowledge from other domains (Carlile, 2002; Hargadon, 2002). Ideas that appear to challenge the status quo and detract from a skill unit's focus can also be dismissed by managers, killing off opportunities for novel ideas to incubate and materialise

(Garud et al., 2013; March, 1991). Employees' best chance of ensuring the emergence of novel ideas is selecting alters who possess Ability, that is, the skills to refine ideas to the point they can be practically implemented. When management clearly sees the advantages and benefits of the novel idea, they will be more inclined to provide support to implement it.

The selection of a benevolent alter will help employees feel safe in the belief that the alter will act with the focal actor's interests at heart. Several advantages accrue to the focal actor. Approaching benevolent alters ameliorates the fear in IG where the superior benefit potential promised by innovative ideas makes them susceptible to idea theft (Dutton et al., 2002). Benevolent alters will be willing to collaborate with others from different domains or work clusters, and support information flow from different divisions essential for idea recombination (Burt, 2004; Hargadon, 2003). Additionally, employees will be motivated to share ideas with alters who are perceived to want to assist in refining the innovation, even if the benefits from a novelty are not of communal interest. Alters will also collaborate in coordinating joint action across relevant divisions to support the implementation of innovation.

Alters with Integrity are also essential to employees tasked with innovation. The successful development and implementation of innovation depends on the ability of project teams to deliver on promises. This is critical for idea security, coordination across multiple divisions (van der Vegt et al., 2010), supporting novel ideas, and staying put to help iron out any unanticipated issues that usually arise during IG and IR (Berardo & Scholz, 2010). If an alter chosen to assist in providing support for idea implementation fails to uphold his or her promise, a potentially fruitful idea might become stagnant or fail altogether (Fletcher & Fitness, 1990; Klein & Knight, 2005). Taken together, perceptions of Ability, Benevolence and Integrity will predict tie formation in the IG and IR networks. This leads to the following hypotheses:

*H1a: Perceptions of alters' Ability will be positively associated with tie formation in innovation networks.*

*H1b: Perceptions of alters' Benevolence will be positively associated with tie formation in innovation networks.*

*H1c: Perceptions of alters' Integrity will be positively associated with tie formation in innovation networks.*

## 5.2    The moderating effect of Benevolence and Integrity

While employees with Ability and skills are sought after by employees to assist in IG and IR, some employees of them may behave in certain disagreeable ways, like being abrasive. These behaviours can give off the perception that these skilled employees are not trustworthy.

Literature on trade-off between cognition and affect (Casciaro & Lobo, 2005, 2008) has suggested that there is an interplay between these elements. Analysis into the boundary conditions show that likeability or affect moderates the relationship between skills of an alter and tie formation. As mentioned in Chapter 1, Casciaro and Lobo (2005, 2008) suggested that affect is a different construct than perceived trustworthiness as defined by Mayer et al. (1995). This poses a trade-off question to employees: would they approach alters who are perceived to have high Ability but low Benevolence or Integrity?

Informed by these findings, this research analyses the boundary conditions for the interplay between Benevolence and Ability, and between Integrity and Ability, within the innovation process. Attention was among the trade-offs employees make when deciding who to trust for support to innovate. Alters with skills need to be included in the network for employees to access their skills; however, the alters' level of perceived Benevolence and Integrity may decisively influence the decisions of colleagues.

This research focuses on the interplay between dimensions of trustworthiness in the formation of IG and IR ties. H1a states that Ability predicts tie formation. To test for the boundary conditions of this relationship, I examine whether Benevolence and Integrity moderates this effect. This is informed by the findings of Casciaro and Lobo (2005) that in the formation of ties in support of complex projects, employees will choose a likeable but less skilled alter over a competent but unpleasant alter. Casciaro and Lobo (2008) found support for the hypotheses that, "negative interpersonal affect renders task competence virtually irrelevant in a person's choice of a partner for task interactions but … positive interpersonal affect increases a person's reliance on competence as a criterion for choosing task partners, facilitating access to organisational resources relevant to the task" (p. 655). Working with agreeable alters bodes well for projects: strong positive affective feelings and smooth task execution usually result. But for innovation, there lies a drawback, because skills and diverse ideas of less likeable alters – 'competent jerks' (p. 1) – tend to remain untapped. Suboptimal IG and IR may result from the inaccessible resources. This runs counter to the diverse knowledge domains required for useful novel ideas to emerge through recombination (Elsbach & Hargadon, 2006; Hargadon, 2002, 2003). I suggest that in a similar manner to affect, Benevolence and Integrity both play moderating roles in tie formation for innovation.

Focusing on Benevolence first, the idea of alters chosen primarily for their Benevolence has great implications for innovation. Similar to the arguments put forth by Casciaro and Lobo (2008), the positive Benevolence experienced in ties in response to incentives can trigger *behavioural self-regulation mechanisms* (Davidson et al., 1990; Gray, 1994). The idea behind

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these mechanisms is that: (1) behaviour can be simplified into approach and avoidance tendencies; and (2) affect motivates people to take action (Carver et al., 2000). These mechanisms include the behavioural *approach* system that prompts action towards goals, and the behavioural *inhibition* system that responds to signals of punishments or lack of rewards due to negative Benevolence. I relate these to positive and negative perceptions of Benevolence respectively, because a person's choice of tie formation is linked to the perception that the potential work partner has the focal person's interests at heart.

Behavioural self-regulation theories can be applied to positive and negative Benevolence in innovation processes, since they correlate with approach and avoidance behaviours related to risks. High perceptions of alter's Benevolence leads to the view that task-related resources are within reach. This activates the behavioural approach system that reaches for resources. Actors will then start relying on Ability as a criterion for tie formation because the related resources are perceived to be available, and the focal person moves towards objectives at the specific stage of the innovation process. Conversely, when a potential work partner or alter is perceived to have low Benevolence, the focal person may believe that resources essential to the completion of the relevant stage of innovation are beyond reach. Consequently, tie formation with this alter is perceived to be untenable, activating the behavioural inhibition system which inhibits movement towards the alter. Subsequently, the overall effect is that when Benevolence or Integrity is low, the alter's Ability is less relevant to tie formation.

Simply put, when someone is perceived to not have the ego's interests at heart (low Benevolence), whether that person is perceived to be skilled or not is irrelevant. It is thus unlikely that this alter will be sought after for IG-related or IR-related tasks. This holds true even if this alter was made a formal team member. In contrast, alters perceived to have their colleagues' interests at heart will be sought after for both IG and IR. In line with findings that affect can have an overwhelming hold on interactions (Casciaro & Lobo, 2005; Chua et al., 2008), it is hypothesised that perceptions of Benevolence will moderate the importance of Ability for tie formation. Taken together, this leads to the following hypothesis:

*H2: The association between alter's perceived Ability and tie formation is moderated by Benevolence such that the relationship between Ability and tie formation is stronger when Benevolence is high, and weaker when Benevolence is low.*

I further propose that the Integrity of the alter will also moderate the relationship between Ability and tie formation. The ability of alters to deliver as promised is important to reduce risks in innovation. The novelty and complexity involved means that every component needs to be delivered as required and on time. Failure to do so will jeopardise the implementation.

Choosing alters who have high perceived levels of Integrity is an obvious course of action for employees working on innovations. But the absence of Integrity is to likely to impede tie formation for innovation.

Here, behavioural inhibition systems are expected to come into play again (Gray, 1994). Currently how Integrity predicts tie formation is not well understood. Alters perceived to deliver on promises are more likely to be approached if they are also perceived to be skilled. Conversely, actors who are deemed unlikely to fulfil promises, or are seen as opportunistic will be less likely to be selected, even if they are perceived to be skilful. Opportunistic and skilled actors are avoided because they are perceived to be more likely to commit idea theft. Similar to the effect of low Benevolence, tie formation with alters with low Integrity is perceived to be untenable, activating the behavioural inhibition system. With these arguments, it is suggested that Integrity moderates the relationship between Ability and IG and IR tie formation. This lead to the next hypothesis:

*H3: The association between alter's perceived Ability and tie formation is moderated by Integrity such that the relationship between Ability and tie formation is stronger when Integrity is high, and weaker when Integrity is low.*

## 5.3    Impact of Self-monitoring on Innovation Networks

The significance of personality attributes and its association with networks and innovation have been well-established (Burt et al., 2013; Tortoriello & Krackhardt, 2010), with King's (1990) study referencing a large body of literature that looks at personality traits as antecedents of individual creativity performance. The literature has also suggested that personality characteristics of team members are relevant to the formation of ties within the innovation process (Stoker et al., 2001; Zhou et al., 2009). As mentioned in Chapter 4, initial analyses found that out of the multiple personality and team climate variables studies, only self-monitoring turns out to be significant. Since the studies on the impact of these variables are secondary, the insignificant variables are omitted for brevity.

### 5.3.1 The influence of Self-monitoring

Self-monitoring has been shown to influence network position and job performance. Research on acquisitive and protective impression management (Costa, 2003; Wolfe et al., 1986) has linked both to innovation behaviour and performance, and suggested that self-monitoring is linked to trustworthiness (Gangestad & Snyder, 2000). While there is a tendency for people to view outgroup members, as opposed to ingroup members, as less trustworthy (cf. Tajfel, 1982), those with higher self-monitoring scores will be successful in overcoming these negative

perceptions. Specifically, outgroup individuals that have higher self-monitoring scores will be able to better project positive impressions compared to those with low self-monitoring scores (Flynn et al., 2001). High self-monitors are thus able to project agreeable self-image to people from different backgrounds, to reach diverse groups, and to be perceived to be as trustworthy (Oh & Kilduff, 2008). An alter carrying out such image projection through the reshaping of intermediate psychological processes (Costa, 2003, p. 326-327), may influence a focal employee's perception of an alter's trustworthiness. In this research self-monitoring is treated as a personality characteristic of alters that distally influences an employee's tie choices for innovation. I specifically suggest that SMA and SMP will play roles in driving ego's tie-forming activity in IG and IR networks' tie formation.

### 5.3.2 Acquisitive (SMA) and Protective (SMP) Self-Monitoring in innovation networks

Acquiring information to refine ideas is central in an IG network. To deal with challenges of IG, employees will seek colleagues or superiors who are perceived to be trustworthy, alters who understand the innovation scenario and how his or her related ideas will bring benefits, and are expected not to behave opportunistically. A high self-monitoring individual will be more skilful in the forms of self-presentation (Arkin, 1981; Lennox, 1988; Weisz et al., 1984), in terms of being able to project such a trustworthy image to alters. They achieve this by showing their ability and positive image, possibly through adoption of similar domain-specific phrases or showcasing his or her expertise in understanding the focal actor's specialisation when discussing ideas. By doing so, they are able to extract information, establish knowledge pathways, and optimise their channels of communications to help implement novel ideas. High SMP egos would attempt to show concern for the alter, especially when discussing the problems associated with the novel idea. They are better skilled to show empathy and solidarity, and adopt strategies to make the alter feel comfortable and safe to discuss novel ideas. These are more important when the alter is from a different background, domain or division.

In the IR networks characterised by social-political processes, central to these processes are implementation of novel ideas and protecting information related to it. Employees will seek access to actors perceived to be benevolent, able to assist in bringing resources to implement the ideas, and have Integrity to deliver on promises. Trustworthy actors are perceived to be open to suggestions, less resistant to novel ideas, willing to help deal with unanticipated problems, and assist with coordinating and securing resources. In turn, the focal actor or ego benefits from being part of an innovation implementation effort that can be beneficial to all involved, while gaining status, an important political commodity. Similar to within IG networks, high SMA egos would attempt to project a positive image by showing that they have

the ability to assist the alter in securing resources. High SMP egos would attempt to protect their image by showing concern for the alter through projecting an image of a person who has parallel interests in implementing the ideas.

Taken together, I propose that SMA and SMP will predict tie formation in IG and IR. Self-monitoring will play a critical role in impression management and consequently IG and IR tie formation. I suggest that in IG and IR circles, high self-monitoring egos engage in SMA and/or SMP to project the image of a trustworthy actor by projecting a positive image, protecting that image, and avoid being perceived negatively (Costa, 2003, p. 326). This leads to the following hypotheses:

*H4a: An ego's score of Acquisitive self-monitoring will be positively associated with tie formation in IG networks.*

*H4b: An ego's score of Acquisitive self-monitoring will be positively associated with tie formation in IR networks.*

*H4c: An ego's score of Protective self-monitoring will be positively associated with tie formation in IG networks.*

*H4d: An ego's score of Protective self-monitoring will be positively associated with tie formation in IR networks.*

## 5.4    Data and Results

### 5.4.1 Descriptive statistics

In order to better understand the effect of trustworthiness on tie formation, Table 5-1 shows the descriptive statistics for the main variables concerning overall firm environment and tie formation drivers for both firms. In total, 21 usable responses were received from firm B representing 5 project teams, and 132 responses from firm C, representing 11 research programs (similar to project teams). This corresponds to a response rate of 36% and 24% for firm B and C respectively. The resultant IG and IR networks consisted of 43 and 33 employees respectively in Firm B, and 337 and 237 employees respectively in Firm C.  The networks in firm C are approximately eight times bigger than that of firm B, with correspondingly more ties. Firm B has three project teams. In firm C, instead of having project teams, eight programs revolve around innovation. However, the network degree or average number of ties sent out by employees in both firms is similar (for IG, 2.28 vs. 2.44). The larger network size in firm C accounts for the lower value of density (0.01 vs. 0.05). Across the firms' networks, the similarity between the statistics implies that, despite the different sizes, these firms' IG and IR

networks are comparable in many respects. A non-response analysis (not shown here) was carried out to ascertain if there were specific differences between respondents and non-respondents, and no such differences were found.

Looking at the values of trust variables, the levels of trust propensity and trustworthiness across the firms are very similar. Overall, there are no significant differences in the perceived trustworthiness of alters for IG and IR, but significantly less disclosure occurring in the incremental-innovation environment of firm B as opposed to the innovation-biased firm C. The demographics of both firms are also quite similar, except that the employees in firm B on average have longer tenures than those in firm C. This pattern of similarity is also observed in the network attributes, across firms and across networks.

Table 5-1: Descriptive statistics for relevant variables in tie formation of IG and IR ties.

| Category | Variable | Firm B Mean | S.D. | Firm C Mean | S.D. |
|---|---|---|---|---|---|
| Respondents | - | 21 | - | 148 | - |
| Network size | IG | 43 | - | 337 | - |
| | IR | 33 | - | 237 | - |
| | Male | 42 | - | 269 | - |
| | Female | 1 | - | 56 | - |
| No. of dyads | N, IG | 89 | - | 695 | - |
| | N, IR | 46 | - | 390 | - |
| | Disclosure | 3.47 | 2.06 | 5.44 | 1.49 |
| Demographic | Project Teams | 3 | - | 8 | - |
| | Office location | 2 | - | 13 | - |
| | Seniority | n/a | - | 4.26 | 1.15 |
| | Tenure | 5.53 | 1.53 | 3.70 | 1.81 |
| | Same project team | 0.46 | - | 0.16 | - |
| | Same office location | 0.24 | - | 0.12 | - |
| | Availability | 5.53 | 1.53 | 5.20 | 1.09 |
| Tie Strength | Perceived Closeness | 5.29 | 1.67 | 5.18 | 1.47 |
| | Contact frequency | 5.01 | 1.66 | 5.11 | 1.58 |
| Network Attributes | Avg. Degree IG | 2.28 | - | 2.44 | - |
| | Avg. Degree IR | 1.47 | | 1.29 | |
| | Density IG | 0.05 | - | 0.01 | - |
| | Density IR | 0.02 | | 0.00 | |
| | Closure IG | 0.31 | - | 0.23 | - |
| | Closure IR | | | | |
| | Avg. Distance IG | 2.39 | 1.36 | 5.64 | 2.50 |
| | Avg. Distance IR | 1.62 | 0.67 | 3.58 | 1.74 |

*5.4.2 Testing hypotheses 1a-1c*

First, I focus on the impact of Perceived Trustworthiness on tie formation. Table 5-2 shows results of MRQAP regressions on all firms' IG and IR networks. Model 1 introduced the demographic control variables of project team membership, office co-location, tenure and seniority. Model 1a added the control variables of availability, perceived closeness and trust propensity to Model 1 in order to ascertain the impact of control variables typically used in network studies to tap relational factors. In Model 2, elements of trust and trustworthiness were added to explore the impact of trust as a predictor beyond the control variables. Focusing on Hypothesis 1a, Ability was found to be a significant positive predictor of tie formation across both firms' IG and IR networks. Similarly, Benevolence was also significant in the IG and IR networks of both firms, providing full support for Hypothesis 1b. Integrity was only a significant predictor of tie formation in IG networks of Firm C, providing partial support for Hypothesis 1c.

Looking at the adjusted r-squared values across the firms, there was considerable variance in tie formation accounted for by the control and trustworthiness variables. In Firm B, 9% of the variance in the IG network and 8% of the variance in the IR network are accounted for by the controls. Only an additional 7% and 1% for the IG and IR networks respectively are added through the inclusion of the trustworthiness factors. Most of the variance in firm B is thus from Availability, and trust elements add little significance beyond. In contrast, for Firm C, the control variables account for only 18% of the variance, with the trustworthiness variables accounting for an additional 64%. In its IR network, the trustworthiness variables account for an additional 14% above and beyond the 24% predicted by the control variables. Compared to firm B, trust accounts for a far more significant portion of the observed variance. Note that the beta weights reported in MRQAP are not comparable to typical regression coefficients obtained through normal OLS regression. So while the reported significance of the variables is useful, the beta weights are not.

Although not hypothesised, I examined the effect of the trust variables of Reliance and Disclosure on IG and IR tie formation. Model 3 shows the results of the MRQAP runs. These results show that Disclosure was only significantly associated with firm B's IG tie formation, and Reliance was only significantly associated with firm B's IR tie formation. The lack of consistency in the findings shows that in these firms, Reliance and Disclosure were both not associated with ties for innovation. This is further supported by the fact that Reliance and Disclosure do not account for any significant variance in the networks tested.

Table 5-2: MRQAP regression for trust elements on IG and IR networks across firms B and C.

| IG network | FIRM B | | | | FIRM C | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 1a | Model 2 | Model 3 | Model 1 | Model 1a | Model 2 | Model 3 |
| *Controls* | | | | | | | | |
| Project Team | .06* | -.12 | -.20* | -.19 | .11** | .62** | .04 | .02 |
| Location | .09** | -.27** | -.25* | -.24* | .10** | .20** | .02 | .00 |
| Seniority | .04 | -.08 | -.01 | -.01 | .02** | -.10** | -.10** | -.10** |
| Tenure | n/a | n/a | n/a | n/a | .01** | .05 | -.01 | -.00 |
| *Relational factors* | | | | | | | | |
| Availability | - | .16 | .23* | .27* | - | .00 | -.12** | -.09** |
| Closeness | - | .18 | .16 | .13 | - | .00 | .02 | .02 |
| Trust Propensity | - | .10 | .04 | .05 | - | .04 | .00 | -.00 |
| *Trustworthiness* | | | | | | | | |
| Ability | - | - | .23* | .05** | - | - | .10** | .10** |
| Benevolence | - | - | .06* | .01* | - | - | .17* | .13* |
| Integrity | - | - | .32 | .35 | - | - | .61** | .55** |
| *Trust* | | | | | | | | |
| Disclosure | - | - | - | -.36* | - | - | - | -.02 |
| Reliance | - | - | - | .02 | - | - | - | .13 |
| Adj R-Squared | .01 | .09 | .16 | .16 | .03 | .18 | .82 | .82 |
| **IR network** | | | | | | | | |
| | | | | | | | | |
| *Controls* | | | | | | | | |
| Project Team | .06* | .07 | .03 | .12 | .08** | .32** | .19* | .14 |
| Location | .09** | .16 | .18 | .23* | .07** | .12 | .11 | .05 |
| Seniority | .04 | -.03 | -.07 | -.06 | .03** | .22** | .23** | .22** |
| Tenure | n/a | n/a | n/a | n/a | .01** | .04 | .02 | .03 |
| *Relational factors* | | | | | | | | |
| Availability | - | -.21* | -.16 | -.15 | - | -.10 | -.11* | -.04 |
| Closeness | - | .23* | .13 | -.07 | - | .16** | .15** | .16** |
| Trust Propensity | - | -.16 | -.12 | -.05 | - | -.07 | -.05 | -.05 |
| *Trustworthiness* | | | | | | | | |
| Ability | - | - | .02* | .32* | - | - | .19** | .20** |
| Benevolence | - | - | .25* | .23* | - | - | .47** | .36 |
| Integrity | - | - | -.01 | .03 | - | - | -.18 | -.35 |
| *Trust* | | | | | | | | |
| Disclosure | - | - | - | -.26 | - | - | - | -.01 |
| Reliance | - | - | - | .31** | - | - | - | .40 |
| Adj R-Squared | .01 | .08 | .09 | .13 | .02 | .25 | .37 | .38 |

*p<.05, **p<.01; based on 2000 permutations

Overall, the trustworthiness variables add considerably more variance to the prediction of tie formation, beyond the control variables, in the larger R&D organisation that focused on radical, rather than incremental innovation. The larger organisation is seen to offer a much more expansive pool of potential ties, and placed greater importance on innovation for career progression and security, compared to the smaller firm. The radical nature of innovation in this

organisation meant that novel ideas and solutions were particularly valuable, reinforcing the need for trust during generation and implementation.

### 5.4.3 Moderation analyses to test hypotheses 2-3

To test for hypotheses 2 and 3 relating to the moderating effect of Benevolence and Integrity on the relationship between Ability and tie formation, LRQAP analyses were conducted (see section 4.4.2 for explanation). This was done to obtain accurate regression coefficients that MRQAP could not provide.

Testing for hypotheses 2 and 3 on the moderating effect of Benevolence and Integrity required the identification of ties linked to low and high levels of trustworthiness. For this purpose, low and high Benevolence ties are characterised by ties established with alters whose Benevolence score correspond to the 'Disagree' or the 'Agree' portion of the survey scale respectively. Scores of 1 to 3 on the Likert scale correspond to low Benevolence, and 5 to 7 corresponds to high. The problem arises when the neutral point on the Likert scale does not define a clear threshold. The middle point can be defined as either on the high or the low value subset of ties, because it can be reasonably defined both as perception of lack of rewards or lack of punishment (Gray, 1994). Given the probability that the proportion of negative perceptions in most empirical data is only 1 to 8% of the distribution of ties in organisations (Labianca & Brass, 2006; Labianca et al., 1998), choosing this threshold may not be advisable due to conceptual and methodological issues. Conceptually, it may be problematic for a few unpopular yet skilled individuals to not be in the loop when employees seek out IG or IR resources.

Applying this boundary condition to the original network creates low and high Benevolence matrices. This approach allows the establishment and exploration of boundaries of low and high Benevolence, which potentially include some positive affective elements. Inclusion of neutral and mild scores can imply that being perceived to be benevolent is not enough for an alter's Ability to be appreciated. Instead, being perceived to be benevolent is essential for consideration in IG and IR stages, that is, it is a necessary but incomplete condition for tie formation. I first calculated the cumulative distribution of the raw survey scores for each of the points on the Likert scale used (1 through 7) for the relevant trustworthiness dimensions. The cumulative distributions of low and high Benevolence and Integrity ties (not shown here) are in line with existing empirical findings (Gersick et al., 2000; Labianca & Brass, 2006; Labianca et al., 1998). From a methodological perspective, a small number of negative observations might reduce statistical power. For these reasons, the number of low Benevolence ties includes the negative and the neutral responses in the gathered data, similar to the approach used by

Casciaro and Lobo (2008). Based on this, I specified response 4 on the scale to correspond with the low Benevolence and low Integrity tie matrix.

Table 5-3 presents the logit regression coefficient results for the LRQAP correlation of low and high Benevolence networks of all firms, regressed onto Ability. To test for moderation effects of Benevolence on tie formation due to Ability, high and low Benevolence effects are included as Models 4H and 4L respectively, but controlling for Integrity.

The results show that across all firms and both stages of the innovation process, Benevolence moderates the relationship between perceived Ability and tie formation. When Benevolence is low, the LRQAP coefficient for ability is close to zero and insignificant, indicating that increases in the perceived Ability of an alter will have virtually no impact on tie formation. In contrast, when Benevolence is high, increases in perceived Ability translate significantly into the likelihood of the alter being sought after for IG and IR. A graphical depiction of the moderation effect of Benevolence on the relationship between Ability and Tie Formation for firm B is shown in Figure 5-2 and Figure 5-3. Collectively these support Hypothesis 2.

Table 5-3: The moderating effect of Benevolence on the relationship between Ability and Tie Formation.

| Ability | Firm B | | Firm C | |
|---|---|---|---|---|
| | IG | IR | IG | IR |
| Model 4L: Low Benevolence | .00 | .02 | .02* | .00 |
| Model 4H: High Benevolence | .24* | .38** | .22* | .28** |
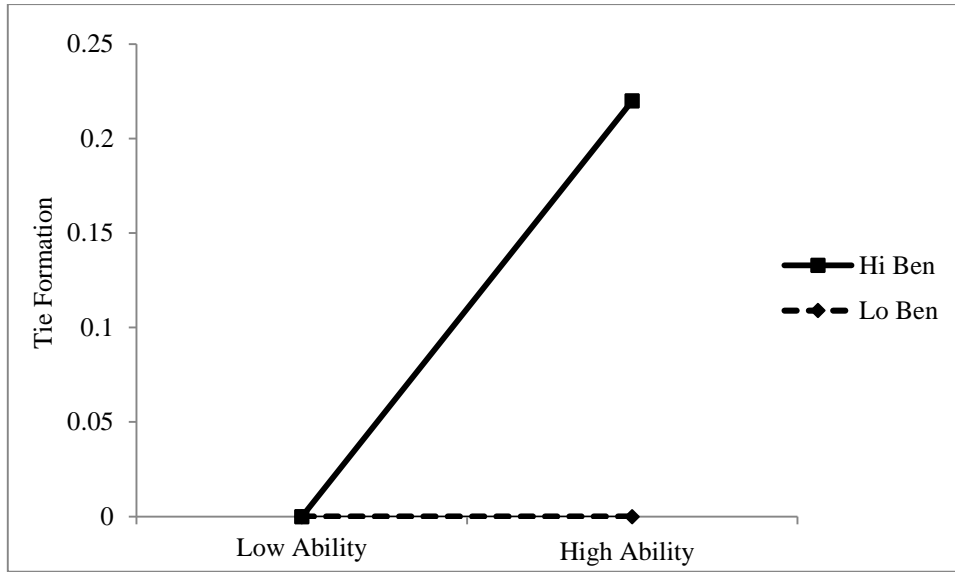
Figure 5-2: Graphical depiction of the moderation effect of Benevolence on the relationship between Ability and Tie Formation in IG networks (Firm C).
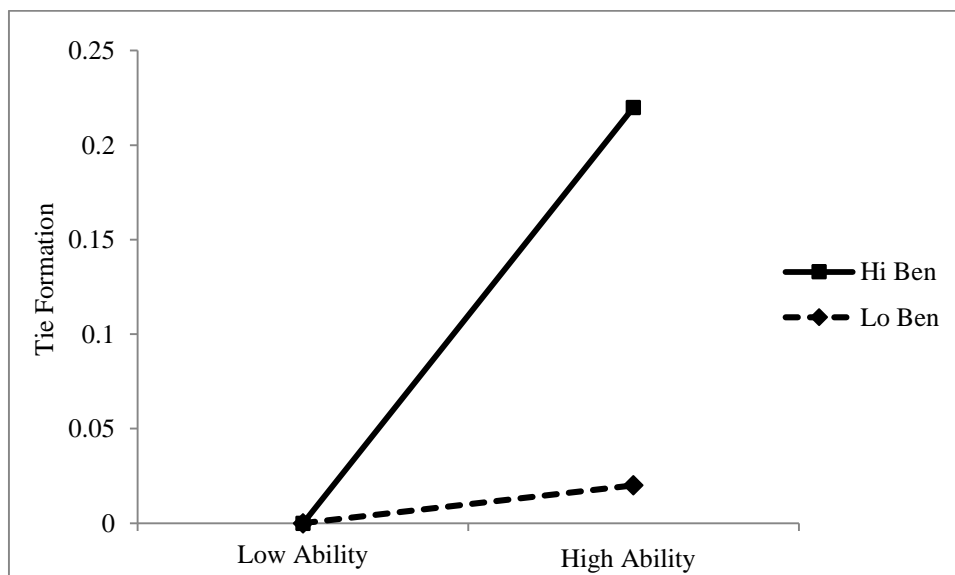


Figure 5-3: Graphical depiction of the moderation effect of Benevolence on the relationship between Ability and Tie Formation in IR networks (Firm C).

Table 5-4 presents results to the analyses testing the moderation effect of Integrity on the relationship between Ability and tie formation. Similar to models 4L and 4H, to test for the moderation effect of Benevolence on tie formation due to Integrity, the high and low Benevolence effect models are Models 5H and 5L respectively.

In both the IG and IR networks of firm B, the regression coefficients are consistently negative and significant at low levels of Integrity. Only the IR network coefficient is significant at high

levels of Integrity. For firm C, at low levels of Integrity, the coefficients are zero and non-significant, but the IR network coefficient is significant at high levels of Integrity. This indicates that when the alter is perceived as having low Integrity, tie formation is *less* likely the more competent the alter is perceived to be, or not at all. For firm C, the moderation effect is only significant for its IR network. Taken together, this suggests that Integrity does moderate the relationship between Ability and tie formation, as hypothesised. Hence, the results partially support Hypothesis 3.

Table 5-4: The moderating effect of Integrity on the relationship between Ability and Tie Formation.

| Ability | Firm B | | Firm C | |
|---|---|---|---|---|
| | IG | IR | IG | IR |
| Model 5L: Low Integrity | -.79** | -.37** | 0 | 0 |
| Model 5H: High Integrity | -.15 | .37* | -.01* | .06** |

### 5.4.4 Hypotheses 4a-d: SMA and SMP

The results presented in Table 5-5 shows a differential effect of SMA and SMP on IG and IR tie formation. To test for hypotheses 4a-4d, model 6, which is model 1a plus the variables of SMA and SMP, was used in this part of the MRQAP analysis.

The results show that in IG networks, SMA and SMP are not significantly associated with tie formation. However, in line with hypotheses 4c and 4d, SMA was significantly associated with IR tie formation in firm C, and SMP was significantly associated with tie formation in IR networks of both firms B and C (p<.01). Overall, these results provide no support for hypotheses 4a and 4b, partial support for hypothesis 4c, and full support for hypothesis 4d.

These results suggest there is a differential effect of SMA and SMP across IG and IR networks. The dissimilar but associated challenges faced by employees tackling IG and IR seem to make high self-monitors more popular in IR as opposed to IG. Of note is also the fact that self-monitoring accounts for a larger variance in IR networks as opposed to IG networks. Both SMA and SMP account for only 2-3% of the variance across firms' IG networks, but 6-9% of the variance across IR networks. The pattern of variance addition by elements of self-monitoring is consistent across the firms' IG and IR networks. The conclusion here is that unlike trust, the impact of self-monitoring is unaffected by firm size.

Table 5-5: MRQAP Regression for SMA and SMP on IG and IR networks across firms B and C.

| IG network | FIRM B | | FIRM C | |
|---|---|---|---|---|
| | Model 1a | Model 6 | Model 1a | Model 6 |
| *Controls* | | | | |
| Project Team | -.12 | .02 | .62** | .72** |
| Location | -.27** | -.35* | .20** | .09 |
| Seniority | -.08 | -.10 | .01 | -.08 |
| Tenure | n/a | - | -.09** | .08 |
| Availability | .16 | .14 | .00 | -.01 |
| Closeness | .18 | .07 | .04 | -.08 |
| Trust Propensity | .10 | .13 | .00 | .05 |
| *Self-monitoring* | | | | |
| SMA | - | .07 | - | .08 |
| SMP | - | -.07 | - | -.03 |
| Adj R-Squared | .09 | .12 | .18 | .27 |
| **IR network** | | | | |
| *Controls* | | | | |
| Project Team | .07 | .16 | .32** | .42** |
| Location | .16 | .23 | .12 | .04 |
| Seniority | -.03 | -.09 | .21** | .17* |
| Tenure | n/a | - | .04 | .08 |
| Availability | -.21* | -.25 | -.09 | -.04 |
| Closeness | .24* | .26* | .07 | .10 |
| Trust Propensity | -.16 | -.22 | .16** | -.17** |
| *Self-monitoring* | | | | |
| SMA | - | -.01 | - | .17* |
| SMP | - | .11* | - | .10** |
| Adj R-Squared | .08 | .10 | .25 | .31 |

*p<.05, **p<.01; based on 2000 permutations

Table 5-6 summarises these findings. The results give full support to hypotheses 1a-1b, and partial support to hypothesis 1c. Ability and Benevolence, and to a lesser extent, Integrity, are positively associated with tie formation. The results also fully support hypothesis 2, that Benevolence moderates the relationship between Ability and tie formation. When Benevolence is high instead of low, the relationship between Ability and tie formation is stronger. Hypothesis 3 is partially supported, in that Integrity moderates the relationship between Ability and tie formation. When Integrity is high in IR networks, the relationship between Ability and tie formation is stronger. When Integrity is low, the relationship between Ability and tie formation is either weaker or non-existent. More importantly, in firm B, when Integrity is low, Ability is *negatively* associated with tie formation. The results partially support hypothesis 4c, and fully support hypothesis 4d that ego SMA and SMP scores predicts tie formation in IR networks. The discussions from these findings will be detailed in Chapter 7.

Table 5-6: Summary of hypotheses and findings.

| Hypothesis | Support |
|---|---|
| H1a: Perceptions of alters' Ability will be positively associated with tie formation in innovation networks. | Full |
| H1b: Perceptions of alters' Benevolence will be positively associated with tie formation in IG and IR networks. | Full |
| H1c: Perceptions of alters' Integrity will be positively associated with tie formation in IG and IR networks. | Limited |
| H2: The association between alter's perceived Ability and tie formation is moderated by Benevolence such that the relationship between Ability and tie formation is stronger when Benevolence is high, and weaker when Benevolence is low. | Full |
| H3: The association between alter's perceived Ability and tie formation is moderated by Integrity such that the relationship between Ability and tie formation is stronger when Integrity is high, and weaker when Integrity is low. | Partial |
| H4a: An ego's score of Acquisitive self-monitoring will be positively associated with tie formation in IG networks. | None |
| H4b: An ego's score of Protective self-monitoring will be positively associated with tie formation in IG networks. | None |
| H4c: An ego's score of Acquisitive self-monitoring will be positively associated with tie formation in IR networks. | Partial |
| H4d: An ego's score of Protective self-monitoring will be positively associated with tie formation in IR networks. | Full |

## 5.5 Summary

This chapter discussed the hypotheses and analyses related to RQ1 and RQ3 of this research, that is, how does the perceived trustworthiness of other actors, and ego personality variables, influence employee choice of ties in IG and IR networks. Each hypothesis and justification was described, starting with the influence of trustworthiness on tie formation in innovation, followed by the moderating effect of Benevolence and Integrity, and finally the impact of SMA and SMP on IG and IR network tie formation. Results of the corresponding QAP regressions were then reported, the statistical significance discussed, and empirical support for the hypotheses explained. Overall, Ability, Benevolence and Integrity are found to predict the formation of IG and IR ties, SMA and SMP predict tie formation in IR but not IG networks,

and Benevolence and Integrity both moderates the impact that Ability has on tie formation across the innovation networks.

The next chapter discusses RQ2, that is, is there a network structure in innovation that is linked to trust. The discussion is centred on a special type of network structure posited to be related to trust: Simmelian ties. Specifically, it looks at Simmelian ties as a network structure that can boost trust levels between employees.

## CHAPTER 6   Simmelian Ties: Triadic Network Structure and Trust

### 6.1   Introduction

Trust is imperative for innovation because there are significant challenges and risks associated with the generation and realisation of novel ideas. Kleinknecht (1989) suggested that these risks include lack of funding, meeting market demands, cost escalation, high perceived costs of novel ideas, lack of skills and lack of information on innovation policies that can stunt a project. Other risks include idea theft, failure to implement plans, failure to meet deadlines, and poor idea selection and refinement that can lead to lacklustre products. Many of these risks are related to unforeseen circumstances, that is, uncertainties. Uncertainties create issues in task execution, but their adverse impact on project progress can be somewhat alleviated with trust. While it has been suggested that trust can be engendered by network structures (Uzzi, 1996, 1997), current research has not empirically ascertained what these structures are.

Chapter 3 discussed the idea that certain types of structures, specifically triads, help develop trust. Wong and Boh (2010) showed how network structures of focal managers significantly impact on their reputation. Explicitly, the managers' network attributes such as network heterogeneity, non-overlapping contacts, and network density play important roles in enhancing the manager's peer reputation for trustworthiness. Studies specifically on triadic structures (Obstfeld, 2005; Uzzi, 1996) have also shown how third parties can become advocates who communicate information about a focal actor, influencing the actor's reputation. This is achieved through transmitting information about the focal actor's past behaviour, records, accomplishments and traits. Should it be transmitted by a party that is already perceived to be trustworthy, trust transference is expected to occur (Ferrin et al., 2006) and reinforce the levels of trust between the embedded dyads within the communication network (Uzzi, 1996).

Research has also shown that structures alone cannot explain concepts that were previously thought to generate innovation. Tortoriello and Krackhardt (2010) challenged the accepted view that bridging ties between domains is central to bringing about innovations. Their central argument was that although a wide breadth of knowledge is essential for generating ideas, the differences between domains creates barriers that boundary spanning individuals need to overcome (Tushman & Scanlan, 1981b). Research by Tortoriello and Krackhardt (2010) on 276 R&D scientists and engineers

found that the impetus for innovation is very much dependent on whether those boundary spanning ties were Simmelian ties. In short, the advantages usually associated with bridging ties in generating innovations are dependent on whether the bridging ties are Simmelian ties.

So what is unique about Simmelian ties? Tortoriello and Krackhardt (2010) pointed out that, "not all bridging ties are equal with regard to their innovative potential... depends on the microstructural context in which they are embedded...the existence of common third-party ties around a focal bridge substantially changes the nature of the bridging relationship through which knowledge flows" (p. 168). The embeddedness and transparency that such structures allow enable the actors involved to facilitate common understanding and norms, reduce miscommunication and carry out coordinated action to tackle tasks. Tortoriello and Krackhardt (2010) also posited that open communication channels allow for the transmission of reputation within such networks, but stopped short of discussing trust development mechanisms in such triads.

This chapter examines the relationship between Simmelian ties and trust, and answers the second research question, "Is there a specific trust-linked network structure at play in innovation networks?" This chapter lays out hypotheses in support of the assertion that Simmelian ties are strongly associated with trust. Currently, there has been no empirical work that supports the assertion that they are linked. While trust in networks has been studied (e.g., Burt & Knez, 1995; Ferrin et al., 2006), the network strongly associated with it has not. The approach used to analyse the data was explained in Chapter 4 of this thesis. Arguments in support of these hypotheses, and how these arguments contribute to our body of knowledge on social networks and trust literature are discussed in the next sections.

### 6.1.1 Simmelian ties

Simmel (1950) proposed that a triadic network configuration that consists of three actors, with each actor having ties with the other two, are qualitatively unique. Dyads embedded in such triads are fundamentally different from non-embedded dyads due to quality, dynamics and stability granted by the presence of the third party. Krackhardt (1999) expanded on this and defined a Simmelian tie as a triadic network configuration with three actors who are reciprocally tied to one another. This has been a motivation for research looking into characterising these differences (Krackhardt, 1999; Tortoriello & Krackhardt, 2010).

Simmelian ties differ from other triads in that for non-Simmelian ties, at least one embedded dyad has asymmetrical ties. Collectively, connected triads can be one of three mutually exclusive and exhaustive types: (a) a Simmelian tie; (b) an asymmetric tie, where ties are not reciprocated, and (c) a sole-symmetric tie, where a reciprocated tie exists at least between one or two dyads within (p. 186). Triad type (a) is a the only closed, fully-reciprocal triadic structure. Figure 6-1 depicts these triads and the embedded dyads.
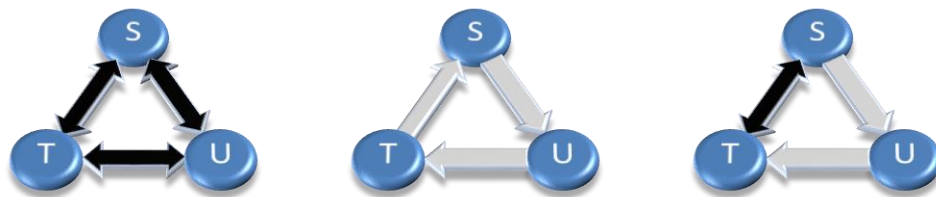


Figure 6-1: Diagram showing (left) a Simmelian tie, (middle) an asymmetric tie between all three actors, and (right) a sole-symmetric tie between S and T with asymmetric ties between S and U, and between U and T.

### 6.1.2 Characteristics of dyads in Simmelian ties

The presence of the third person or *tertius iungens* (Obstfeld, 2005) in a Simmelian tie alone does not make it unique. The reciprocal ties between all three within it, does. An echo chamber effect due to the reciprocal triadic structure allows a focal actor to compare his or her observations of an alter with the feedback from the other, learn about the alter, and work interdependently towards their common goal. Additionally, this also increases the level of agreement and solidarity between all actors. Krackhardt and Kilduff (2002) found that Simmelian tied dyads, relative to all dyads in general, reach higher agreement concerning network tie formations and embeddedness in organisations. This agreement leads to a governing influence. Consequently this makes actors behave non-opportunistically, and raises the levels of trustworthiness. As an example, an opportunistic employee might misuse trust at every opportunity in one-off transactions (Burt, 1999), but might be less inclined to do so if the relationship is longer lasting, and where reputational effects are in play. Repeating similar opportunistic behaviour within the same networks will increase the probability of the said actor being 'found out', unless the actor dissolves existing ties and creates ties with new actors. Embedded ties in such

triadic structures thus reduce the possibility of opportunistic behaviour (Uzzi, 1997).

A change in or adoption of social behaviour may require redundant exposure from multiple contacts that provide the necessary reinforcement. Redundancy thus brings benefits, and triads provide platforms for this purpose. Krackhardt and Kilduff (2002) found that Simmelian tied dyads, relative to all dyads in general, reach higher agreement concerning network tie formations and embeddedness in organisations. Similarly, in an experimental internet study, Centola (2010) found that adoption and solidarity were more likely when participants received "redundant" encouragement from multiple ties. In addition to fostering behavioural change, redundant ties also provide credibility or verification of information and make one less dependent on single sources of information or other sources (Brass, 2011; Krackhardt & Kilduff, 2002). While strong ties and highly-dense networks may provide good proxies for redundant ties, friends and disconnected contacts may provide the same redundant information. Brass and Halgin (2012) proposed a focus on redundant content (what flows through the connections) in place of or in addition to redundant positions in the network. While everyone needs to know a doctor or a car mechanic, we often find that having a redundant backup doctor or car mechanic to provide a second opinion is useful. Rather than avoiding redundancy, embracing it may represent an additional resource that can lead to success.

For trust to be established and built upon, stability is essential. Trust is built on motives of tie formation (van de Bunt et al., 2005) that give structure and meaning to the ties; hence, networks are formed. In a recent review of innovation processes, Garud et al. (2013) described how novel ideas that have gestated for some time can shock the innovation system when they appear (p. 5). The process that follows that gestation is actually quite complex, going down many research paths and obstacles. There are participant dynamics on top of this, which further convolute the whole process. As such instability and dynamics limit the ability of trust to grow and thrive. A network structure that allows for some semblance of stability is therefore advantageous for managing trust relations.

Additionally, the presence of the third actor within Simmelian triads provides an indirect information channel to and from an alter. Perceptions of trustworthiness of others increases when the ability to learn through observations and gaining secondary feedback on an alter increases, as well as when employees understand well and support the interdependency between their roles and tasks.

Triads are also said to bring a fundamental difference in the way actors communicate within an innovation network. Tortoriello and Krackhardt (2010) argued that the presence of Simmelian ties will change the nature of the bridging relationship. This is due to the way such ties are made up of common third-party ties around a focal bridge between two domains (p. 168). Specifically, the presence of boundary spanners embedded within Simmelian ties combines the advantages of bridging access to novel knowledge with highly stable, very cohesive and coordinated action. They theorised that triadic bridging relations facilitate formation of common knowledge and shared meanings, promote cooperation and coordinate action required to integrate the diverse sources of knowledge prevalent in innovation processes. In such triadic relations, actors learn one another's roles and will share their tasks, ideas, issues, problems and solutions, as well as resources and effort. Such sharing help boost security, especially in a Simmelian tie through the three mechanisms defined previously. These shared relations also help to align the actors' objectives and clarify perspectives of one another, allowing for a deeper understanding of the others' idiosyncrasies, nuances and personality (Buskens, 2003; Buskens & Raub, 2002). When alignment has taken place, actors can then make the right decisions on who, when and how to effectively trust others because they are able to form the right perceptions of other actors' Ability, Benevolence and Integrity. In other words, it allows actors to manage uncertainties and risks.

According to Krackhardt (1999), switching from a basic dyad to a reciprocal triad (a Simmelian tie) qualitatively changes the characteristics of the embedded dyads in three major ways. Figure 6-2 shows these three mechanisms diagrammatically.
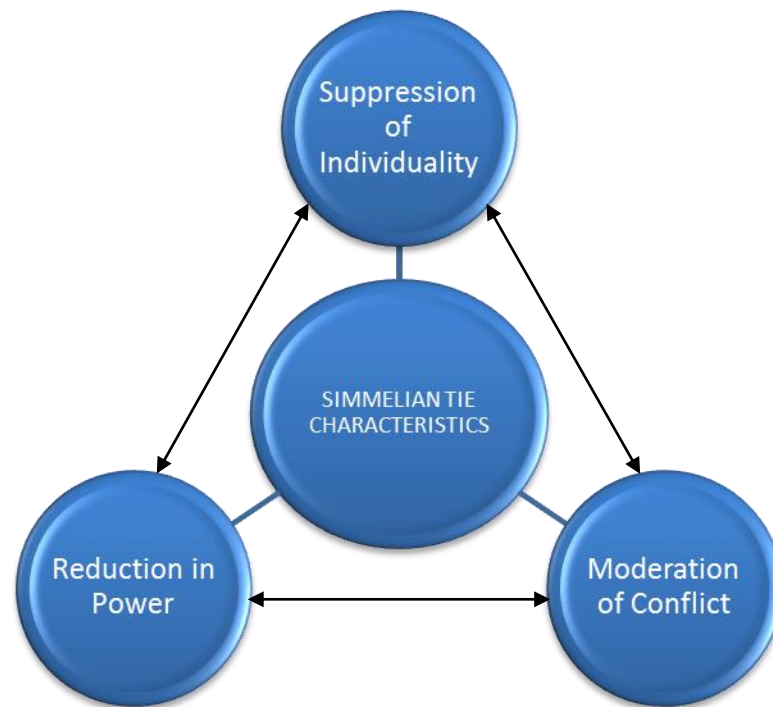
Figure 6-2: Mechanisms of Simmelian ties

Firstly, Simmelian ties *reduce individuality in the embedded dyads*. In disconnected dyads, the individuality of the actors is preserved. In triads, a majority can be mustered to outvote any particular individual, forcing upon members some level of conformity and solidarity. This effectively suppresses the individual's desires in preference for the greater good of the group.

Secondly, Simmelian ties *reduce the power* of actors. Actors in a dyad have considerably more power than those in a triad, as in a transaction, an actor in a dyad can threaten to dissolve the tie if demands are not met, and force the alter to consider calling the other's bluff or to capitulate. However, in a triad, actors who carry out such threats will be left isolated and leave the remaining dyad to console and carry on operations with each other. This is supported by the findings of Berardo and Scholz (2010) that showed how actors involved in decisions on estuary watershed policies opt for transitive, reciprocal relationships when dealing with high risk scenarios due to the probability that other parties will defect from an earlier agreement. Berardo and Scholz (2010) suggested that triadic ties such as these provide 'bridging social capital' as well as 'bonding social capital' (Burt, 2005). The former is associated with IG, as it facilitates the search function of suitable partners, while the latter is associated with IR, as it "can ease the difficult negotiations and reduce the need for costly enforcement mechanisms involved in ensuring the success of collaborative efforts" (Berardo & Scholz, 2010, p. 643). Thus

effective reduction in power of an actor may reduce the probability of an actor carrying out threats, as well as simultaneously raising the levels of perceived trustworthiness within the Simmelian tie.

Thirdly, in a conflict, Simmelian ties *moderate the stance* of conflicting actors. In dyads, actors tend to take harder stances over time that can create tense situations that escalate. As for triads, the presence of the third party can moderate the positions taken by the feuding parties. This is accomplished by the third party taking a neutral stance when presenting the position of one feuding side to the other. Simmel (1950, p. 145) pointed out that, "The appearance of a third party indicates transition, conciliation, and abandonment of absolute contrast". The mere presence of the third party can also dissuade the arguing parties from further escalating the feud.

The characteristics listed above contribute to the group's learning and control at the expense of individuality and power. Taken together, Simmelian ties allow for far more effective learning and solidarity to occur. The reciprocal ties among the three actors embedded in the structure makes for open communications. The third actor acts as an echo chamber and redundant contact, allowing for learning and affirmation of that learning. In turn, this allows for the management of risks, allowing actors to safely and confidently carry out tasks, coordinating operations and contributing to the final innovation output. Based on these premises, actors in triads are expected to be less free, more interdependent, and more constrained, but experience more stability compared to actors in dyads (Krackhardt, 1999, p. 185). The next section relates each of the Simmelian tie mechanisms described earlier in framing the hypotheses facilitating trustworthiness reinforcement.

### 6.1.3 Conceptual framework and Hypotheses

For actors embedded in Simmelian ties, I suggest that they will have high perceptions of trustworthiness of their alters, more so than those in other triadic structures. Taking together the findings outlined above (Krackhardt, 1999; Obstfeld, 2005; Tortoriello & Krackhardt, 2010; Wong & Boh, 2010), I posit that when people are in a Simmelian triad, the reciprocity among actors creates open channels of communication. Consequently, this brings about a level of transparency to the actions of everyone involved. The embedded actors are more inclined to behave in a trustworthy manner to maintain the positive reputation that they have earned as well as retain the relationships they have formed. This in turn has a recursive influence on the perceptions of trustworthiness of

alters within the Simmelian triad, giving it the special characteristics and uniqueness that Simmel (1950) postulated. Other triadic structures such as non-symmetrical triads and asymmetrical triads do not have reciprocity between all three members; accordingly, actors in these triads do not enjoy the same advantages that those in Simmelian triads do. I apply these generic ideas from Simmel (1950, pp. 118-169) to the dimensions of trustworthiness, starting with Ability. Perceptions of Ability are developed in conjunction with the mechanisms of Simmelian ties. In *suppression of individuality* moving towards conformity, the actor who has a different opinion knows that he or she will have to bring others towards their point of view. This can be achieved by presenting strong and cohesive arguments supporting the ideas. Doing so gives the perception to the others that the actor knows the subject matter. In the moderation of conflict, two disagreeing parties will require the third actor to become a mediator if they want to make some headway past a stalemate. A skilled mediator will be able to leverage on his or her presentation skills, choosing to use words and taking stances that gets across his or her argument in a non-partisan way. In power reduction scenarios during threats from one actor, the other two will have to rely on each other's abilities to make up for any adverse impact, which can include reduction in resources and capabilities. Reliance allows each actor to accurately gauge the alter's Ability.

Benevolence is the second important element that develops within Simmelian ties. Following the argument in support of Ability's role, Benevolence helps lubricate the relationship mechanisms in Simmelian ties. In suppression of individuality, the focal person who has a novel idea will naturally feel pressured to either accept the consensus, or convince at least one of the triad members to buy into the idea. The focal person will approach the alters perceived to be benevolent, i.e. to have care and concern for the focal person. In moderation of conflict, within the triad, the mediator will be motivated to represent the interests of the other two actors fairly, since everyone's actions are apparent for all to see, and any biasness or opportunistic behaviour will be observed. Thus, the mediator will act benevolently towards the other actors. Being perceived to be benevolent by the other two actors further strengthens perceptions of trustworthiness. In power reduction, during threats of withdrawal by one actor, the remaining actors will have to depend on each other for backup in case the threat is carried out. This acts as an incentive for them to develop deeper mutual Benevolence. Through the reciprocal ties, the focal actor will be able to better hone his or her perceptions of this Benevolence.

What of Integrity? This element describes those who deliver on promises while playing roles in the distinct mechanisms described above. It also describes those who maintain commonly accepted principles, standards and values. During suppression of individuality, the actors in the triads are expected to reach a consensus. This behoves all parties to adhere to the mutually-agreed policies and plans. As any digression from those plans will probably be picked up by the others due to the reciprocal relations that facilitate solidarity, and acts as a deterrent against opportunistic behaviour. In moderation of conflict, the mediating actor is expected to represent the other actors' interests fairly. This entails fair and responsible representation that meets expectations. The mediator is less inclined to act without Integrity, so will not be dishonest during the arbitration. The fact that the parties in dispute still maintain reciprocal ties implies that any digression from these expectations might be picked up quickly, as opposed to brokers who bridge separate parties in dispute. In power reduction, when threatened by one actor, actors in the remaining dyad will support each other and do their best to deliver on promises, because failure will lead to mutual loss. The reciprocal ties between all three actors allows all parties to apprise their alters' level of Integrity, acting as an incentive for actors to act according to mutually-agreeable guidelines.

The arguments presented before the hypotheses highlight the reasons why Simmelian ties are associated with high perceived trustworthiness levels. They describe the mechanisms by which trustworthiness of actors within these special types of triads come into being and develop. Within the mechanisms described, the reciprocal ties act as a deterrent against actors failing to bring skills (Ability) to the table, behaving with Benevolence towards the alters, or acting with honesty and Integrity in their interactions. Although this research does not capture the evolution of these ties, it does capture the instant in which these ties are present. The assumption here, then, is these ties and the associated levels of trust are time-dependent (Blumberg et al., 2012, p. 66), and a history of communication must have occurred for these ties to have come into being and remain stable. As such, it is posited that Simmelian ties characterise groups that experience high levels of trust within an organisation.

Thus, this research hypothesises that dyads in Simmelian triads are associated with high levels of perceived trustworthiness between the dyads. It is suggested that this structure drives the mechanisms that are related to the development of perceived trustworthiness. The Simmelian tie allows all parties to coordinate their actions, allowing improved perceptions of Ability. Missing ties or non-reciprocal ties between actors in a triad

reduces or removes these reinforcing mechanisms. Consequently, these effects are more significant for Simmelian ties, and less so for non-reciprocated ties or for sole-symmetric non-triadic ties. Hence, I predict the following hypotheses:

**H5a: Alters will be perceived as higher in Ability in Simmelian than non-Simmelian ties.**

**H5b: Alters will be perceived as higher in Benevolence in Simmelian than non-Simmelian ties.**

**H5c: Alters will be perceived as higher in Integrity in Simmelian than non-Simmelian ties.**

### 6.1.4 Analytical approach

This research used data from the same firm C outlined earlier. Firm B was excluded because of the relatively low number of relevant ties meant that meaningful analysis could not be carried out. Testing for the Simmelian tie hypotheses required three main steps (Borgatti et al., 2013, p. 252). These were outlined in the methods chapter, but briefly, the IG and IR networks of the firm were merged, then decomposed into three matrices containing the separate dyadic components of the triads identified (Simmelian ties, Asymmetrical dyads, and Sole-symmetrical dyads). LRQAP regressions were then run on these networks by regressing the control variables and componential dyads onto the perceived trustworthiness dimensions. For full details, please refer to pp. 61-64. Three models were generated: Model 13 tested for the impact of the three different componential dyads against Ability, Model 14 tested for the dyads' impact against Benevolence, and Model 15 tested for the dyads' impact against Integrity. Unconnected triads were not tested in this research as the research scope does not take into account perceptions of trustworthiness between unconnected actors. On a conceptual level, unconnected triads are not expected to be associated with trust, as the disconnect reflects on the lack of perceived trust between actors.

## 6.2   Results

### 6.2.1 Descriptive statistics

To better understand the effect of trustworthiness on tie formation, Table 6-1 shows the relevant descriptive statistics for the main variables related to tie formation. The types and number of each dyadic type show how rare Simmelian ties are within organisations. Dyads embedded in Simmelian triads of firm C's networks comprise 2.5% of total ties.

Levels of Ability, Benevolence, and Integrity hover around 5.5 to 6.0, with very similar standard deviation values. These indicate a relatively similar level of alter trustworthiness across the three dimensions.

Table 6-1: Descriptive variables for Simmelian tie-trust analysis

| | | Firm C | |
|---|---|---|---|
| Category | Variables | Mean | S.D. |
| N | | 349 | n/a |
| No of dyads | IG + IR | 852 | n/a |
| | Simmelian | 22 | n/a |
| | Non-symmetrical | 704 | n/a |
| | Asymmetrical | 126 | n/a |
| Demographic | Programs | 8 | n/a |
| | Office locations | 13 | n/a |
| | Availability | 5.20 | 1.09 |
| | Same project team | 0.16 | - |
| | Same office location | 0.12 | - |
| | Tenure | 3.70 | 1.8 |
| | Seniority | 4.26 | 1.2 |
| Trust | Ability | 6.04 | 1.43 |
| | Benevolence | 5.55 | 1.42 |
| | Integrity | 5.96 | 1.42 |
| Personality Attribute | Trust Propensity | 5.93 | 0.82 |
| Tie Strength | Perceived Closeness | 5.18 | 1.47 |
| | Contact frequency | 5.11 | 1.58 |
| Network attributes | Avg. Degree | 2.44 | - |
| | Density | 0.01 | - |
| | Closure | 0.23 | - |
| | Avg. Distance | 5.64 | 2.50 |

With typical regression methods, a low number of ties is usually problematic. However, the use of logit regression QAP means both the presence *and* absence of ties is important in identifying the impact of these ties on the levels of trustworthiness. I leverage this for my analysis that follows.

### 6.2.2 Controls

The controls for this analysis are as follows: Program Membership, Office Location, Seniority, and Tenure. Briefly, none of the controls were consistently significant in any of the models tested in firm C's network (see Table 6-2).

As a caveat, additional controls such as Availability, Closeness, and Trust Propensity were initially included. Unfortunately, in the version of LRQAP used, the addition of these controls caused the software to crash. This was the inevitable result of the relative

newness of this portion of the software UCINET, which still has certain limitations in terms of computational stability with a large number of variables.

### *6.2.3 Testing the Simmelian-trust hypotheses*

The analysis focused on the relationship between perceived trustworthiness with the type of networks. Table 6-2 shows results of LRQAP regression of firm C's amalgamated IG and IR Simmelian tie and non-Simmelian tie embedded dyadic network structures onto the specific Perceived Trustworthiness dimensions of dyadic alters, namely, Ability, Benevolence and Integrity.

The results show that all dimensions of perceived trustworthiness are predicted by the three triadic structures (p<.05). However, the size of the coefficients associated with Simmelian ties regressed onto Ability, Benevolence and Integrity are distinctively larger than the values for the two non-Simmelian structured networks. As a reminder, the size of the beta weights in LRQAP can take ranges between negative to positive infinity, and can then be interpreted as linear effect size. This can then be compared for different variables. See Chapter 4, pp. 61-63 for an explanation. These results suggest that the odds for the dyads to be associated with higher levels of Ability, Benevolence, and Integrity, respectively are higher when the dyads are embedded in Simmelian ties. Subsequently, these results confirm that alters embedded in Simmelian ties are perceived to have higher levels of trustworthiness compares to those in non-Simmelian ties; as such, it provides full support for Hypotheses 5a-c.

Table 6-2: Regression coefficients of LRQAP variables for firm C regressed onto Ability, Benevolence and Integrity.

| **Innovation network** | Firm C | | |
|---|---|---|---|
| | Model 13 Ability | Model 14 Benevolence | Model 15 Integrity |
| *Controls* | | | |
| Seniority | -.44 | -.02 | -.02 |
| Project Team | 2.30** | 2.47** | 1.40** |
| Office Location | 1.44** | 1.40** | 1.29** |
| Tenure | .02 | .02 | -.05* |
| *Triadic structure* | | | |
| Asymmetrical | .54** | 1.68* | .22* |
| Sole-Symmetrical | .11* | 1.14** | .67* |
| Simmelian | 4.79** | 5.85** | 2.95** |

## 6.3   Summary

This chapter discussed the hypotheses and analyses related to Simmelian ties and how it predicts trustworthiness. The results support the idea that the closed triadic network structures that characterise Simmelian ties promote the formation of trust through the significant correlation between Simmelian ties and Ability, Benevolence, and Integrity.

# CHAPTER 7  Discussions and Conclusions

This chapter discusses the findings, contributions, limitations, and conclusions of this research. The main focus of this thesis is on identifying how trustworthiness influences employees' tie formation choices for innovation, and a network structure that is strongly related to trust. Overall, this research has three main findings: trustworthiness dimensions predict tie formation in innovation networks, Simmelian ties correlates strongly with trustworthiness dimensions, and self-monitoring only influences the formation of IR network ties. The findings and their contribution to theory and management practice are detailed here. This is followed by a review of the limitations of the research. I conclude this chapter with suggestions for future research to deepen our understanding of networks and trust in innovation.

## 7.1  Overall Findings

While trust has been implicitly linked in the extant literature with the effective functioning of social networks, its explicit role in tie formation, and consequently in network structure formation and maintenance, was unclear and unexplored. This research contributes to the literature by extending scholarly understanding of the role that trust elements play in social networks at different stages of the innovation process. Trust was found to play a major role in self-selected networks when members have more choice over their alters instead of being bounded by factors such as hierarchies or chains of command. This is especially pertinent when considering the different phases of the innovation process.

I hypothesised that when employees are able to actively select their alters, dimensions of perceived trustworthiness is significantly linked to these choices. I found empirical support for these hypotheses, confirming that perceived trustworthiness is indeed an overarching construct that determines network formation. All three dimensions of trustworthiness - Ability, Benevolence and Integrity – were found to play a significant role in tie formation for phases of the innovation process. The findings in this research contribute to refining our understanding of trust, social networks, and innovation by showing how Ability, Benevolence, and Integrity are critical to the execution of task-related action in innovation.

Additionally, results from firms B and C showed perceptions of alter's Ability are a necessary but insufficient requirement for tie formation. Benevolence and Integrity were shown to be moderators of the relationship between Ability and tie formation for innovation. Another study-specific finding is the possible role of network size in influencing the importance of trust in supporting tie formation. Trust was shown to account for more variance in the larger firm C compared to firm B.

Furthermore, Simmelian ties were found to be more strongly related to perceived trustworthiness dimensions than other triadic structures. The relationships between self-monitoring and tie formation in innovation processes were also studied here. While these variables have been implicitly linked with social networks in the literature, this research explicitly extends our understanding of the role that these variables play in networks during stages of the innovation process. These findings and their contribution to the literature are detailed in the following sections.

## 7.2    Theoretical and Practical Implications of the Findings

### 7.2.1 Main effects of Perceived Trustworthiness on Tie Formation

This study provides empirical evidence that fully or partially supports the hypothesised relationships on the role of trust in innovation networks. In terms of trust, this research contributes to the literature by clarifying the influence of interpersonal trustworthiness dimensions on innovation-oriented relationships. Perceived trustworthiness is indeed an overarching construct that determines IG and IR network formation. Specifically, Ability, Benevolence, and Integrity are important during both phases of the innovation process. My findings show that project members were consistently more likely to seek information and advice for generating and realising ideas from people they perceived to be *competent* and *benevolent*. The significance of Ability and Benevolence as criteria for selecting a partner for innovation related work generalised across both firms and stages of innovation. In contrast, the perceived Integrity of a potential partner was an important criterion only for idea generation and only in the large research intensive firm.  These dimensions of trustworthiness were significant predictors even after controlling for the influence of partner availability and relationship closeness - relational variables commonly used in social network research as proxies of trust - as well as demographic variables (e.g. co-project membership, co-location and seniority).

A strength of this study is the support found for several of the hypothesised relationships across both innovation networks (IG and IR) and across two separate organisations

operating in different industries. The overall consistency of these findings provides confidence in the robustness of these analyses. In contrast, conclusions from prior research in network literature have been drawn from just a single organisation in a specific industry (e.g., Borgatti & Cross, 2003; Ohly et al., 2010).

It is interesting to note that there are patterns that differentiate the smaller, incremental innovation firm B from the larger, radical innovation firm C. The findings reveal that some relationships are influenced by the context, holding only in one firm or for one stage of the innovation process. Notably, trustworthiness adds considerably more variance to the prediction of tie formation in the large R&D firm that focused on radical innovation (64% for IG; 12% for IR), particularly in its idea generation network, compared to the smaller firm that focused on incremental innovation (between 5-7%). This is suspected due to the fact that the larger firm offered a much more expansive pool of potential ties, and placed greater importance on innovation for career progression and security, compared to the smaller firm. The radical nature of innovation in the larger firm meant that novel ideas and solutions were highly valued and critical for employee career success and status, reinforcing the need for trust during idea generation, and to a lesser extent for idea realisation.

A related finding is that in fairly restricted networks where the choice of alters is limited, as well as in firms carrying out incremental innovation, Benevolence is important but not to the same extent as in firm C. When employees have little choice in term of who they approach for IG, Ability is paramount. Additionally, in firm C where there are more alters available to choose from, Integrity is significantly predictive of IG tie formation. These findings suggest that the main effects of trustworthiness need to be interpreted with moderation or contextual effects in mind.

Two aspects of these findings contribute new knowledge. Firstly, this is the first study to empirically shown that trustworthiness dimensions of Ability, Benevolence, and Integrity are significantly associated with tie formation for IG and IR. These results advance our understanding that perceived trustworthiness is the overarching construct in tie formation during innovation processes.

Secondly, IR networks show an interesting trust dynamic revolving around Integrity that is probably driven by contextual differences. Contrary to hypothesis 1c, Integrity did not significantly predict IR tie formation. This thesis suggests that this was influenced by innovation phase. When employees need to obtain resources to push through novel ideas, only perceptions of alter Ability and Benevolence are important. As for IR, the risks

typically associated with idea theft are lower, and this corresponds with the relative insignificance of Integrity. Consequently, Integrity is less critical in the IR phase of the innovation process. These points to Integrity being differentially associated with tie formation in different phases of the innovation process.

This also explains why Integrity emerged as a significant predictor of tie formation for idea generation in the large firm, but not for IR or the other firm. Because idea generation was so important for career success in the large R&D firm, these employees were more vulnerable to the opportunistic behaviour of their colleagues, making Integrity a critically important criterion when choosing who to work with. More generically, these context-specific findings suggest that the role and importance of trust for tie formation is influenced by firm characteristics, particularly the organisation's position on the incremental-radical innovation spectrum (Gilson & Madjar, 2011; Madjar et al., 2011) and size (potential partner pool) and stage of innovation.

These findings suggest two important practical contributions to the management of trust in innovation networks. Firstly, by building trust between project team members, one may be more likely to be sought after as a collaborator for innovation. Such interaction can enable innovation project teams to discover and consequently gain access to necessary resources for the successful delivery of projects. IG activities require employees to feel that they are able to freely exchange ideas and refine them with the alters they chose without fear of ideas being stolen or ridiculed. IR activities require employees to have access to alters who are able to contribute resources, as well as coordinate and execute tasks in support of the innovation. The easier it is for employees to find trustworthy alters, the easier it is for them to carry out innovation activities. One way this can be achieved is to facilitate the formation of Simmelian ties between employees. Firms can organise get-togethers of innovation project team members in less formal surroundings where mutual understanding can readily develop in formal, reserved atmospheres. Here they are more likely to discuss matters not related to work, build a social connection, and discover other common interests that may help improve their perceptions of each other's trustworthiness.

To enhance social networks for innovation work in project teams, management can carry out activities and training that reinforce employee Benevolence and Integrity in the workplace, in addition to skill and knowledge development. This can be supported by an organizational culture and set of management practices that reinforces trustworthy conduct as a core value and behavioural expectation (see Hurley et al., 2013). Examining

the level and types of trust in the firm's social networks also provides a starting point for diagnosing problems in networks and tailoring interventions. Attempting to align resources in firms through project team formation requires an understanding of the drivers of connections. For example, there might be pockets of disconnected people within the teams who are central to some of the firm's innovative ideas. Without knowing why they are isolated, it is difficult to plan effective interventions in order to speed up the process of utilizing these patents either internally or developing them into marketable products (Chesbrough, 2004; Chesbrough et al., 2006). This research suggests that perceived trustworthiness is one important driver that can be assessed and enhanced to make a specific network thrive. For example, if the problem in a project team is that there is a climate of self-interested behaviour as opposed to benevolence, interventions can be put in place to align interests, develop common goals and support, role model and develop collegial behaviour (Dietz & Gillespie, 2011).

Managers can better deploy resources in support of innovation based on empirical data rather than intuition if they know their firms' levels of collective trust and network health. From a practical perspective, an understanding of how innovation networks and trust develop permits insight into how employees can utilise their human capital during socialisation. These insights will also provide a basis for policies and methods needed to increase the success rates of innovation projects. Facilitating the formation of reciprocal triads to boost trustworthiness perceptions is one example of these methods. Such facilitation can focus on the formation of ties between actors who perceive each other to have high levels of Ability and Benevolence.

Secondly, it is practical and meaningful to measure the trust levels within innovation project team networks. While networks are not always proxies for trust and can be the result of more structured and restrictive conditions, they can be indicators of choke-points and suboptimal information flow paths, and trust can relieve these problems. Tagging trust levels with network ties or email pathways allows management to capture a snapshot of the firm's trust networks. Through observing the dynamics of these structures, managers can qualitatively ascertain if there are any problems in the network. These include identifying isolated employees or inadequate communication channels between critical gatekeepers. For example, very tight clusters with multiple triads may indicate high trust levels that are useful to IR, but not be so useful during IG. Sparse internal networks on the other hand, may be associated with low trust levels between employees. This may require intervention from management to ascertain the cause of the divide.

Conversely, sparse cross-team or organisational networks may indicate strong trust-driven ties, because motives to form heterogenous ties must be over and above homophilous drivers. Management can take advantage of the presence of network brokers, by facilitating similar actors to become additional brokers of networks, or in the case of IG, by turning them into voluntary gatekeepers.

### 7.2.2 On the moderating effect of Benevolence and Integrity

This thesis analysed the moderation effect between dimensions of trustworthiness in the formation of IG and IR ties. To innovate, employees with skills need to be selected in order access their knowledge and skills. Using the same argument of behavioural self-regulation mechanisms used by Casciaro and Lobo (2005, 2008), I hypothesised that Benevolence and Integrity separately moderates the relationship between Ability and tie formation for innovation, and found support for both hypotheses. These results reinforce the idea that interpersonal trust influences employees' choices for tie formation for innovation, and aid understanding of the interplay between Ability and network structures. In terms of trust, this research contributes to this understanding by going beyond interpersonal affect (Casciaro & Lobo, 2005, 2008) to encompass interpersonal trust within innovation-oriented relationships by identifying the trade-offs employees make when choosing who to trust for support to innovate.

Benevolence was found to moderate the relationship between perceived Ability and tie formation for both idea generation and idea realisation, such that Ability only significantly influences tie formation when the alter is perceived to be high in Benevolence. When the person is perceived to be low in Benevolence, Ability is largely irrelevant as a criterion for partner selection. This suggests that when choosing who to seek information and advice for innovation, people first consider whether the other party is benevolent, and then if so, how competent they are. A clear implication is that individuals with high levels of competence will not be sought out if people question whether they genuinely care and have concern for others. Benevolence is thus crucial to opening up relationships that bring in skills and expertise in support of innovation.

An interesting pattern of moderation effects was found for Integrity. When a potential partner was perceived to have high Integrity, their Ability became a relevant criterion for tie formation, but only for idea realisation. When the Integrity of a potential partner was perceived to be low, their competence became either a negative criterion for tie formation (Firm B) or was irrelevant (Firm C). This suggests that in at least some firms, skilled

actors who lack Integrity – that is, the highly competent Machiavellian - are actively avoided for innovation work. These actors might be perceived as opportunists, idea thieves or employees who will not fulfil their promises, thus posing too much risk to the individual and the innovation project. In other firms, the lack of Integrity of a potential partner simply renders their competence irrelevant for tie formation. The overall implication of these findings is that a) highly skilled employees will not be sought out for innovation related work, if they are perceived to lack Integrity, and b) Integrity is pivotal for tapping into people's task-related resources to innovate, but its influence is constrained to the IR phase.

Three aspects of these findings contribute new knowledge to the literature. Firstly, this is the first time the moderation effect of Benevolence and Integrity on the relationship between Ability and tie formation has been empirically shown. This extends the previous work of Casciaro and Lobo (2008) that shows how affect influences whether people seek out task-related resources of potential partners. The current research indicate that positive perceptions of Benevolence and Integrity of alter is pivotal to opening up relationships that bring in skills to generate and realise ideas. As stated by Casciaro and Lobo (2008), general affect is different to perceived trustworthiness. The former is an ego-centric emotion, while the latter is a perception of alters driven by motivation. The novel contribution of the current study is in showing that the moderation effect *also* holds for Benevolence and Integrity. A clear implication of this finding is that, despite high levels of competence, individuals will not be sought out for idea generation and realisation if people question whether they genuinely care and have concern for others, and whether they uphold promises made. Hence, the mere perception of Ability of the alter is inadequate for tie formation. Strong Benevolence, and to a lesser degree, Integrity, are the main drivers for employees to seek out others for assistance to innovation.

Secondly, Integrity differentially moderates the relationship between Ability and tie formation for IG and IR. High Ability alters are specifically approached for IR, which intuitively is logical. However, their Integrity is paramount. To implement ideas, alters who deliver on promises are much sought after to ensure final delivery of innovation. The same is not the case for IG, where the more nebulous nature of novel ideas means not all are practical to be realised. Novel ideas can be deemed impractical due to many reasons: immature support technology, excessive resources required, and time constraints. This contrasts with low Integrity but highly competent Machiavellian alters,

who are clearly *avoided* when they have high perceived Ability. Taken together, Integrity is essential in unlocking IR ties to alters with Ability.

Thirdly, the similar results obtained from likability by Casciaro and Lobo (2008) and Benevolence in this research imply the possibility that affect may spill over to perceived trustworthiness, and vice versa. Yet liking someone may not be an adequate reason for giving trust. A confusion between the two constructs can perhaps lead to excessive trust, a condition that can lead to poor innovation performance (Bidault & Castello, 2010). This suggests a future research direction determining the recursive relationship between affect and trustworthiness.

These results suggest an important practical contribution. Alters perceived to be benevolent and have Integrity are more likely to be sought after for innovation, contingent on the perception of employees that the alters are also perceived to have Ability. In highly technical organisations, however, the availability of such skilled personnel may be limited, such that alters perceived to have low Benevolence or Integrity are totally bypassed even though they may have unique skills critical to project success. What this suggests is that managers need to ascertain not only if the selection of benevolent but unskilled others is widespread, but also if there is *non*-selection of skilled employees. Clearly, the selection of incompetent alters, as well as the non-selection of competent alters, are detrimental to the success of innovation, since this impacts on the information flow, collaboration and coordination that networks bring. Such an example may be in the case of the hiring of computer hackers as IT security personnel (Shinder & Cross, 2008). For the latter case, management may bring in tighter controls in order to facilitate tie formation but reduce the possibility of opportunistic behaviour on the part of the low Benevolence or Integrity employees.

### 7.2.3 Findings on self-monitoring

This thesis expands our understanding of the role of self-monitoring elements specifically during the IG and IR networks by hypothesising links between networks and SMA or SMP. This is the first network study that looks at the separate impact of the elements of self-monitoring, namely, acquisitive (SMA) and protective self-monitoring (SMP). In traditional literature, self-monitoring was examined as a unidimensional construct, and has been found to predict central network positions in an innovative firm (Mehra et al., 2001), brokering roles in a radiology department (Oh & Kilduff, 2008), and internal promotions (Kilduff & Day, 1994). This current research extends our knowledge by

showing that SMA and SMP correlate with tie formation in social-political IR networks, but not in IG networks.

Overall, people high in SMA (those who adjust their actions to fit the situation to project a positive image) are more sought after for IR compared to those low in SMA. Thus, they are more likely to receive ties. High SMA employees carry out actions that project a positive image and portray themselves in a positive light, for example by showing that they recognise the project environment and scenario, and understand the terminologies and issues related to the implementation of the novel idea. These egos project the perception to others that they can help secure resources, and are able to coordinate tasks to realise the innovation. The impression management literature refers to this as assertive impression management (Arkin, 1981; Costa, 2003), or 'getting ahead'. In this manner, high SMA egos consequently become more popular in the networks for the realisation of novel ideas.

Likewise, employees who score highly on the SMP scale (i.e., those who can better read others' cues and respond appropriately) (Wolfe et al., 1986) are more sought after for IR compared to low SMP employees. Here, high SMP employees are able to show how well they understand an alter's emotions, perspectives, and concerns, and project an image of their being in tune with, or being 'part of the clique' and getting along with others. These actions are carried out to prevent damage to their current social image, driven by negative affective states such as embarrassment or shame (Tetlock & Manstead, 1985). Consequently, they are perceived as better suited for implementation of innovations. Taken together, high SMA and SMP egos are more sought after for IR, and become more popular to help realise the novel idea.

These findings suggest two contributions to literature. One, both SMA and SMP play significant roles specifically in the IR process. This adds a more refined angle to previous findings on the importance of self-monitoring in networks (Kilduff & Day, 1994; Mehra et al., 2001; Sasovova et al., 2010). Additionally, I reflect upon the findings of Kilduff and Day (1994) that showed self-monitoring to predict internal promotions leading to seniority. While self-monitoring can explain how high SMA and SMP employees are more likely to be in senior roles, the results here show that self-monitoring is effective in IR networks. This knowledge can then be extended into other scenarios where organisations put emphasis on idea realisation.

Secondly, SMA and SMP were found not to be associated with IG tie formation, suggesting that self-monitoring is inconsequential for IG tie formation. To recap, IG is

an environment where creating new ideas, seeking out new work methods, and generating and refining ideas take place. This is the innovation stage where domain expertise is valued and significant. I also reflect upon the findings here that perceived Ability and Benevolence are conclusively significant tie predictors of IG. Taken together, formation of IG ties are very much dependent on the ability of an employee not merely acting appropriately or reading another's cues, but on being able to contribute technical thoughts to the idea smorgasbord. 'Getting ahead' by projecting a positive image, or 'getting along' by protecting the established social image, possibly by being a 'yes man' and agreeing to whatever idea is floated, is not seen as helpful. This leads to high SMA and SMP employees not specifically sought for IG.

These perspectives lead to a practical managerial approach that can be used to achieve better innovation project outcomes. In the implementation of novel information, high SMA and SMP employees could be chosen to play central roles in IR networks. Their innate aptitude will give them the advantage in securing the necessary resources and navigating issues that crop up. Capabilities of high SMA and SMP actors is even more critical in newly-formed or highly dynamic teams, since they are known to become the focal point of networks (Mehra et al., 2001) and bring new, unconnected alters together (Sasovova et al., 2010). In such scenarios it is in the firm's interest to create a culture of trust so that new employees are able to quickly develop perceptions of alter's trustworthiness. For example, the introduction of new members into a project team will require the formation of ties between the new person and existing team members. Firms can capitalise on high self-monitoring employees' capabilities to facilitate and perhaps speed up the tie formation process.

*7.2.4 On Simmelian ties*

This thesis contributes to literature on the relationship between trust and network structures. Previous studies on Simmelian ties have focused on how these ties influence actors' perceptions of network positions in the overall structure (Krackhardt & Kilduff, 2002). This includes studies on the role of Simmelian ties in supporting bridging structures for knowledge transfer (Tortoriello & Krackhardt, 2010) that are critical for IG. By focusing on how these reciprocal triads help build trust and solidarity, this current research extends our comprehension on how closed reciprocal triads lead to increased levels of trustworthiness and consequently to solidarity and cohesiveness. Consequently, we obtain a much better understanding of what constitutes an observable network

measure of trust. A grasp of the antecedents of cohesiveness can aid in the transfer of knowledge across boundaries (Hargadon, 2002; Szulanski, 2003) as well as the coordination of tasks in support of innovation.

Employees embedded in Simmelian ties experience benefits due to unique characteristics. Krackhardt and Kilduff (2002) suggested that Simmelian ties is a special type of network structure that supports solidarity, and claimed that "dyadic processes of agreement formation become particularly powerful in the context of a specific type of group" (p. 288). My research has found empirical support for the idea that in innovation networks, compared to other non-reciprocal triadic network structures, dyads embedded in Simmelian ties have higher levels of perceived trustworthiness between actors embedded in this structure. This is independent of firm size or innovation focus of the firm, be it radical or incremental. These factors help such triads to create their own identity and cultural definitions (Bijlsma-Frankema et al., 2008; Romney et al., 1986). The open communication channels that are characteristic of Simmelian ties imbue the occupants with the opportunity to learn about each other, interrelate via sensemaking, and coordinate action towards a common goal, while control allows for the development of understanding of the common working culture through the transmission of information about the other alters. This not only constrains behaviour, but also and more importantly allows coordination between actors. Notably, control gives structure to the expression and interpretation of a work culture (Krackhardt, 1990). The resultant trust building leads to reinforced solidarity and conformity, but not at the expense of idea generation, refinement and execution.

This analysis provides credence to the suggestion by Tortoriello and Krackhardt (2010) that Simmelian tie theory can complement current research knowledge in social networks. Explicitly, it helps explain scenarios where accessing other domains to glean and transfer novel ideas can be reinforced with strong levels of trust in order to facilitate the transfer of tacit, 'sticky' knowledge (Szulanski, 1996, 2003). Thus, the strong levels of perceived trustworthiness within these embedded dyads allow employees to earn a reputation for being trustworthy for the benefit of the common good. Through sensemaking, actors embedded within the Simmelian tie can appreciate the differences in perspectives of their alters, and provide opportunities to advance ideas for the purpose of IG. The resultant solidarity is created even when individual idiosyncrasies and barriers are present. Similarly, in IR, employees earn the reputation of being trustworthy in terms of bringing resources to implement the innovation, as well as coordinating tasks. In this

way, trusted alters can gain access to invaluable knowledge resources and the cooperation to execute ideas.

Taken together, one confirmatory perspective can be raised. The findings show that employees in Simmelian ties, compared to non-reciprocal triads, will perceive each other to be more trustworthy in all three dimensions, that is, Ability, Benevolence, and Integrity. The impact of Simmelian ties is stronger than in asymmetric, and to a lesser degree, in sole-symmetric dyadic ties. The closed and reciprocal nature of the dyads embedded in Simmelian ties act as an effective mechanism that helps actors to perceive levels of solidarity that open and non-reciprocal structures cannot offer. Risks that exist in innovation can be somewhat alleviated if employees ensure that their communication structures of relationships associated with those risks are embedded in Simmelian ties.

These perspectives lead to four practical managerial approaches that can be used to achieve better innovation project outcomes. Firstly, in the extraction of novel information and its transfer to another domain, bridging ties used to execute this operation can be configured as Simmelian ties to overcome the uncertainties. An example of this is in technology transfer programs between firms or divisions. Here, instead of assigning the task of technology transfer to just one person in each organisation, there are advantages to having the process carried out within a triad, or across triads. While this may not guarantee the formation of Simmelian ties between the employees, it increases the possibility of its formation through the open channels of communication between those involved. I suggest a similar argument holds for teams responsible for coordinating innovation implementation, or when dealing with sensitive or confidential information.

Secondly, scenarios that require coordination of skills can benefit if people involved in those situations communicate within a Simmelian triad. Consider work groups such as an operating theatre team, a crew on an oil rig, or sailors working on the deck of an aircraft carrier, where skills are paramount to safe and successful operations. There are numerous anecdotes of how members of these groups experience interpersonal friction due to a multitude of issues outside of work. These groups can benefit from communicating in a Simmelian tie network structure, because it improves perceptions of alters' Benevolence and Ability levels. Additionally, the presence of the third person helps moderate conflict and maintain an air of camaraderie that is required to sustain task execution, especially when perceptions of alter's Ability and Integrity suffers.

Thirdly, to facilitate healthy levels of criticism and creative friction, management of trust is needed. As highlighted by Bidault and Castello (2010), excessive levels of trust can

reduce the novelty of the creative process, but inadequate levels can kill it off. Given this, the presence of network structures such as Simmelian ties can provide managers with nuances as to the 'trust health' of the project. Further, they can oversee the pathways and levels of trust within the IG and IR phase through network cohesiveness. Deducing if there are excessive or low levels of trust, managers can then determine the type of trust that is being exhibited in that network, and decide how to intervene. The presence of closely-knit, dense ties in a team carrying out IG may foretell the selection of ideas that are technically safe, but not novel, especially if the employees perceive alters to be highly Benevolent. In addition, taken with the third practical contribution, Benevolence can be used as a tool to manage IG and IR relationships where the task at hand requires interdependent coordination and solidarity. For example, in generating and refining ideas, choosing alters perceived to have high Ability and Integrity but are less benevolent may be a preferred and rational decision to generate creative friction in developing superlative proposals. Training can also help. Firms can identify deficiencies in skills, and roll out tailored training programs to the identified employees. In executing ideas and securing resources, selecting benevolent alters may be cogent to maintain coordination and the associated tight information channels. In this manner, firms can actively manage self-selected tie formation through leveraging on alter Benevolence and Ability.

Fourthly, self-monitoring and Simmelian ties, among others, are viable intervention approaches to assist management with facilitating interpersonal trust within innovation. Having high self-monitors in Simmelian ties turns them into efficient conduits of information as well as distributors of resources in innovation networks. Results of trust and self-monitoring analysis can be used to decide how to facilitate the restructuring of networks for trust generation and reinforcement. Intervention methods include organising small discussion clusters in an informal atmosphere, and grouping together disconnected employees with a high self-monitoring person. Other methods include the participation of high self-monitors in IR circles, since they are known to become the focal point of networks (Mehra et al., 2001) and bring new, unconnected alters together (Sasovova et al., 2010).

Altogether, these findings inform management practice of the potential of trust management to optimise innovation processes in project teams. Attempting to align resources in firms through project team formation requires an understanding of the drivers of connections, as well as the associated measures. Examining the trust

relationships allows us to start diagnosing problems in networks and to propose remedies based on these measures. If it is known that the presence of pockets of disconnected people within teams is due to inadequate Benevolence, management could undertake action in the form of activities such as interest alignment, employee profiling, or reshuffling of team members. If there are inadequate levels of Ability among the alters in an employee's network, management could organise training clinics which brings the employee in contact with others who are experts in the field.

Ethical issues around the use of network data to identify actors with low Benevolence or Integrity may restrict its utility. The findings of this research suggest that management may be able to overcome this obstacle by facilitating the formation of more Simmelian ties. Through this approach, employees can develop a heightened perception of work colleagues' trustworthiness. Thus, the findings of this current research provide opportunities for innovation processes in project teams to be honed through the management of trust.

## 7.3    Limitations and Future Research

As with all research, this study has several limitations, which also suggest avenues for future research. These are outlined in the following sections.

### 7.3.1 Causality

In network regression studies such as this, the cross-sectional design precludes conclusions about causality between trust and interaction. It is not clear in this research if trustworthiness precedes or follows tie formation. Previous research (Buskens et al., 2010; Gulati, 1995; van de Bunt et al., 2005; Wong & Boh, 2010) suggest that trust is not only a determinant, but also a consequence of tie formation and network structure. The activation of the different dimensions of trust and self-monitoring implies that IG and IR networks will evolve differently; this can partly account for the presence of non-linear trust effects (Bidault & Castello, 2010; Uzzi, 1996; Zhou et al., 2009). Investigating this curvilinear trust-effect relationship is a potentially enriching research direction.

Future research would further benefit from longitudinal studies into how trustworthiness and network structures recursively influence each other. Such studies can help uncover how networks and trust co-evolve, and assist firms in designing and controlling the trajectory of their communication networks for optimal performance.  The results could extend our understanding by eliminating other potential alternative explanations, such as

frequency (Gulati, 1995). It would also be useful to test for directionality in order to ascertain causality, that is, does structure allows levels of perceived trustworthiness to increase, or do higher levels of perceived trustworthiness lead to the formation of ties and consequently structures such as Simmelian ties? Answers to these questions will allow managers to capitalise on the right strategies to instil trust across the innovation phases. Furthermore, understanding how perceived trustworthiness influences the relationship between actual trust behaviour, network structures and employee performance is also a fruitful area for future research.

### 7.3.2 Generalisability of findings

This research focused on the innovation networks of two firms, and hence its generalisability to other types of networks and firms requires further examination. It is possible but unlikely that the findings might be specific to the research setting and the firms represented. Findings from prior research in network literature have been drawn from just a single organisation in a specific industry (e.g., Borgatti & Cross, 2003; Ohly et al., 2010). In contrast, the findings here are robust across two firms that deal with different levels of innovation in different industries. Studying the impact of trust in different industries, firms, and cultures will improve the generalisability further. Additionally, further examination can be carried out into the effect of Ability, Benevolence, and Integrity on tie formation in non-innovation related work tasks, where different risks are present, to determine the pervasiveness of this relationship.

In terms of innovation, the results here indicate that some relationships appear to be context specific, or apply to only one firm or one stage of the innovation process. The implication is that greater understanding of which effects are context-specific versus generalisable findings are required. Thus, it is recommended that future research use multi-firm studies or meta-analysis that measure discrete networks for different stages of the innovation process to provide greater understanding of the potential moderators and boundary conditions to the role of trust in social network formation.

On the moderation effect of Benevolence and Integrity, future research should examine the interplay between perceptions of trustworthiness and interpersonal affect, to tease out whether these factors have additive or redundant influences on tie formation. Since trust and interpersonal affect are understood to be conceptually distinct concepts (Casciaro & Lobo, 2008), uncovering any links between the two constructs will be of great interest.

Further investigation is also required to be carried out to clarify the role of perceived Integrity in unlocking task-related competencies in organisations.

Further complicating this interplay is the general observation in the data of the idiosyncrasy of Integrity in influencing tie formation. Further work is required in analysing the effect of Integrity on tie formation in multiple scenarios to ascertain its characteristics towards developing a more complete framework of the trust-network linkage.

### 7.3.3 Organisation size and context specificity

A pattern that emerges suggests that organisation size may influence the role of trust in supporting tie formation for innovation. This current research cannot conclusively ascertain this link. The effect of organisation size on trust should be further examined to determine how trust influences tie formation under different scenarios. I argue that larger organisational size will present a more expansive and diverse set of alters that a focal actor can choose from. In this scenario, I suggest actors are more likely to rely upon trust as a tie formation mechanism, unless other more context-specific variables such as control come into play. In the larger picture, interplay between trust and these variables might lead to interesting trade-offs that employees make in tie selection. Policies will be a very interesting variable since it is one factor that managers can typically control (Becker, 2005; Bijlsma-Frankema & Costa, 2005; Buskens, 2003; Carlson & Wu, 2012). This will clarify how important trust is in various scenarios, when its influence waxes and wanes, and how certain factors that can be managed influence the interplay.

### 7.3.4 Performance

An obvious limitation of this research is that it does not link network structures for innovation and trust elements to performance. Linking structures and trust levels to performance measures can clarify the antecedents for effective and, more importantly, ineffective innovation networks and associated trust. Some of these measures can range from quantitative indicators such as rate of innovation progress against milestones, ROI, number of patent trades, to softer social indicators such as media mentions, employee satisfaction, and community perceptions. Further work could focus on how these structures are associated with performance indicators such as patents filed, and rate of project progress, for example, whether the focal project is on, ahead or even behind schedule. These will enable management to ascertain the effectiveness of its strategies in managing networks and trust for improved performance.

Another possible avenue for future research is to establish the levels of perceived Ability, Benevolence, and Integrity that are related to optimal levels of trust for innovation. Following Bidault and Castello (2010), it is clear that innovation practitioners will benefit from knowledge of what constitutes optimal levels of trust. Future research can determine the specific innovation processes and phases in which Ability, Benevolence, and Integrity each contribute to trust (Schoorman et al., 2007), and how in turn these are associated with successful or failed innovation projects. This can answer questions about optimum trust levels for innovation. Additionally, such research could provide an avenue to clarify the conundrum surrounding the interdependency or high correlation between Benevolence and Integrity observed in empirical studies conducted in laboratory settings (Schoorman et al., 2007).

### 7.3.5 Simmelian ties

This current research provides clear empirical evidence that Simmelian ties are an innovation network structure that is assessed to be strongly correlated with high levels of trust. However, this study does not discriminate among the contributions of Simmelian ties to the different stages of innovation. Rather, the current study amalgamated both the IG and IR networks to obtain reasonably sized innovation networks. This had the added benefit of increasing the statistical power of the analysis. The study could be extended to study separate IG and IR networks, in order to give greater statistical power to the analysis and clarify if the findings relate equally to IR and IG.

As mentioned previously, recent work into links between innovation and trust implies that there is a sweet spot of trust for optimal innovation performance of organisations (Bidault & Castello, 2010). However, while the curvilinear effect is difficult to link to observable indicators, network structures linked to trust levels are good measures because the presence and absence of ties, and structures such as Simmelian and non-Simmelian ties can be captured, plotted, and displayed. By monitoring the communication networks during the innovation process, network structures can be proxies for levels of trust. Clarifying this link would be a further step towards assisting practitioners in quantifying the optimal levels of trust that exist within organisations. Trouble spots can be identified, and a more through measurement carried out to ascertain the issues and possible remedies.

Another possible avenue of research is to look at the causality or recursive effects of Simmelian ties on swift trust (Meyerson et al., 1996). The idea of swift trust is that in the

absence of traditional sources of trust, people employ other methods to compensate. This is especially so when strangers are suddenly thrust into a scenario that requires them to work in a team and engage in trusting behaviour while not having the luxury of time to learn about the trustworthiness of alters. Such scenarios often occur in emergency situations such as during a natural disaster, a roadside accident, and at a battlefield triage. Swiftly building up trust will contribute to increasing the chances of the team's success, while reducing the adverse impact of such calamities. Similarly, online businesses and virtual teams would benefit from swift trust that is difficult to build up since actors only communicate electronically with limited, if any, actual social interaction (Robert et al., 2009). This ability to develop trust will facilitate transactions, reduce costs, and enhance reputation. Additionally, this will help counter the tendency towards an increased perception of risks within virtual teams and online transactions that reduces the likelihood of future trusting behaviours. It will be useful to determine if, and if so, how, Simmelian ties influences the development of swift trust.

### 7.3.6 Self-monitoring

This research studies the alter's levels of trustworthiness and posits that self-monitoring acts as a distal variable to tie formation. However, it does not analyse how the alter's SMA and SMP impacts on trust. Provisionally, the literature has suggested that impression management variables of SMA and SMP can be hypothesised to influence trustworthiness (Costa, 2003; Oh & Kilduff, 2008), but it has not been empirically supported. I did not examine this link as it is beyond the scope of this thesis, but I contend that self-monitoring is a valid predictor of trustworthiness. This link shows promise for future research.

A related avenue for further research is to examine the additional network attributes of high and low self-monitors in different phases of innovation. The current study suggests that, *ceterus paribus*, high SMA and SMP actors will receive more ties, that is, become more popular in innovation networks. These tendencies would shape the network evolution and create the network dynamics that can be associated with certain processes. It would be interesting, for example, to study whether there is interplay between SMA and SMP in terms of trust elements and conflict. This is of interest especially in line with trust research in innovation (Bidault & Castello, 2010) that found that task conflict had a curvilinear impact upon innovation performance (De Dreu, 2006). Outcomes from such

research could be used to further quantify the balanced level of trust that is essential for successful conflict management, and subsequently innovation performance.

### 7.3.7 Trust, optimal levels of trust, and repairing trust

Another aspect in optimal trust levels that can be analysed in the future is the moderation effect of dimensions of perceived trustworthiness on the relationship between trustworthiness dimensions, network structures, and *trust repair* (Gillespie & Dietz, 2009; Kim et al., 2004; Tomlinson & Mayer, 2009). Relating these to trust repair performance will make the findings useful for firms experiencing crises caused by trust violation.

Trust spillover is another aspect that can be explored in future research. Analysis can focus on whether trust dimensions in different innovation phases reinforce or cloud judgement of alters' trustworthiness. Such spillovers can occur through the mechanism of social contagion that is facilitated by networks (Burt, 1987). The different objectives of phases of the innovation process suggest that key trust elements will differ from phase to phase. This assessment should be across different innovation phases in different industries to explore the nuances in trust-network relations related to innovation.

### 7.3.8 Reciprocity

Another avenue for future inquiry is the impact of reciprocity on trust and network development. This research is limited in that only reciprocal ties in Simmelian ties have been explored. Reciprocity is significant because recent work in the leader-member exchange (LMX) and network literature (Ferrin et al., 2012) has suggested that trust exchanges are mutual and reciprocal (Tierney et al., 1999). This is contradictory to unidirectional models developed on trust (Mayer et al., 1995; Schoorman et al., 2007). However, to this point there has been limited research on studies into this reciprocal links between alter and ego trust relations (Serva et al., 2005) due to the difficulties in untangling the reciprocal relationships (Ferrin et al., 2012). Future research in this direction can contribute to the literature by making clear how reciprocity influences the dynamics of perceptions of trustworthiness and trust as a whole.

### 7.3.9 Impact on other Innovation phases and Innovation spectrum

Additionally, further examination can be carried out into the effect of Ability, Benevolence and Integrity in other innovation phases (Janssen, 2003; Janssen et al., 1997), where different risks are present to see just how generalisable this relationship is.

These environments such as Problem Identification and Idea Promotion might entail different levels of trustworthiness than in IG and IR, and knowing this will be useful for managers. In executing ideas and securing resources, selecting benevolent alters might be important in maintaining coordination and the associated tight information channels. Future research should clarify the organisational conditions under which relying on interpersonal affect in creating informal work ties are constrained or encouraged. Additionally, one could analyse the impact of the innovation focus of a firm on the trust-structure interplay. Analysis has suggested that trust may play different roles for firms at different positions along the incremental-radical innovation spectrum (Gilson & Madjar, 2011; Madjar et al., 2011); however, it is still not known if trust works in the same way for different levels of innovation intensity. Research into this aspect will inform theory about its impact, and assist innovation practitioners and managers in achieving the right level of trust for specific innovation phase.

## 7.4    Conclusions

This research has examined the influence of perceived trustworthiness and trust on the formation of social network ties in project teams during the idea generation and idea realisation stages of innovation. It found support for the hypotheses that various dimensions of trustworthiness influence tie formation across these two stages of the innovation process. Specifically, all three dimensions of perceived trustworthiness (Ability, Benevolence and Integrity) predict tie formation for both idea generation and idea realisation. Remarkably, the perceived Benevolence of a potential partner, an affective construct, consistently emerges as an important predictor of idea generation and implementation, beyond Ability and other structural constraints of network formation. Moderation analyses revealed that perceived Ability only predicts tie formation when the alter is perceived to be benevolent, or have Integrity. Acquisitive and protective self-monitoring (SMA and SMP respectively) were also found to predict only IR tie formation. Additionally, Simmelian ties, which is a particular form of closed triadic network structure, were found to be strongly associated with trustworthiness.

Despite limitations such as the cross-sectional design of this research, the current study has created a platform for further analysis into how structures of networks interact with trust elements and self-monitoring in support of innovation. The results supports the idea that trust and perceived trustworthiness, and self-monitoring dimensions, predict specific

tie formation. The activation of the different dimensions of trust and self-monitoring implies that IG and IR networks evolve differently and can partly account for the presence of non-linear trust effects (Bidault & Castello, 2010; Uzzi, 1996; Zhou et al., 2009).

Taken together, these results advance our understanding that trustworthiness is an overarching construct in tie formation during innovation processes. Demonstrating Benevolence, that is, collegial behaviour and concern for others, is central to unlocking ties that brings resources essential for innovation into project teams. This research extends current knowledge on self-monitoring by clarifying that it has a differential impact on stages of innovation. Further, the research suggests that Simmelian ties are strongly related to perceived trustworthiness, and is a network structure that can be utilised to strongly develop trust within teams, especially when confronted with highly risky tasks that require close coordination and solidarity for success. These findings are useful for innovation researchers and practitioners looking for ideas on how to manage trust within the different stages of the innovation process.

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## Appendix A: Survey used for Study 1

**Part A: All Employees' Networks**

Name Generator Questions based on IWB (de Jong & Hartog, 2008; Ramamoorthy et al., 2005)

Please identify an innovative project that you were assigned to: _____

*Idea Generation Networks*

Referring to the project you specified above, over the last six months (or since the last survey in this series), are there any work-related contacts from which you regularly sought information and advice to help you with:

1. Creating new ideas for difficult issues

2. Searching out new work methods, techniques, or instruments

3. Generating original solutions to solve problems?

   Please nominate up to eight contacts who meet at least one of the criteria above.

*Idea Realization Networks*

Referring to the project you specified above, over the last six months (or since the last survey in this series), are there any work-related contacts from which you regularly sought information and advice to help you with:

1. Acquiring approval for innovative ideas

2. Making important company members enthusiastic for innovative ideas

3. Transforming innovative ideas into useful applications

4. Introducing innovative ideas into the work environment in a systematic way

   Please nominate up to eight contacts who meet at least one of the criteria above.

**Network Alter Attributes**

The following questions refer to the persons you mentioned in Part A.

(Unless mentioned, scored on a 7-point Likert scale unless specified, 1= strongly disagree, 7=strongly agree)

Tie Strength

*Contact Frequency (Hansen, 1999)*

Over the last six month, while working with this person on a project (On a 7-point Likert scale unless specified, 1= Few times a year,2=Once every 2-3 months,3=Once a month, 4=Twice a

month, 5= Once a week, 6= Few times a week, 7= Daily), in general, how often do you communicate with this person?

*Closeness*

Over the last six month, while working with this person on a project (On a 7-point Likert scale unless specified, 1= not at all close, 7=very close), how close is your working relationship with this person?

Difficult Tie

1. I have a difficult relationship with this person.

Advice Tie

1. This person's advice is useful to me.

**Part B: Project Team Members' Networks**

Name Generator Questions based on IWB (de Jong & Hartog, 2008; Ramamoorthy et al., 2005)

Please identify an innovative project that you were assigned to: _____

*Idea Generation Networks*

Referring to the project you specified above, over the last six months (or since the last survey in this series), are there any work-related contacts from which you regularly sought information and advice to help you with:

1. Creating new ideas for difficult issues
2. Searching out new work methods, techniques, or instruments
3. Generating original solutions to solve problems?

Please nominate up to eight contacts who meet at least one of the criteria above.

*Idea Realization Networks*

Referring to the project you specified above, over the last six months (or since the last survey in this series), are there any work-related contacts from which you regularly sought information and advice to help you with:

1. Acquiring approval for innovative ideas
2. Making important company members enthusiastic for innovative ideas
3. Transforming innovative ideas into useful applications
4. Introducing innovative ideas into the work environment in a systematic way

Please nominate up to eight contacts who meet at least one of the criteria above.

**Network Alter Attributes**

The following questions refer to the persons you mentioned in Part A.

(Unless mentioned, scored on a 7-point Likert scale unless specified, 1= strongly disagree, 7=strongly agree)

*Ability*

1. This person carries out his/her job with professionalism and dedication.
2. I believe this person has much expert knowledge on the field I need advice in.

*Benevolence (Levin & Cross, 2004)*

1. I assume this person will look out for my welfare.
2. I feel this person cares about what happens to me.

*Integrity (Mayer et al., 1995)*

1. I never have to wonder if this person will stick to their word.
2. I believe sound principles guide this person's behaviour.

Trust (Gillespie, 2003)

*Reliance*

1. I rely on this person for work-related judgements.
2. I rely on this person's task-related skills and abilities.

*Disclosure*

1. I share personal feelings with this person.
2. I confide in this person about personal issues affecting my work.
3. I share ideas I have on this project with this person.

Availability (Levin & Cross, 2004)

1. It would generally be hard for me to get in touch with this person.
2. This person generally responds quickly to my inquiries.

Tie Strength

*Perceived Closeness (Hansen, 1999)*

Over the last six month, while working with this person on a project (On a 7-point Likert scale unless specified, 1= not at all close, 7=very close):

1. How close is your working relationship with this person?

*Contact Frequency (Hansen, 1999)*

Over the last six month, while working with this person on a project (On a 7-point Likert scale unless specified, 1= Few times a year,2=Once every 2-3 months,3=Once a month, 4=Twice a month, 5= Once a week, 6= Few times a week, 7= Daily):

1. In general, how often do you communicate with this person?

**Part C: Personality and Team-level Attributes**

Unless specified, all measures are scored on a 7-point Likert scale (1= strongly disagree, 7=strongly agree)

Team Climate for Innovation (Anderson & West, 1998; Kivimaki & Elovainio, 1999)

The following questions relate to your current program:

1. I am very clear about the team objectives.
2. I think the team objectives are useful and appropriate.
3. I agree with team objectives.
4. The team objectives are worthwhile to my team.
5. We share information generally in the team rather than keep it to ourselves.
6. On this project, my team and I are "in this together".
7. This team is always moving toward the development of new answers.
8. Assistance in developing new ideas is readily available.
9. The team continually monitors its own performance in order to improve its effectiveness.
10. My team colleagues provide useful ideas and practical help to enable me to do my job to my best ability.
11. My colleagues and I monitor each other so as to maintain a higher standard of work.
12. Team members are prepared to question the basis of what the team is doing.


Trust Propensity  (Costa & McCrae, 1992b)

1. I tend to be cynical and sceptical of others' intentions.
2. I believe that most people are basically well-intentioned.
3. I think most of the people I deal with are honest and trustworthy.
4. I'm suspicious when someone does something nice for me.
5. My first reaction is to trust people.
6. I tend to assume the best of people.
7. I believe that most people will take advantage of you if you let them.
8. I have a good deal of faith in human nature.

NEO-Five Factor Inventory (Gosling et al., 2003; Rammstedt & John, 2007)

1. I am talkative.
2. I tend to find fault with others.
3. I do a thorough job.
4. I often feel depressed.

5. I am original and come up with new ideas.

6. I am reserved.

7. I am helpful and unselfish with others.

8. I can be somewhat careless.

9. I am relaxed and handle stress well.

10. I am full of energy.

11. I start quarrels with others.

12. I am a reliable worker.

13. I can be tense.

14. I am ingenious and a deep thinker.

15. I am curious about many different things.

16. I generate a lot of enthusiasm.

17. I have a forgiving nature.

18. I tend to be disorganized.

19. I worry a lot.

20. I have an active imagination.

21. I tend to be quiet.

22. I am generally trusting.

23. I tend to be lazy.

24. I am emotionally stable and not easily upset.

25. I am inventive.

26. I have an assertive personality.

27. I can be cold and aloof.

28. I persevere until the task is finished.

29. I can be moody.

30. I value artistic, aesthetic experiences.

31. I am sometimes shy and inhibited.

32. I am kind and considerate to almost everyone.

33. I do things efficiently.

34. I remain calm in tense situations.

35. I prefer work that is routine.

36. I am outgoing and sociable.

37. I am sometimes rude to others.

38. I make plans and follow through with them.

39. I get nervous easily.

40. I like to reflect and play with ideas.

41. I have few artistic interests.

42. I like to cooperate with others.

43. I am easily distracted.

44. I am sophisticated in art, music or literature.

Team Climate for Innovation (Anderson & West, 1998; Kivimaki & Elovainio, 1999)

The following questions relate to your current program:

1. I am very clear about the team objectives.

2. I think the team objectives are useful and appropriate.

3. I agree with team objectives.

4. The team objectives are worthwhile to my team.

5. We share information generally in the team rather than keep it to ourselves.

6. On this project, my team and I are "in this together".

7. This team is always moving toward the development of new answers.

8. Assistance in developing new ideas is readily available.

9. The team continually monitors its own performance in order to improve its effectiveness.

10. My team colleagues provide useful ideas and practical help to enable me to do my job to my best ability.

11. My colleagues and I monitor each other so as to maintain a higher standard of work.

12. Team members are prepared to question the basis of what the team is doing.

Self-monitoring (Lennox & Wolfe, 1984)

*Acquisitive Self-monitoring (SMA)*

1. I have the ability to control the way I come across to people, depending on the impression I wish to give them.

2. When I feel that the image I am portraying isn't working, I can readily change it to something that does.

3. Once I know that the situation calls for, it's easy for me to regulate my actions accordingly.

*Protective Self-monitoring (SMP)*

1. My power of intuition is quite good when it comes to understanding others' emotions and motives.

2. I can usually tell when I've said something inappropriate by reading it in the listener's eyes.

3. In conversations, I am sensitive to even the slightest change in the facial expression of the person I'm conversing with.

Locus of Control (Spector, 1988)

1. My success depends on whether I am lucky enough to be in the right place at the right time.
2. To a great extent my life is controlled by accidental happenings.
3. When I get what I want, it is usually because I am lucky.
4. My life is determined by my own actions.
5. When I get what I want, it is usually because I worked hard for it.
6. It is not wise for me to plan too far ahead, because things turn out to be a matter of bad fortune.
7. Whether or not I am successful in life depends mostly on my ability.
8. I feel that what happens in my life is mostly determined by people in powerful positions.
9. I feel in control of my life.
10. Success in business is mostly a matter of luck.


- END OF SURVEY -

## Appendix B: Survey used for Study 2

QUESTIONNAIRE

**Part A: Network**

Name Generator Questions based on IWB (de Jong & Hartog, 2008; Ramamoorthy et al., 2005)

Please identify an innovative project that you were assigned to: _____

*Idea Generation Networks*

Referring to the project you specified above, over the last six months (or since the last survey in this series), are there any work-related contacts from which you regularly sought information and advice to help you with:

1. Creating new ideas for difficult issues
2. Searching out new work methods, techniques, or instruments
3. Generating original solutions to solve problems?

Please nominate up to eight contacts who meet at least one of the criteria above.

*Idea Realization Networks*

Referring to the project you specified above, over the last six months (or since the last survey in this series), are there any work-related contacts from which you regularly sought information and advice to help you with:

1. Acquiring approval for innovative ideas
2. Making important company members enthusiastic for innovative ideas
3. Transforming innovative ideas into useful applications
4. Introducing innovative ideas into the work environment in a systematic way

Please nominate up to eight contacts who meet at least one of the criteria above.

**Network Alter Attributes**

The following questions refer to the persons you mentioned in Part A.

(Scored on a 7-point Likert scale unless specified, 1= strongly disagree, 7=strongly agree)

Perceptions of Alter's Trustworthiness (Mayer et al., 1995)

*Ability*

Over the last six month, prior to seeking information/advice from this person on a project:

1. This person is very capable of performing his/her job.

2. I believe this person has much expert knowledge on the field I need advice in.

*Benevolence (Levin & Cross, 2004)*

Over the last six month, prior to seeking information/advice from this person on a project:

1. This person cares about my welfare.

2. This person will go out of his/her way to help me.

*Integrity (Mayer et al., 1995)*

Over the last six month, prior to seeking information/advice from this person on a project:

1. I never have to wonder if this person will stick to their word.

2. Sound principles seem to guide this person's behaviour.

Trust (Gillespie, 2003)

*Reliance*

Over the last six month, while working with this person on a project:

1. I rely on this person for task-related skills and abilities.

*Disclosure*

Over the last six month, while working with this person on a project:

1. I share my feelings about work with this person, even negative feelings and frustrations.

2. I share novel ideas I have on this project with this person.

Availability (Levin & Cross, 2004)

Over the last six month, while working with this person on a project:

1. This person is available when I need him/her.

Tie Strength

*Perceived Closeness (Hansen, 1999)*

Over the last six month, while working with this person on a project (On a 7-point Likert scale unless specified, 1= not at all close, 7=very close), how close is your working relationship with this person?

*Contact Frequency (Hansen, 1999)*

Over the last six month, while working with this person on a project (On a 7-point Likert scale unless specified, 1= Few times a year,2=Once every 2-3 months,3=Once a month,

4=Twice a month, 5= Once a week, 6= Few times a week, 7= Daily), how often do you communicate with this person, on average?

**Part B: Personality and Team-level Attributes**

Unless specified, all measures are scored on a 7-point Likert scale (1= strongly disagree, 7=strongly agree).

Team Climate for Innovation (Anderson & West, 1998; Kivimaki & Elovainio, 1999)

The following questions relate to your current program:

1. The program objectives are worthwhile to its members.
2. My program colleagues and I are "in this together".
3. My program colleagues provide useful ideas and practical help to enable me to do my job to the best of my best ability.
4. Program members are prepared to question the basis of what they are doing.


Trust Propensity  (Costa & McCrae, 1992b)

1. I believe that most people are basically well-intentioned.
2. I think most of the people I deal with are honest and trustworthy.
3. My first reaction is to trust people.


NEO-Five Factor Inventory (Gosling et al., 2003; Rammstedt & John, 2007)

1. I tend to find fault with others.
2. I do a thorough job.
3. I am reserved.
4. I am relaxed and handle stress well.
5. I have an active imagination.
6. I am generally trusting.
7. I tend to be lazy.
8. I am kind and considerate to almost everyone.
9. I am outgoing and sociable.
10. I get nervous easily.
11. I have few artistic interests.
12. I persevere until the task is finished.
13. I generate a lot of enthusiasm.
14. I worry a lot.
15. I like to reflect and play with ideas.

Self-monitoring (Lennox & Wolfe, 1984)

*Acquisitive Self-monitoring (SMA)*

1. Once I know what the situation calls for, it's easy for me to regulate my actions accordingly.

2. I have found that I can adjust my behaviour to meet the requirements of any situation I find myself in.

*Protective Self-monitoring (SMP)*

1. My power of intuition is quite good when it comes to understanding others' emotions and motives.

2. I can usually tell when I've said something inappropriate by reading it in the listener's eyes.

Proactivity (Bateman & Crant, 1993; Seibert et al., 1999)

1. Nothing is more exciting than seeing my ideas turn into reality.

2. If I see something I don't like, I fix it.

3. If I believe in an idea, no obstacle will prevent me from making it happen.

- END OF SURVEY-

## Appendix C: Results for Other Predictors of Tie Formation

At the start of this research, I had hypothesized that several personality variables will predict tie formation for IG and IR. Except for self-monitoring, it was initially expected that the selected variables will not have a differential effect across IG and IR networks. For example, Neuroticism was expected to have a negative effect on tie formation across all networks. However, data analysis on the link between various personality variables in the firms found that most of them were not significant. Since these are not relevant to the primary research objective, these analyses were omitted from the thesis. Results of the MRQAP analysis are nevertheless included here to present the complete picture. To aid the reader, the descriptions of these variables are repeated here. The specific matrices developments are described in the following notes.

### C 1.    Locus of Control

Locus of control (LOC) is defined as a "generalized expectancy that rewards, reinforcements or outcomes in life are controlled either by one's own actions (internality) or by other forces (externality)" (Spector, 1988, p. 335). Those who have high LOC will tend to be proactive in seeking out resources to help secure rewards, which imply that they will tend to form ties. Contrast this with low LOC actors who believe that their rewards are controlled by external forces. Consequently the latter are content with allowing outside powers determine their future, hence they are less likely to form ties.

To measure LOC, ten items from the scale developed by Spector (1988) were used. Sample items include "My success depends on whether I am lucky enough to be in the right place at the right time", and "To a great extent my life is controlled by accidental happenings". The NxN matrices for LOC are formed by applying actor $i$'s average self-scores of LOC across all the columns, representing a sender (ego) effect. When regressed against IG or IR networks as the DV, this represents ego's LOC effect on tie formation.

### C 2.    Proacticvity

Proactivity captures the varying levels of people's activity. This is in line with the observation that people behave differently even if they were tasked with the same roles. Some directors will take initiatives, while others conform to the status quo. Employees can also be similarly seen to undertake new ventures, while others are content with existing scenarios. These people are labelled either as 'proactive' or 'passive' (Bateman & Crant, 1993).

To measure Proactivity, three items from the scale developed by Bateman and Crant (1993) and further refined by Seibert et al. (1999) were used. Sample items include "Nothing is more exciting than seeing my ideas turn into reality". The NxN matrices for Proactivity are formed by applying actor *i*'s average self-scores of Proactivity across all the columns, representing a sender (ego) effect. When regressed against IG or IR networks as the DV, this represents ego's Proactivity effect on tie formation.

## C 3.    *Five Factor Inventory (FFI)*

Overall research on personality has found that most of the variability across individuals can be measured using five different constructs known as the "Big Five"): Neuroticism, Extraversion, Openness to Experience, Conscientiousness and Agreeableness (N, E, O,C, A)(for a full explanation, see Costa & McCrae, 1992b). Taken together, there is enough empirical evidence to suggest that some psychological traits influence network structure formation (Burt et al., 1998; Kalish & Robins, 2006; Klein et al., 2004; Mehra et al., 2001), especially Neuroticism, Extraversion, and Openness.

To measure elements of the Five Factor Inventory, 15 items from the NEO-FFI scale developed by Costa and McCrae (1992b) and further refined by Gosling et al. (2003) and Rammstedt and John (2007) were used. All five dimensions of Agreeableness, Conscientiousness, Extraversion, Neuroticism and Openness were measured with three items each. Sample items include "I tend to find fault with others", "I do a thorough job" and "I have an active imagination". The NxN matrices for each of the FFI dimensions are formed by applying actor *i*'s average self-scores of the relevant dimension across all the columns, representing a sender (ego) effect. For example, when the NxN matrix of Neuroticism was regressed against IG or IR networks as the DV, this represents ego's Neuroticism effect on tie formation.

## C 4.    *Team Climate for Innovation (TCI)*

While most of the predictors here are psychological variables, scholars have emphasized that surrounding environmental support plays an important role in the success of project teams (Amabile, 1997; Anderson & West, 1998; Conti et al., 1996). Teams aiming to innovate are required not only to generate ideas, but align team members for IR (Somech & Drach-Zahavy, 2011). While optimizing the conditions to foster creativity requires reaching out to various domains to gather diverse sets of knowledge, realising ideas requires convergence in teams along the lines of shared cognition (Bledow et al., 2009). Research have shown that team climate for innovation (TCI) will interact with team creativity and be critical in enhancing the

implementation of innovations (Somech & Drach-Zahavy, 2011). For that reason, this research includes this team-level concept as a variable.

To measure Team Climate for Innovation (TCI), four items from the scale developed by Anderson and West (1998) were used, measured on a seven-point Likert scale. Items include "The program objectives are worthwhile to its members". The NxN matrices for TCI are formed by applying actor $i$'s average self-scores of TCI across all the columns, representing a sender (ego) effect. When regressed against IG or IR networks as the DV, this represents ego's perception of TCI effect on tie formation.

Tables C1 through C4 shows the MRQAP results of these various personality level and TCI as predictors of tie formation for firms B and C respectively. They show that only a few of these variables significantly predict tie formation, and when they do, their effect is stage-AND firm-specific, but not robust across firms or innovation stage. This does not provide strong support for any insightful hypothesis that can be constructed linking the variables to tie formation. The secondary nature of the related research question reduces their importance. They are duly relegated to the Appendix and not presented in the main body of research.

Table C1: MRQAP regression of the predictors of tie formation in Firm B's IG networks.

| IG network | FIRM B | | | |
|---|---|---|---|---|
| | Model 1b | Model 1c | Model 1d | Model 1e |
| *Controls* | | | | |
| Project Team | -.12 | -.12* | -.03 | -.15 |
| Location | -.27** | -.27* | -.30* | -.24* |
| Seniority | -.08 | -.08 | -.01 | -.06 |
| Tenure | n/a | n/a | n/a | n/a |
| *Relational factors* | | | | |
| Availability | .16 | .15 | .22 | .13 |
| Closeness | .18 | .18 | -.02 | .17 |
| Trust Propensity | .10 | .12 | .20 | -.03 |
| *Personality Variables* | | | | |
| Locus of Control | - | -.03 | - | - |
| *FFI* | | | | |
| A | - | - | -.32* | - |
| C | | - | -.41* | - |
| E | | - | -.05 | - |
| N | | - | -.25 | - |
| O | | - | .35* | - |
| *Team level variable* | | | | |
| Team Climate for Innovation | | - | - | .21 |
| Adj R-Squared | .09 | .16 | .20 | .10 |

Table C2: MRQAP regression of the predictors of tie formation in Firm B's IR networks.

| IR network | FIRM B | | | |
|---|---|---|---|---|
| | Model 1b | Model 1c | Model 1d | Model 1e |
| *Controls* | | | | |
| Project Team | -.07 | .07 | .14 | .07 |
| Location | .16 | .16 | .20 | .16 |
| Seniority | -.03 | -.02 | -.14 | -.03 |
| Tenure | n/a | n/a | n/a | n/a |
| *Relational factors* | | | | |
| Availability | -.21* | -.20 | -.30 | -.21* |
| Closeness | .24 | .23* | .24 | .24* |
| Trust Propensity | -.16 | -.17 | -.32* | -.16 |
| *Personality Variables* | | | | |
| Locus of Control | - | .02 | - | - |
| *FFI* | | | | |
| A | - | - | .07 | - |
| C | - | - | -.05 | - |
| E | - | - | -.15 | - |
| N | - | - | .06 | - |
| O | - | - | .09 | - |
| *Team level variable* | | | | |
| Team Climate for Innovation | - | - | - | -.01 |
| Adj R-Squared | .08 | .08 | .08 | .08 |

Table C3: MRQAP regression of the predictors of tie formation in Firm C's IG networks.

| IG network | FIRM C | | | |
|---|---|---|---|---|
| | Model 1b | Model 1c | Model 1d | Model 1e |
| *Controls* | | | | |
| Project Team | .62** | .62** | .74** | .62** |
| Location | .20** | .20** | .10 | .19** |
| Seniority | -.09** | -.10** | -.09 | -.10** |
| Tenure | .05 | .06 | .13** | .04 |
| *Relational factors* | | | | |
| Availability | .00 | .00 | -.02 | -.01 |
| Closeness | .00 | .00 | -.12* | .00 |
| Trust Propensity | .03 | .02 | .06 | .00 |
| *Personality Variables* | | | | |
| Proactivity | - | .05 | - | - |
| *FFI* | | | | |
| A | - | - | .01 | - |
| C | - | - | -.03 | - |
| E | - | - | -.06 | - |
| N | - | - | -.14* | - |
| O | - | - | .03 | - |
| *Team level variable* | | | | |
| Team Climate for Innovation | - | - | - | .09* |
| Adj R-Squared | .18 | .18 | .32 | .20 |

Table C4: MRQAP regression of the predictors of tie formation in Firm C's IR networks.

| IR network | FIRM B | | | |
|---|---|---|---|---|
| | Model 1b | Model 1c | Model 1d | Model 1e |
| *Controls* | | | | |
| Project Team | .32** | .31** | .42** | .32** |
| Location | .12 | .11 | .07 | .12 |
| Seniority | .22** | .22** | .34** | .22** |
| Tenure | .04 | .06 | .09 | .04 |
| *Relational factors* | | | | |
| Availability | -.10 | -.09 | -.04 | -.10* |
| Closeness | .16** | .16** | .03 | .16** |
| Trust Propensity | -.07 | -.14** | -.18** | -.08 |
| *Personality Variables* | | | | |
| Proactivity | - | .19** | - | - |
| *FFI* | | | | |
| A | - | - | -.27 | - |
| C | - | - | .26 | - |
| E | - | - | -.01 | - |
| N | - | - | -.14 | - |
| O | - | - | -.15 | - |
| *Team level variable* | | | | |
| Team Climate for Innovation | - | - | - | .01 |
| Adj R-Squared | .25 | .27 | .34 | .25 |