Collaborative New Product Development: Modelling Inter-Organisational Intensity.

By

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Declaration:

The author hereby declares that, except where duly acknowledged, this thesis is entirely her own work

Signed:

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The PhD is dedicated to the memory of my father, James Walsh. RIP.

Abstract

The increased pace of global change combined with the inherent risks that exist in the innovation and NPD process has accelerated the move towards more integrative models of innovation. This move has been broadly welcomed by innovation scholars and practitioners. However, successful collaborative innovation is still proving difficult to achieve.

Previous research in this area has suggested that the intensity of collaboration plays an important role in achieving innovation success with more intense collaboration driving better outcomes. But to date, the concept of collaborative innovation intensity (CII) has not been fully operationalised. Because of this gap in our understanding of what constitutes CII, empirical studies have provided only limited insight into how intensely partners should be involved and so practitioners' experience and unsubstantiated prescriptions remain the best guide to determine appropriate collaborative intensity levels.

Utilising a positivistic philosophy, a measure was developed for the CII construct. Further modelling was undertaken to test the relationships between hypothesised predictor constructs, CII, and hypothesised outcome constructs. The population of interest was all Irish industrial firms involved in collaborative NPD in the B2B context. The unit of analysis was the dyad from one side of the partnership only. The methodology involved a cross sectoral postal survey of NPD managers and or CEOs. This resulted in 185 usable responses. These key informants completed the survey based on their perceptions of their relationship with their closest NPD partner. Goodness-of-fit indices for the CII scale development model were excellent with good to excellent indices reported for the predictor-CII-outcome model. Two rival models were rejected in favour of the second order factor model adopted for the CII scale. One rival predictor-CII-outcomes model (TCE) was rejected in favour of the SET developed model.

The major theoretical implication of the results of this research is the development of a rigorous measure for the construct of CII. This scale was developed using a SET

lens, consequently, this research makes a substantial contribution to both SET and RET. It is envisaged that this scale will aid managers in the development of a roadmap to more successful collaborative NPD.

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List of Acronyms

AMOS	Analysis of Moment Structures
ASV	Average Shared Variance
AT	Agency Theory
AVE	Average Variance Explained
B2B	Business to Business
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CII	Collaborative Innovation Intensity
CR	Composite Reliability
CVI	Content Validity Index
EFA	Exploratory Factor Analysis
GFI	Goodness-of-fit Index
IBM	International Business Machines
IOR	Inter-Organisational Relationships
KMO	Kaiser-Meyer-Olkin
LTO	Long term Orientation
MSV	Maximum Shared Variance
NPD	New Product Development
NIH	Not Invented Here
PCA	Principle Components Analysis
PCLOSE	p of ClOSE FIT
PET	Political Economy Theory
RBV	Resource based View
RDT	Resource Dependence Theory
RET	Relational Exchange Theory
SEM	Structural Equation Modelling
SET	Social Exchange Theory
SME	Small Medium Enterprise
RMSEA	Root Mean Square Error of Approximation
SPSS	Statistical Package for the Social Sciences
SRMR	Standardised Root Mean Square Residual
TCE	Transaction Cost Economics
WIT	Waterford Institute of Technology

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Chapter One: Introduction

1.1 Introduction and Background to the Study

The increased pace of global technological change and the need to develop more ready to use solutions, combined with the inherent risks that exist within the innovation and new product development (NPD) process has accelerated the breakdown of the more traditional 'stage-gate' models of NPD, leading to a move towards more integrative ones (Chesbrough and Appleyard 2007). Innovation scholars (Hillebrand and Biemans 2004, O'Hern and Rindfleisch 2010, and Lynch, O'Toole, and Biemans 2016) have welcomed this shift. This move to more integrative models has proved to be the driving force behind conferences, special issues, numerous books and literally hundreds of papers to date. In line with this shift, governments have also increasingly sought to realign their policy frameworks towards open innovation. For example, the European Horizon 2020 approach which encourages moves towards a more collaborative approach away from the more traditional linear model. However, although research suggests that intense collaboration plays an important role in innovation success (Herstatt and von Hippel 1992, Gruner and Homburg, 2000, Håkansson and Waluszewski 2007, Athaide and Klink 2009, and Lynch et al. 2016), the concept of collaborative innovation intensity (CII) has not been defined and operationalised formally in the literature (Lynch et al. 2016). It should be noted that a number of authors have approached the measurement issue in the context of user involvement in NPD (Shaw 1985, Biemans 1991, and Gruner and Homburg 2000). However, they have tended to approach the concept from a mechanistic perspective with the focal firm organising user involvement in a hierarchical rather than a collaborative way. Consequently, these studies have associated intense involvement with the number of users or project duration, while ignoring the degree of participation that the user has. This is a critical issue as user involvement has been shown to be more complex than examining the number of users or frequency of contact; it also implies detailed examination of all cooperative interactions. The intensity of these cooperative interactions refers to the

strength or depth of participation and influence that each partner has in the innovation process and can be conceptualized along a continuum ranging from a hierarchical (one-way) relationship where one partner is in control, to joint performance of activities (collaborative) (Biemans 1991). Because of this gap in our understanding of what constitutes CII, empirical studies have provided only limited insight into how intensely partners should be involved and so the practitioner's experience and unsubstantiated prescriptions remains the best guide to determine appropriate collaborative intensity levels. As a result, the implication for practice is that if an organisation cannot distinguish between intensity levels, they may invest resources in collaborative relationships that lead to a non-significant contribution to innovation outcomes (Wynstra and Pierick 2000, and Lüthje and Herstatt 2004).

1.2 Theoretical and Philosophical Approach to Study

An initial gap exists between theory and practice in the field of inter-organisational collaborative relationships which can in some respects be attributed to the domination of neo-classical economic rooted theory such as transaction cost economics (TCE), agency theory (AT), political economy theory (PET), and resource dependence theory (RDT) in explaining close inter-organisational relationships. For example, TCE which has been employed in many IOR studies advises that under certain conditions, coordination and control of vital resources is more effective and efficient in the formation of hierarchical IOR rather than the close collaborative relationships that are the focus of this research. Consequently, the selection of a theoretical framework for this research was based on its appropriateness to the understanding of these close collaborative relationships in the B2B context. Following a review of the major theoretical perspectives employed in the IOR and innovation literature it was decided that social exchange theory (SET) represented the most appropriate approach as it specifically addresses these close IORs. The underlying world view for this research is positivist with an ontological perspective of realism. The epistemological stance is encompassed in the belief that while knowledge is not absolute, it can be accumulated, tested and either retained or discarded. Finally, the methodological approach is nomothetic. The focus of a

nomothetic approach is to obtain knowledge through objective methods. This is outlined in further detail in chapter five.

1.3 Level of Analysis and Method

In order to facilitate this work's overarching hypotheses, the level of analysis is the IOR. The dyad between firms is the unit of analysis, involving the perspective from only one side of the dyad and that of only one key informant per firm.

The measurement development approach used in this thesis is quantitative. It follows the procedures as outlined by Churchill (1979), Gerbing and Anderson (1988), and Hinkin (1998). These procedures address the following steps to ensure academic rigour in measure development:

- Item Generation
- Content validity of items
- Questionnaire Administration
- Exploratory Factor Analysis
- Confirmatory Factor Analysis and Construct Validity

The methodology for the CII measure development is outlined in detail in chapter six.

1.4 Research Objectives and Hypotheses

The main objective of this research is to develop a measure of collaborative innovation intensity (CII). The antecedents and conditions under which a variety of intensity levels are present will be examined in an overall intensity model. In addition, the intensity of CII will be examined against innovation performance outcome variables. It is envisaged that practice and policy guidelines for the implementation of successful collaborative innovation will stem from the findings of the research.

1.4.1 Objectives of Research

The objectives of the research are as follows:

1. To inform substantive theory by the development of a measure for the construct of CII in the B2B context.
2. To develop an antecedents-process-outcomes model.

3. To test the above model for the effect of high and low levels of CII on innovation outcomes.

1.4.2 Research Hypotheses

Based on the literature review which will be presented in chapters two, three and four, the following hypotheses were formulated:

H1a to H1f hypotheses relate to the measurement model.

H1a: Joint communication is a dimension of CII.

H1b: Joint information exchange is a dimension of CII.

H1c: Joint learning is a dimension of CII.

H1d: Joint problem solving is a dimension of CII.

H1e: Joint creativity is a dimension of CII.

H1f: Joint social bonding is a dimension of CII.

H2a to H5h hypotheses relate to the structural model.

H2a: Benevolent trust is an antecedent of CII.

H2b: Cognitive commitment is an antecedent of CII.

H2c: Senior management support is an antecedent of CII.

H3a: NPD outcomes is an outcome of CII.

H3b: Long term relationship orientation is an outcome of CII.

H4: Higher levels of CII deliver improved outcomes.

H5a: Exploitative innovation moderates the relationship between CII and NPD outcomes.

H5b: Exploitative innovation moderates the relationship between CII and long-term relationship orientation.

H5c: Explorative innovation moderates the relationship between CII and NPD outcomes.

H5d: Explorative innovation moderates the relationship between CII and long-term relationship orientation.

H5e: Market turbulence moderates the relationship between CII and NPD outcomes.

H5f: Market turbulence moderates the relationship between CII and long-term relationship orientation.

H5g: Technological turbulence moderates the relationship between CII and NPD outcomes.

H5h: Technological turbulence moderates the relationship between CII and long-term relationship orientation.

1.5 Contribution of Study to Current Academic Research

The foremost contribution of this research is to measurement. This is achieved through the development and operationalisation of a second order multi-dimension measurement scale for the construct of CII. This addresses the identified gap in the literature and it is perceived that the CII scale will further advance substantive knowledge in the IOR, innovation, NPD, user involvement, and supply chain literature.

The second contribution relates to theory. Through the employment of SET as the underlying theoretical framework, this study further advances research on close IORs, specifically in the innovation context. Explicitly, it has broadened the theoretical understanding of close collaborative innovation relationships in terms of both ongoing economic and social exchanges, by identifying specific exchange characteristics such as high inter-dependencies, friendship, closeness, commitment and trust.

It is perceived that the development of both the CII measurement and the subsequent structural model (antecedents-CII-outcomes) will contribute to the development of a roadmap to successful innovation for managers. In addition, it is anticipated that these research findings will act as a valuable tool for policy makers in the formulation of National innovation policy.

Chapter ten presents the research contributions in more detail.

1.6 Limitations of the Research

Results of this study should be analysed by the reader in light of the research limitations of which there are several. Major limitations involved: the employment of one theoretical framework, sole focus on the dyad, and reporting aspects.

This study is limited to one theoretical perspective that being the SET perspective. Other possible choices could have been AT, TCE, or PET. However, as this research is concerned with the measurement of the intensity of close collaborative relationships, SET was judged as being the most appropriate theoretical framework.

Relational exchange that focuses solely on a dyad is open to criticism, as it may be too narrow in its approach and could be accused of neglecting the more complex network issues. Conceptually, one would have to concede that a network approach may be more appropriate, because the relationship between any two interacting parties may well be influenced by other connected exchange relations (Cook and Emerson 1978). However, both funding and time constraints rendered the network approach to this research unworkable.

In common with the majority of other IOR researchers, the reporting aspect of this study involved the perceptions of one side of the dyad as perceived by one key informant. Studies by Anderson and Narus (1990) and Anderson and Weitz (1992) indicate that models from one side of the dyad do not always reflect the perception of the other partner, therefore, as a future research direction a study involving both sides of the dyad could be undertaken. Kumar, Stern, and Anderson (1993) indicate that a more rigorous approach would be to collect data from more than one key informant. However, as many of the firms involved in this research were SMEs, the likelihood is that only one key informant would exist in the organisation. In addition, the surveys were personally addressed to either innovation managers or managing directors, ensuring that the most informed people within the firm completed the survey.

1.7 Structure of Thesis

The thesis is comprised of ten chapters. Table 1.1 outlines the structure of the thesis by chapter.

Table 1.1 Thesis Structure

Chapter	Related to:	Detail
Chapter 1		Introduction
Chapter 2	(Research background)	The Innovation construct Characteristics of the innovation construct Reasons why organisations engage in innovation **Innovation Models** • Closed innovation model • Open innovation model **B2B collaboration.** • User involvement innovation • Supply Chain Innovation B2B collaboration through SET theoretical lens
Chapter 3	(Research objective 1)	Definition of CII for this research. **Dimensions of CII:** • Joint communication • Joint information exchange • Joint learning • Joint problem solving • Joint creativity • Joint social bonding Conceptual Framework of CII
Chapter 4	(Antecedents-CII-Outcomes model)	Presents hypothesised structural model diagrammatically **Hypothesised antecedents of CII:** • Benevolent trust • Cognitive commitment • Senior management support **Hypothesised outcomes of CII:** • NPD outcomes (economic and relational) as one measure • Long term orientation **Hypothesised moderators of CII-outcomes relationship:** • Exploitative innovation • Explorative innovation • Market turbulence • Technological turbulence **Control Variables:** • Partner choice

		• Prior relationship duration • Firm size **Alternative structural model (TCE framework) including TCE predictor constructs:** • Dependence. • Asset specificity
Chapter 5	(Research philosophical assumptions) (Research objective 1)	Reviews a number of research philosophical assumptions (Burrell and Morgan 1979) Establishes the philosophical framework for this thesis Restates the research objectives Establishes and validates the choice of postal survey as the mode of data collection in the context of this research Testifies to the survey design including: • Wording of survey • Sequencing of questions • Instructions for completion of survey • Aesthetics of survey • Addresses the implementation of the survey Testifies to the sampling process including: • Defining the population • Defining the sampling frame Presents a blueprint of survey administration
Chapter 6	(Research objective 1)	Establishes CII as a reflective construct (Jarvis MacKenzie and Podsakoff 2003) Testifies to the CII measurement development approach (Churchill 1979, Gerbing and Anderson 1988, Hinkin 1998) including: • Item generation (involving a comprehensive literature review resulting in the generation of an initial pool (23 items), that specify the theoretical domain of CII • Content validity of items (Lynn 1986) • Questionnaire administration (Pilot Study statistical analysis)
Chapter 7	(Antecedents-CII-Outcomes model)	Details the scales employed for each SET structural model variable with specific reference to literature source

		Details the scales employed for alternative TCE structural model variable with specific reference to literature source Testifies to the testing for reliability and validity of each measure (EFA)
Chapter 8	(Research Objectives 1 and 2)	Findings including: • Research sample characteristics • Measurement model specification • Structural model specification • CFA results for both models • Moderation analysis • Alternative structural model
Chapter 9	(Research objectives 1 and 2)	Presents an analytical discussion integrating the results from chapter 8 with theory
Chapter 10	(Research objectives 1 and 2)	Outlines theoretical and methodological contributions including managerial implications The chapter closes with a discussion on study's limitations and suggested future research directions

Source: Compiled by Author

1.8 Chapter Summary

Focal to this study is the understanding of close inter-organisational collaborative relationships in the context of innovation, the development and operationalisation of a measurement scale for the CII construct, the design of a model that identifies the antecedents and the outcomes of CII and finally the investigation of the impact of discriminant intensity levels on innovation outcomes by statistically testing the impact of high intensity levels of CII compared with low levels. Based on these objectives, the dyad was employed as the level of analysis and the methodology used for data collection and analysis reflects the positivistic philosophy of the project. The conceptualisation of this research is based on SET which provides a broader framework for the understanding of collaborative IOR. The contributions of this research to measurement, theory and practice are briefly outlined. This is followed by an overall summary of the limitations of the research. The chapter closes by presenting the structure of the thesis.

Chapter 2 Collaborative Innovation in the B2B Context

2.1 Introduction

The purpose of this chapter is to examine the role of innovation in the literature to date. Firstly, the role of innovation in sustaining competitive advantage in today's ever-changing business environment is outlined. Several definitions of innovation are then presented. This is followed by an outline of the varying types of innovation that currently feature in the literature including explorative and exploitative. Pursuant to this, the chapter presents innovation models developed in the literature including closed innovation, but with a specific focus on collaborative models including customer involvement and supply chain innovation. In the context of these collaborative models, SET is used as the underlying theoretical base for this thesis.

2.2 Concept of Innovation

What is innovation? The term "innovation" is loosely employed in the literature and is often substituted for creativity, knowledge or change. As a result definitions of innovation are numerous and diverse across the literature with each focusing on different aspects of the construct. However, most definitions imply the adoption of a new idea or behaviour. As early as the 1920s, Schumpeter coined the first definition of innovation, this stressed the novelty or newness aspect. Schumpeter believed that innovation is reflected in novel outputs: either a new product or an improved product, a new method of production, a new market, a new source of supply, or even a new organisational structure. This theme of newness is supported by other researchers across the decades including Baregheh, Rowley, and Sambrook (2009), Thompson (1965), and West and Anderson (1996).

2.2.1 Characteristics of Innovation

Innovation has been defined in the literature to date in terms of the following:

- The type innovation
- The aim of innovation
- The nature of innovation
- The social context of innovation
- The stages of innovation

The types of innovation include product and services development. There is a large body of academic literature in both research areas, see, for example, Schleimer and Shulman (2011). The social context of innovation refers to any social entity system or group of people in the innovation process. For example, much research has been undertaken in the context of innovation in cross functional teams (McDonough 2000). For this research the social context of innovation is the B2B dyad. The stages of innovation refer to all the steps involved in the innovation process including, ideation, screening, preliminary market assessment, preliminary technical assessment, concept development and concept testing (Lynch el al. 2016). The next two sections will discuss the aim and nature of innovation in detail with reference to the current research.

2.2.2 The Aim of Innovation

It has been argued that innovation is crucial for the survival of firms with one famous author suggesting that innovation "*strikes not at the margins of the profits and the outputs of the existing firms, but at their foundations and their very lives*" (Schumpeter 1942:84). This view is even more valid today with the emergence of the knowledge economy, intense global competition and considerable technological advances. To ensure survival in this ever-more challenging environment, organisations must be able to cope with increasing complexity, in addition to high speed change (Banu Goktan and Miles 2011). In effect, organisations with the capacity to innovate will be able to meet these challenges and exploit new products more effectively than non-innovative organisations (Jean, Kim, and Sinkovics 2010).

Innovation is seen as critical for all types of organisations including start-ups as well as established firms. By its nature, innovation can be a powerful vehicle for new organisations to successfully enter the market, thereby undermining the established firms. On the other hand, to counterbalance this threat, established organisations must innovate to maintain their competitive position in the face of new and emerging or 'disruptive' technologies (Christensen, McDonald, Altman, and Palmer 2016).

However, innovation isn't easy, even with an extra focus on innovation in organisations, the performance hurdles for success have still increased considerably. In effect, innovation is an expensive and risky activity which, in the main generates positive outcomes in terms of a firm's performance. However, innovation may also deliver negative outcomes. These negative outcomes may include increased exposure to market risk, employee dissatisfaction, or unwarranted changes. To overcome these difficulties, more and more organisations are engaging in collaborative innovation. Organisations believe that engaging in collaboration will lead to more success with less market risk, for example, through involving customers in innovation (Lynch et al. 2016). Traditional and open innovation models are discussed in the following paragraphs.

2.2.3. The Nature of Innovation

The nature of innovation refers to the form of the innovation as in is it something new or improved. The form of the innovation has been defined in the academic literature as radical or incremental (Athuahene-Gima 2005, Gatignon, Tushman, Smith, and Anderson 2002). In related strategic management literature, the form of innovation has been classified as either explorative or exploitative (Jansen, Van Den Bosch, and Volberda 2006, Benner and Tushman 2003, and Tushman and O'Reilly 1996). Organisations that engage in explorative or radical innovation are pursuing new knowledge and developing new products designed to meet the needs of new customers or markets (Benner and Tushman 2003:43). Explorative innovation develops new designs, creates new markets and develops new channels of distribution. It requires new knowledge and/or departure from existing knowledge (Jansen et al. 2006, and Benner and Tushman 2003). In contrast, organisations engaging in exploitative or incremental innovation build on existing knowledge and

expand current products or services for existing customers and or markets (Jansen et al. 2006, and Benner and Tushman 2003). They broaden existing knowledge and skills, improve established designs, expand on existing products and services and increase the efficiency of existing distribution channels (Abernathy and Clark 1985:5). Further discussion on the nature of innovation will be undertaken in chapter 4 and chapter 7.

2.2.4 Innovation Models

2.2.4.1 Closed Innovation Model.

Ever since Schumpeter (1934) announced his theory of innovation, entrepreneurship and economic development, economists, policy makers, and business managers have adopted the "closed" or "producers" model of innovation. One of the key reasons for this was the lack of involvement of both universities and/or governments in industrial and commercial applications of scientific research. This led organisations to set up their own research and development (R&D) departments, which allowed them to completely control NPD cycles. Put succinctly, this model assumed and still assumes that the most important designs for innovations would originate with the producer and be supplied to consumers via goods and services which were for sale. The traditional NPD model ("closed innovation") is one in which organisations are exclusively responsible for product generation, including idea generation, manufacture, marketing, and distribution. Closed innovation implies a deep vertical integration (from manufacturing tools to after sales services). Each organisation can and must only depend on itself in particular regarding critical technologies. The closed innovation paradigm led to the "not invented here" syndrome, this promoted a closed approach encompassing the view that everything coming from outside of an organisation was suspicious and not reliable. Within the closed innovation paradigm, the process leading to innovation is completely controlled, all the intellectual property is developed internally and kept within company frontiers until the new product is released to market.

However, not everybody believed in the completely closed innovation model. Consequently, this model was consistently challenged by innovation management

practitioners and academics, for example, Chesbrough (2003) and von Hippel and Katz (2002). However, even prior to their research, others were investigating and developing "more open" innovation models. For example, within the R&D management field, the network model advanced by Rothwell, Rothwell, and Zegveld (1985), more than forty years ago, promoted the need for external linkages within the innovation process. This supported the work of Carter and Williams who as far back as 1959 suggested that a key characteristic of a progressive organisation was the quality of incoming information. In the same vein, other research has demonstrated the importance of acquiring information and knowledge from outside the organisation through work on "gatekeepers". This is supported by Tushman (1977) who added to this body of work by exploring the wider notion of boundary spanners or individuals who collect and exchange knowledge and information on behalf of a firm. In both the practice and academic context, research around internal and external R&D is showing that companies that are involved in internal R&D are better able to access externally available information (Cohen and Levinthal 1989, and Mowery 1983). These research studies show that firms had already recognised and were facing the challenge of working outside their boundaries for several decades prior to 2003. As a result, firms spent large sums of money addressing issues such as not-invented-here syndrome (NIH), scanning and networking, and developing absorptive capacity. Moreover, the fifth-generation model of R&D management presented by Rothwell in 1992, emphasises the need for increased external focus utilising information technologies. Crucially, as a result of the move towards collaborative innovation, the 1970s and 1980s witnessed technological partnerships expand at a rapid rate. With the costs of innovation ever increasing, it became evident that an organisation could not remain competitive and remain in technological isolation. So, the forging of IORs became the solution to ensure business survival. Indeed, as early as 1986, Von Hippel was advocating customer integration in the innovation process. However, power and control were still strictly centralised and ultimately the companies designed the products and had the final say on what should be produced (Pitt, Watson, Berthon, Wynne, and Zinkhan 2006).

2.2.4.2. Open Innovation Model

Open innovation has become one of the most talked about concepts in innovation management. Henry Chesbrough's 2006 book has received 4203 citations (Google Scholar, March 2019) since being published, with interest in the topic been shown by a wide range of disciplines including economics, psychology, and sociology (Von Krogh and Spaeth 2007). Open innovation is defined as "*the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively*" (Chesbrough 2003).

The easiest way to understand the open innovation paradigm is to compare it with the traditional vertical integration model, where internal innovation led to internally developed products that were then distributed by the firm.

In the "open innovation" discussion, Chesbrough (2003) presented a number of contrasting attributes for both closed and open innovation paradigms which have become the cornerstone for understanding the difference between both (see Table 2.1). While contrasting opposite attributes of both innovation models may make it easier to have this discussion around the benefits and detriments of both paradigms in a theoretical context, the literature seems to suggest that the pure "closed innovation" traditional model didn't really exist. Consequently, many argue that the "open innovation" paradigm is not a revolution but rather an evolution that has occurred over a number of decades (Trott and Hartmann 2009). Table 2.1 outlines and contrasts the principles of closed and open innovation.

Table 2.1 Principles of "Closed Innovation" and "Open Innovation"

Six Principles of Closed Innovation	Six Principles of Open Innovation
The smart people in our field work for us	Not all the smart people work for us so we must find and tap into the knowledge and expertise of bright individuals outside our company
To profit from R&D, we must discover, develop, produce and ship it ourselves	External R&D can create significant value, internal R&D is needed to claim some portion of that value
If we discover it ourselves, we will get it to market first	We don't have to originate the research in order to profit from it
If we are the first to commercialise an innovation, we will win	Building a better business model is better than getting to market first
If we create the most and best ideas in the industry, we will win	If we make the best use of internal and external ideas, we will win

We should control our intellectual property (IP) so that our competitors do not profit from our ideas	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our business model

Source: Chesbrough (2003): 26

Other studies have queried why the "open innovation" term or concept was embraced so fully by both academics and practitioner. In real terms there is no specific answer to this; however, several situational variables go a long way to explaining the rationale. Firstly, open innovation is an assigned single term to a collection of developments, that is, it became the "catch all" term that encompasses, connects, and integrates a range of activities that already existed. This facilitated academics and practitioners to revise the design of innovation strategies in a networked world. Secondly, the timing of the work was apt. This work coincided with the heightened interest in outsourcing, networks, core competencies, collaboration, and the internet. Thirdly, Chesbrough's work offers broad opportunity for the development of, for example, integrated theory, measurement instruments, and most importantly a starting point for improvement. B2B collaboration including customer-involvement and supply chain innovation is now discussed.

2.3 B2B Collaboration

Collaborative innovation can best be defined as an inter-organisational relationship type in which the participants agree to invest resources, mutually achieve goals, share information (Ring and Van de Ven 1994, Stank, Crum, and Arango 1999 and Barratt and Oliveira 2001), share rewards (Phillips, Lawrence, and Hardy 2000), and responsibilities as well as jointly make decisions and solve problems (Spekman, Kamauff, and Myhr 1998). It is based on mutual trust, openness, shared risk and shared rewards that yield a competitive advantage, resulting in better innovation performance than each individual firm would achieve on their own (Hogarth-Scott 1999). It implies cooperation or some form of alliance between the organisations. These collaborative relationships are formed with the view to minimising the cost of investment, spreading risk, and gaining access to complementary resources. Similarly, some firms establish close, long-term working relationships with suppliers and customers who depend on one another for much of their business, developing

interactive relationships with partners who share information freely, work together when trying to solve common problems when designing new products, who jointly plan for the future, and who make their success inter-dependent (Spekman et al. 1998). The following two sections outline two specific types of B2B collaboration.

2.3.1 User Involvement Innovation

In support of the open innovation paradigm, ongoing research in both the marketing and innovation literature has acknowledged, that to ensure NPD success, user involvement or customer participation in the process is certainly recommended if not sometimes essential (Biemans 1991, Chang and Taylor 2016, Gruner and Homburg 2000, and Lynch et al. 2016). This notion that customer participation can improve a firm's innovation performance has led to firms increasingly involving customers at various stages of the NPD process (Fang 2008, and Lynch et al. 2016). In the ideation stage (idea generation and concept testing), customers are engaged to provide needs related knowledge, evaluate the potential of new product ideas, and the refinement and often selection of promising new ideas for future consideration. In the product development stage (product design and engineering), customers have been shown to provide solution-related knowledge such as technical advice or design skills, and finally in the launch stage (prototype testing and market launch) customers are involved in proto-type testing in a "live" setting and help with the launch of the new products. However, this approach does not always guarantee success, and many organisations have found it difficult to leverage customer participation in the innovation context (Kristensson, Gustafsson, and Archer 2004).

A common thread in user involvement studies particularly in marketing studies is that customer involvement is a matter of knowledge management (Chang and Taylor 2016) and that a better understanding or knowledge of customers can contribute to the development of more effective products (Sawhney, Wolcott, and Arroniz 2006). Paralleling this knowledge management approach, marketing literature generally proposes a stage gate model of the development process starting with the ideation stage (including discovery and concept development), progressing to the development stage (product design, development and testing), followed by the commercialisation stage (Chang and Taylor 2016 and Cooper 2008).

In contrast, the innovation or NPD literature is more concerned with moving from a product centric perspective to a broader solution perspective (Tuli, Kohli, and Bharadwaj 2007), in which the customer is regarded as a co-developer to be engaged (Fang 2008), rather than simply a source of information useful for NPD. Essentially, customer participation is the integration of customers into firm activities, where they contribute needs and solution-related inputs into the firm's NPD process, generally addressing an internal knowledge gap (Nambisan 2002, and Chang and Taylor 2016). This entails customer involvement in various NPD activities such as ideation, resource inputs, knowledge exchange and co-development (Fang 2008, and Chang and Taylor 2016). This practice of integrating end users in various stages of the NPD process, as practiced by Unilever and other firms both large and small, can be described as customer participation (Fang 2008). This definition embraces the progressive user-involvement in NPD ideology (von Hippel 2005, and Schulze and Hoegl 2008), as opposed to the arms-length ideology of simply listening to the customer (Urban and Hauser 2004). Advocates of customer participation, frequently illustrate the benefits of customer involvement in the NPD process including: successful reduction of costs (Mishra and Shah 2009), improved decision making (Griffin and Hauser 1993), increased complementary knowledge and resources (Coviello and Joseph 2012), and enhanced product innovativeness (Fang 2008). However, as a counterbalance it should also be pointed out that under certain circumstances there may be drawbacks and risks related to customer participation in new product development. These include limiting radical product innovation (Gruner and Homburg 2000). The rationale put forward here is that customers lack creative ideas (Christensen 1997), have shown themselves in some instances incapable of effectively communicating their needs, and that the complexity of NPD management within the focal firm is increased due to their involvement (Chang and Taylor 2016). Other risks include loss of proprietary or sensitive information and exposure to opportunistic behaviour (Noordhoff, Kyriakopoulos, Moorman, Pauwels, and Dellaert 2011).

Marketing thought has evolved from a focus on transactions to a focus on the relationships that companies have with their customers and other actors (Lagrosen 2005). Several researchers have found that well managed relationships can alleviate

the effect of inadequate NPD performance (Priluck 2003). This is supported by other research that has shown that NPD involving customers is related to customer relationship management processes (Rollins, Pekkarinen, and Mehtälä 2011). Relationship marketing goes beyond the distanced relationship often researched using quantitative tools and concentrates on the interactions between the parties to the relationship as the most important part of marketing research (Gummesson 1999). This is supported in the user involvement literature, where it has been shown that market innovation and NPD generally take place in ongoing customer-supplier relationships (Håkansson and Snehota 1989), with both the manufacturer and the user contributing to the overall process (Håkansson and Waluszewski 2007). With this approach, customer involvement goes well beyond knowledge sharing and takes the form of direct participation through ongoing interactions by the customer in various activities related to new product development. These ongoing interactions between supplier and customer often lead to novel solutions even when still at the problem identification stage (Baraldi 2008, Biemans 1991, and Johnsen and Ford 2007).

In the B2B context, co-development has been shown not only necessary for the generation of new ideas but is also often necessary for putting the solutions to use (Johnsen and Ford 2007, La Rocca and Snehota 2014). While the benefits and limitations of customer involvement in NPD have been explored quite extensively, the actual process of customer involvement or close collaboration during NPD has been much less researched (Laage-Hellman, Lind, and Perna, 2014, and Tuli et al. 2007). Empirical studies on the customer involvement process or collaboration process in NPD are rare and there is a tendency to black box the process of how customers are involved. The need for more fine-grained empirical studies of intra- and inter-organizational arrangements and practices aiming at involving customers in NPD has been voiced (Biggemann, Kowalkowski, Maley, and Brege 2013, Coviello and Joseph 2012, and Tuli et al. 2007). What are the features of the NPD process involving customers, and how does the process unfold over time? What patterns of interactions emerge between the supplier and customer organizations as a new product solution is developed with the involvement of the customer? Research in

related fields, particularly innovation, shows that participation of external actors (including customers) in the NPD process is common (Coviello and Joseph 2012, Enkel, Gassmann, and Chesbrough 2009) and suggests that the process is less unilateral than generally assumed.

Several studies have shown that developing new product solutions in B2B markets entails extensive interaction in customer supplier relationships (Baraldi 2008, Håkansson et al. 2009, Harrison and Finch 2009 and Johnsen and Ford 2007). Interaction is needed because the complex solutions offered cannot be conceived and developed and then implemented by a single firm actor, they must be "enacted jointly" between the user/customer and producer/supplier organisations (Johnsen and Ford 2007, and La Rocca et al. 2014). Capturing the factors that shape outcomes of such interactive solution development process in buyer-seller relationships requires a 'relational process perspective' because "solution effectiveness depends on supplier and customer behaviours" (Tuli et al. 2007: 13). A common theme in studies that have broached the topic of customer-supplier interaction in relation to the development of new solutions is that the outcomes of the process depend on the organisational practices and roles at company boundaries that are involved in creating value for customers (La Rocca and Snehota 2014, Tuli et al. 2007, and Wieβmeier, Thoma, and Senn 2012). Customer involvement becomes manifest in the pattern of interactions with the customer, and the pattern of interactions is a paramount antecedent of both technical and commercial outcomes of the solution development process. While the importance of these interactions is acknowledged, few empirical studies regarding the interaction pattern at the customer/supplier interface have been reported.

In summary, customer involvement has been suggested as being central for innovation, in both the marketing and innovation literature. Two types of customer involvement approaches are recognised in the literature: knowledge management, and co-development. The knowledge management approach in effect means limited involvement for the customer (mainly at the ideation stage), whereas co-development aims for the customer to be involved in all aspects of the innovation. Co-development has been recognised in several studies as involving ongoing

intensive interaction between the customer and the manufacturer. It has been recognised in the literature that there has been little and/or disjointed empirical research on the nature and intensity of these interactions, specifically studies that use a relational perspective. This current research sets out to fill this research gap. By adopting a social exchange theoretical perspective, the type of ongoing interaction within the collaboration will be investigated and defined. A measure will then be developed for CII.

2.3.2. Supply Chain Innovation

Supply chains are now operating in more dynamic environments that are characterised by globalisation, rapidly evolving technologies, and increased customer responsiveness. This requires firms to look beyond their organisational boundaries and evaluate how the resources and capabilities of suppliers and customers can be utilised to create exceptional value. Put succinctly, a supply chain strategy now requires more integrative and collaborative efforts. This concept has received heightened attention resulting in a high volume of research over the years. Consequently, supply chain collaboration is now considered crucial to the maintenance and development of a supply chain's competitive edge. As a direct result of the research available in both the academic and practice literature, the last number of years have seen firms strive to achieve greater supply chain collaboration in the hope of leveraging the resources of their customers and suppliers in order to meet the current dynamic market needs (Cao and Zhang 2011, Lejeune and Yakova 2005).

In simple terms, supply chain collaboration can be viewed as two or more autonomous organisations working jointly to plan and execute supply chain operations (Simatupang and Sridharan 2002). Some research has posited that collaboration delivers a range of benefits and advantages to its partners (Matsuno and Mentzer 2000), including: shared risks (Olorunniwo and Li 2010), access to complementary resources (Soosay, Hyland, and Ferrer 2008), reduced transaction costs and enhanced profitability (Singh and Power 2009), and competitive advantage over time (Matsuno and Mentzer 2000). Collaboration in supply chains is especially important for innovation as partners realise the various benefits of innovation such

as higher quality, lower costs, more timely delivery, efficient operations and effective co-ordination of activities (see Table 2.1). For example, strategic alliances are beneficial to those seeking technological innovation by complementing resources of members who are at the same level of the value chain (horizontal integration) or gaining knowledge from key sources either upstream or downstream of the supply chain (vertical integration) (Lamming 1993, Spekman et al. 1998). However, organisations pursuing discontinuous innovation (which takes place when a new or existing player in an industry changes the rules in an unusual way) might consider participating in "collaborative dalliances" (Phillips, Lamming, Bessant, and Noke 2006). In "collaborative dalliances", supply chain partners test radical ideas outside of their normal relationships. The literature supports the link between collaboration and innovation in the supply chain. Corsten and Felde (2005) posit that supplier collaboration has positive effects on buyer performance. Suppliers may contribute to a firm's innovation by performing R&D of their own. Moreover, suppliers often have valuable knowledge of production and fulfilment processes that influence a firm's performance. Finally, suppliers can transfer ideas for better products and features that could enable the buying firm to enhance products (Corsten and Felde 2005). Supplier collaboration facilitates the sharing of tacit and explicit knowledge and enhances knowledge creation and innovation spillovers from the supplier (Inkpen 1996). Collaboration reduces purchasing costs by lowering contracting costs, frequent communication, improved coordination, and acts as a joint approach to operational problem-solving (Cannon and Homburg 2001). Another study by Simatupang and Sridharan (2005) found that supply chain members who had higher levels of collaboration practices were able to achieve better operational performance and innovation activities. Similarly, Sahay (2003) also argued that collaboration enables value creation in supply chain activities. The capacity to innovate can be enhanced through incremental and radical innovations. These innovations can be in various logistics activities such as new product development, process improvements, service delivery, inventory management, technology transfer and capacity planning. Swink (2006: 37) argues that, "*the organisation's ability to collaborate is key to its innovative success*" and upon recognising this, many firms are implementing new organisational structures, communication technologies and incentive systems in

order to grow their collaborative potential in important areas. The key to successful supply chain management is seeking improved inter-organisational relationships that can enhance innovation. However despite the universality and potential benefits of supply chain collaboration, few firms have fully benefited from its potential (Cao and Zang 2011). Consequently, the research is ongoing. The following section reviews the overall literature in this area.

Supply chain management research in the literature is far reaching and comprehensive. It examines the role of trust and commitment, the type of relationships including collaborative versus arm's-length relationships, level of collaboration, collaborative communication, information sharing, and performance outcomes to name but a few. A relationship model designed and tested by Walter (2003) examined the antecedents and key characteristics of close relationships in a supply chain. His findings highlight the need for customers to move towards a relational approach in order to encourage and enable suppliers to participate in collaborative NPD. In addition, the results suggest that customers benefit from adopting a strategy of developing a supplier's trust and commitment. In effect, his conclusions suggest that supply and purchasing managers should treat suppliers more like partners than vendors. This was supported by research that was undertaken by Crook, Ketchen, Combs, and Todd (2008) who suggest that when independent firms enter into a collaborative relationship with others they can achieve advantages beyond what could be achieved in an arm's-length relationship. Simpatung and Sridharan (2005) retained this focus on supply chain collaboration when they developed an instrument that set out to measure the extent of collaboration in the supply chain (where the supply chain comprised the dyadic relationship of suppliers and retailers). Their findings highlight the need for customers to move towards a relational approach in order not only to encourage but also to enable suppliers to participate in NPD. Following on from this research, Kwon and Suh (2004) attempted to empirically validate the relationship between trust and commitment in a supply chain context. They concluded that trust is positively related to asset specificity and negatively related to behavioural uncertainty. Simpatung (2004) considered constraints in the context of collaborative supply chain. In

addition, he sought to apply the theory of constraints approach with a view to overcoming the difficulties with releasing potential benefits in supply chain collaboration. Fynes, Voss, and de Búrca (2005) reviewed the effect of supply chain relationships on quality performance. Whilst the research undertaken in the context of supply chain collaboration is broad and far reaching, interestingly, the same gap surrounding measurement of CII exists.

2.4 Collaborative Innovation through a Social Exchange Theory Lens

Collaborative relationships in the B2B context have been studied for nearly three decades in the industrial marketing literature. The studies have been undertaken from a range of different perspectives including economic (Coase 1937 and Williamson 1979), organisational studies (Ring and Van de Ven 1994), sociology (Blau 1964, Emerson 1962) and law (Macneil 1980). Two typologies of B2B relationships have been identified in the literature, firstly transactional or arm's-length exchange and secondly collaborative or relational exchange. Transactional relationships are characterised by low interdependence, short term commitment, a written contract outlining pre-agreed terms and conditions, narrow communication channels, and low trust. Transactional relationships are in effect, pure economic exchanges concerned with solely the economic exchange of goods and/or services between the parties. These relationships have in the main, been studied using a TCE theoretical lens (Williamson 1979). At the other end of the continuum, collaborative relationships are characterised by continuous reciprocal economic and social exchanges, long-term relationship orientation, loosely specified terms and conditions, and high levels of trust and commitment. Generally, the studies of collaborative relationships have been undertaken using a relational or SET theoretical approach (Homans 1958, Thibault and Kelley 1959, and Blau 1964).

However, TCE and SET are not the only theoretical frameworks that have been applied with the aim of gaining a greater understanding of the interactions that occur in IORs. These frameworks can be conceptualised along a continuum ranging from economic dependence at one end to a reliance on behavioural rationale at the other

(Barringer and Harrison 2000). Theories grounded in strong economic rationale include AT (Eisenhardt 1989), and RBV (Pfeffer and Salancik 1978). In contrast, PET in common with SET, is also behavioural based (Dwyer and Welsh 1985).

Having reviewed the theoretical frameworks previously applied in the context of close IORs, the researcher decided to adopt the SET lens as being most appropriate for this research. This reflects the work undertaken by Chang and Taylor (2016), Fang (2008), Lynch et al. (2016) and others (see Table 2.2).

SET was initially developed to examine interpersonal exchanges that are not purely economic. The sociologists responsible for the early development of this theory include Homans (1958), Thibaut and Kelley (1959), and Blau (1964). These theorists view people's social behaviour in terms of the exchange of resources. Blau defines economic exchanges as the "*voluntary actions of individuals that are motivated by the returns they are expected to bring and typically in fact bring from others*" (1964: 91), and he views social exchange as an ongoing reciprocal process in which actions are "*contingent on rewarding reactions from others*" (1964: 6). Unlike macro and micro economic theories which were designed to consider both types of exchange, SET was designed to examine inter-personal exchanges. According to SET, exchanges are created and maintained because of a shortage of resources which prompts actors to engage with one another to obtain valuable inputs. Thus, SET focuses on the social relations and personal ties between the actors that shape the exchange of resources and benefits. Personal ties can be viewed as the bonds that result from ongoing successful mutually rewarding interactions. They are founded on trust, reciprocation and reward. While its origins are at the individual level, social exchange theory has been extended to organisational and inter-organisational levels (Aiken and Hage 1968, Jacobs 1974, and Levine and White 1961).

In applying the SET lens several assumptions are made and are outlined in this section. The organisations in this research are engaging in collaborative innovation relationships because they both believe that more successful innovation outcomes will be achieved as a partnership, as opposed to a standalone entity. So, self-interest is the original motivation. In real terms, the relationship is prompted by a scarcity of

crucial innovation resources within their own organisation boundaries, for example, creative resources or technical know-how that is stored tacitly. There is no pre-determined set of obligations prior to the collaborative innovation relationship. The ongoing interactions in this relationship are voluntary. For each voluntary exchange there is an expectation of reciprocity. When this expectation of reciprocity is fulfilled, the ties between the parties become closer and they engage in more voluntary and reciprocal exchanges. These exchanges are not only economic but also include social exchanges which encourages even more voluntary and reciprocal exchanges. This is self-perpetuating, the more ongoing the voluntary and reciprocal exchanges become, the closer or friendlier the organisations become, this then generates a higher level of trust and commitment, which encourages more exchanges. Over time, as a result of both the closer ties and ongoing exchanges between the organisations, a long-term orientation of the relationship is adopted. CII is reflected by ongoing exchanges in the innovation process including joint communication, joint information exchange, joint problem solving, joint learning, joint creativity, and joint social bonding. The definition of CII will be outlined further in chapter 3. These exchanges are ongoing and are individually distinguishable, with each one reflecting CII. CII is a measure of the depth of these exchanges at a point in time. In this research, the SET framework is adopted in the context of understanding how different levels of CII arise in a B2B relationship. The framework pinpoints how the role of the reciprocal exchanges reflect the development of close relationships but also the roles played by the existence of trust and commitment between the partners. Table 2.2 details some of the collaborative research studies undertaken to date.

Table 2.2 Collaborative Innovation Research

Author	Type	Country	Theory	Method	Sample Size	Aspects of Collaboration	Dimensions of Collaboration	Findings
Bahemia et al. (2017)	Supplier and Customer Involvement	UK	TCE	Survey	N=205 14% RR	Collaboration with different partner types	Breadth Depth	Positive gains accrue from opening up the project to multiple partners. There is a positive and direct relationship between partner newness and innovation performance. Positive and significant relationship between breadth and performance where there is strong appropriability. Negative direct relationship between depth of openness and innovation performance.
Baraldi (2008)	Supplier and Customer Involvement	Sweden	IMP	Qualitative Case Study		Customer and Supplier collaboration	Breadth	NPD solutions entail extensive interaction in customer-supplier relationships. NPD solutions cannot first be conceived and then implemented, must be enacted jointly between user and supplier. Research focuses on the role of sales in customer/supplier involvement in NPD.

Coviello and Joseph (2012)	Customer Involvement	New Zealand	Open frame, draws on a range of theoretical arguments	Inductive process method		Customer and Supplier Collaboration		The authors use an inductive process method to study how six major innovations were developed for B2B markets by small and young technology firms. Three of the six were successful with the other three failing. The successful projects were distinguished by the application of customer participation.
Cao and Zhang (2011)	Supplier	USA	Relational View Extended RBV	Web Survey	N=227	Supply chain collaboration Process Relations	Information sharing Goal congruence, Joint decision making Incentive alignment Resource sharing, Joint communication Joint knowledge creation	Reliable and valid scales for supply chain collaboration and collaborative advantage.
Fang (2008)	Customer Involvement	Not outlined in research	RET	Survey	N=143	Customer involvement as an information source and a co-developer	Participation Process	The author differentiates dimensions of customer participation: the customer as an information source and the customer as a co-developer.
Lawson et al. (2009)	Supplier Involvement	UK	RET	Web based surveys	N= 111 RR = 14.8%	Formal and informal	Knowledge sharing	There is a non-significant relationship between

						socialisation mechanisms Knowledge sharing		formal socialisation and knowledge sharing. Informal socialisation was positively and significantly related to knowledge sharing. Formal socialisation was positively and significantly related to higher levels of informal socialisation. Knowledge sharing was positively associated with supplier development outcomes and in turn with supplier development performance. Improved buyer product development was positively related to financial performance.
Morgan et al. (2018)	Customer Involvement	USA	RET	Email survey	N=243	Customer involvement in different activities	Single item measure	Customer involvement is positively related to NPD performance. Innovativeness mediates the relationship between customer involvement and NPD performance A firm's absorptive capacity positively mediates the relationship between customer involvement and NPD performance. A firm's absorptive capacity positively moderates the

								relationship between customer involvement and product innovativeness.
Mishra and Shah (2009)	Supplier and customer involvement	Finland Sweden Germany Japan Korea USA	RBV Complementary theory	Part of "High Performance Survey" Manufacturing Survey (2005-2006)	N=189	Supplier involvement Customer Involvement, Cross functional teams	Second order collaborative competence measured by first order constructs Supplier and customer involvement Cross functional teams	Collaborative competence has a significant effect on project performance but an insignificant effect on market performance. .
Petersen et al. (2005)	Supplier Involvement	USA	RET TCE Organisational Design Theory Network Governance	Case Studies Survey	N = 134	Supplier involvement	Intensity of Involvement Stages of Involvement	Selection of supplier with the right capabilities and culture to work on project key positively associated with effective decision making by project team. (True regardless of the stage of involvement). Where the supplier assumes high responsibility involvement at the design stage is positively associated with effective decision making by project team.
Wagner and Hoegl (2006)	Supplier Involvement	Germany Switzerland Austria	RBV Relational	Case Study		Collaboration on know-how projects Collaboration on capacity projects	Closeness of the relationship	Closeness of the collaborative relationship particularly when the outcome of the project is unclear or risky. The degree of supplier involvement is influenced by the level of trust and

								commitment between the parties.
Yli-Renko et al. (2008)	User involvement.	USA	RET	Mail survey Telephone interviews Web searchers Archival data			Closeness of the relationship	The authors argue that the impact of customer involvement on NPD success depends on firstly: how dominant the customer is in terms of revenues and secondly the size and relational embeddedness of the customer portfolio.

Source: Compiled by Author

Key: Author(s) = cited author(s), Type=partner type, Country =research origin, Theory= research theoretical framework, Method=data collection, Sample size= number in sample, Aspects of collaboration= characteristics of collaboration being studied, Dimensions of collaboration= Depth/breadth, Findings=findings of research.

2.5 Chapter Summary

This chapter defines and outlines the characteristics of innovation. It presents the key reasons why organisations innovate. It details both the traditional model of innovation (closed innovation) and the open innovation model and compares both models from a literature perspective.

This leads to a discussion on collaborative innovation including customer involvement and supply chain innovation. The chapter closes with a detailed analysis of SET. This section focuses on the SET framework in the context of CII. Chapter 3 presents the conceptual framework for the CII measure.

Chapter 3 Defining Collaborative Innovation Intensity (CII)

3.1 Introduction

CII is a second order latent construct. By its nature, this behaviour is not observable and is therefore reflected in other behaviours referred to as dimensions in this research. This chapter identifies the dimensions of CII. Six dimensions including the degree of joint communication, joint information exchange, joint learning, joint problem solving, joint creativity and joint social bonding are presented and discussed. Their place in the literature to date is explored including their roles in other NPD research studies and finally the characteristics of each dimension are explored with specific reference to the extant literature that has been published to date. The next section will define CII in the context of this research.

3.2 CII Defined

CII is the degree (or breadth) to which business-to-business relationship partners jointly engage in the innovation process. The CII construct is abstract and consequently is not observable. Rather it is reflected by six sub processes or dimensions. The six sub-processes that reflect CII are joint communication, joint information exchange, joint learning, joint problem solving, joint creativity and joint social bonding. These six sub-processes are observable and vary in intensity. The measurement of CII is cross sectional across these six dimensions at a point it time. For CII to be high, the firms must be strong in all six dimensions. The following sections discuss the six dimensions in the context of CII.

3.3 Dimensions of CII

3.3.1 Joint Communication

3.3.1.1 Joint Communication and Relationships

The foundational relationship marketing authors of the 1980s and 1990s, for example, Webster (1992), highlight the importance of developing close relationships with customers. Research further indicates that long-term high-quality relationships with customers potentially enable an organisation to create a competitive advantage relative to organisations without such relationships (Ganesan 1994). In this regard, communication plays a vital role in maintaining these relationships (Morgan and Hunt 1994, and Palmatier, Dant, Grewal, and Evans 2006).

Specifically, poor communication quality not only damages mutual relational exchange (Mohr, Fisher, and Nevin 1996), but also impedes information exchange between the partners (Jaworski and Kohli 1993). Hence, researchers have focused on the provision of actionable guidelines for managers to develop effective joint communication strategies and programmes (Joshi 2009, Mohr and Nevin 1990, Mohr et al. 1996, and Paulraj, Lado, and Chen 2008).

In the IOR literature, joint communication is seen as of particular importance within channel systems. Mohr and Nevin (1990), describe joint communication in this context as being akin to the social glue that holds the parties together. In the same vein, Schein (1994) suggests that this communication is the “lifeblood” and “circulatory system” of an IOR. Mohr and Nevin define joint communication in terms of intensive relationship building as certain communication facets including frequency, bi-directionality, format and content. Mohr and Nevins’ definition of joint communication with reference to relationship building is accepted and supported in other business literature, with some studies showing that the more successful partnerships exhibit better joint communication processes (Holden and O’Toole 2004, and Mohr and Spekman 1994).

Joint communication facets as defined by Mohr and Nevin (1990) are also explored by other authors in the partnership literature where it is suggested that it is the quality and the content of communication that is the key ingredient to partnership success (Anderson and Narus 1990, PemartÍn RodrÍguez-Escudero, and Manuera-Alemán 2018). It is also posited that content and quality are strong determinants of trust development (Morgan and Hunt 1994) which in turn strengthens the relationship. Another facet, two way or bi-directional communication is also recognised as critical to fostering and maintaining value enhancing IORs (Anderson et al. 1994, Mohr et al. 1996, and Schultz and Evans 2002). These characteristics of joint communication will be further discussed later in this chapter. Table 3.1 outlines a selection of IOR research studies that demonstrate the importance of joint communication in the context of B2B collaborative NPD.

Table 3.1 IOR Studies that include Joint Communication

Author	Findings
Anderson and Narus (1990)	Joint communication is defined as the formal and informal sharing of information. The-emphasis is on the quality of information as opposed to the quantity.
Mohr and Nevin (1990)	Joint communication in the channel context can be compared to the social glue that holds the parties together.
Mohr and Spekman (1994)	To achieve the benefits of collaboration, effective communication between the partners is essential. Communication quality is perceived as a key factor of partnership success. Quality relates to the timeliness, accuracy and relevance of the content communicated.
Kanter (1994)	Joint communication is one of the key dimensions required for successful IORs.
Morgan and Hunt (1994)	Timely, relevant and reliable joint communication fosters trust.
Mohr et al. (1996)	Collaborative communication differentially affects outcomes under various types of governance. Specifically combining collaborative communication with low levels of governance may be a viable strategy to enhance outcomes.
Hutt, Stafford, Walker and Reingen (2000)	Communication across boundary spanners strengthens co-operative relationships.
Holden and O'Toole (2004)	The role of the individual facets of communication in IOR governance.
PemartÍn et al. (2018)	The role and effect of the individual facets of communication on NPD out comes.

3.3.1.2 Joint Communication and NPD

The literature is replete with studies that explore and discuss the role of joint communication during NPD. The studies can be grouped together by different criteria, one such grouping being different NPD approaches (previously discussed in chapter 2). These include traditional intra-organisational projects, distributed intra-organisational projects, and distributed inter-organisational projects.

Communication in traditional product development projects (single firm, one location) has been studied extensively over the years. These studies incorporate communication between individuals (Kyriazis, Couchman, and Johnson 2013, and Massey and Kyriazis 2014), and between functions (Jacobsen, Grunert and Sϕndergaard, Steenbekkers, Dekker, and Lähteenmäki 2014, and Tang, Mu, and Thomas 2015). Findings demonstrate that frequent, bi-directional and quality communication is crucial to successful NPD outcomes in the traditional closed model approach.

Distributed, intra-organisational NPD projects (single firm, different locations) although still carried out by a single firm, are further complicated because implementation is carried out across different geographical locations (Leenders, Engelen, and Kratzer 2003, and Suchan and Hayzak 2001). The findings from these studies suggest that this type of NPD approach creates significant communication challenges for both team leaders and members. However, frequent, bi-directional and quality communication is still cited as being crucial in achieving successful NPD outcomes.

While joint communication in intra-organisational NPD forms the foundation for communication studies during inter-organisational NPD (crossing organisational boundaries), joint communication in this context has been shown to pose even more difficulties including such factors as lack of trust, organisational culture alignment and even legal issues. The following section will focus on joint communication in NPD projects in IORs.

Collaboration between suppliers and customers is one form of inter-organisational collaboration. With this approach, the customer does not only outsource production,

but also outsources part of the product development to the supplier. The type of supplier involvement varies, sometimes frequent communication is undertaken reflecting close collaboration, whereas at other times a more distant relationship with infrequent communication is formed. Wynstra and Pierick (2000) suggest a classification of supplier involvement according to the development risk and the degree of development responsibility held by the supplier. These authors presume that communication needs also vary as a result of these criteria. If the development risk is high and the supplier has high development responsibility, frequent, interactive communication through rich media, such as face-to-face communication, is recommended reflecting high levels of CII. If the development risk is still high, but the supplier's development responsibility is low, less interactive communication is sufficient, because the supplier needs mainly to comment on what is or not possible to manufacture, thereby reflecting a low level of CII. Where the development risk is low and the supplier takes care of the development quite independently, the use of rich media and frequent communication is recommended, as the supplier needs to know exactly what is required. Finally, where the development carries low development risk and low design responsibility for the supplier, minimal communication using media of low richness suffices. Wynstra and Pierick (2000) suggest that firms can adopt an involvement type that best meets their purposes using this development risk criteria and determine the communication approach that will deliver the best NPD outcomes.

The joint communication process may be at different intensity levels depending on the phases of a NPD project, thereby reflecting different levels of CII. The early project phases carry a high level of uncertainty and the supplier cannot be given all the details at once. Moreover, designs may change during the project when new information becomes available. To reduce any uncertainties that the supplier faces, Wynstra and Pierick (2000) suggest that joint communication in the early phases of the product development should be frequent and interactive. Regular face-to-face communication is best suited in this context. Furthermore, face-to-face meetings are, according to these authors, the easiest way to check whether both parties have understood each other correctly. Wynstra and Pierick also stress the importance of

rapid communication lines, so that product development is not delayed as a result of inefficient communication. By rapid lines they mean direct contacts, for example, between the development engineers from both sides. Early supplier involvement has brought several benefits, improving both project effectiveness, in terms of product costs and quality, and project efficiency, in terms of development cost and time (Johnsen 2009, Schiele 2010, and Wagner and Hoegl 2006). Most of the product costs are formed during the product development phase. Therefore, during this phase the supplier should have access to all available information. The suppliers can bring their design and manufacturing knowledge into the design phase, resulting in better product designs and easier manufacturing. Moreover, the suppliers can identify potential problems and solutions early, reducing both the time and cost of design (Sun, Yau, Suen, and Kwok 2010). In addition to early problem solving, supplier involvement helps product designers understand the manufacturing restrictions and pay attention to them (Wagner and Hoegl 2006). However, early supplier involvement does not always lead to success. The results can even be the opposite, for example, increased development and product costs, lower product performance and longer than expected development time (Moon, Johnson, Mariadoss, and Cullen 2018). In addition, a lack of communication and trust may lead to unclear agreements and differing expectations, which complicates collaboration (Sjoerdsma and van Weele 2015). Outsourcing the design phase is difficult because of high technological uncertainty connected with the design process. The writing of an accurate agreement or deciding the correct price poses special challenges as well (Wagner and Hoegl 2006). Moreover, problems arise if the customer fails to communicate its requirements and expectations to the supplier correctly. In addition, if a clear project plan and work-packages are missing or the basic principles of collaboration have not been decided, differing interpretations may develop. If the customer does not have a well-defined product development process it can be difficult to decide when and how the suppliers should be involved (Wynstra, Van Weele, and Weggemann 2001). As demonstrated here, there is a broad range of literature that explores and discusses the role of joint communication in collaborative NPD.

Croom (2001) further categorises the interaction processes between the supplier and the customer. He posits that interaction between companies takes the form of formal or ad-hoc communication. A formal, more pre-determined communication uses channels such as team meetings with resident engineers. These formal communication channels can be described through standard operating procedures. In contrast, ad-hoc communication is a less formal and reactive form of interaction and may pose challenges. Officially, ad-hoc communication is quite often handled as if it does not exist, often resulting in it not being supported. As ad-hoc communication has been shown to be beneficial, this is not an effective approach. Table 3.2 summarises the main IOR studies that include joint communication in both intra-organisational and inter-organisational NPD.

Table 3.2 NPD Studies and Joint Communication

Author	Main Findings
Croom (2001)	In early supplier involvement it is important that both structured and ad-hoc processes for the interaction are developed. A lack of ad-hoc interaction may lead to failure.
Jacobsen et al. (2014)	Both structural and process mechanisms can support internal communication. Internal and external uncertainty increases the need for internal communication. The need for internal communication is higher in the early stages of NPD.
Kyriazis et al. (2013).	The integration of specialist knowledge is at the core of all best practice NPD processes. In order to achieve this integration, functional specialists need to communicate effectively with one another. The role played by formal and informal communication on relationship investment and perceived relationship effectiveness is examined.
Leenders et al. (2003)	Team creativity is essential to the performance of an NPD team. Findings suggest that team creativity requires a moderate frequency of communication, and a low level of communication centralisation. A three factor model including: member proximity, communication modality and team task structure is presented that addresses how creativity and NPD can be managed through effective design and management of virtual teams.
Massey and Kyriazis (2014)	Where different functional managers recognise their interdependence, they engage in more frequent, bi-directional communication. This has been shown to positively influence the quality and effectiveness of their relationship which can in turn enhance NPD project success.
Sjoerdsma and van Weele (2015)	Findings from this research demonstrate that a closer relationship allows for greater knowledge transfer

	between partners, more innovative ideas and positive NPD outcomes.
Wynstra and Pierick (2000)	Four types of supplier involvement were defined: strategic, critical, arms-length and routine. Communication interfaces for these types were defined in terms of direction of the information flow, the communication media used, the amount of communication, the topics discussed and the functions involved. The purpose of this classification is to help companies select a suitable supplier involvement type and understand the communication requirements it poses.
Wynstra et al. (2001)	This study examines three related critical issues for supplier involvement in collaborative NPD: (1) identification of specific processes and tasks for the broader area of purchasing involvement in product development (2) forming an organisation that supports such tasks and (3) staffing the organisation with people that have the right skills.

3.3.1.3 Collaborative Studies that include Communication

There is a broad range of literature that explores and discusses the role of joint communication in collaborative NPD. Two such studies are outlined here. The first study outlined is the seminal work of Gruner and Homburg (2000) whose research is in the context of user involvement. The second outlined is undertaken by Pemartín et al. (2018). In contrast to Gruner and Homburg, this research is carried out in the context of supplier involvement. It is also the most up to date published research that this researcher could find in the research area of collaborative communication.

Gruner and Homburg (2000) through the combination of field interviews (12 in the German machinery sector) followed by a survey (1219 respondents with a response rate of 25.6 percent) identified the key elements of the measure customer interaction intensity and developed a scale for the measurement of this construct. The effect of different intensities was then modelled on the outcome variables of NPD success. Six items of the construct were identified with frequency of meetings with customers being one. Their findings suggest that the intensity of customer interaction during the early and late stages of the new product development process can increase new product success whereas interaction during the medium stages yields no performance impact.

The most recent study in this area was undertaken by Pemartín et al. (2018). This research investigates the impact of the facets of collaborative communication on NPD outcomes. The facets of communication are defined as: frequency of communication, formality of communication, and bi-directionality of communication. Each facet of communication has its own measure (borrowed or adapted from previous published research). The outcomes of NPD are quality of product and adherence to budget and schedule. The research focuses exclusively on communication between organisations as the success of NPD work carried out in collaboration has been deemed in previous work to depend on how well partners interact and communicate with one another (Hoegl and Gemüenden 2001). Data was collected using a web-based questionnaire. The initial sample included 2679 companies from diverse sectors. These sectors were chosen because they had been previously shown to have high innovation and NPD collaboration rates. 207 responses were received indicating a response rate of 7.7 percent. While the response rate could be interpreted as low, n=207 is considered adequate for the statistical analysis that was undertaken in this research. Co-variance path analysis with maximum likelihood (ML) estimation (IBM AMOS 20) was used to test the hypotheses. Findings were as follows: frequency of communication positively influences adherence to budget and schedule but does not have a significant impact on product quality. Formality of communication has no significant impact on either product quality or adherence to budget and schedule. Reciprocal feedback has no significant impact on budget and schedule but has a significant impact on product quality.

3.3.1.4 Key Elements of Communication Measured in Previous Studies

Organisational communication includes many elements. The following elements are collated from the literature. Communication has at least two parties, a sender and a receiver, and their communication depends on a relationship. Communicators may be part of a communication network and depending on the structure of the organisation or network the direction of communication can be upwards, downwards or horizontal (Downs and Adrian 2012).

Frequency of contact between organisations otherwise termed as the timeliness of communication is discussed in much of the alliance/partnership/NPD literature (Antoncic and Prodan 2008, and Pemartín et al. 2018). It has been suggested that a minimum amount of contact is necessary to ensure adequate co-ordination. However, on the other hand too much contact can overload team members particularly in the NPD area, perhaps leading to group think.

Formal and informal communication is another facet that is widely discussed in the literature (Schreiner, Kale, and Corsten 2009, and Tang and Thomas 2015). In formal communication, the message flows through official, prescribed channels, determined by the organisational hierarchy or job functions. Formal, more predetermined communication uses channels such as team meetings and resident engineers. These formal communication channels can be outlined through standard operating procedures (Croom 2001). In contrast, informal communication is based mainly on personal relationships. It is spontaneous, interactive and rich and is often exchanged interactively (Tang and Thomas 2015). Both formal and informal communication has been linked to improved NPD performance outcomes (Polat, Lynne, Akgün, and Onat 2018). While both types have also been linked to joint learning, informal communication has been shown to have a greater impact (Tang and Thomas 2015).

A further classification of joint communication is by media use. Today, much of organisational communication takes place through electronic media. When choosing a suitable communication media, media richness theory offers some advice (Ambrose, Marshall, Fynes, and Lynch 2008). According to Ambrose et al., media richness theory managers will use communications channels with the appropriate level of richness for the purpose in hand. This reflects previous findings which reference the value of face-to-face communication for transmitting messages containing equivocality, whereas written media is better suited for unequivocal messages. Table 3.3 summarises the main IOR research studies that include the key elements of joint communication.

Table 3.3 Elements of Joint Communication Measured Previously

Author	Findings
Antoncic and Prodan (2008)	Open and prompt communication is vital for successful IORs. Poor communication between partners can significantly undermine relationship performance.
Ambrose et al. (2008)	According to media richness theory, managers will choose communication channels with the most appropriate level of richness for a given purpose.
Croom (2001)	In formal communication, the messages flow through official prescribed channels.
Downs and Adrian (2012)	The book outlines and discusses organisation audits and encompasses all aspects of communication.
Pemartín et al. (2018)	Frequency of communication between partners during the NPD process is vital to product quality and aids adherence to budget and schedule for the project.
Polat et al. (2018)	This study has a holistic view of team factors to examine their relationship with team communication. Communication contributes to technical and practical processes such as learning, new idea development, and creativity. This paper attempted to offer a contribution to the technology and innovation management (TIM) literature by presenting a model for researchers and project managers to understand potential interrelationships among team level factors (team autonomy, stability, member experience, and empowerment), team trust, and team formal and informal communication in NPD teams.
Tang and Thomas (2015)	This study investigates the influence of different communication modes on joint learning. Findings suggest that for tasks defined by exploration, informal or face to face communication is positively associated with joint learning. In contrast for tasks defined by exploitation, formal communication is positively related to joint learning.

3.3.1.5 Summary and Hypothesis

Communication between partners has been identified in the alliance literature as being key to IOR success (Andersen and Narus 1994, Holden and O'Toole 2004, and Mohr and Nevin 1990) and the NPD literature as being instrumental in the success of the NPD development process (Gruner and Homburg 2000, and Pemartín et al. 2018). Key aspects of communication mentioned in previous studies are the content and quality (Mohr and Spekman 1994) and modality (Ambrose et al. 2008). For this research joint communication is defined as an ongoing exchange between both organisations. It is characterised by the frequency of meetings between the organisations, regular face- to- face interactions, formal and informal communication and a high number of people from both organisations being involved. Previous literature reasoning leads to the following hypothesis:

H1a: Joint communication is a dimension of CII.

3.3.2 Joint Information Exchange

3.3.2.1 Joint Information Exchange and Relationships

Information exchange in business relationships can be defined as the expectation by both parties that information that is useful will be openly shared. This open sharing of information is evidenced by the willingness of both parties to share important even proprietary information (Cannon and Perreault 1999). Through the development of several models and frameworks in the literature including Barratt (2004), Kauser and Shaw (2004), Mohr and Spekman (1994), and Morgan and Hunt (1994), our understanding of the meaning and the role of information exchange in the IOR context has been greatly enhanced. Each of these frameworks and models adopt a different focus with regards to the construct, with some emphasising the importance of how and when the information exchange occurs (Anderson and Narus 1990, and Heide and Miner 1992) and others concentrating on the type of information exchanged (Mohr and Spekman 1994). However, the focus of much of the extant research is on the content characteristic of the information exchanged (Mohr and Spekman 1994).

The specific characteristics of information exchange are discussed later in this chapter. All of these frameworks have one common denominator, that being that information exchange is an important predictor of partnership success (Sambasivan, Siew-Phaik, Abidin Mohamed, and Choy Leong 2011). While most partnerships will display the characteristic of information exchange to some extent, partnerships that engage in a higher intensity of said behaviour exhibit a higher degree of success (Dyer and Singh 1998, Mohr and Spekman 1994, and Kwok, Sharma, Singh, Gaur, and Ueno 2018). Partnership success is testified to be: more efficient completion of tasks through co-operation (Heide and Miner 1992), additional success being achieved in the maintenance of the partnership (Anderson and Narus 1990), and increased levels of satisfaction with partnership outcomes (Anderson and Narus 1990, and Morgan

and Hunt 1994). Table 3.4 summarises the findings of B2B studies that include joint information exchange.

Table 3.4 IOR Studies that include Joint Information Exchange

Author	Findings
Anderson and Narus (1990)	Distributor and manufacturer working partnership, concentrates on the efficacy of information exchange, as opposed to the frequency. Information exchange leads to trust which leads to co-operation.
Barratt (2004)	Information exchange, particularly the transparency and quality of the information flows is critical to supply chain collaboration success.
Cannon and Perreault (1999)	Joint information exchange is one of the key connectors in buyer-seller relationships in B2B markets.
Dyer and Singh (1998)	Knowledge/information sharing routines lead to generation of relational rents.
Heide and Miner (1992)	Information exchange leads to more efficient completion of tasks through co-operation.
Kauser and Shaw (2004)	Behavioural characteristics including information exchange are key to the success of international alliances.
Kwok et al. (2018)	In a study of 205 international joint ventures (based in China), findings show that local and foreign partners collaborate through information exchange leading to better performance outcomes.
Morgan and Hunt (1994)	Formal and informal sharing of information fosters trust which leads to co-operation.
Mohr and Spekman (1994)	The systematic availability of information allows people to complete tasks more effectively (Guetzkow, 1965), is associated with increased levels of satisfaction (Schuler, 1979), and is an important predictor of partnership success (Devlin and Bleackley, 1988).
Sambasivan et al. (2011)	Communication with frequent and relevant information exchange enhances partnership success.

3.3.2.2 Joint Information Exchange and NPD

Information exchange during NPD refers to the extent to which partners effectively exchange critical information pertaining to the product idea, market and competition, and other issues within the NPD process. Within the early new product development literature, several studies were undertaken to seek the determinants

of NPD success. Some studies include a broad range of possible determinants (Athaide and Klink 2017, Calantone and Cooper 1981, Cooper and Kleinschmidt 1987, and Montoya-Weiss and Calantone 1994), while others focus on a detailed analysis of a limited range of key determinants of NPD outcomes, for example, Athaide and Klink (2009) and Petersen, Handfield, and Ragatz (2003). Intense information exchange is identified in both the general and specialist studies as a determinant. Due to the wider objectives of the extant research, no attempt has been made within these generalist studies to examine how the intensity of the information exchange affects the success of NPD. Focus within the more specialist studies is on user involvement in the NPD process with Zirger and Maidique (1990) suggesting that the development process for NPD success is characterised by frequent and deep customer interaction at all levels and all through the development and launch process. Information exchange is a variable of this customer interaction.

In the later product development literature, much still continues to be written regarding the impact of information exchange on the overall NPD performance outcomes. In the main, this impact is believed to be positive (Fang 2008, and Foss, Laursen, and Pedersen 2011). However, Koufteros, Vonderembse, and Jayaram (2005), suggest that this positive performance impact is not always a given and may depend on partner type (customer of supplier). Their findings suggest that information sharing with suppliers negatively affects product innovation and quality. In contrast, in the user involvement literature, the bi-directional transfer of often large amounts of information is seen as vital to ongoing collaboration in the NPD context.

3.3.2.3 Collaborative Studies that include Joint Information Exchange

Several studies were undertaken investigating customer interaction (including information exchange), for example, Biemans (1991), Gruner and Homburg (2000), and Shaw (1985). Biemans (1991) investigated the level of interaction in the Dutch medical equipment industry (n=17), but did not analyse any performance implications. In the same vein Shaw (1985), through his research in the British medical equipment industry (n= 34), found that customer interaction was related to

NPD success. Building on this previous research, Gruner and Homburg (2000) investigated the impact of customer interaction across different stages of the development process in NPD. The seminal research of Gruner and Homburg (2000) unveiled a research deficit regarding customer interaction as a means to improve new product success. Prior to Gruner and Homburg (2000) previous studies had provided mainly descriptive data on the impact on NPD outcomes of customer interaction. In addition, reliable and valid measurement of complex constructs had not been a primary concern of the studies. Through their empirical research they developed scales for *"intensity of customer interaction", the "characteristics of involved customers", and "NPD success".* These scales were developed by undertaking a deductive approach to the research and the application of advanced techniques of measurement development and validation. The research found that the intensity of customer interaction had an impact on the success of the project particularly during the early and late stages of the process.

3.3.2.4 Key Elements of Information Exchange Measured in Previous studies

NPD literature has established a positive link between information exchange and innovation or NPD performance outcomes. As already outlined, this exchange of information between the partners reduces uncertainty and allows for successful NPD performance outcomes (Un, Cuervo-Cazurra and Asakawa 2010). It is also suggested that the greater the intensity of information exchange between the partners, the greater the level of NPD effectiveness. The literature is replete with research outlining various facets of information exchange. As a result information exchange has been classified through different parameters, for example, types of information shared, goal(s) of information shared, and level of sharing.

It has been suggested that depending on the different types of information exchanged that different NPD performance outcomes may be achieved. Content appears very frequently in the extant literature with many authors citing that the exchange of sensitive or proprietary information is key to the success of a partnership (Fang 2008, and McNally and Griffin 2007). Huber and Daft (1987) suggest that closer

ties result in more frequent and more relevant information exchanges between high performing partners. By sharing information and by being knowledgeable about each other's business, partners are able to act independently in maintaining the relationship over time. The systematic availability of information allows people to complete tasks more effectively, is associated with increased levels of satisfaction (Graca, Barry, and Doney 2015, and Schuler 1979), and is an important predictor of partnership success (Brinkerhoff 2002, Devlin and Bleackley 1988, Du, Lai, Cheung, and Cui 2012, and Ryu, So and Koo 2009).

Another facet of information sharing that has been explored in the literature is the relevance of the information exchanged (McEvily and Marcus 2005, and Uzzi 1997). Both papers posit that for joint problem solving to occur that it is necessary for the partners to share information that is relevant to the problem. However, in much of the literature to date the focus has been on the content of the information being exchanged with most authors citing the exchange of proprietary or sensitive information between the partners as being key to successful outcomes including NPD outcomes (Cannon and Perreault 1999, Heide and John 1992, Heide and Miner 1992, McEvily and Marcus 2005, and Selnes and Sallis 2003). It is posited that increased levels of this type of information or knowledge sharing between partners can help in integrated problem solving, take advantage of a partner's knowledge and expertise and enhance the resultant products or processes (Takeishi 2001).

3.3.2.5 Summary and Hypothesis

Information exchange has been posited as crucial to the success of partnerships in the general relationship literature (Andersen and Narus 1990, Cannon and Perreault 1999, Dwyer et al. 1987, Frazier 1983, Mohr and Spekman 1994, and Morgan and Hunt 1994). In the main, it is suggested that it is the efficacy as opposed to quantity of the information exchange that is critical. While it is noted that all partnerships display the information exchange characteristic, it is suggested that partnerships that have a higher intensity of information exchange on the critical issues tend to have greater partnership success (Mohr and Spekman 1994). Following an NPD literature review, two types of studies have

been identified regarding the determinants of NPD success both generalist and specific research studies (Gruner and Homburg 2000). The generalist and specialist research studies both identify information exchange as a key determinant of NPD success. Prior to Gruner and Homburg (2000), most research was descriptive with little attention paid to measurement development or validation. Through their empirical research, they addressed the then research gap surrounding the link between the intensity of information exchange and NPD success and the impact of the characteristic of customers involved in the NPD. For this research joint information exchange is defined as the ongoing sharing of information between both organisations. The intensity of joint information exchange is characterised by the sharing of information both freely and frequently between partner organisations, the sharing of information with a partner if this information (including proprietary information) is of value to them, and by being able to contact anybody in one's partner organisation. Previous literature reasoning leads to the following hypothesis:

H1b: Joint information exchange is a dimension of CII.

3.3.3 Joint Learning

3.3.3.1 Joint Learning and Relationships

Organisational learning can be defined as a psychological process that exists at various levels of the organisation (Bontis, Crossan and Hulland 2002, and Crossan and Bedrow 2003). Crossan and Bedrow define the joint learning process as involving knowledge acquisition, information distribution, information interpretation and the creation of organisational memory. They suggest organisational relationships are an effective way to acquire new knowledge, thereby enhancing the success of the organisation. However, these relationships are not without risk, because either party can opportunistically use the IOR framework to exploit their partner's expertise, otherwise termed as self-interest seeking with guile by one of the partners (Hennart 1991, Khanna, Gulati, and Nohria 1998, Kogut 1991, Pisano 1989, and Williamson 1991). Consequently, the potential for conflict is ever present. Much of the IOR literature has focused on this potential for opportunism and has adopted the TCE lens to examine and explain this aspect. The TCE lens is a narrow one and has been

criticised by many scholars, as it does not capture the social exchanges and management relationships that exist between partners during the formation and post formation phases of IORs. Consequently, it does not capture all the variables that are inter-woven in joint learning in the IOR context.

The extent to which joint learning between partners is achieved is dependent on each organisation's absorptive capacity and on the transparency and co-ordination strategies that are adopted by the partnership (Cohen and Levinthal 1990, Lane and Lubatkin 1998, and Ring and Van de Ven 1994). While it has been shown that the extent of absorptive capacity that exists in each organisation will determine the extent of joint learning achieved by the partnership, low transparency and non-cooperative behaviour will hinder this joint learning. In addition, joint learning has proven to be complicated because often the knowledge that is being exchanged is tacit (Polyani 1948). As this knowledge tends to be embedded in context specific relationships (Granovetter 1985), joint learning has proven extremely difficult to achieve. It has been shown that mutual respect and a willingness to accommodate each other's values and beliefs is required to facilitate joint learning in relationships. General Motors and Toyota demonstrated the challenges with General Motors struggling to transfer Toyota's manufacturing capability without questioning its own fundamental operating philosophies (Inkpen 1996). A harmonious relationship will enhance management effectiveness by reducing conflicts that arise due to structural and cultural differences. A partner who adopts a cooperative mode of behaviour is more likely to comply with the rules and discipline necessary to achieve the goals of the alliance. As some studies of learning in relationships indicate, the complexities of inter-firm learning underline the need to consider the dynamic interaction and exchange processes that facilitate this higher-level phenomenon (Doz 1996, Nooteboom 2000, and Steensma and Lyles 2000).

The learning relationships in which partners engage in joint learning constitute an important category of all IORs, for example, Bstieler and Hemmert (2010), Brettel and Cleven (2011), and Yan and Dooley (2014). In much of this research, it is argued that organisations that wish to share critical information or know-how with their partner must first understand where the relevant information or know-how resides

and who within the partner organisation possesses it (Dyer and Singh 1998). Close personal interaction between the partners enables individual members to develop this understanding. Joint learning is then contingent upon the exchange environment and the mechanisms that exist between the partners. Urban and von Hippel (1988) argue that close and intensive interaction between individual members of the partnership acts as an effective mechanism for joint learning. Therefore, joint learning success rests upon an iterative process of exchange between the partner organisations and the extent to which the members of both organisations have direct and close contact with each other (Arrow 1994, and Badaracco and Badaracco 1991). A Social Exchange approach provides the basis for such interaction. Building on the work of Selnes and Sallis (2003), for this research joint learning is defined as an ongoing process between organisations, where by adapting formal and informal interactions (1) partners share knowledge, (2) jointly make sense of this knowledge and (3) jointly integrate this knowledge into relational memory. High intensities of CII are reflected by high intensities of joint learning.

3.3.3.2 Joint Learning and NPD

In the literature, NPD is defined as a knowledge intensive activity (Goffin and Koners 2011), and as such, it is suggested that sustained improvement in NPD is dependent on knowledge transfer or ongoing joint learning between organisations (Cousins, Lawson, Petersen and Handfield 2011). This joint learning has been shown to change the way in which organisations approach problem solving which in turn helps them to avoid repetition of the same errors in the NPD process (Goffin and Koners 2011). However, the literature also finds that organisations are finding it difficult to learn from the NPD process and are in many cases repeating the same mistakes in subsequent projects (Michael and Palandjian 2004).

One of the main barriers to successful joint learning in NPD is that much of the knowledge generated is tacit, it is difficult to transfer, is connected with doing and is dependent on the interaction between individuals from both organisations (Goffin and Koners 2011, Mascitelli 2000, and Sarin and McDermott 2003). There has been much discussion in the literature surrounding the key role of tacit knowledge transfer

in successful NPD (Thomke and Fujimoto 2000), it is also recognised that the underlying processes for knowledge creation and dissemination in NPD are not well understood. Consequently, this knowledge creation and dissemination is proving difficult to achieve (Frank and Ribeiro 2014). However, one proposal in the literature that has been shown to be successful in this context, thereby, leading to successful innovation, is the employment of NPD teams (Akgün, Lynn, and Yilmaz 2006, Bstieler and Hemmert 2010, and Sarin and McDermott 2003). NPD teams are organisational work groups where individuals from diverse personal and organisational backgrounds come together for a limited time period. The team then works in close collaboration towards the creation, design, development and marketing of a new product(s) (Hyung-Jin Park, Jong Won Lim and Birnbaum-More 2009). In the context of inter-organisational collaboration, the team does not have to be a structured formal group but may manifest itself as a loosely connected network of individuals based in either organisation. The goal of these individuals is the superior marketplace success of this new product. As widely noted in relevant academic and popular literature one factor of NPD teams which can be applied to this inter-organisational network of individuals is that the knowledge acquired by an individual within the network, transcends beyond the individual mind and becomes a collective property that facilitates the mission of the group. This team learning is dependent on the interactions between individuals (Joshi, Sarker, and Sarker 2007) with tacit experience being transferred through regular informal or formal interactions. Table 3.5 summarises research findings linking joint learning and NPD.

Table 3.5 NPD Studies and Joint Learning

Author	Findings
Akgün Lynn and Yilmaz (2006)	The study purports to develop and empirically test a model of the team learning process and the teams impact on team performance in new product development teams.
Bstieler and Hemmert (2010)	Team and individuals learn through trial and error that is brought about by numerous interactions between members.
Frank and Ribeiro (2014)	This research presents a comparison of 14 knowledge transfer models. The comparison is based on content analysis. The main contribution of the study is the proposition of a new knowledge transfer model that integrates previous models so as to

	provide a more complete and consistent knowledge transfer framework.
Goffin and Koners (2011)	NPD is a complex activity that is dependent on knowledge generation and learning. Much of the knowledge generated is tacit, and is difficult to express. It is also connected with problem solving.
Joshi et al. (2007)	Findings indicate that members of NPD teams transfer significant knowledge through extensive interaction with other team members.
Lawson et al. (2011)	A combination of a firm's technical capabilities and an increase in joint learning leads to improved NPD and financial performance.
Mascitelli (2000)	The ability to create a stream of revolutionary new products can represent a sustainable competitive advantage for firms in almost any industrial sector. This research suggests that successful NPD, especially breakthrough innovations result from the harnessing of tacit knowledge. This tacit knowledge rests with the individual and project teams. Tacit knowledge lies beneath the surface of conscious thought and is accumulated through a lifetime of experience, experimentation, perception and learning by doing.
Michael and Palandjian (2004)	Organisation learning is believed to be critical to the competitiveness of the firm.
Sarin and McDermott (2003)	Study of 229 members (n=229) from 52 high-tech NPD projects, empirically demonstrates that team learning has a strong positive effect on innovativeness and speed to market of new products.
Thomke and Fujimoto (2000)	In this study the authors propose a link between problem solving and/or knowledge transfer and NPD performance.

3.3.3.3 Collaborative Studies that include Joint Learning

Few studies have investigated the relationship between joint learning and NPD outcomes. In fact, following an overarching literature review only one study could be found that empirically investigated this relationship. This research study was undertaken in 2003 by Sarin and McDermott. The research investigates intra organisational learning and the specific NPD outcomes: speed to market, and level of innovation introduced to the new product. The study was undertaken in the high-tech industry and consisted of two phases. In phase one nine organisations participated, with 26 in-depth interviews being carried out with NPD managers, NPD team leaders, and team members. In phase two, a survey instrument was administered to 246 individuals from 64 new product development teams. The findings statistically show that joint learning within NPD teams has a significant

positive relationship with speed to market and the level of innovation added to the new product being developed.

3.3.3.4 Key Elements of Joint Learning Measured in Previous studies

Joint learning in research studies to date is often viewed from both the knowledge based and learning based views of the organisation. The knowledge-based view depicts an organisation as storerooms of competencies and knowledge (Grant 2002, and Kogut and Zander 1996), whereas the learning based view is focused on the acquisition of knowledge with a view to the development of firm specific capabilities. Both knowledge and learning theorists recognise that the success or failure of joint learning in any alliance may be impacted by the characteristics of knowledge.

Joint learning can be characterised into two categories: degree and type. The degree of inter-organisational learning can be viewed as the amount of knowledge and information that partners need to share and receive. It has been argued in the literature that organisations capable of effective joint learning through knowledge transfer are more productive than organisations that are less capable of knowledge transfer (Argote 2012, Hansen 2002, and Kogut 2000). Other potential benefits of joint learning include advanced capabilities, creation of new resources (Khanna, Gulati, and Nohria 1998) and improved productivity and innovation (Hitt, Bierman, Shimizu, and Kochar 2001). Joint learning can be characterised as tacit and explicit (Collins 2010).

Explicit learning is easily codifiable and as such can be transferred easily, for example, in the form of written procedures (Kogut and Zander 1992). On the other hand, tacit learning is difficult to transfer, relates to doing and is dependent on the interaction between individuals in both organisations (Dyer and Singh 1998). It has been suggested in the literature that both metaphors and stories can aid in tacit joint learning. It is argued that metaphors aid in the transfer of tacit knowledge because they can communicate meaning where no explicit language is available, especially regarding complex and ambiguous experiences (Maravihas and Martins 2019). One of the reasons that it is claimed that metaphors can express what is not easily explainable is that firstly, metaphors can generate new meaning, secondly, that they

can render vague abstract ideas tangible and finally, because of their promotion of different ways of thinking, it is suggested that their use helps people to explain and understand complex organisational phenomenon. Central to the argument concerning the transfer of tacit knowledge using images is that it allows for the communication of a process. This matters because tacit skills are about capabilities, they are a process, and they are about doing things. Combining the importance of the articulation of tacit skills between both organisations in joint learning during NPD and the argument put forward by the literature regarding the success of metaphors and stories in the achievement of this articulation, the use of metaphors and stories has been identified as a measurement item of the joint learning process for this research. The utilisation of knowledge sharing routines has been identified as a method of facilitating tacit knowledge transfer and therefore joint learning. The shared routines represent the organisational memory and the transfer of the learning is being achieved through the use of the shared routines. Consequently, the use of shared routines has been adopted as a measurement item for this research. IORs vary in terms of their learning capabilities and thus some relationships perform better because they have developed appropriate learning mechanisms. Cannon and Perreault (1999) refer to these as operational linkages. It is argued in the literature that sometimes joint learning or transfer of knowledge is not effective because the receiving organisation is not equipped to understand what is being transferred. The use of a common vocabulary in relation to the project should facilitate effective joint learning. Therefore, the use of a common vocabulary has been adopted as a measurement item for joint learning for this research. This common or unique language goes beyond the language itself; it addresses the subtleties and underlying assumptions that are the crux of day to day interaction within any collaboration. It facilitates people's ability to gain access to others and to their knowledge and it allows for the evaluation of the likely benefits of exchange and combination of this knowledge. It provides a medium in which participants understand each other and facilitates the building of a common vocabulary. In this regard, it not only helps share ideas but also enhances the efficiency of communication between people with similar background or practical experience. Accordingly, a unique language will help engage the parties to actively engage in joint learning.

3.3.3.5 Summary and Hypothesis

Organisational learning is a multi-level phenomenon with inter-organisational learning being facilitated through the forming of relationships. Joint learning is contingent upon the exchange environment with Urban and von Hippel (1988) arguing that close and intensive interaction between members of the partnership act as an effective mechanism for joint learning. NPD is recognised in the literature as a knowledge intensive activity (Goffin and Koners 2011) with some researchers suggesting that improvement in NPD is dependent on ongoing joint learning between organisations (Gupta and Wilemon 1996, and Takeuchi and Nonaka 1986). The literature suggests that one of the main barriers to joint learning success in NPD is that much of the knowledge generated is tacit, which is difficult to transfer, is connected with doing and is dependent on the interaction between the individuals from both organisations (Dyer and Singh 1988, Goffin and Koners 2011, Mascitelli 2000, and Sarin and Mc Dermott 2003). One proposal in the literature identifies the utilisation of NPD teams as driving tacit knowledge transfer success (Akgün et al. 2006, and Bstieler and Hemmert 2010). The key elements of joint learning are identified in the literature as follows, the use of metaphors and stories (Goffin and Koners 2011), the use of knowledge sharing routines (Dyer and Singh 1988), and the adoption of a common vocabulary (Madhaven and Grover 1998). For this research, Joint learning is the development of new knowledge through ongoing interaction between the partners. The intensity of joint learning is characterised by the development of new knowledge through the adoption of knowledge sharing routines and a common language that is unique to the partner relationship. Previous literature reasoning leads to the following hypothesis:

H1c: Joint learning is a dimension of CII.

3.3.4 Joint Problem Solving

3.3.4.1 Joint Problem Solving and Relationships

Shared participation is one of the concepts that is mentioned repeatedly in the literature in relation to collaboration (Cannon and Perreault 1999, Heide and Miner

1992, McEvily and Marcus 2005, Schleimer and Shulman 2011, and Selnes and Sallis 2003). Some authors write of shared responsibilities (Cannon and Perreault 1999, Heide and Miner 1992, McEvily and Marcus 2005, Schleimer and Shulman 2011, and Selnes and Sallis 2003), others of shared decision making (Schleimer and Shulman 2011, and Dwyer, Schurr, and Oh 1987), some of shared planning (Andersen, Lodish, and Weitz 1987, Bstieler and Hemmert 2010, and Dwyer, Schurr, and Oh 1987), and even more of joint problem solving (Akgün, Lynne, and Yilmaz 2006, Cannon and Perreault 1999, Heide and Miner 1992, Kumar, Banerjee, Meena, and Ganguly 2016, McEvily and Marcus 2005, and Mohr and Spekman 1994). According to these studies, all these facets of sharing to different degrees can be observed in any collaborative undertaking. IOR problem solving has also been defined as the degree to which the parties to an exchange share the responsibility for maintaining the relationship itself and for whatever problems that arise during the relationship (Heide and Miner 1992). Such arrangements typically include routines for troubleshooting, thus enabling the resolving of any difficulties as they arise. Through problem solving, exchange partners develop relationship specific norms and specialised language, allowing for the successful transfer of complex chunks of tacit knowledge (Hansen 1999). Problem solving arrangements greatly enhance the learning that occurs in exchange relationships because, rather than exiting the relationship when there is a problem with the NPD project, either technical or relational, the parties work through the difficulties and receive direct feedback about activities and operations.

3.3.4.2 Joint Problem Solving and NPD

During NPD in an IOR, the use of inter-organisational teams is often employed. Inter-organisational teams are composed of representatives from both organisations. A potential advantage of using inter-organisational teams is the integration of knowledge that is unique to each organisation, through successful Interaction, leading to joint solutions that neither party would have found on their own. However, this advantage depends on the degree to which the knowledge within the team can be successfully shared. Misunderstandings can arise and valuable time may be wasted (Hagel and Brown 2005). Members of inter-organisational teams can succeed in overcoming these coordination losses by engaging in joint problem solving, which

provides a forum for interaction among team members and facilitates a middle ground from which to move forward with the project. Joint problem solving in IOR teams is defined as a process of ongoing mutual effort that the partners undertake to diagnose and overcome obstacles that are blocking project effectiveness (Narus and Anderson 1995). This process enables members of inter organisational teams to coordinate functions and work out problems ‘‘on the fly’’ thereby not only enriching the partnership with new solutions and new combinations of ideas (Uzzi 1997) but also speeding up the NPD.

3.3.4.3 Collaborative Studies that include Joint Problem Solving

Only one empirical NPD collaborative study was identified that incorporates joint problem solving. This research was undertaken by Bstieler and Hemmert (2010), with their research examining factors including joint problem solving that supports learning and time efficiency on inter-organisational project teams in new product development partnerships.

Their findings suggest that joint problem solving is particularly important for both learning and time efficiency within NPD. They additionally argue that to achieve optimal outcomes in collaborative NPD projects, such behaviours as joint planning and joint responsibilities also appear to be vital for successful collaboration

3.3.4.4. Key Elements of Joint Problem Solving Measured in Previous studies

The first key element of joint problem solving outlined in the literature is the provision of the opportunity to try, experiment, make mistakes, and then seek feedback from each other. It is suggested that such engagement in joint problem solving early in projects is critical to IOR project team success. Learning from the experiences of partner firms at the start can have a significant impact on the course and success of the collaborative NPD project. If the partners participate significantly in decisions and actions, joint problem solving will not only reduce information asymmetry, but will also generally ensure the buy-in of all partners (Saxton 1997). As a result, values and objectives of partners will be mutually understood and intertwined and will foster even more joint learning. Joint problem solving also

means not cutting corners but rather carrying out the development task faster in the long-term by drawing on the knowledge and skills of the involved partner firms to solve development problems.

3.3.4.5 Summary and Hypothesis

The extant literature suggests that specific joint problem solving behaviours such as joint planning and joint responsibilities reflect collaborative innovation within the firm. For this research joint problem solving is defined as an ongoing exchange between both organisations in an attempt to resolve any problems that arise. The intensity of joint problem solving is characterised by the partners supporting each other's objectives, by both partners making suggestions regarding the NPD project, by applying joint goals, and engaging in both joint decision making and joint planning. By the partners treating the problems that arise throughout the partnership as joint, and by adopting unique troubleshooting routines thus finding solutions. Previous literature reasoning leads to the following hypothesis:

H1d: Joint problem solving is a dimension of CII.

3.3.5 Joint Creativity

3.3.5.1 Joint Creativity and Relationships

Scholarly attention to creativity and innovation has increased dramatically over the past 30 years, resulting in these closely related phenomena emerging from the shadows of organisational behavioural scholarship into the mainstream literature (Sarooghi, Libaers, and Burkemper 2015).

Creativity has always been at the heart of human endeavour. Aligned with innovation, which can be defined as the creation of unexpected value, it is now seen as pivotal to organisational performance. With the shift to knowledge economies worldwide, there is vast interest in creativity and innovation in the workplace. Creativity is the process of delivering novel, appropriate ideas in any realm of human activity, from science to the arts to education to business to everyday life (Amabile and Pratt 2016). The ideas must be novel, that is, different from what's been done

before, but they can't simply be bizarre, that is, they must be appropriate for the problem or opportunity presented (Koen, Ajamian, Boyce, Clamen, Fisher, Fountoulakis, Johnson, Puri, and Seibert 2002). Group or team creativity closely reflects the definition of individual creativity and is defined once again as the process of delivering novel and useful ideas concerning products, services and processes by a team of individuals working together (Wang, Kim, and Lee 2016). "Individuals working together" is the key element of this definition. Finally, organisational creativity is defined as the conception of valuable new products, services, ideas, procedures, or processes by persons working together in a complex social system (Gupta and Banerjee 2016). Specific ways to enhance joint creativity have been identified at the micro level in the workplace, including: specific leadership styles, enough autonomy in day to day activities (Dong, Bartol, Zhang, and Li 2017) and constructive feedback (Zhou 2008). At the macro level, organisational creativity requires organisations to set up an environment and systems that increase the number of ideas generated. Creativity has been seen to flourish in organisations that support open ideas, these organisations inspire people and create innovative products and/or services (Rozman and Kovač 2015). This research is concerned with joint creativity as a reflection of CII. Joint creativity is a process of creating useful new ideas and novel solutions through ongoing exchange when working together. In contrast, innovation is defined as the successful exploitation of new ideas: it is the profitable outcome of creativity; it involves the application of products, services, procedures or processes in a specific context. In the world of organisations, lack of either creativity or innovation is seen as leading to an organisation standing still and unable to meet change. However, achieving creativity and innovation within an organisation is not easy, creativity cannot be turned on and off on demand, and innovation does not occur in a vacuum. Effective organisational strategies and frameworks need to be put in place to encourage both processes (Martins and Terblanche 2003).Table 3.6 outlines examples of IOR studies that include joint creativity.

Table 3.6 IOR Studies that include Joint Creativity

Author	Findings
Dong et al. (2017)	Transformational leadership fosters team creativity partially through its impact on knowledge sharing.
Gupta and Banerjee (2016)	Defines group and organisation creativity.
Koen et al. (2002)	The creativity and innovation process is defined by three distinct sections: the fuzzy front end (joint creativity), NPD process and the commercialisation process.
Martins and Terblanche (2003)	Organisational characteristics that foster creativity include: entrepreneurial mind set, freedom or autonomy, risk taking, teamwork, marketing orientation, decision-making, and flexibility.
Rozman and Kovač (2015)	Focus is on three creativity and innovation processes: individual creativity, organisational creativity processes and the management of creativity.
Sarooghi et al. (2015)	Examines the relationship between creativity and innovation.

3.3.5.2 Joint Creativity and NPD

An increasing number of researchers from a range of research areas, for example, strategic management, technology and innovation management, strategic networking, and organisation management, find that joint creativity in the context of NPD, strengthens the competitiveness of firms that operate in dynamic environments (Bicen and Johnson 2016, Bahemia, Squire, and Cousins 2017). For example, collaboration with external partners can result in new ideas and knowledge for NPD (Lawson, Krause, and Potter 2015) and can allow firms access to the complementary assets needed to turn a new product into a commercial success Brettel, and Cleven 2011). The open innovation paradigm, advocated by (Chesbroug, (2003), suggests that product success stems from the employment of the right mix of internal and external resources. It is his view that organisations can go it alone but that they can also benefit from another organisation's resources as well as from other organisation's usage of their resources. In this way they can use the creative minds of people outside of their own organisation. The challenge is building and managing innovative inter-organisational processes to achieve this (Li, Eden, Hitt, and Ireland 2012).

Some research argues for the use of teams in new product development. This approach has been associated with higher process performance, with increased speed of development, with overall project success, and organisational performance

(Shan, Song, and Ju 2016). The positive influence that the use of teams has on increasing the speed to market and project success in new product development can be explained by the greater information diversity made possible by wide involvement (Tang et al. 2015). Tang et al. suggest that this diversity of information is taken into consideration in NPD decision-making, which in turn leads to greater problem-solving creativity. Table 3.7 summarises the main NPD studies that include joint creativity.

Table 3.7 NPD Studies and Joint Creativity

Author	Findings
Bahemia et al. (2017)	Relates the construct "newness" to creativity and innovation. Links creativity and innovation to competitive advantage.
Bicen and Johnson (2016)	Suggests that technological advancement and the development of new and creative products are key driving forces of economic growth.
Brettel and Cleven (2011)	Based on Kitchell's (1995) Innovation Adoption model. This model argues that an organisation's cultural norms strengthen its capacity for collaboration. Collaboration leads to better NPD performance outcomes.
Li et al. (2012)	This research suggests that a governance structure be used to balance the tension between knowledge sharing and knowledge leakages.
Cousins et al. (2015)	Findings suggest that the relational rents, in the form of improved product and project performance attained from supplier development activities in NPD are not achieved directly but rather indirectly, via improvements in the supplier's creative and technological capabilities.
Shan et al. (2016)	Empirical study. N=103. Suggests inverted u-shaped curve between functional diversity and new product creativity relationship with the relationship being stronger when project uncertainty is high.

3.3.5.3 Collaborative Studies that include Joint Creativity

Multi-level empirical studies in creativity are rare in the literature with several calls being made for such studies in the last ten to fifteen years (George 2007 and Leenders et al. 2003). As a result, Bissola, Imperatori, and Colonel (2014) undertook a large-scale experimental study of multi-level creativity involving 119 groups, each consisting of teams of 11 undergraduates, with each team developing a new product. Data collection was by means of questionnaires, direct observation, and semi-structured individual self-assessments by participants. A total of 1358 people were involved. A combination of correlation analysis and cluster analysis was undertaken for the statistical analysis.

The research confirms the combined importance of both individual creativity and team composition in sustaining the creative performance of NPD teams. In addition, it provides useful evidence for the design of NPD teams to foster creative performance. The findings of the research suggest that different combinations of individual traits and collective processes combine and interact enabling a similar level of creative performance from different configurations of individual and team elements. The research did not demonstrate any single team composition that constantly generated creative and novel solutions. Rather, it suggests that various team configurations, based on team composition and interpersonal interactions including coordination, control and diversity management processes, can be effective in achieving joint creativity.

The research introduces different multi-dimensional measures of team creative performance, relevant to the generalisation and comparison of the research results. In addition, it offers several guidelines for the design of "organisational NPD teams" through the combination of diversity and interpersonal management, as well as co-ordination and control processes.

3.3.5.4 Key Elements of Creativity measured in Previous Studies

The literature is replete with research on all aspects of creativity including theoretical models, levels of analysis including how each level of analysis is inter-linked, and finally determinants that influence all levels of creativity.

Six models of creativity are outlined in the literature to date. These six frameworks are well adopted within the field of creativity and innovation in the work environment. Some have received more empirical support than others, but they all emphasise the role of different determinants of either creativity or innovation. Perhaps the major drawback of these frameworks is that each one either centres on idea generation or the implementation of ideas. Furthermore, although different levels of analysis are considered in each framework, some put more emphasis on the individual level of analysis (model of individual creative action) while others are more concerned with the team level (input-process-output model).

Studies are organised by four levels of analysis including: individual, team, organisation and multi-level. Studies at the individual level can be summarised under three sub-headings, including, individual factors, task context and social context with further sub-categorisations under each heading (Anderson, Potočnik, and Zhou 2014). Notable advances have been made at the team level of analysis in the last fifteen or so years. This can be attributed in no small way to two theoretically driven meta-analysis studies that have been published at this level (Hülsheger, Anderson, and Salgaldo 2009 and Rosing, Frese, and Bausch 2011). Although it has to be recognised that there remains a much larger body of research at the individual-level of analysis, research into workgroup and/or work-team creativity and innovation is of particular value in today's competitive environment. Particularly as organisations have unquestionably moved to more team-based structures and are much more reliant on teams to develop and implement novel and useful solutions. These studies can be grouped under team structure and composition, team climate and processes, and finally, team leadership.

The organisation level of analysis is structured under the following headings: management related factors, knowledge utilisation and networks, structure and strategy, size, resources, culture and climate, external environments and innovation diffusion. Many studies have been published in the last ten years at the organisation level of analysis of creativity and innovation. These studies seek to give clarity to the role of diverse organisational and external environmental factors at this level. It is of interest that some of this research provides a full and conceptual explanation of the link between individual creativity and organisation creativity.

Early studies in creativity focus on the individual's personality traits, cognitive abilities such as linguistic ability and mental flexibility that are believed to be associated with successful creativity (Amabile 1988). Building on this research, other scholars have investigated and attempted to understand the relationship between individual and team and/or organisational or IOR creativity (Amabile 1997). Emphasis has been placed on the link between the individual, team and organisational creativity (Woodman et al. 1993).

As a result of this previous work, several factors have been suggested that influence organisational creativity: organisational climate, leadership style, organisational culture, resources and skills and structures and systems of an organisation. Organisational climate is seen as key, with most creativity scholars suggesting that a climate of participation and freedom of expression encompassing performance standards being the most effective climate to drive organisational creativity. Reflecting this work (Feurer, Chaharbaghi, and Wargin 1996) developed an organisation creativity approach (based on his work with Hewlett Packard) with the following steps:

- Interaction but with small barriers
- Constant stimuli
- Freedom to experiment without blame
- The opportunity to build on past ideas

Many creativity scholars believe that a participative leadership style is conducive to creativity whereas more autocratic styles are likely to diminish it. A leadership vision is therefore focal to managing creative individuals. It is suggested that leaders must effectively communicate a vision that promotes and facilitates creativity through all available channels thereby constantly encouraging others to think and act creatively (Cook 1998). To achieve these goals it is also posited that leaders need to possess certain characteristics in order to develop conditions under which organisational creativity can flourish the most imperative one being the ability to form effective work groups (Amabile and Gryskiewicz 1989). These teams or work groups are discussed separately below.

It is suggested that the use of teams generates a greater variety of information to be taken into consideration in new product development decision making, which in turn leads to greater problem solving creativity (Griffin 1997). More recent research by Bissola, Imperatori, and Colonel (2014) has investigated the variables that lead to successful creativity in cross functional teams. Their findings have contributed to the creativity literature in some unexpected ways. In line with previous literature in the area, firstly, they find that individual creativity positively contributes to the overall creative performance of NPD teams (Bharadwaj and Menon 2000, and Pirola-Merlo

and Mann 2004). They then investigated the other variables that lead to successful team creativity and find, that success is not only driven by individual creativity. Their findings suggest that success is driven by different sets of individual traits and collective processes that are combined and interfaced through collaboration, thus enabling similar levels of performance from different configurations of individual and team constituents.

3.3.5.5 Summary and Hypothesis

Both creativity and innovation are key processes in maintaining competitive advantage in the current global environment. While creativity and innovation are closely linked, they are also separate processes within their own right. Creativity is the generation of novel and valuable ideas and innovation is the successful exploitation of these ideas. Effective organisational strategies need to be implemented to encourage both processes.

To date six models of creativity are outlined in the literature. Research has been undertaken at four levels of analysis including individual, team, organisational and multi-level. Within these studies several factors have been investigated for example at the organisational level: climate, leadership style, organisational culture, resources and skills and structures and systems of an organisation.

It is no surprise that several creativity studies have been undertaken in the context of NPD. A common theme in these studies is the social nature of creativity especially in the context of cross functional teams.

For this research joint creativity is defined as the creation of new ideas and the generation of novel solution through ongoing exchange. The intensity of joint creativity is characterised by new ideas being created and novel solutions being generated through the partners working together. Previous literature reasoning leads to the following hypothesis:

H1d: Joint creativity is a dimension of CII.

3.3.6 Joint Social Bonding

3.3.6 1 Joint Social Bonding and Relationships

Business studies, especially marketing research, have examined the role of social bonding in IORs (Barnes, Leonidou, Siu, and Leonidou 2015). Several studies, for example, Carey, Lawson, and Krause (2011), and Krause, Handfield, and Tyler (2007) link joint social bonding to performance outcomes.

Social bonding for this research is defined as ongoing social exchanges or interactions between individuals in IORs. These close relationships are believed to reflect intense IOR collaboration. It is suggested in the extant literature that this intense collaboration improves outcomes. Social bonding or interaction in either a personal or a business environment entails the establishment of familiarity, friendship, and personal confidence, built through ongoing interpersonal exchange between the parties. This bonding leads to relationships that may range in depth from a one-off business relationship to one that involves close personal ties. The maintenance of a close relationship implies a great degree of self-disclosure, concern for the partner, and presence of liking for the other person. In business, these interpersonal ties may be a form of social capital (Kwon and Adler 2014), which acts as a counter pressure to dissolve the collaborative relationship, leads to satisfaction in the partnership (Huang, Luo, Liu, and Yang 2016), and entails social commitments. SET posits that interpersonal relations are reflective of close inter-firm relationships (Kwon and Adler 2014). This mirrors previous literature, where it is suggested that personal contact reflects a high level of cooperation between organisations (Inkpen and Tsang 2005). In other literature, the establishment of close ties between the partnering organisations is reflective of close collaboration and partnership success (Zaheer, Gözübüyük, and Milanov 2010). Table 3.8 summarises the findings of IOR studies that include joint social bonding.

Table 3.8 IOR Studies that include Joint Social Bonding

Author	Findings
Barnes et al. (2015)	The study is conducted among a sample of 202 Hong Kong based importing companies, regarding their relationships with Western based manufacturers. The research finds that inter-personal effects have a positive influence on financial outcomes.
Carey et al (2011)	Findings suggest that joint social bonding is positively related to relational social capital. Relational social capital is positively related to buyer costs and innovation improvements. Buyer perspective. Survey of 160 medium to large manufacturing firms in the UK.
Huang et al. (2016)	Results from 225 manufacturer-distributor dyads in China indicate that strong ties between boundary spanners benefit exchange partners in the inter-organisational relationships through two boundary-spanning behaviours- information exchange and external representation.
Inkpen and Tsang (2005)	This study identifies the links between join social bonding and knowledge transfer. Conceptual study from the organisational perspective.
Krause et al. (2007)	Research findings suggest that there is a positive relationship between joint social bonding and buyer performance improvements (cost, quality, delivery and flexibility. Survey, 373 US firms in the automotive industry. Buyer perspective.
Kwon and Adler (2014)	Sources of social capital lie in social exchanges between actors in both organisations in the context of IOR. (This study is a literature review of all theoretical developments reference social capital).
Zaheer et al. (2010)	Social bonding between managers in different organisations improves financial performance. Joint social bonding aids tacit knowledge transfer .Joint social bonding is effective when the environment demands high levels of exploitative behaviour.

3.3.6.2 Joint Social Bonding and NPD

Social network literature predominantly explores the nature of the bond between two or more social actors in the main focusing on the effect of that this bond has on knowledge and information sharing in both the context of individuals and IORs (Ganesan, Malter, and Rindfleisch 2005). An important feature of social network theory is tie strength. In this context, tie strength refers to the frequency of interaction between the partners (Granovetter 1985). When a partnership has strong ties, it is viewed as having a higher degree of closeness and reciprocity (Marsden and Campbell 2012, Rindfleisch and Moorman 2001). This may lead to two-way interaction between the partners at the individual level and is generally associated with knowledge flow in both directions (Marsden and Campbell 2012, and Sosa 2011). The existence of strong ties facilitates inter-organisational member social interactions or social bonding (Inkpen and Tsang 2005). This social bonding is imperative for the diffusion of new ideas between the partners (Sosa 2011).

3.3.6.3 Collaborative Studies that include Joint Social Bonding

The prevailing view across much of the relationship literature is that social interaction has little or no association with business relationships (Iaccobucci and Ostrom 1996). There is evidence that this view is maintained amongst practitioners with Rodriguez and Wilson (2002) finding that American managers viewed social bonding as "unimportant" and of "no purpose" in the development of long term business relationships. As a result of this perspective studies that include social bonding in collaborative settings are under-represented in organisational research. However, one such study was carried out by Clark and Fujimoto (1989) based on the performance of Japanese automakers over US and European automakers, Clark found that it is not only the extent of supplier involvement that is important to partnership success, but also the quality of the relationship. He found that in Japan that the relationship was of a long term nature, was more one of partnership, and was based on reciprocity, involved investment and sharing of knowledge. Yli-Renko et al. (2001) investigated the relationship between social capital, knowledge acquisition and knowledge exploitation in networked young technology-based firms. They identified social interaction as an aspect of social capital and measured it as the extent to which the relationship between network members is characterized by personal and social ties. They found that social interaction is significantly positively related to knowledge acquisition and that knowledge acquisition is positively related to new product development through the shortening of product development cycles. In addition, social ties encourage different organisations in a network to integrate and combine specialized knowledge that is central to new product development (Cohen and Levinthal 1990). Also, social ties encourage relationship-specific investments which reduce the number of product defects and lead to faster development times (Dyer and Singh 1998).

3.2.6.4 Key elements of Joint Social Bonding Measured in Previous Studies

At a base level, achieving social interactions in any organisational or inter-organisational setting depends on an incumbent individual's willingness to assist others, to share ideas and feedback and, in turn, to provide information to others

and to receive recognition from others (Seers, Petty, and Cashman 1995). Social bonding can be defined as ongoing social interactions. It has been shown that these social interactions are aided by the presence of friendships between members of the collaboration group. These workplace friendships have been shown to create social ties and effective bonding. This assists with functions such as decision making, influence sharing and provides an emotional support system for a collaborative group. So how have organisations encouraged individuals to become friends thereby encouraging social bonding? The literature to date has suggested the establishment of inter-organisational NPD teams as the vehicle to encourage ongoing social bonding and the development of close relationships.

Research suggests that interpersonal factors influence team member performance (Banks, Batchelor, Seers, O'Boyle Jr., Pollack, and Gower 2014). Researchers recognize that two factors have the ability to allow NPD teams to develop close relationships: 1. connectedness, and 2. social integration. Connectedness refers to the degree of interaction or contact among virtual NPD team members (Sheremata 2000). When team members are more connected, they are more likely to engage in close and personal interactions, conduct frequent consultations, and invest effort into coordinating activities with other team members (Menon and Menon 1997). "Thicker" (meaningful and timely) communication increases connectedness and allows for greater team cohesiveness (Badrinarayanan and Arnett 2008). In turn, it has been suggested that this team cohesiveness is positively related to effective decision making (Chidambaram 1996). Some research recommends that team members meet for face-to-face interaction especially during the initial set-up stages to promote social integration (Martins et al. 2004). This face-to-face interaction is conducive for "sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills" (Nonaka and Takeuchi 1995:.62). These workplace friendships nourish high-quality relationships because NPD team members can trust and value each other, share interests, and view the emotional and instrumental support as a valuable means of growth and dependence (Berman et al. 2002). This serves as a motivational force to engage in high-quality relationship development (i.e. they see their colleagues as friends rather than as formal

colleagues). Evidence supporting this claim can be found in an empirical study by Herman, Dasborough and Ashkanasy (2008) who found that workplace friendship accounted for substantial variance in team cohesion. Based on this, we suggest that workplace friendship may be a necessary condition for, and is conducive to, the formation of high-quality team collaboration.

3.3.6.5 Summary and Hypothesis

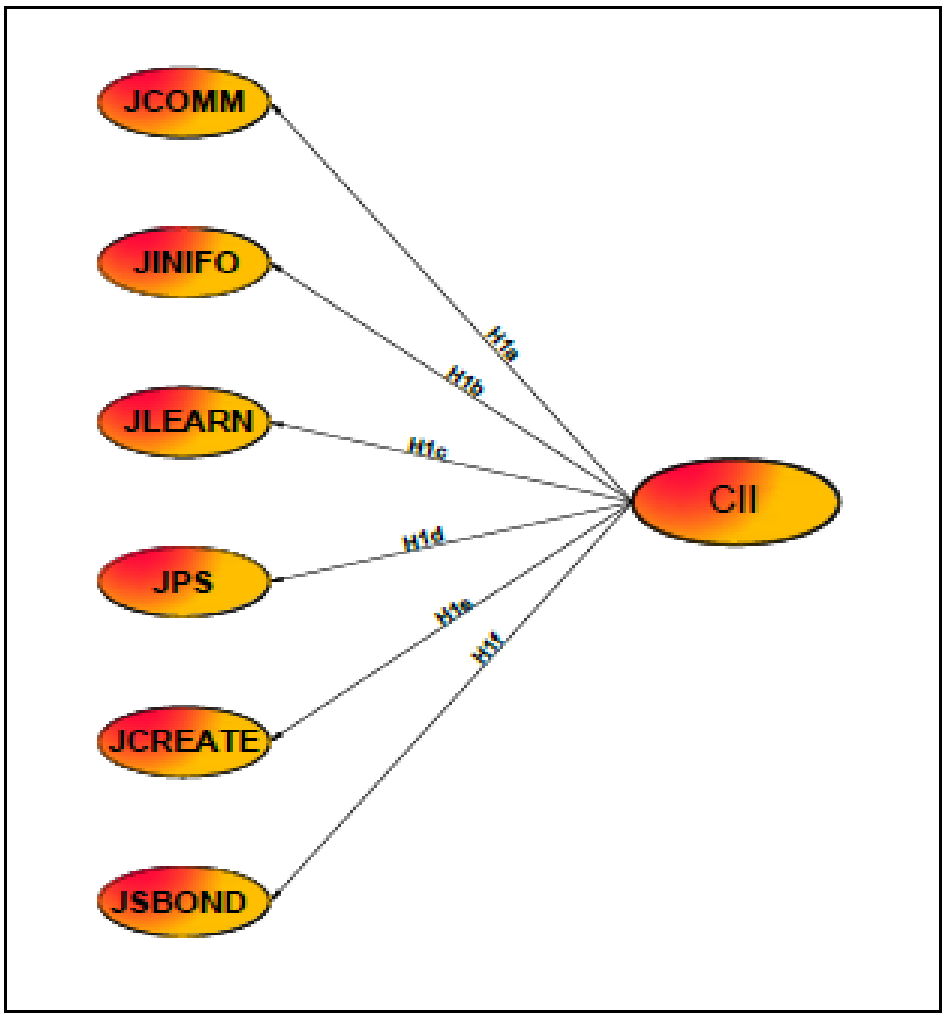
It is suggested in the alliance literature that ongoing social bonding leads to stronger relationships by acting as a counter pressure to dissolve the relationship (Seabright, Levinthal, and Fichman (1992), by increasing satisfaction with one's partner (Mohr and Spekman 1994) and by achieving a high level of co-operation between partners (Inkpen and Tsang 2005). For this research joint social bonding is defined as an ongoing exchange between the organisations that leads to a closer relationship between the partners. The intensity of joint social bonding is characterised by the actors in both organisations enjoying working together, by developing friendships and by becoming closer through working together.

Previous literature reasoning leads to the following hypothesis:

H1f: Joint social bonding is a dimension of CII.

3.4 CII Conceptualisation (Measurement Model)

Figure 3.1 outlines the conceptual framework for this research. It demonstrates that CII is reflected by the six dimensions and restates the hypotheses for each dimension.



Key: CII= Collaborative innovation intensity, JCOMM= joint communication, JINFO= joint information exchange, JLEARN = joint learning, JPS= joint problem solving, JCREATE= joint creativity, JSBOND = joint social bonding.

Figure 3.1 CII Conceptual Framework

For the purpose of the conceptualisation of CII, the literature review has been far reaching, including teams, NPD, knowledge management and IOR literature. As this research is the first that has attempted to develop a measure for the CII scale, the literature to date has not presented the six dimensions in the same way as this study now does. However, the review does show that all of the dimensions have been researched before in different ways and that relationships have been found to exist

between them. For example, Selnes and Sallis (2003) highlighted the relationship specifically between joint communication, joint information exchange, and joint learning. The knowledge management literature has demonstrated relationships specifically between joint communication, joint information exchange and joint learning (Kogut and Zander 1992). Csikszentmihalyi and Sawyer (2014) suggest relationships between joint creativity and interaction and others find relationships between joint social bonding and collaborative NPD (Albrecht and Ropp 1984, and

Nemiro 2002). Interestingly, each individual dimension in its own right has been shown to be related to partnership success. In the partnership and IOR literature, where theoretical models are developed to drive partnership success (Andersen and Narus 1990, Dwyer et al. 1987, and Mohr and Spekman 1994), the findings include, in particular, joint communication, joint information exchange and joint problem solving. Other prior research has suggested that in some contexts that a dimension may act either as a predictor or an outcome of another dimension, for example, Powell et al. (1996), Nonaka and Takeuchi (1995) and Dawson (2000) who all suggest that joint communication facilitates joint information exchange which leads to joint learning. This is not applicable to this research as it takes a cross-sectional picture at a particular point in time. For this study there is no sequential relationship between the dimensions.

For the measurement of CII, it is hypothesised that the six dimensions happen concurrently during collaborative NPD, yes they are related but they exist in parallel and are not dependent on each other. They are in fact completely separate, however the intensity of each dimension is reflective of CII.

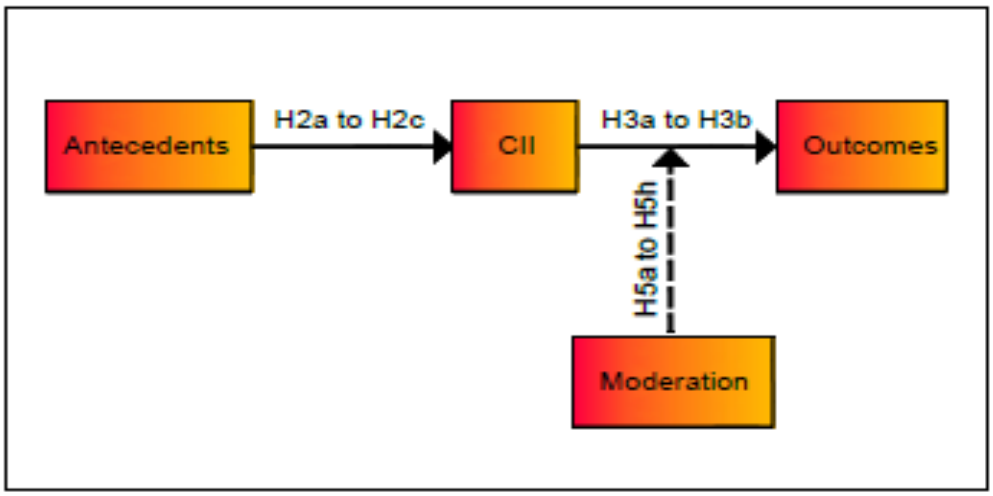
3.5 Chapter Summary

This chapter defines CII in the context of inter-organisational NPD. It presents the dimensions of CII including rationale and definitions for each dimension and their place in the extant literature to date. The following chapters outline measures for each dimension.

Chapter 4 Structural Model

4.1 Introduction

The structural model comprises two distinct sub-models. Firstly, the measurement model, which develops and tests the CII second order factor scale (see, chapter 3), and secondly the structural model which is estimated to test the relationships between CII, antecedents, outcomes and moderator variables. In addition, several control variables are included in this structural model. The chapter defines the variables within the context of a literature review and categorises each variable as an antecedent, an outcome, a moderator or a control variable. A diagrammatical representation of the antecedents-process-outcomes model (this is a schematic diagram of the SEM structural model) identifying the hypotheses for this research is presented in Figure 2.1 below.



Key: Antecedents = Benevolent trust, Cognitive commitment and Senior management support. Outcomes= NPD outcomes and LTO. Moderation=Type of NPD, Market Turbulence and technological Turbulence

Figure 4.1 Schematic Diagram of SEM Structural Model

4.2 Antecedents of CII

This research study hypothesises that CII has three antecedents including: benevolent trust, cognitive commitment and senior management support. These hypotheses are based on previous published research studies and while it is not claimed that these are the only antecedents of CII, it is believed that these are the key antecedents in the context of this research and its SET assumptions.

Many scholars allude to the importance of overall trust and overall commitment in the formation and maintenance of collaborative relationships (Blomqvist, Hurmelinna and Seppänen 2005, Dibben 2000, Hardwick, Anderson, and Cruickshank 2013, Mohr and Spekman 1994, and Morgan and Hunt 1994). In fact, both concepts have been identified in previous research as playing a significant role in all business relationships (Camén, Gottfridsson, and Rundh 2011), with some authors suggesting that they are the key determinants or antecedents of specifically close relationship (Batt and Purchase 2004). Even though trust and commitment are often closely related in practice and are viewed as mutually enforcing in IORs, they are distinct concepts, consequently a formal definition of each in the context of this research will be outlined in the following sections.

4.2.1 Benevolent Trust

From a literature perspective, trust is increasingly recognised as multi-dimensional, and exists at the individual, organisational, inter-organisational and network level. Trust has been studied within economics (Sako 1992), sociology (Miller and Steinberg 1975), social psychology (Lewis and Weigert 1985), organisational management (Ellonen, Blomqvist, and Puumalainen 2008), marketing (Schoder and Haenlein 2004), and entrepreneurship (Zhang and Hamilton 2010). Trust has been used as an explanatory framework in TCE (Williamson 1975), SET (Morgan and Hunt 1994), and RBV (Squire, Cousins, and Brown 2005). This has resulted in the literature presenting a complicated picture of trust, and it being replete with definitions of different types of trust with none being able to offer universal application (Anderson, Steinerte, and Russell 2010).

At the lowest level, trust is based on the belief in what a partner can do and how he or she will behave in a future oriented relationship that is characterised by risk. Can an alliance partner be trusted? Are they reliable? Would they do anything to harm us? Will they take care of the relationship and us? While these questions certainly capture the general essence of trust, this is not the complete picture, with most experts believing that trust is a multi-dimensional phenomenon (Castaldo 2003) that is rooted in two distinct bases one rational and the other benevolent (Blomqvist, et al. 2005, Cullen, Johnson, and Sakano 2000, Kramer 1999, and Moorman, Deshpande, and Zaltman 1993).

The rational element of trust embodies an actor's analytical attempt to evaluate the other party's competence for the specific task of the collaboration. For example, parties often evaluate future orientated capabilities such as technological or substantive knowledge, this is especially true in dynamic and uncertain environments (Blomqvist et al. 2005). It is really a question of whether an actor can fulfil their promise. Does he or she have the knowledge, know-how and/or resources needed to engage in the collaborative relationship? This rational or calculative element of trust stems from a purely economic perspective, where an actor attempts to evaluate or predict the potential benefits of engaging in a collaborative relationship with the other party (Blomqvist et al. 2005).

Beyond the calculative or rational element is the question of whether the parties are prepared to use their knowledge and resources in collaborative activities and operations (Cullen et al. 2000). This benevolent trust embraces the belief that a business partner takes into consideration the mutual interests of the partnership and not only their own (Blomqvist et al. 2005). Each party believes that their partner's decisions will be beneficial to their business, that they get a fair deal from their partner and that the relationship is marked by a high degree of harmony (Mohr and Spekman 1994). This implies a collaborative orientation.

H2a: Benevolent trust is an antecedent of CII.

4.2.2 Cognitive Commitment

In both a social and organisational context (Blau 1964, Dwyer et al. 1987, and Wilson 1995), it is acknowledged that the establishment of any type of exchange relationship requires some level of not just trust but also commitment. It is believed that the deeper the level of commitment, the closer the relationship becomes (Dwyer et al. 1987). It has been suggested in the literature that commitment is an integral characteristic of successful relationships. Commitment has been studied in buyer-seller relationships (Anderson and Weitz 1992), relationship marketing (Morgan and Hunt 1994), strategic alliances (Cullen et al. 2000), B2B relationships (Zabkar, Makovec and Brencic 2004) and marketing strategic alliances (Voss, Johnson, Cullen, Sakano, and Takenouchi 2006). The source of commitment in collaborative relationships can be said to be two-fold: affective and cognitive. The affective dimension of commitment in a close collaborative relationship is defined as an emotional input which reflects an individual's positive feelings towards the relationship involving happiness, liking, enjoyment, etc. The cognitive dimension of commitment is defined as the belief that the relationship is so valuable that the participants intend to expend maximum efforts at continuing the relationship far into the future (Andersen and Weitz 1992, Dwyer et al 1987, Goodman and Dion 2001, and Morgan and Hunt 1994).

The commitment scale used in this study is cognitive and was adapted from Morgan and Hunt (1994). Morgan and Hunt's conceptualisation of commitment based their definition on research from social exchange, marriage, and organisational fields that is the works of Cook and Emerson (1978), Thompson and Spanier (1983), and Meyer and Allen (1984) respectively. In expending maximum efforts to maintain the relationship, it will become closer, leading to higher CII.

H2b: Cognitive commitment is an antecedent of CII.

4.2.3. Senior Management Support

Strategic management and marketing scholars have demonstrated the importance of the third antecedent, senior management support, in firstly, fostering trust and commitment in IORs (Chen, Tsou and Ching 2011, and McIvor and Humphreys 2004),

secondly, encouraging inter-organisational collaboration and thirdly, successfully achieving strategic performance goals (Zu, Fredendall, and Douglas 2008). Consequently, for this research senior management support is hypothesised as the third antecedent of CII.

H2c: Senior management support is an antecedent of CII.

4.3 CII Outcomes

4.3.1 NPD Outcomes (relational and economic)

The NPD outcomes construct in this research relates to both relational and financial outcomes. The importance of relationship satisfaction on business success has long been recognised. Anderson and Narus (1990) argue that buyer satisfaction is an important consequence of buyer-seller transactions. Cannon and Perreault (1999) suggest that satisfaction with a collaborative relationship presents an important outcome of any business exchange. Relationship satisfaction is a positive affective state resulting from all aspects of the collaborative relationship (Geyskens Steenkamp and Kumar 1999, and Del Bosque-Rodríguez, Agudo and Gutiérrez 2006). It is also one of the most studied outcomes in the channel relationship management literature and is an important outcome of CII in the context of any B2B relationship (Athaide and Klink 2009, Duarte and Davis 2004, and Frazier 1983). In addition to the relationship satisfaction measure included in the channel relationship literature some form of economic measure is also sought. The economic measurement items in this scale relate to market share, return on investment and profit expectation. These are standard scale items in the context of financial outcomes and are included in numerous NPD empirical research studies, for example, Athaide and Klink (2009).

For this research the respondents were presented with a list of statements relating to the impact of CII on specific economic and relational expectations and asked to assess if each expectation was exceeded. Four satisfaction metrics and three economic metrics were included in the NPD outcomes scale.

H3a: NPD outcomes is an outcome of CII.

4.3.2 Inter-Firm Long Term Relationship Orientation (LTO)

An organisation with inter-firm long term relationship orientation is defined as having a future focus. It believes in the inter-dependence of outcomes of both organisations, and as such it is focused on achieving joint future goals. In other words, it is willing to delay short term economic success in order to build for the future. In contrast, short term relationship orientation is defined by a focus on short term economic success. A partner is only concerned with the options and outcomes of the current period. The long term relationship orientation definition applied to this research is as follows: a partner's long term orientation is the perception of inter-dependence of outcomes in which both the partners and joint outcomes are expected to benefit the partner. This definition was adapted from Ganesan (1994). It has been suggested that the difference between long term and short term relationship orientation can also be explained by the nature of organisational exchanges adopted by the partners. Consequently, the focus on relationship marketing has intensified in the academic research domain (Morgan and Hunt 1994, and Paulraj et al. 2008). However, the construct is not transaction specific, rather it is a relationship specific construct (Noordewier, John, and Nevin 1990), and hence LTO will vary relationship by relationship. In the context of SET, LTO in an existing relationship, relates to more than just the length of the relationship but is more an indicator of the closeness of the relationship (Kelley and Thibault 1983, and Ganesan 1994).

H3b: Long term orientation is an outcome of CII.

4.4 Moderating Variables

4.4.1 Exploitative and Explorative Innovation

Organisational scholars such as March (1991) explicitly differentiate between explorative and exploitative innovation. Exploitation is defined as the leveraging of existing capabilities. Exploration refers to the pursuit of new knowledge of things that might come to be known. Several scholars including: He and Wong (2004), Jansen, Van Den Bosch and Volberda (2006), Levinthal and March (1993), and McGrath

(2001), argue that a central concern of an organisation's innovation strategy relates to the decisions on how to divide attention and resources between explorative and exploitative activities. With explorative innovation comes a high level of risk, which may in the short term affect financial returns, but may deliver higher financial returns in the long term. In contrast, with exploitative activities although perhaps delivering stable financial returns in the short-term, long term results may be at risk due to a loss of market share as a direct result of not being able to meet changing customer demand.

In exploitative collaborations, the main purpose relates to the enhancement of existing organisational competencies. Exploitative collaborations focus on the links between pre-existing technologies and products (Teece 1992). Consequently, exploitative oriented collaborative processes benefit from clear performance objectives that are easily translated into measurable outputs, with outcomes being monitored by formalised monitoring and control systems. Hence, these collaborative relationships are characterised by clear outcomes and operational procedures.

In contrast, explorative collaboration is viewed as instrumental in the creation of new competencies with learning and experimentation figuring prominently. The transfer of tacit knowledge is critical in this type of collaboration. To achieve such learning objectives, collaboration partners rely far more on personal and informal modes of monitoring and control. As the type of collaboration focuses more on novelty than efficiency, job responsibilities tend to be less explicit and work procedures are more flexible (Christensen and Overdorf 2000).

In the context of this research, the type of innovation is of both statistical and theoretical interest because previous research has suggested that the type of NPD engaged in by partners may impact the outcomes of the collaboration (Belderbos, Faems, Leten, and van Looy 2010, and Laursen and Salter 2006). Consequently, the type of innovation is hypothesised as moderating the relationship between CII and NPD outcomes.

H4a: Exploitative innovation/NPD moderates the relationship between CII and NPD outcomes.

H4b: Exploitative innovation/NPD moderates the relationship between CII and LTO.

H4c: Explorative innovation/NPD moderates the relationship between CII and NPD outcomes.

H4d: Explorative innovation/NPD moderates the relationship between CII and LTO.

4.4.2 Market Turbulence

Market turbulence can take the form of instability or unpredictability of markets, changes in markets, changes in market structure or in the degree of competition within the market. They are difficult to forecast and can occur at any time. These market changes may have an impact on the relationship between CII and NPD outcomes (Calantone, Garcia, and Dröge 2003). For example, two organisations are involved in a very close innovation relationship where all ongoing NPD performance targets are being met and as a result all expectations are that the final performance outcomes will be positive. However, just before their new product(s) is released to the market, a new competitor enters the market resulting in a change in the market structure and as a result forecast NPD financial returns do not materialise. This is external to the CII of the relationship, so consequently for this research, market turbulence is hypothesised as moderating the relationship between CII and NPD performance outcomes.

H4e: Market turbulence moderates the relationship between CII and NPD outcomes.

H4f: Market turbulence moderates the relationship between CII and LTO.

4.4.3 Technological Turbulence

This is defined as the rapid rate of technological change and is considered to be an important environmental factor that influences the success of innovation (Calantone et al. 2003, and Chang and Taylor 2016). The unpredictability of rapid and significant changes such as the emergence of new and breakthrough technologies could drive a major NPD development into obsolescence before it is even seen by the market. Previous research shows that technological turbulence may have a major impact on the outcomes of NPD. This impact is not related to CII and consequently for the purpose of this research, technological turbulence is treated as a moderator of the relationship between CII and performance outcomes.

H4g: Technological turbulence moderates the relationship between CII and NPD outcomes.

H4h: Technological turbulence moderates the relationship between CII and LTO.

4.5 Control Variables

4.5.1 Choice of Partner

Successful NPD requires firms to develop routines and practices to collaborate with suppliers or B2B customers and/or cross-functional employee teams. Some firm involve suppliers in their NPD endeavours while others opt to involve B2B customers as partners. Authors in favour of using suppliers suggest that supplier involvement in the NPD process is critical to accelerating the pace of product development (Fujimoto and Clark 1991, Eisenhardt and Tabrizi 1995, Gupta and Souder 1998). It is believed that suppliers are more likely to identify potential problems such as unrealistic designs. Another advantage of this approach is that it opens outsourcing possibilities, thereby reducing the internal complexity of projects, in turn allowing people to concentrate on shortening the critical path of the NPD project. In addition to shortening development cycles (Deck and Strom 2002), supplier involvement has been shown to have a positive impact on other outcome measures including lower development costs (McGinnis and Vallopra 1999 and Perks 2000), improved design (Swink 1999), and enhanced product quality (Hoegl and Wagner 2005, and McGinnis and Vallopra 1999).

Similarly, other authors advocate the involvement of customers in the innovation process (Gruner and Homburg 2000, and Lynch et al. 2016). Evidence suggests that involving customers in the NPD process ensures that a firm is up to date on changing customer tastes and requirements thereby, using this knowledge to reduce risk and uncertainty in the innovation process.

While the literature is replete with research advocating the effectiveness of customer involvement or supplier involvement in collaborative NPD, there is little or no empirical research investigating the impact if any, of the category of partner choice on CII. Does choosing a user as a collaborative NPD partner affect CII in a different way than to selecting a supplier as a partner for the same NPD project? As the

literature to date has not explored these questions in relation to CII, type of partner is used as a control variable in this research, with question 4 on the survey asking respondents to classify their partners as either customers or suppliers.

4.5.2 Duration of Previous Relationship

Several contributions from the relational contracting and the relationship marketing literature have acknowledged the importance of the history of a B2B relationship and how it increases the closeness and effectiveness of an IOR (Dwyer et al. 1987, Granovetter 1985, and Heide and John 1992). The extant literature suggests that close collaborative relationships emerge incrementally by beginning with minor informal interactions that require little trust as they involve little risk. Then, over time, as transactions are repeated and partners gain experience working together, the relationship becomes closer as it involves relational exchange. Benevolent trust which is an antecedent variable in the structural model may be related to the length of previous relationship as benevolent trust is time dependent and normative and develops when there are frequent transactions between business actors. Consequently, duration of previous relationship is used as a control variable. Question 5 of the survey asks respondents to categorise the duration of their relationship using discrete year bands.

4.5.3 Firm Size

There is much debate within the literature regarding the relationship between firm size and innovative performance (Schleimer and Shulman 2011). The ability to spread risks over a range of projects and access to greater financial resources may give larger organisations an advantage over smaller organisations (Faems et al. 2005). In addition, large firms seem more capable of acquiring the complementary assets (distribution channels, raw materials suppliers) that are necessary for the commercialisation of innovation. In contrast, smaller organisations may have the advantage in terms of creativity, speed and flexibility especially when new technologies have an impact (Bower and Christensen 1995). As both large and small organisations will participate in this research, question 1 in the general company classification of the survey asks respondents to categorise the size of their firm by turnover band.

4.6 Alternate Structural Model (TCE framework)

In terms of further testing the structural model, an alternate model will be formulated using TCE as the underlying theoretical framework. Cognitive commitment, benevolent trust (both SET constructs) and senior management support will be removed from the structural model and replaced with two TCE theoretical constructs, dependency and asset specificity. All other constructs will remain as was in the SET structural model. Pursuant is a discussion in the context of previous literature of both TCE constructs.

4.6.1 Dependence

Much of the research on the construct of dependency has been undertaken in the context of the channel relationship literature. Frazier (1983) defines dependency as being a retailer's need to maintain a specific channel relationship to achieve the retailer's goals. For this research this can be interpreted as organisation A, being dependent on organisation B, to ensure that organisation A achieves its innovation goals. This is termed as asymmetrical dependence (Emerson 1962). Dependence refers to one partner's need to maintain the relationship in order to achieve desired goals. The concept of dependence is closely linked to power (Blau 1964, and Emerson 1962).

4.6.2 Asset Specificity

Asset specificity is a key construct in IOR research. Riordan and Williamson (1985: 55) define asset specificity as the "durable investments that are undertaken in support of particular transactions". Collaborating inter-organisational partners invest in specific assets out of task needs and/or goodwill. Asset specificity is a sunken commitment with little value outside a specific transaction or specific transactions. It is a critical management decision that ultimately affects partnership performance.

IOR literature has interpreted the relationship between asset specificity and performance in two ways (TCE and RET). TCE claims that specific assets invested in a partnership increase the hazard of opportunism and hence transaction costs (Heide and Stump 1995 and Parkhe 1993). Based on the level of asset specificity,

organisations select an appropriate governance structure for the partnership that most effectively reduces the hazard of opportunism (David and Han 2004). TCE predicts that partnership performance will be maximised when opportunistic behaviour is reduced.

This research develops an alternative model that models asset specificity and dependency as antecedents of CII. This model is then compared with the original developed SET model.

4.7 Chapter Summary

This chapter presents the variables included in the structural model. Benevolent trust, cognitive commitment, and senior management support are hypothesised as antecedents of CII. Pursuant to this, NPD outcomes (both relational and economic) and LTO are determined as outcomes. Three moderating variables are established for this research, including type of NPD, market turbulence and technological turbulence. In conclusion, the chapter looks at other potential determinants and classification variables that are included in the survey instrument. The following chapter, chapter 5, outlines the philosophical approach to the research and presents the methodology including data collection and preliminary data analysis.

Chapter 5 Research: Philosophical Approach and Design

5.1 Introduction

All research is based on underlying philosophical assumptions regarding what constitutes 'valid' research and which research method(s) is/are appropriate for the development of knowledge in a given study. In order to conduct and evaluate any research, it is therefore important to know what these assumptions are. In this chapter, common philosophical assumptions are explored and discussed, at the same time the tensions between the approaches are outlined. In addition, the chapter outlines the research methodologies, and research design used in the study, including strategies, instruments, and processes involved. The approach to data collection is also outlined.

5.2 Research Philosophy

Two major schools of creating new knowledge exist that in real terms are exact opposites with varying philosophical positions existing between them. Collis and Hussey (2003) labelled these opposing views as positivism and phenomenology, while Burrell and Morgan (1979), termed them objectivism and subjectivism, with Hughes and Sharrock (2016), characterising them as positivism and interpretive alternatives. This thesis takes a positivistic approach to developing new knowledge. The positivist approach has its origins in the natural sciences and the modern period of Western philosophy, whereas phenomenology or subjectivism evolved as a result of criticism of positivism. Figure 5.1 depicts the two major philosophical traditions and their respective assumptions relating to the major discriminating factors of ontology, epistemology, human nature and methodology between them.

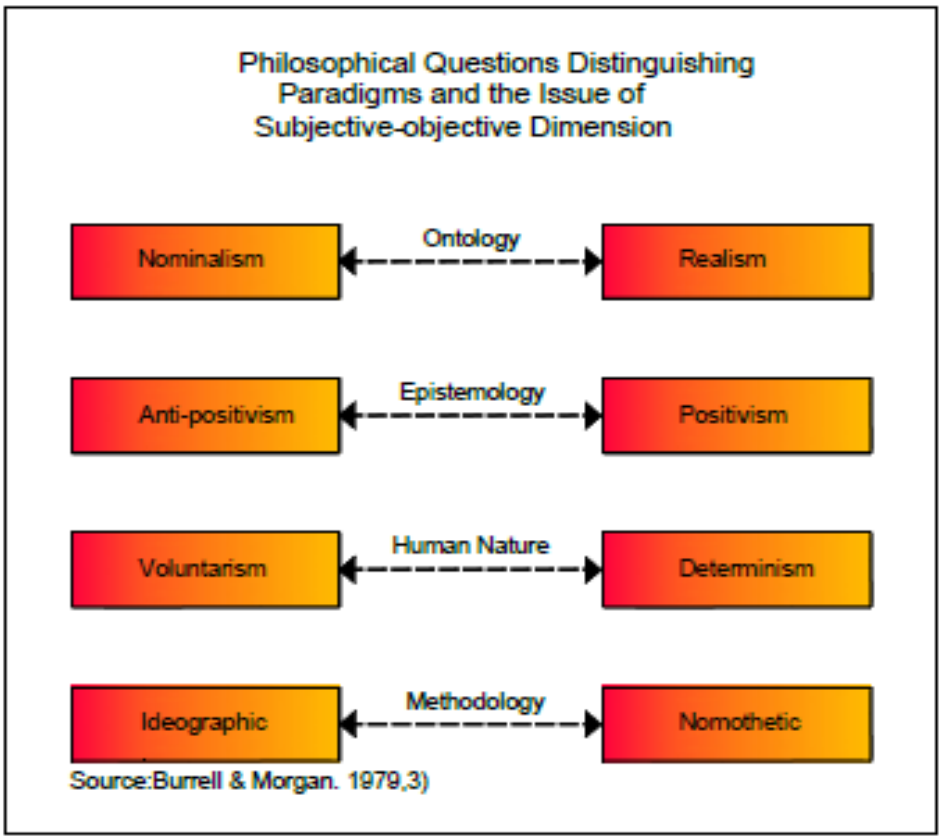


Figure 5.1 Social Science Assumptions' Analysis

The first assumption, ontology, is the philosophical study of the nature of being or reality, and the assumptions that a given researcher has about the way that the world operates (Saunders, Lewis, and Thornhill 2009), that is, what things if any exist? Or is reality only "the product of one's mind?" (Burrell and Morgan 1979:1). The second assumption, epistemology, is the branch of philosophy that deals with the study of knowledge and what we accept as being valid knowledge. It addresses such questions as "what does it mean to say we know something?" and fundamentally "how do we know what we know?" For example, much of marketing research has assumed that reality exists and is waiting to be discovered and that this knowledge is identifiable and can be communicated to other people. The third assumption concerns human nature and refers to the distinguishing characteristics including ways of thinking, feeling, and acting, in effect, the question of what it means to be human. The final assumption, methodology, is the researcher's tool-kit, it encompasses all of the

different approaches available to the social scientist to facilitate the investigation of phenomena. It should be noted that starting with the ontological assumption, each of the assumptions are interdependent. For example, a researcher's epistemological stance stems from their ontological stance. If a researcher believes in a concrete reality that is external to him/her, an epistemology of positivism is necessitated. This then leads to a deterministic assumption of human beings, that is, they are products or their environment and an accompanying methodology that is nomothetic, that is which emphasises "*the importance of basing research on systematic protocol and technique*" (Burrell and Morgan 1979: 6).

5.2.1 Is There a Right Perspective?

There has been an ongoing robust debate between the advocates of both traditions, it can of course be argued that debates on ontology and epistemology are futile because there is no philosophical solution. There is no right or wrong philosophical stance. This has led some academics to offer alternative approaches with (Eastman and Bailey 1996) suggesting a more pragmatic "*just get on with it*" approach. Hughes and Sharrock (2016) concur and have gone as far as to suggest that ontological and epistemological matters are irrelevant. In practice, it may well be that the more pragmatic approach is the one adopted. However, it is this researcher's opinion that undertaking a review of all of the schools of philosophy provides an opportunity to match the best methodology to the research question and certainly to minimise methodological error.

5.2.2 The Philosophical Approach to this Thesis

A review of the marketing literature demonstrates that the majority of marketing researchers have a positivist worldview, for example, Alegre, Lapiedra and Chiva (2006), Bush and Hunt (2011), Calantone, Cavusgil, and Zhao (2002), Hunt (2014), Kim and Atuahene-Gima (2010), Naidoo (2010), Hunt and Vitell (2006), and Zhang and Duan (2010). In addition, this researcher has in the main worked in a number driven environment as an accountant, and therefore the positivist worldview has always been her natural habitat. However, this view was inherent and was not driven by any understanding of the varying philosophical schools of thought. Interestingly, having gained some understanding of these schools and taking into consideration

this research study objectives, the worldview is still the same, but now the researcher has a broader understanding of the rationale behind this view. The following paragraphs outline this researcher's stance on ontology, epistemology, human nature and the method chosen to investigate this research problem.

From an ontological perspective, for this present study, the researcher being basically a realist perceives that reality exists and is waiting to be discovered. However, the perspective is not "extreme-realist" and is qualified by the belief that although reality is tangible, that human beings do play a role in forming this reality.

Regarding the stance on epistemology, it is always necessary to emulate the scientific rigour of the natural sciences in the social sciences, while at the same time recognising the importance of human subjectivity in the quest to understand human behaviour. Thus, while knowledge is not absolute, it can be accumulated, can be tested and either retained or discarded (Gill and Johnson 2010).

This researcher views human nature as both deterministic and voluntaristic, that is, humans are born into a structured society, yet societal structures evolve through human interaction. Indeed, human beings are constantly engaged in receiving, interpreting and acting on information through social exchange. The basis of this intermediate approach concerns the question "what is being researched?" The focus of this research is the measurement of CII at a given point in time. The qualification of a given point in time is important as the researcher believes that at a given point in time societal structures are fixed.

Based on the ultimate needs of this research study, the methodological approach is nomothetic. The focus of a nomothetic approach is to obtain objective knowledge through scientific methods. Hence, quantitative methods of investigation are used to enable findings of statistical significance. The nomothetic approach is characterised by its approach to precise measurement, investigation of large groups, through objective and controlled methods thereby driving replication and generalisability. This approach reflects the development approach for scales and measures as outlined in the seminal literature including (Churchill 1979, Hinkin 1995, and Gerbing and Anderson 1988).

The philosophical and methodological approach for this thesis reflects similar published scale development research in the innovation area, for example, Alegre, et al. (2006), Pemartín et al. (2018) and Ritter and Gemünden (2003).

5.3 Research Objectives

The main empirical objective of this research is to develop a new measure for CII in the context of a B2B relationship. The following sections outline the research design. The measurement model development and testing methodology will be outlined in chapter 6.

The second research objective for this study is the development of an antecedents-process-outcomes model (structural model). The structural model development and testing approach will be outlined in chapter 7.

The third research objective is using the antecedents-process-outcomes model to test the high and levels of CII on innovation outcomes. Findings will be outlined in chapter 8.

5.4 Research Outline

As already outlined in chapter 1, specific to measurement development is a quantitative methodology, as scale development requires data that is numeric in format. The most common quantitative research tool is the survey. The quantitative study utilises a highly structured instrument allowing that "*the varying perspectives and experiences of people can fit into a limited number of pre-determined response categories to which numbers are assigned"* (Patton 1990:14). This approach results in data that is timely, and which in turn lends itself to rigorous testing from the reliability and validity perspective.

A postal survey mode was chosen for this research as having reviewed all available mode options, it was felt that it was the most efficient and effective way to collect data from a high volume of organisations (Blumberg, Cooper, and Schindler 2005). Telephone interviewing was rejected for a number of reasons, firstly, because it has been shown to only be useful when using short surveys comprised of simple

questions (Blumberg et al. 2005), secondly, because it frequently proves difficult to reach the most appropriate respondent by telephone (Blumberg et al. 2005) and thirdly it was believed that a persuasive accompanying cover might induce more respondents to participate. Face-to-face interviewing was deemed inappropriate mainly due to budgetary and time constraints. Lastly, an online survey was considered but it was also rejected, in the main because of (1) the lack of a sampling frame with targeted email addresses and (2) the response rate might be biased towards people who would be more comfortable with the online medium. These respondents may be significantly different from the target population that is senior managers (Burns, Bush, and Sinha 2014). Although recognising that the postal mode has a number of weaknesses, for example, low response rates, low data collection speed, and lack of control over the interviewing process, it is believed that for this particular research its advantages, for example, extensive respondent reach, lack of interview bias and relatively low costs, render it the most appropriate approach.

5.5 Survey Design

As a postal survey comes under the complete control the respondent (Stern, Bilgen, and Dillman, Smith, and Christian 2014), extra care and attention was given to its design. While no definitive set of procedures for designing an effective postal questionnaire exists in the literature, much has been written identifying the critical factors surrounding this area (Brace 2018, Denscombe 2014, De vaus and de Vaus 2013, Stern et al. 2014, and Woodside 2011). The most critical factor in the design is a clear understanding of the information that is to be collected, as the survey is the vehicle for the research. Prior to and during the development of the survey a thorough literature review was undertaken to ensure that all questions placed on the questionnaire emanated from the objectives of this research, as failure to do so might result in a research instrument that did not achieve the research goals (Church and Waclawski 2017). In line with previous guidelines, included in the survey development was an extensive testing stage (Ambrose and Anstey 2010, Bryman 2016, Bulmer 2017, Hair, Hult, Ringle, and Sarstedt 2016). This is discussed fully in chapter 6 as part of the measure development methodology.

Secondly, decisions regarding the editing, coding, processing and statistical analysis of the data were taken into consideration at the design stage of the questionnaire. For example, with certain types of statistical analysis, the level of measurement becomes a critical issue in the design of the questionnaire (Hair et al. 2016).

Thirdly, the needs of the respondent were also considered at the design stage. Every effort was made to ensure that any costs incurred by respondents, time spent, and mental effort needed for participation was kept to a minimum.

Having taken all these considerations on board, the structure of the questionnaire and the procedures for pre-testing are now discussed in detail.

5.5.1 Wording

Some authors have noted that research results can be seriously biased when it isn't clear to the respondent what the researcher is asking in a question (Payne 2014). At worst, poor wording may cause a respondent to ignore a question or in other instances to answer it incorrectly, thereby contributing to item non-response error and measurement error. Thus, to ensure that the importance of wording of each question was addressed, the wording used is simple, clear and explicit, with each question clearly explaining the issue being addressed.

5.5.2 Question Sequence

Much of the extant literature places emphasis on the sequence of questions with Dillman et al. (2014) suggesting that the first question on any survey is in fact the most important and may well impact the participation decision. With this in mind, the questionnaire began with a series of simple questions about the nature of the respondent's NPD process, for example, *Is your company involved in NPD process? Describe the type of NPD (exploitative or explorative),* Is *your chosen partner a supplier or a customer?* To answer each of these questions, respondents were only required to tick a box. This was an attempt to build the respondent's confidence and to get them thinking about their NPD process. The scale that measures CII was then presented. Because of this a sense of continuity and flow was built into the questionnaire. Five possible antecedent measures including: dependency, cognitive commitment, benevolent trust, asset specificity and senior management support

were then addressed. Pursuant to this came the two outcome scales (long term relationship orientation and NPD outcomes). Next, the second and third moderation measures (market turbulence and technological turbulence) were presented. The first moderation variable, type of NPD had been addressed in the opening section. The final questions on the survey relate to control variables including the size of company (gross sales), ownership of company and finally industry category. In structuring the questions in this order, questions that are similar in content and within content areas are grouped together. This allows the respondent to establish a particular train of thought, in the hope that the respondent will produce more valid answers. A full copy of the questionnaire is included in Appendix A.

5.5.3 Instructions

As the postal survey must act as its own advocate, a set of clear instructions are pivotal to the success of data collection. Three types of instructions were included with this questionnaire, referencing general, transitional and question answering.

General instructions were included in both the cover letter and on the face of the questionnaire. The general instructions were used to firstly introduce the researcher, to outline the purpose of the research, to explain whom the questionnaire was targeted at and why, how/where their answers should be recorded and also informed the respondent on how and where to return the survey on completion. The second type of instruction introduced each section on the questionnaire. The third and final type of instruction was designed to help the respondent to answer each question at hand. The utmost care was taken to ensure that all instructions were clear, concise and well written.

5.5.4 Aesthetics

The physical appearance and layout of the questionnaire has been shown to be a major determinant of response rate (Fink 2015). Consequently, the aesthetics of this questionnaire was kept much to the forefront during the design stage. Colour was used in each section of the survey.

Firstly, an 8-page questionnaire was printed as a booklet, on high quality A4 paper by a professional printer. This ensured that the respondent's first impression was one

of professionalism (Brace 2018). This also gave the appearance of the questionnaire being shorter as it facilitated a double page format for questions, hereby addressing the respondent's concerns surrounding the length of time required to complete the survey. The double page format also allowed for greater flexibility in the spacing of questions, preventing overcrowding of questions which in the past has led respondents to assume that the survey was more complex than it actually is, resulting in a reduced response rate (Lietz 2010). In addition, instructions were placed in close proximity to the questions and were distinguished from the questions by using different bold type.

As the cover page is seen before any other part of the questionnaire, it was designed to give a positive impression (Krosnick 2018). Included on the front cover is: (i) The Waterford Institute of Technology School of Business official logo (sponsor) (ii) the study title, and (iii) the name, qualifications, mobile number and email address of the researcher. By adding the School of Business logo, greater legitimacy was added to the research with a view to improving the response rate. The name and details of the researcher being on the cover page ensured that if the respondent needed to contact her that the details were easily accessible (Bradburn, Sudman, and Wansink 2004). Care was taken when designing the study title, to ensure that it portrayed not only the topic but also how interesting the research is in a clear and concise manner, with a view once more to improving response rate (Brace 2018). In addition, general instructions were also placed on the front cover, firstly, to provide a sense of professionalism, but also at the outset, to reduce any concerns that the respondent may have surrounding the completion of the questionnaire.

5.5.5 The Cover letter

The cover letter was printed on the Institute's letterhead, reflecting the Institute's sponsorship, and the mailing included a FREEPOST stamped envelope for the questionnaire return. Each letter was hand signed (using blue ink) by the researcher. Where possible, the cover letter was addressed to the individual who was listed in the sampling frame.

The wording of the cover letter was developed by the researcher and was based on the guidelines set out by Dillman (2011), that is, using a relatively short, personalised and positively worded approach, stressing not only the importance of the project but also appealing for their expert help. The cover letter also assured the respondent of the anonymity of their response during data analysis (Brace 2018). A copy of the cover letter can be seen in Appendix B.

5.6 Implementation of the Survey

The implementation of postal survey involved two distinct processes, firstly the sampling process and secondly the administration of the survey.

5.6.1 The Sampling Process

The sample process for this study included: defining the population and the sampling frame.

5.6.1.1 Defining the Population

At a theoretical level, the population for this research is all manufacturing companies that are involved in collaborative innovation during NPD. At a statistical level, the only population that this research had access to is all manufacturers that are currently operating in Ireland. Senior management, specifically managing directors and new product development managers were selected as ideal respondents for this research not only because of their knowledge of the process being researched (Dillman 2011, Dillman, Smyth and Christian 2014, and Fowler 2013) but also because these were the names listed on the Data Ireland database, which allowed the researcher to personalise cover letters with the view to improving the response rate due to this personal approach.

5.6.1.2 Defining the Sampling Frame

5.6.1.2.1 Sample Size

The required sample size for SEM is debatable. Several texts were reviewed in this area, but the researcher could not find a definitive “best practice” recommendation even though a number of these were seminal works. In effect, the sample figures

ranged in the region of 100 to over 5000 (Iacobucci 2009, and MacCallum, Browne, and Cai 2006). Two central risks have been identified with using too few participants.

Firstly, the patterns of co-variation may not be stable, because chance can substantially influence correlations among items when the ratio of participants to items is relatively low, and secondly, the development sample may not adequately represent the intended population (DeVellis 2003). Gorsuch (1990) proposed guidelines for sample size based on minimum ratios of participants to items (5:1 or 10:1) which has been widely cited in counselling psychology research. In contrast, Bentler and Chou (1987) perceived that the sample should be based on the alternative rationale of the number of observations per variable, suggesting that ratio of 5 observations per variable is sufficient. Caveats with this suggestion are that firstly the data is normally distributed and secondly that each latent variable has multiple indicators. Hair et al. (2016) suggest that if the assumption of normality does not hold for the data, then the sample size needs to increase by approximately 15 observations per parameter. They further posit that if model misspecification is a concern that sample size should be increased over the normal requirements. Furthermore, they propose that at a minimum that sample size should be greater than the number of covariances/correlations in the input matrix. Finally, they believe that there is a link between the sample size and the complexity of the model, consequently, they propose a ratio of five observations per parameter at a minimum, with a ratio of ten observations being preferable. Concurring with other research whose cite sample sizes less than 100 as a concern, Kline (1998) and Hair et al. (2016) conclude with a recommendation of a minimum size of 200 observations with increases where appropriate.

Based on this prior research, a major objective of this study was to obtain a sample size as large as possible. A sizeable n=1665 cross-industry sector was chosen utilising the Data Ireland (formerly Kompass Ireland). Selection criteria were as follows:

- All manufacturing firms in Ireland;
- All multi-Nationals were excluded.

There were three response waves: three weeks after the initial mailing a reminder letter with a replacement survey was posted to organisations that had not responded. This was followed up one week later with a telephone call.

Groups were checked for non-response bias based on procedures as outlined by Armstrong and Overton (1977). There were no significant differences between group characteristics such as size of company and industry sector.

Table 5.1 Response Rates

Responses	Number of Responses
Gone out of Business	8
Refused Participation	5
Sub-total	**13**
Completed Surveys Returned	545
Not involved in NPD	125
Not involved in collaborative NPD	222
Involved in collaborative NPD	**185**
Response Rate including all responses	33%
Response Rate completed surveys	**32%**

5.7 Survey Administration

The survey was posted to all manufacturing companies on the Data Ireland listing (n=1665). Each respondent was sent a cover letter, a questionnaire and a prepaid self-addressed envelope. Other research in this area has found that incentives motivate respondents to complete mail surveys (Jobber and Reilly 1998). In line with this prior research, respondents for this research were promised a report summarising the major findings.

As responses were received, they were dated, encoded, and entered immediately onto an Excel spreadsheet. IBM SPSS, Version 24 was used for data screening.

5.8 Chapter Summary

This chapter outlines the philosophical approach to the research. It continues by presenting the research design. Chapter 6 will present the methodological approach adopted for the measure development of CII.

Chapter 6: Development of Overall Measurement Model

6.1 Introduction

This chapter outlines the process for the assessment of the measurement items for each construct included in the overall measurement model while the next chapter outlines the items for each construct included in the overall structural model. Chapter 8 presents findings from the estimation of both the measurement and the structural model. The first section in this chapter outlines the rationale regarding the use of both formative and reflective models within research and presents the reasoning for the use of a reflective model in this study. Next, it details the framework of measure development for the CII instrument which is adapted from Churchill (1979), Gerbing and Anderson (1988), and Hinkin (1995). This part of the chapter is divided into five major sections- item generation, content validity of items, questionnaire administration, EFA, and CFA including construct validity.

6.2 Reflective versus Formative Models

In developing any measurement model, the first step is defining the model as either reflective or formative. Jarvis, MacKenzie, and Podsakoff (2003) suggest that there are a number of decision rules that should be applied before determining whether a construct is reflective or formative. For the purpose of this research, these decision rules determine that a reflective perspective be adopted in the development of a measure of CII. Table 6.1 details the decision rules for formative and reflective constructs.

Table 6.1 Decision Rules for Formative and Reflective Models

Decision Rule	Formative Model	Reflective Model/This Research
Direction of Causality	Items to construct	Construct to items
Are indicators: (a) defining characteristics? (b) manifestations of the construct?	Defining Characteristics	Manifestations
Do changes in the indicators/items cause changes in the construct?	Yes	No
Do changes in the construct cause changes in construct? Or cause changes in the indicators/items?	No	Yes
Are indicators inter-changeable?	No	Yes
Should indicators have the same or similar content?	No	Yes
Should indicators share a common theme?	Not necessarily	Yes
Would dropping one of the indicators alter the conceptual domain of the construct?	It is possible	No
Co-variation among the indicators.	Not necessary for indicators to co-vary with each other	Indicators are expected to co-vary with each other
Should a change in one of the indicators be associated with changes in other indicators?	Not necessarily	Yes
Nomological net of the construct Indicators	Nomological net for the indicators may differ	Nomological net for the indicators should not differ
Are the indicators/items expected to have the same antecedents and consequences?	Indicators are not required to have the same antecedents and consequences	Indicators are required to have the same antecedents and consequences

Source: Jarvis, MacKenzie, and Podsakoff (2003): 203

6.3 Measure Development of CII

A multi-dimension measure of the CII construct was developed following the procedures outlined by Churchill (1979), Gerbing and Anderson (1988) and Hinkin (1998). Each stage is discussed below:

- Item generation
- Face and content validity of items
- Questionnaire development
- Exploratory Factor Analysis
- Confirmatory Factor Analysis and construct validity

6.3.1 Item Generation

Successful item generation is seen as key to the development of sound measures (Hinkin 1998). Three approaches to item generation have been adopted in the extant literature including deductive, inductive or a combination of both approaches. A deductive approach was adopted for item generation during this research. This involved a comprehensive review of the extant literature in order to generate an initial pool of items that specified the theoretical domain of CII. However, CII has not been fully defined previously in the context of innovation/NPD in the reviewed literature. As outlined in chapter 3, the following definition has been developed for CII for this research. CII is the degree or breadth to which B2B relationship partners jointly engage with each other during the innovation process. For this research, the CII process is reflected by six dimensions or sub processes including the degree of: joint communication, joint information exchange, joint learning, joint problem solving, joint creativity and joint social bonding. These six dimensions should vary in intensity. The measurement of CII is an indicator of the intensity of the six sub processes which together reflect the construct at any given point in time.

Using the CII definition, several tentative items that appeared to represent the six dimensions of CII were either borrowed or developed from existing literature. This resulted in an initial pool of 26 items. Tables 6.2 to Table 6.7 detail these initial pool items by dimension and include the literature source(s) for each item.

Table 6.2 Joint Communication Measurement Items

Item Name	Item	Source
comm1	The frequency of meetings between us is high	Gruner and Homburg (2000)
comm2	People from both organisations regularly meet face-to-face	Gruner and Homburg (2000), Selnes and Sallis (2003), and Paulraj et al. (2008)
comm3	Communication takes place both informally and formally	Mohr et al. (1996), Mohr and Sohi (1995), and Heide and John (1992)
comm4	A high number of people are involved from both organisation	Paulraj et al. (2008)

Table 6.3 Joint Information Exchange Measurement Items

Item Name	Item	Source
info1	Information is shared freely between us	Adapted from Heide and Miner (1992), McEvily and Marcus (2005), and Cannon and Perreault (1999)
info2	We provide information if it helps our partner	McEvily and Marcus (2005)
info3	Proprietary information is shared between our organisations	Mohr and Spekman (1994), Cannon and Perreault (1999), Heide and John (1992), Heide and Miner (1992), Selnes and Sallis (2003) and McEvily and Marcus (2005)
info4	Our partner provides us with information freely	McEvily and Marcus (2005), Schleimer and Shulman (2011)
info5	We can contact anybody in our partner organisation as and when we please	Adapted from Yan and Dooley (2014)
info6	We exchange information frequently	Cannon and Perreault (1999)

Table 6.4 Joint Learning Measurement Items

Item Name	Item	Source
learn1	We have developed a common language that is unique to this relationship	Akgun Lynne and Yilmaz (2006), Lorange (1988)
learn2	Through interaction we develop new knowledge	Bstieler and Hemmert (2010)
learn3	We adopt unique knowledge sharing routines for joint learning	Dyer and Singh (1998)

Table 6.5 Joint Problem Solving Measurement Items

Item Name	Item	Source
Psolve1	We apply joint goals	Schleimer and Shulman (2011)
Psolve2	We support each other's objectives	Andersen and Narus (1994)
psolve3	We engage in joint planning	Schleimer and Shulman (2011), and Cannon and Perreault (1999)
psolve4	We engage in joint decision making	Selnes and Sallis (2003)
psolve5	Problems that arise throughout the project are treated as joint problems	Heide and Miner (1992), and McEvily and Marcus (2005)
psolve6	Both partners make suggestions regarding the NPD project	Selnes and Sallis (2003)
psolve7	We adopt unique troubleshooting routines for problem solving	Selnes and Sallis (2003)

Table 6.6 Joint Creativity Measurement Items

Item Name	Item	Source
create1	We are creative	Author
create2	New ideas are created when we work together	Leenders van Engelen and Kratzer (2003)
create3	Novel solutions are generated through working together	Subin and Workman (2004)

It was not possible to source a scale for joint creativity that the author believed addressed the domain of the joint creativity construct. Therefore, items were borrowed from two previous scales with the first item "we are creative" being added to ensure that the domain of the construct was adequately addressed.

Table 6.7 Joint Social Bonding Measurement Items

Item Name	Item	Source
social1	We become closer when working together throughout the process	Author
social2	We get enjoyment out of working together	Author
social3	We become friendlier throughout the process	Author

It proved impossible to source a prior measure for joint social bonding. Consequently, the three-item scale used in this research was developed by the author. The scale is anchored in SET, social networking and social capital literature.

In the literature to date, no specific rules exist regarding the number of items to be retained for each measure, but some helpful guidelines do exist (Hinkin 2005). Keeping the number of items low is seen as an effective means of reducing response biases caused by respondent boredom or fatigue. Additional items also demand more time in both the development and administration of the scale. However, some research has suggested that at a minimum at least four items are needed to successfully check the homogeneity of a scale (Harvey, Billings, and Nilan 1985). In contrast Cook (1981) believes that adequate internal consistency can be achieved with as little as three items. In arriving at the number of items per scale for this research, the researcher has been guided by both theoretical and statistical testing of the survey instrument.

6.3.2 Face and Content Validity

A panel of eight experts was established to examine face and content validity. Each judge was asked to review the instrument for grammar, organisation, appropriateness and confirmation that the instrument flowed logically. This part of process did not result in any items being deleted. However, one item, "we have developed a common language that is unique to this relationship" (learn1), needed further explanation to ensure that the expert's interpretation was the same as what the researcher had intended. As a result, the wording of this item was amended with the word "language" being replaced by the word "vocabulary". This item now reads "We have developed a common vocabulary that is unique to this relationship".

For the determination of content validity, a two-phase approach in line with Lynn (1986) was adopted. Another panel of experts including both academics and practitioners were presented with a definition of the collaborative innovation construct as well as a list of all the items. In phase one, the judges were asked to rate or evaluate each item as: not relevant (1) somewhat relevant (2) quite relevant (3) or highly relevant (4). In phase two, the judgement phase, the Content Validity Index (CVI) was computed for each item. The CVI for each scale item is the proportion of experts who rate an item as a 3 or 4 on a four-point scale. Example: 6 of 8 content experts rated an item as relevant (3 or 4), the CVI would be 6/8 =.75. For the purpose of this research any item with a CVI of less than .78 was deleted. This resulted in three items being deleted. The items relate to the dimensions joint communication, joint information exchange and joint problem solving and are as follows: "A high number of people are involved from both organisations (comm4), "We exchange information frequently" (info6) and "We adopt unique troubleshooting routines for problem solving" (psolve7). Table 6.8 outlines the result of the measure purification results.

Table 6.8 Content Validity: Measure Purification Results

Instrument Items	Not Relevant (1)	Somewhat Relevant (2)	Quite Relevant (3)	Highly Relevant (4)	CVI
The frequency of meetings between us is high			1 1	1 1 1 1 1 1	1
People from both organisations regularly meet face-to-face		1	1 1 1 1	1 1 1	.875
Communication takes place both informally and formally			1	1 1 1 1 1 1 1	1
Number of people involved from both organisations is high		1 1 1	1 1 1	1 1	**.625**
Information is shared freely between us				1 1 1 1 1 1 1 1	1
We provide information if it helps our partner		1	1	1 1 1 1 1 1	.875
Proprietary information is shared between our organisations			1 1 1 1 1 1	1 1	1
Our partner provides us with information freely			1 1	1 1 1 1 1 1	1
We can contact anybody in our partner's organisation as and when we please			1 1 1 1	1 1 1 1	1
We exchange information frequently		1 1 1 1 1	1 1 1		**.375**
We have developed a common vocabulary that is unique to this relationship			1 1 1 1 1 1	1 1	1
Through interaction we develop new knowledge				1 1 1 1 1 1 1 1	1
We adopt unique knowledge sharing routines for joint learning			1 1	1 1 1 1 1 1	1
We apply joint goals				1 1 1 1 1 1 1 1	1
We support each other's objectives		1		1 1 1 1 1 1 1	.875
We engage in joint planning				1 1 1 1 1 1 1 1	1
We engage in joint decision making			1 1	1 1 1 1 1 1	1

Problems that arise throughout the project are treated as joint problems			1	1 1 1 1 1 1 1	1
Both parties make suggestions regarding the NPD project				1 1 1 1 1 1 1 1	1
We adopt unique troubleshooting routines for problem solving		1 1	1 1	1 1	**.57**
We are creative			1 1	1 1 1 1 1 1	1
New ideas are created when we work together				1 1 1 1 1 1 1 1	1
Novel solutions are generated through working together		1	1 1 1 1	1 1 1	.875
We become closer when working together throughout the process		1 1	1 1 1 1	1 1	.75
We get enjoyment out of working together		1 1	1 1 1 1 1 1		.75
We become friendlier throughout the process		1	1 1 1 1 1	1	.875

The remaining 23 items were then included in a pilot study (n=63), the statistical results of which are outlined below.

6.3.3 Measurement Approach

6.3.3.1 Pilot Study

In analysing the data from the pilot study (n=63), a solely exploratory analysis was employed using IBM SPSS 24. A reliability analysis was conducted using Cronbach's alpha and item-to-total correlations tests. EFA (principle components method) was used to measure factorial validity. The items for joint communication, joint learning, joint creativity and joint social bonding generated item-to-total correlations scores >.5, and loaded on one factor, with all factor loadings being greater than .5. This indicates statistical significance as per thresholds suggested by Hair et al. (2010). However, the items for joint information exchange and joint problem solving cross-loaded on two factors. No items were deleted at this stage because it was felt that the underlying theory supported the inclusion of these items going forward, and that

the small sample size may have been a feature in the cross-loadings. Full pilot study statistics are presented in Appendix C.

6.3.3.2 Postal Survey

The 23 retained items were administered within a survey instrument. A five-point Likert-scale was used for all measures. The antecedent, outcome, moderation, and control variables were also included in the survey instrument. Chapter 5 outlined the postal survey design in detail.

It is important to note that as powerful statistical tests are to be carried out in this research and confidence in the results are required, the largest sample possible was used that was feasible within both the timeframe of the research and applicable budget constraints. Maximisation of the sample size was critical, as both EFA and CFA have been shown to be particularly susceptible to sample size effects. A more detailed discussion on the importance of sample size for statistical analysis was undertaken in chapter 5. An analysis of response rate and sample size was also outlined in the same chapter (n=185).

The first statistical test carried out on the data was Harman's Single-Factor Technique (Podsakoff et al. 2003). This test was applied to address common method bias in the development of the CII scale. This is in addition to the procedural approaches that were undertaken to mitigate common method bias in this research (see chapter 5). All items were loaded into an exploratory factor analysis using PCA. The un-rotated PCA revealed the presence of six distinct factors with an eigen-value greater than one. The first six factors together accounted for 67.3 percent of the total variance. The first and largest factor did not account for most of the variance (33 percent). Thus, no general factor is apparent. Whilst it cannot be claimed that all common method bias has been eliminated, or that all recommended procedural remedies were followed, it can be said that by following best practice where feasible, as outlined by Podsakoff et al (2003), all reasonable precautions have been taken to mitigate the occurrence of the bias.

Data was treated to extensive screening. This screening was ongoing throughout the data analysis process. This included undertaking graphical examinations, for

example, data represented as histograms, and testing for outliers in the data. No outliers that affected modelling results were found. The data was then subjected to normal distribution testing (Kendrick 2000, and De vaus 2002). Table 6.9 outlines the results for skewness and kurtosis, these measures are used to assess the extent of the departure from a normal distribution. All the values lie within the range of +1 and -1, indicating that the distribution is symmetrical and that all the variables are suitable for further psychometric testing (Kendrick 2000, Mallery and George *2003, and De vaus 2002). Table 6.9 details the distribution statistics for the six dimensions of CII.

Table 6.9 Distribution Statistics

Valid N =185	Mean Statistic	Std Deviation Statistic	Skewness Statistic	Skewness Std Error	Kurtosis Statistic	Kurtosis Std Error
JCOMM	2.49	.86	.50	.179	.16	.355
JINFO	2.24	.69	.21	.179	.40	.355
JLEARN	2.54	.74	.08	.179	.23	.355
JSBOND	2.02	.72	.56	.179	.50	.355
JPS	2.26	.66	-.016	.179	-.41	.355
JCREATE	2.30	.65	.29	.179	.12	.355
CII	2.26	.50	-.17	.179	-.28	.355

Source: Compiled by author

Following confirmation of normal distribution of the data, the performance of the items was evaluated to ensure that they adequately measured each of the six dimensions. This performance evaluation was undertaken through several tests using IBM SPSS 24. These tests are outlined in the following section.

Item-to-total correlations examines the uni-dimensionality of each scale, that is, that the items in each scale are measuring only one construct rather than a mixture of constructs (Kendrick 2000). If an item does not correlate well, that is, with a correlation value of least .5 (as per Hair et al. 2010), with the other items in a scale, this is an indication that it should be removed from the scale because it is likely that is tapping a different construct (Bryman and Cramer 2012).

Reliability of each scale was assessed using the Cronbach's alpha test. This refers to the extent to which the scale produces consistent results, if repeated measurements are made (De vaus 2002 and Bryman and Cramer 2012). The consensus is for a scale to be considered reliable, coefficient alphas should exceed 0.7 threshold value, Nunnally (1978) and Hair et al.'s (2010) recommended value of 0.6 for exploratory research.

6.3.4 Initial Data Analysis (IBM SPSS 24)

The phases of the initial data analysis were carried out in IBM SPSS 24, all statistical analysis results are reported in Appendix D. Each stage is outlined below.

- The six dimensions of CII were subjected to the Pearson's correlation test. All correlations were found to be significant at the .01 level (two-tailed).
- The items measuring each dimension were then subjected to the Pearson's correlation test. All item correlations for JCOMM, JNFO, JLEARN, JSBOND, JPS and JCREATE were found to be significant at the .01 level (two-tailed).
- Descriptive statistics were generated for all items and all dimensions. Each dimension was then subjected to exploratory factor analysis with KMO and Bartlett's test of sphericity, item communalities, total variance explained, and component matrix being reported.
- Reliability analysis for each dimension included generating a Cronbach's alpha score, reporting item-total-statistics, and Cronbach's alpha score if item deleted.

Based on the initial statistical results (low communalities, low factor loadings (less than .4), cross loadings (greater than .2) three items were deleted from the overall CII scale. "Proprietary information is shared between our organisations (info3) and "we can contact anybody in our partner organisation as and when we please" (info5) were deleted from joint information exchange. "Both partners make suggestions regarding the NPD project" (psolve6) was deleted from joint problem solving.

Table 6.10 Item Deletion Criteria

	Extracted Communality	Factor Loading	Item-Total-Correlation	Initial Cronbach's Alpha	Revised Cronbach's Alpha
Info3	.428	.654	.464	.786	.814
info5	.384	.620	.441	.786	.814
psolve6	390	.624	.495	.850	.850

Factor analysis was then conducted on the revised 20 items of the second order latent CII using principle components analysis extraction and promax rotation. This resulted in a measure of sampling adequacy (KMO test) of .827, Bartlett's test of sphericity was significant, all extraction communalities > .6, except (psolve5) which was .531. The total variance explained was 73.06 percent with the revised Cronbach's alpha for CII being .892. To further test whether the six factors which emerged from EFA adequately captured the construct of CII (20 items), a confirmatory analysis using IBM AMOS 24 was conducted.

CFA determines the factor structure of a dataset. In the EFA the factor structure is explored (how the variables relate, and group based on inter-variable correlations). In CFA the extracted factor structure is confirmed or rejected based on the goodness-of-fit indices.

6.3.5 Confirmatory Factor Analysis (CFA)

As already outlined in the previous section, a major weakness of EFA is the inability to quantify the goodness-of-fit of the resulting factor structure (Long 1983). In addition, EFA involves a post hoc interpretation of the results, whereas CFA specifies a priori relationships between the scales or variables of interest. Items that load clearly in an exploratory factor analysis may still demonstrate a lack of fit in a multiple-indicator measurement model due to lack of external consistency (Gerbing and Anderson 1988). Consequently, data from the primary data collection stage will be examined for scale reliability and validity by adopting a CFA approach (IBM AMOS 24). It is necessary to establish convergent and discriminant validity, as well as

reliability, when doing a CFA. If your factors do not demonstrate adequate validity and reliability, moving on to test a causal model will be pointless. The following measures will be used for establishing validity and reliability and reported in the findings chapter: Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV). As suggested by Hair et al. (2010), the thresholds for these values are as follows:

> **Reliability:** CR > 0.7
>
> **Convergent Validity:** AVE > 0.5
>
> **Discriminant Validity:** MSV < AVE Square root of AVE greater than inter-construct correlations

Convergent validity issues suggest that your variables do not correlate well with each other within their parent factor meaning that the latent factor is not well explained by its observed variables. Discriminant validity issues suggest that variables correlate more highly with variables outside their parent factor than with the variables within their parent factor, meaning that latent factor is better explained by some other variables (from a different factor), than by its own observed variables.

Following validity testing as detailed above, the next step involved tests to quantify the goodness-of-fit of the resulting factor structure (Gerbing and Anderson 1988). IBM AMOS 24. provides a technique that allows the researcher to assess the quality of the factor structure by statistically testing the significance of the overall model and the item loadings on factors. This affords a stricter interpretation of uni-dimensionality. In real terms, CFA is a confirmation that the prior analysis has been conducted in a rigorous and appropriate manner. Because of the availability of numerous goodness-of-fit statistics, the indices used in this research will reflect those used in relevant literature and as suggested by Hair, Anderson, Babin, and Black (2010: 654). They are comparative fit index (CFI), the goodness-of-fit index (GFI), the standardised root mean square residual (SRMR), the root mean square error of approximation (RMSEA) and PCLOSE. The guidelines for analysing a model goodness-of-fit as per Hair et al. (2010) are:

- CFI: values> .90 indicate acceptable models (the closer to 1.0 the better the model fits)

- GFI: Similar to CFI, values > .90 indicate acceptable models (the closer to 1.0 the better the model fits)
- RMSEA : values < .05 reflect a good fit, values > .05 and <.08 reflect an adequate fit, values >.08 and <.10 indicate a mediocre fit and values over .10 signal a poor fitting model
- SRMR: values below .05 indicate an acceptable fit
- PCLOSE: >.05.

Although no longer considered an accurate measure of a model's goodness-of-fit (Byrne 2001, Diamantopoulos and Siguaw 2000), the chi-square statistic and its accompanying degrees of freedom and p value are also reported here because they have been traditionally reported in the literature.

Once the overall fit of the model was examined, additional interpretation was carried out. First, each model coefficient (e.g. item) was individually examined for degree of fit. By selecting a desired level of significance, the t-values will be used to test the null hypothesis that the true value of specified parameters is zero thus determining if the items are good indicators of a scale. Those items that are not significant may need to be eliminated. Secondly, modification indices were considered, as the modification indices provide information regarding unspecified parameters or cross-loadings. A large modification index indicates that a parameter might also contribute explained, but unspecified, variance in the model. Where the output revealed large modification indices, the measurement model was re-specified allowing the items with the largest indices to load on the specified corresponding factor. However, this re-specification was only made where it was theoretically plausible. The output was then re-examined, with special attention to t-values for all specified loadings.

6.4 Chapter Summary

This chapter outlined the framework for the measurement development of CII. Chapter 7 will outline the framework for the analysis of the structural model, with chapter 8 presenting the findings for the CFA of both measurement and structural models.

Chapter 7 Reliability and Testing of Non-CII Constructs in the Structural Model

7.1 Introduction

This chapter presents the results of the statistical assessment of each construct that is included in the structural model. The next chapter presents the findings from the estimation of both the measurement and the structural model.

The chapter is divided into three main sections based on this research's conceptualisation. These sections relate to the structural model's antecedents, outcomes, and moderation variables. Each section details scale items and reports EFA findings based on this study's data collection. Any adjustments (based on either theoretical or statistical reasoning) made to the original scales are also outlined.

7.2 Structural Model Measures

There are two critical approaches involved in the structural modelling process: (1) the sourcing of prior measures from the literature for each construct and (2) the testing of these measures for reliability and validity. A review of the existing literature was undertaken in order to identify the relevant measurement scales. The scales used in this study are believed to possess content and/or face validity because they have been tested rigorously and generalised in the published literature. All scales use a five-point Likert scale with 1 = strongly agree and 5 = strongly disagree. Each of the measurement scales underwent further testing for validity and reliability using EFA and CFA as part of this research.

7.3 Antecedent Variables

This work's conceptualisation contains three antecedent variables: benevolent trust, cognitive commitment and senior management support. It is not considered that there are only three antecedent variables of CII, but rather that these three are the most critical within the context of the SET theoretical framework.

7.3.1 Benevolent Trust (H2a)

The first antecedent variable is benevolent trust. The benevolent trust scale used in this study is adapted from Mohr and Spekman (1994) and the items are listed in Table 7.1. The measure is a three-item differential scale. Some contextual changes in the scale resulted in the word "partner" being used in this research rather than the word "manufacturer" that was used in the original scale. The results of the initial EFA are detailed in Table 7.1. The PCA extraction method using promax rotation was applied generating the following results: .732 KMO measure of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .76 to .82, and total variance explained of 78.71 percent. All items loaded strongly on one factor with a Cronbach's alpha score of .864. The score based on the survey data for this research was much higher than the .75 achieved by Mohr and Spekman (1994). This may well be as a result of changing the second item "*we feel that we get a fair deal from our partner*" from the reverse worded item "*we feel that we do not get a fair deal from our partner*" that was used in the original scale. Table 7.1 shows EFA results and Cronbach's alpha score for the Benevolent Trust Scale.

Table 7.1 Benevolent Trust Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.864		
We trust that our partner's decisions will be beneficial to our business		trust1	.872
We feel that we get a fair deal from our partner		trust2	.904
The relationship is marked by a high degree of harmony		trust3	.896

7.3.2 Cognitive Commitment (H2b)

The cognitive commitment scale used in this study is adapted from Morgan and Hunt (1994) and the items are listed in Table 7.2. The measure is a three-item differential scale. Small changes were made to the wording of the original scale for contextual reasons. The PCA extraction method using promax rotation was applied generating the following results: .746 KMO measure of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .807 to .844, and total variance explained of 82.25 percent. All items loaded strongly on one factor with a Cronbach's alpha score of .886. The score based on the survey data collected in this research compares well with the original scale reliability result of .895 achieved by Morgan and Hunt (1994). Table 7.2 shows EFA results and Cronbach's alpha score for the Cognitive Commitment Scale.

Table 7.2 Cognitive Commitment Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.886		
The relationship that we have with this partner is: something that we are very committed to		commit1	.898
The relationship that we have with this partner is: something that we intend to maintain indefinitely		commit2	.904
The relationship that we have with this partner: deserves our maximum effort to maintain		commit3	.919

7.3.3 Senior Management Support (H2c)

Senior management support is measured by a single item measure in this research. This measurement approach was also adopted by Barczak, Griffin and Kahn (2009) in their PDMA best practices survey.

7.4 Outcome Variables

This work's conceptualisation contains two outcome variables, NPD outcomes and LTO. Again, it is not considered that there are only two outcome variables of CII, but rather that these are the most critical in the context of SET.

7.4.1 NPD Outcomes (H3a)

The NPD outcomes scale for this research includes both financial and relationship satisfaction items. It is a 7-item differential scale. It includes five financial items adapted from Ignatius, Leen, Ramayah, Hin, and Jantan (2012) and two relationship satisfaction items adapted from a relational satisfaction scale (Bstieler 2006). The results of the EFA are detailed in Table 7.3. The PCA extraction method using promax rotation was applied generating the following results: .846 KMO measure of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .583 to .718, and total variance explained of 65.97 percent. All items loaded strongly on one factor with a Cronbach's alpha of .913. Table 7.3 shows EFA results and Cronbach's alpha for the NPD outcomes scale.

Table 7.3 NPD Outcomes Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.913		
The NPD collaboration exceeded overall senior management expectations		outcomes1	803
The NPD collaboration exceeded our customer expectations		outcomes2	.798
The NPD collaboration exceeded profit expectation		outcomes3	.833
The NPD collaboration exceeded return on investment expectations		outcomes4	.849
The NPD collaboration exceeded our market share expectations		outcomes5	837
This NPD collaboration has met our expectations		outcomes6	.763
The NPD collaboration has been successful		outcomes7	.804

7.4.2. LTO (H3b)

The LTO scale used in this study was adapted from Ganesan (1994). The original scale was a seven-item differential scale, however, following the initial EFA, lto5, "*we are only concerned with our outcomes in this relationship*" was deleted as it cross-loaded on a different factor. The PCA extraction method was applied using promax rotation generating the following results: .853 KMO measure of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .515 to .724,

and total variance explained of 59.9 percent. All remaining items loaded strongly on one factor with a Cronbach's alpha score of .863. The score based on the survey data for this research is higher than the .82 score achieved by Ganesan in the original research. Table 7.4 shows EFA results and Cronbach's alpha for the LTO scale.

Table 7.4 LTO Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.863		
We believe that in the long run our relationship with this partner will be profitable		lto1	.754
Maintaining a long term relationship with this partner is important to us		lto2	.851
We focus on the long term goals in this relationship		lto3	.759
We are willing to make sacrifices to help this partner from time to time		lto4	.718
We expect this partner to be working with us for a long time		lto6	.817
Any concessions that we make to help this partner will even out in the long run		lto7	.736

7.5 Moderation Variables

Three independent variables were added to the structural model in order to test for moderation effects between firstly, CII and NPD outcomes, and secondly, CII and LTO. Moderation variables include type of NPD (explorative or exploitative), market turbulence and finally technological turbulence.

7.5.1 Type of NPD (H5a to H5d)

Type of NPD is a categorical variable and therefore requires no further discussion in the context of scale measures (H4a to H4d).

7.5.2 Market Turbulence (H5e and H5f)

The measure is a three-item scale and is based on the work of Calantone et al. (2003). These researchers developed the market turbulence scale by adapting three previously developed measures from the literature: Jaworksi and Kohli (1993) who

looked at the composition of customers over time, Li and Calantone (1998) who looked at the market share over time and Miller and Friesen (1982) who measured the ease of forecasting customers' demands and tastes. No changes were made to the original wording of the scale. Items are listed in Table 7.5.

The PCA extraction method using promax rotation was applied generating the following results: KMO measure of .599 of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .495 to .747 for all items, and total variance explained of 61.37 percent. All items loaded strongly on one factor with a Cronbach's alpha score of .682. This score compares favourably with the original of .54 achieved by Calantone et al. (2003). Table 7.5 shows EFA results and Cronbach's alpha score for the market turbulence scale.

Table 7.5 Market Turbulence Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.682		
We cater for many of the same customers as in the past		market1	.703
In general, in our industry, market share is stable amongst the same competitors		market2	.865
Demand and taste are easy to forecast		market3	.774

7.5.2 Technological Turbulence (H5g and H5h)

The scale was originally a five-item scale and was adapted from Calantone et al. (2003). Only the first three items were used for this research as tech4 was reverse coded and tech5 cross loaded equally across two factors (during the first EFA). The PCA extraction method using promax rotation was applied generating the following results: KMO measure of .706 sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging between .698 and .808, total variance explained of 75.35 percent. All items loaded strongly on one factor, with a Cronbach's alpha score of .835. This score compares favourably with the original of .74 achieved by Calantone et al. (2003). Table 7.6 shows EFA results and Cronbach's alpha score for the Technological Turbulence scale.

Table 7.6 Technological Turbulence Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.835		
The technology in our industry is changing rapidly		tech1	.876
A large number of new product ideas have been made possible through technological breakthroughs in our industry		tech2	.898
In our industry the modes of production and services change often		tech3	.829

7.6 Other Variables (TCE Model)

In order to estimate an alternative structural model, two TCE first order variables: dependence and asset specificity, replaced benevolent trust and cognitive commitment in the revised model.

7.6.1 Dependence

The original scale was adapted from Ganesan (1994) and is an eight-item differential scale. Two items relating to sales volume in the original scale were removed due to lack of contextual relevance. The PCA extraction method using promax rotation was applied generating the following results: .843 KMO measure of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .515 to .755, and total variance explained of 63.82 percent. All items loaded strongly onto one factor with a Cronbach's alpha score of .843. This score while not as high as the original score of .94 achieved by Ganesan (1994) but is still favourable. Table 7.7 shows EFA results and Cronbach's alpha score for the Dependence scale.

Table 7.7 Dependence Scale

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.885		
This partner is crucial to our future performance		depend1	.743
It would be difficult for us to replace this partner		depend2	.869
We are dependent on this partner		depend3	.845

We do not have a good alternative to this partner		depend4	.718
This partner is important to our business		depend5	.743
If our relationship was discontinued we would difficulty in replacing this partner		depend6	.861

7.6.2 Asset Specificity

The original scale is a four-item differential scale borrowed from Wagner (2012) and adapted from Ganesan (1994). No changes were made to the original scale. The PCA extraction method using promax rotation was applied generating the following results: .843 KMO measure of sampling adequacy, Bartlett's test of sphericity was significant, extraction communalities ranging from .463 to .734 and total variance explained of 54.75 percent. All items loaded strongly on one factor with a Cronbach's Alpha score of .724. This score, while not as high as the original scale score of .78, is still favourable. Table 7.8 shows EFA results and Cronbach's Alpha score for the Asset specificity scale.

Table 7.8 Asset Specificity

Item Detail	Cronbach's Alpha	Item Name	Factor Loadings
	.724		
If we switched from this partner to another partner, we would lose substantial investments		asset1	.774
We have invested substantially in personnel dedicated to this partner		asset2	.680
If we switched from this to an alternative partner, we would lose knowledge related to the processes of this partner		asset3	.752
Investments in this partner could not be reversed in the case of partner switching		asset4	.750

7.7 Chapter Summary

This chapter outlined the literature source of all the structural model constructs' scales. Items for each scale were detailed and given unique labels. Where changes to

the original scales were undertaken, an explanation was given. EFA factor loadings and reliability scores (Cronbach's Alpha) results were presented. The next chapter estimates the overall measurement and structural model and details all findings from CFA.

Chapter 8: Findings

8.1 Introduction

This chapter firstly outlines the characteristics of the research sample. Following on from chapter six (measurement model development), this chapter estimates three alternative measurement models. The three alternative models include: the second order latent factor model (Measurement Model A), the six-dimension co-varied model (Measurement Model B) and finally a multi item measurement model (Measurement Model C). All relevant loadings and goodness-of-fit indices are reported for each of the three models. The measurement models are then compared from both a theoretical and statistical perspective. The second-order latent factor model represents the best fit from both a theoretical and statistical perspective.

Pursuant to this, the structural model is specified with all relevant loadings and goodness-of-fit indices being reported. The model is then re-specified to include all control and moderating variables. All statistical findings are reported. Finally, an alternative structural model is estimated using TCE variables. All statistical findings are reported. Finally, statistical findings from both SET and TCE models are compared.

8.2 Characteristics of Research Sample

The respondents for this research are categorised by: type of NPD, partner type, criticality of customer, longevity of the relationship, gross sales of organisation, and industrial sector. Of the 185 respondents in this sample only 71 (38 percent) were involved in radical or explorative NPD with 114 (62 percent) engaging in incremental or exploitative NPD (Table 8.1). This would appear to suggest that organisations are building on existing proven products rather than taking the exploratory route, perhaps indicating a risk-adverse culture within organisations. Table 8.2 indicates that customers are still the preferred choice of partner with 102 (55 percent) of the sample choosing customers and 45 percent choosing suppliers. Of the 102

respondents that chose customers 76 percent of the customers were in the top six accounts (Table 8.3). As shown in Table 8.4, most inter-organisational relationships, regardless of partner type involved, are not new with 55 percent of all relationships being in existence for more than seven years and only 5 percent being in existence for less than one year. The last classification variables asked respondents to indicate (1) the industry sector that they were trading in and (2) their gross sales for 2015/2016 (Euros). Although not evenly spread across all sectors it can be seen from Table 8.5 that most sectors are represented in the sample. However, the largest percentage of respondents (38 percent) are in the food, tobacco and beverage sector. Finally, based on gross sales Table 8.6 indicates that 57 percent of the respondents had gross sales of 20 million euros or less for the financial year 2015/2016. The largest percentage of respondents (43 percent) were in the greater than 2 million, less than or equal 20 million band. Table 8.1 to Table 8.6 summarise the results of the above analysis.

Table 8.1 Research Sample Analysis: Type of NPD

	Frequency	Valid Percent	Cumulative Percent
Radical	71	38.4	38.4
Incremental	114	61.6	100
Total	185	100	
Missing	0		
Total	185		

Table 8.2 Research Sample Analysis: Partner Type

	Frequency	Valid Percent	Cumulative Percent
Supplier	83	44.9	44.9
Customer	102	55.1	100
Total	185	100	
Missing	0		
Total	185		

Table 8.3 Research Sample Analysis: Criticality of Customer

Account Grouping	Frequency	Valid Percent	Cumulative Percent
Top 1-2	34	33.33	33.33
Top 3-4	32	31.37	64.7
Top 5-6	12	11.76	76.46
Top 7-8	10	9.82	86.28
Top 9 plus	14	13.72	100
Total	102	100	
Missing	0		
Total	102		

Table 8.4 Research Sample Analysis: Relationship Duration

	Frequency	Valid Percent	Cumulative Percent
Less than one year	9	4.9	4.9
One to three years	52	28.1	33
Four to six years	23	12.4	45.4
Seven years or more	101	54.6	100
Total	185	100	
Missing	0		
Total	185		

Table 8.5 Research Sample Analysis: Industry Sector

	Frequency	Valid Percent	Cumulative Percent
Pharmaceuticals	27	14.6	14.6
Mechanical/Electrical /Electrical Engineering	26	14.1	28.7
Industrial Machinery	15	8.1	36.8
Telecommunications	5	2.7	39.5
Other Manufacturer	29	15.7	55.2
Food	70	37.8	93
Technology	2	1.1	94.1
Chemical/Plastic/Rubber Products	3	1.6	95.7
Construction	2	1.1	96.8
Paper/Paper products/Printing /Publishing	2	1.1	97.9
Others	4	2.1	100
Total	185	100	
Missing	0		
Total	185		

Table 8.6 Research Sample Analysis: Firm Size

	Frequency	Valid Percent	Cumulative Percent
≤ €2 Million	25	13.5	13.5
>€2 ≤ €20 Million	80	43.2	56.8
>€20 ≤ €50 Million	25	13.5	70.3
>€50 ≤ €100 Million	19	10.3	8.5
>€100 ≤ €300 Million	12	6.5	87
>€300 ≤ €400 Million	2	1.1	88.1
>€300 ≤ €400 Million	3	1.6	89.7
>€400 ≤ €500 Million	4	2.2	91.9
>€500 Million	15	8.1	100
Total	185	100	
Missing	0		
Total	185		

8.3 Measurement Model Specification

To establish convergent, discriminant validity and reliability of the measurement model's dimensions several measures were used, including Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV). The thresholds applied for these tests (Hair et al. 2010) are as discussed in chapter 6.

The first set of results for reliability and validity testing are presented in Table 8.7. The AVE for the first order latent factor JLEARN is below .5 which implies convergent validity issues. In effect what this means is that JLEARN is not well explained by its observed variables (jlearn1, jlearn2, and jlearn3). From a statistical perspective it could be argued that JLEARN be removed from the model, but because JLEARN is of such theoretical importance within the CII measure, no action was taken, and the construct was retained. However, to address the convergent validity issues the item with the lowest factor loading jlearn1, "we have developed a common vocabulary that is unique to this relationship" was removed from the scale. Table 8.9 demonstrates that this item deletion generated an AVE of .535 above the required threshold. It should be noted that as a result, CR for JLEARN has now dropped to .696 which is just below the .70 threshold but at .004 no action was taken. The AVE for

JPS is .542 which is very low in comparison to the other latent factors. In order to correct this psolve5 “problems that arise throughout the project are treated as joint problems”, was removed from the measure, as this showed the lowest regression weight loading at .59. The revised model was again tested for reliability and validity with the results being presented in Table 8.9. Table 8.9 demonstrates that all reliability and validity concerns regarding the measurement model have now been addressed.

Table 8.7 Validity and Reliability Measurement Model Constructs

	CR	AVE	MSV	MaxR(H)	JPS	JCREATE	JSBOND	JINFO	JCOMM	JLEARN
JPS	0.854	0.542	0.324	0.863	**0.736**					
JCREATE	0.850	0.656	0.338	0.888	0.542	**0.810**				
JSBOND	0.875	0.700	0.338	0.891	0.508	0.458	**0.837**			
JINFO	0.823	0.611	0.228	0.872	0.477	0.260	0.414	**0.782**		
JCOMM	0.812	0.595	0.165	0.857	0.389	0.311	0.406	0.341	**0.772**	
JLEARN	0.701	0.444	0.338	0.725	0.569	0.581	0.581	0.392	0.389	**0.666**

Table 8.8 Revised Validity and Reliability Measurement Model Constructs (psolve5 and learn1 removed from model)

	CR	AVE	MSV	MaxR(H)	JPS	JCREATE	JSBOND	JINFO	JCOMM	JLEARN
JPS	0.850	0.586	0.304	0.854	**0.765**					
JCREATE	0.850	0.656	0.366	0.887	0.525	**0.810**				
JSBOND	0.875	0.700	0.312	0.891	0.491	0.459	**0.837**			
JINFO	0.823	0.612	0.213	0.870	0.461	0.261	0.415	**0.782**		
JCOMM	0.812	0.596	0.165	0.858	0.397	0.312	0.406	0.341	**0.772**	
JLEARN	0.696	0.535	0.366	0.701	0.551	0.605	0.559	0.391	0.368	**0.731**

Key (Table 8.7 and Table 8.8): ***JPS = joint problem solving; JCREATE = joint creativity; JSBOND= joint social bonding; JINFO= joint information exchange; JCOMM= joint communication; JLEARN = joint learning. CR = composite reliability; AVE= average variance extracted, MSV= maximum shared variance; MaxR(H) = maximum reliability.***

The diagonal value (in bold) is the square root of AVE of the construct. The other values in the table represent the correlations between the respective constructs.

8.3.1 Measurement Model Comparison

IBM AMOS 24 was used to test the three hypothesised alternative measurement models. The first model represents the six co-varied dimensions approach to CII measurement, the second, the second order latent factor approach to CII measurement and the third, the 18 multi-item approach to CII measurement. The two-step model as recommended by Byrne (2010) was followed which involved the initial confirmation of the validity of the indicator variables using (CFA). Table 8.9 compares the standard regression weight loadings for each measurement model at this indicator level. Several of the indicators in model C (multi-item approach) are below .50, in addition, all model fit indices for this model are below the recommended threshold values. Consequently, this model (multi-items) was removed from consideration. The remaining two measurement models, Figure 8.1 and Figure 8.2, were then compared with both theoretical and statistical considerations being evaluated. Table 8.11 compares the remaining two models based on model fit indices. The results of the confirmatory factor analysis (second order latent factor model) are shown in Figure 8.2 and tabulated in Table 8.12. To improve model fit, modification indices were co-varied where appropriate.

Table 8.9 Standardised Regression Weight Loadings: Measurement Models

	Second Order CII (Model A)	Co-varied (Model B)	CII to Items (Model C)
JPS-psolve1	.68	.68	.56
JPS-psolve2	.80	.81	.69
JPS-psolve3	.76	.75	.66
JPS-psolve4	.69	.68	.61
JCREATE-create1	.71	.72	.53
JCREATE -create2	.92	.92	.63
JCREATE-create3	.79	.79	.57
JSBOND-social1	.74	.74	.64
JSBOND-social2	.88	.89	.69
JSBOND-social3	.88	.87	.62
JINFO-Info1	.89	.90	.52
JINFO-info2	.70	.69	.45
JINFO-info4	.74	.73	.47

JCOMM-comm1	.89	.89	.47
JCOMM-comm2	.79	.79	.40
JCOMM-comm3	.60	.61	.47
JLEARN-learn2	.77	.77	.58
JLEARN-learn3	.69	.69	.53

Table 8.10 Modification Indices by Model

Model	Scale	Co-Varied Error Terms	MI
Second Order (Model A)	JPS	e1- e2	13.21
Second Order (Model A)	JPS	e3-e4	13.38
Co-Varied (Model B)	JPS	e1-e2	12.20
Co-Varied (Model B)	JPS	e3-e4	14.64

Key: Second Order=second order factor measurement model, JPS= joint problem solving scale, e1-e2= error term 1 and error 2 relating to psolve1 and psolve2, MI= Modification index, Co-varied = Six dimension co-varied measurement model

Table 8.11 Goodness-of-fit Indices for Measurement Models

Model	x^2	df	p	x^2/df CMIN	GFI	CFI	RMSEA	PCLOSE	SRMR
CII second order factor model with 18 items (Model A)	182.861	127	.001	1.44	.909	.965	.05	.53	.059
Alternative model									
18 Items loading onto six co-varied factors (Model B)	172.032	118	.001	1.46	.914	.966	.05	.49	.053

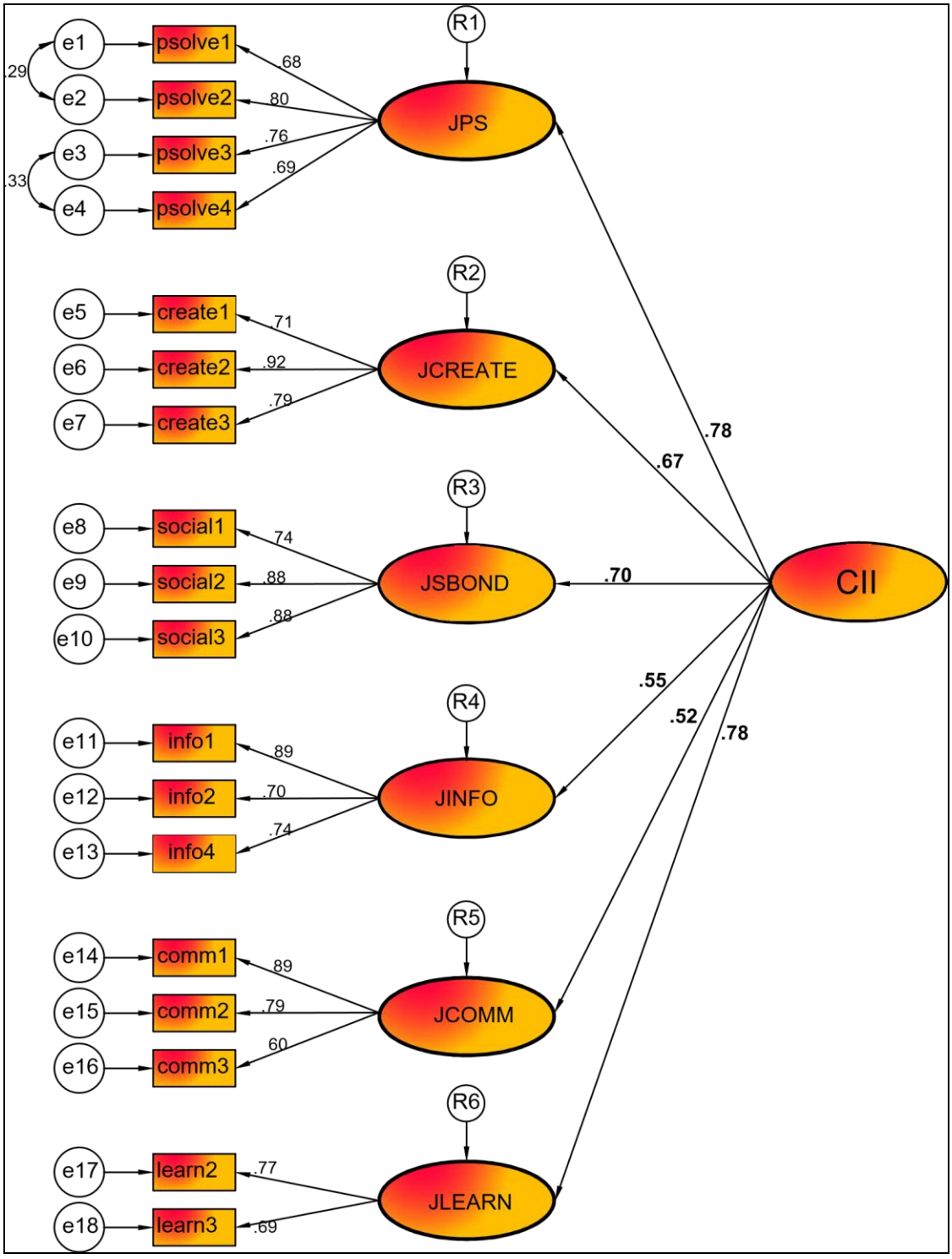
Key: x^2=Chi-Square, df=degrees of freedom, x^2/df=chi Square/df, p= level of marginal significance, GFI= Goodness-of-fit Index, CFI =Comparative Fit Index, RMSEA= Root Mean Square Error Approximation, PCLOSE=p of Close Fit, SRMR= Standardised Root Mean Square Residual

The goodness-of-fit indices for the remaining measurement models as expected, are very similar (except for PCLOSE and SRMR which are marginally better in second order factor model). All indices can be interpreted as excellent based on the thresholds as outlined by Hair et al. (2010). For the purpose of this research, the second order factor model (Figure 8.1) indices support the theoretical proposition that the six distinct but related first order constructs reflect CII (Figure 8.1). An added advantage to using the second order factor model is that it demonstrates a more parsimonious and interpretable model than first order models because the co-varied first order factor assumes zero error at construct level (Chen, Sousa, and West 2005) as opposed to a second order factor model which demonstrates this error by including a residual error term at the construct level. Based on second order factor estimation, all measurement model hypotheses are supported (Table 8.12).

Table 8.12 Measurement Model Hypotheses

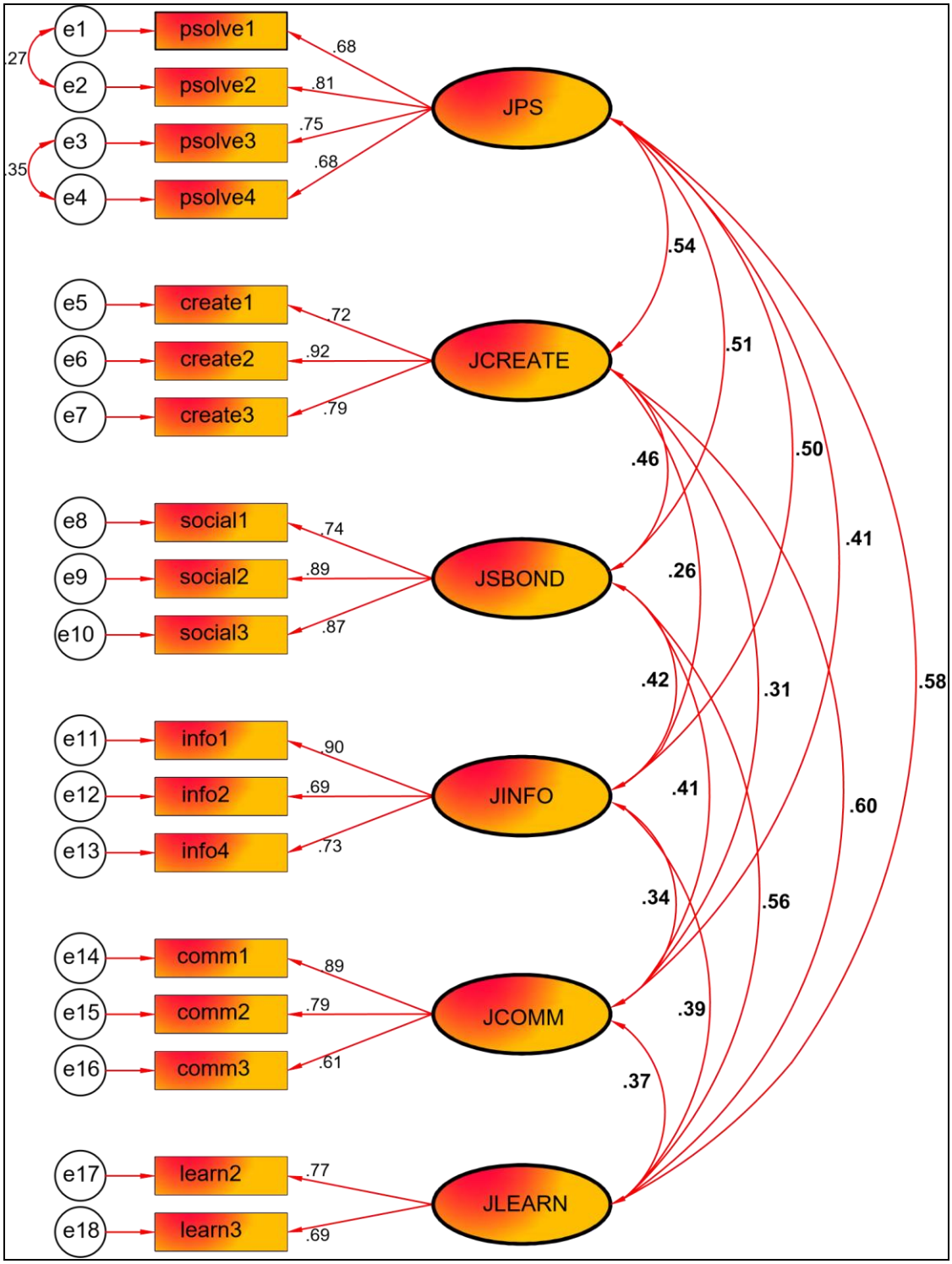
Hypotheses	Standardised Regression Weight	CR	AVE	Supported/Rejected
H1a:Joint Communication is a dimension of CII	.52	.812	.596	Supported
H1b: Joint Information Exchange is a dimension of CII	.55	.823	.612	Supported
H1c: Joint Learning is a dimension of CII	.78	.696	.535	Supported
H1d: Joint Problem Solving is a dimension of CII	.78	.850	.586	Supported
H1e: Joint Creativity is a dimension of CII	.67	.850	.656	Supported
H1f: Joint Social Bonding is a dimension of CII	.70	.875	.700	Supported

Key: p is significant at the .001 level (two-tailed) CR=Composite reliability by dimension, AVE= Average variance explained by dimension, Supported/rejected relates to each measurement model hypothesis



Key: CII=collaborative innovation intensity, JPS=joint problem solving, JCREATE=joint creativity, JSBOND=joint social bonding, JINFO=joint information exchange, JCOMM=joint communication, JLEARN=joint learning e1 to e18 = error terms at the indicator level, R1 to R6 = residual errors at the dimension level. Goodness-of-Fit indices Results*:* CMIN/DF 1.44, GFI.909, CFI .965, SRMR .059, RMSEA 0.05, PCLOSE .531

Figure 8.1 Second Order Factor: Measurement Model A



Key: CII=collaborative innovation intensity, JPS=joint problem solving, JCREATE=joint creativity, JSBOND=joint social bonding, JINFO=joint information exchange, JCOMM=joint communication, JLEARN=joint learning, e1 to e18 = error terms at the indicator level, R1 to R6 = residual errors at the dimension level. Goodness-of-Fit Indices Results: CMIN/DF 1.46, GFI.914, CFI .966, SRMR .053; RMSEA 0.05; PCLOSE .49

Figure 8.2 Six Dimension Co-Varied: Measurement Model B

8.4 Structural Model Specification

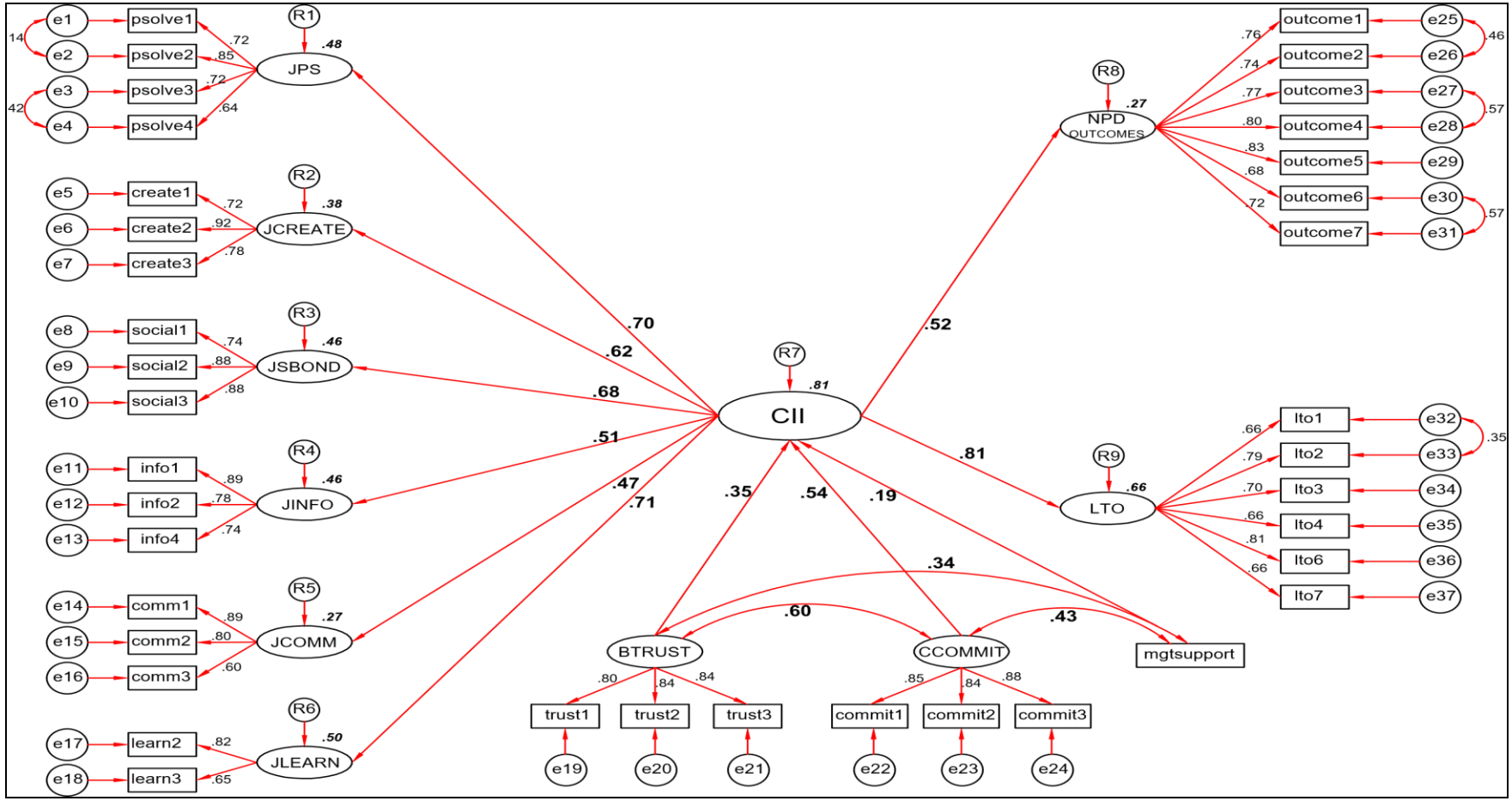
Before identification and estimation of the structural model, each borrowed scale was tested for composite reliability and average variance extracted. All results are within guidelines (>.50 for average variance extracted and >.60 for composite reliability, guidelines are as per Hair et al. (2010)). Table 8.13 outlines composite reliability (CR) and average variance extracted (AVE) for CII antecedent and outcome variables.

Table 8.13 Composite Reliability and Average Variance Extracted (Structural Model Measures)

Construct Variable	Composite Reliability	Average Variance Extracted
Cognitive Commitment	.893	.734
Benevolent Trust	.866	.681
NPD outcomes	.903	.570
Long term Relationship Orientation	.856	.510

Key: Composite Reliability=Reliability for set of scale items, Average Variance Extracted=Amount of variance extracted from scales versus that which can be attributed to measurement error.

Figure 8.3 illustrates the results of the estimation of the SET second order factor structural model. For further clarity, Table 8.14 details the standard regression weight loadings and squared multiple correlations for the antecedent and outcome scales. To improve model fit indices, several error-terms were co-varied (within first order factor scales) based on both theory and high modification indices (all >10). Where this was undertaken, the co-varied error terms related to the same measure (Table 8.15). Final goodness-of-fit indices results are shown underneath Figure 8.3. All the model goodness-of-fit indices reported demonstrate excellent model fit except for GFI (.795) and CFI (.921), both demonstrating acceptable model fit.



Key: CII=collaborative innovation intensity, JPS=joint problem solving, JCREATE=joint creativity, JSBOND=joint social bonding, JINFO=joint information exchange, JCOMM=joint communication, JLEARN=joint learning, BTRUST= benevolent trust, CCOMMIT= cognitive commitment, NPDOUTCOMES= NPD outcomes, LTO=Long term relationship orientation. Goodness-of-fit indices results: CMIN/DF 1.507, GFI .795, CFI .921, SRMR .068, RMSEA .052, PCLOSE .269

Figure 8.3 Structural Model (SET lens)

Table 8.14 details the standard regression weight loadings and squared multiple correlations for the structural model's antecedent and outcome scales.

Table 8.14 Structural Model: First Order Factors-Standardised Regression Weight Loadings and Squared Multiple Correlations

First Order Latent Factor to Indicator	Standardised Regression Weights	R^2
Cognitive Commitment to commit1	.85	.73
Cognitive Commitment to commit2	.84	.70
Cognitive Commitment to commit3	.88	.77
Benevolent Trust to trust1	.80	.64
Benevolent Trust to trust2	.84	.70
Benevolent Trust to trust3	.84	.70
NPD Outcomes to outcome1	.76	.57
NPD Outcomes to outcome2	.74	.54
NPD Outcomes to outcome3	.77	.59
NPD Outcomes to outcome4	.80	.64
NPD Outcomes to outcome5	.83	.70
NPD Outcomes to outome6	.68	.46
NPD Outcomes to outcome7	.72	.53
LTO to lto1	.66	.44
LTO to lto2	.79	.62
LTO to lto3	.70	.49
LTO to lto4	.66	.43
LTO to lto6	.81	.65
LTO to lto7	.66	.43

The standardised regression weight loadings for the two antecedent variables and the two outcome variables are all well above .6. Several error terms were co-varied at the indicator level only where indicators reflected the same measure. This was undertaken to improve model fit. Table 8.15 details the co-varied error terms. It identifies the relevant scale and includes the M.I. score.

Table 8.15 Structural Model SET Lens: Co-varied Error Terms by Scale

Scale	Co-Varied Error Terms	M.I.
NPD Outcomes	e25- e26	43.526
NPD Outcomes	e27-e28	57.103
NPD Outcomes	e30-e31	63.607
LTO	e32-e33	13.430

Key: NPD Outcomes = NPD Outcomes scale, e25 and e26= error term 25 and error 26 relating to outcomes1 and outcomes2, e27 and e28 = error term 27 and error term 28 relating to outcomes3 and outomes4, e30 and e31 = error term 30 and error term 31 relating to outcomes 6 and outcomes 7. LTO =Long term relationship orientation, e32 and e33 = error term 32 and error term 33 relating to lto1 and lto2. MI= Modification index

Table 8.16 shows the hypotheses results for the structural model. All hypotheses were supported. However, the following is noteworthy. The estimated positive relationship between benevolent trust and CII is relatively low at .35, as opposed to the cognitive commitment to CII relationship which estimates a positive relationship of .54. This may be connected to both constructs being modelled as co-varied here (.60 correlation coefficient). This will be further explored in chapter 9. The relationship between senior management support and CII although positive is also lower than expected at .19. Once again, the co-variance relationship between the three antecedent variables may be a factor (senior management support to cognitive commitment is .43 and to benevolent trust is .34). The relationship between CII and NPD outcomes (which combines financial and relational outcomes) is strong at .52, but somewhat less than the relationship between CII and LTO at .81. Table 8.16 details hypotheses results for structural model.

Table 8.16 Structural Model SET LENS: Hypotheses Results.

Hypotheses	Standardised Regression Weight Loading	S.E	C.R	p	Supported/Rejected
H2a: Benevolent trust is an antecedent of CII	.35	.058	4.045	.000	Supported
H2b: Cognitive commitment is an antecedent of CII	.54	.073	5.335	.000	Supported

H2c: Senior management support is an antecedent of CII	.19	.037	3.136	.002	Supported
H3a: NPD outcomes is an outcome of CII	.52	.146	5.029	.000	Supported
H3b: LTO is an outcome of CII	.81	.146	6.011	.000	Supported

Key: S.E. = Standard Error, C.R. = Critical Ratio, p = marginal significance measure: for H2a, H2b, H3a and H3b p is significant at .001 level (2-tailed), for H2c, p is significant at the .01 level (2-tailed)

8.4.1 Control Variables

To further test the nature of the hypothesised relationships in the structural model, several control variables were added to the model. These are as identified in chapter 4. By testing the relationship between each of these variables with CII, then comparing goodness-of-fit indices to the original structural models indices, the effect of each of the control variables on the overall structural model is tested. None of the identified control variables impacted CII or structural model fit in a significant way and are therefore removed from the structural model.

Table 8.17 details the relationship between each control variable and CII. The different goodness-of-fit indices generated as each control variable is added to the model are presented.

Table 8.17 Structural Model: Control Variables.

Control Variables	CMIN/DF	GFI	CFI	SRMR	RMSEA	PCLOSE	CVAR to CII
Structural Model (no control variables)	1.507	.795	.921	.068	.052	.269	
Industry Sector	1.506	.792	.918	.068	.052	.214	.093
Partner Type	1.477	.794	.922	.068	.051	.405	.026
Customer Value	1.492	.793	.920	.068	.052	.331	-.27
Prior Relationship	1.516	.790	.916	.069	.053	.227	.001
Irish Owned	1.503	.789	.918	.067	.053	.223	-.107
Turnover	1.489	.793	.920	.066	.052	.263	-.113

Key: Control Variables, CMIN/DF, GFI, CFI, SRMR, RMSEA, PCLOSE presented for each control variable model), CVAR to CII=standardised regression weight loadings for each control variable to CII. Each control model shows that p is not significant at the .05 level (two-tailed).

8.4 2 Moderation Variables

8.4.2.1 Type of NPD

The first moderation analysis tests the moderation effect of type of NPD (explorative or exploitative), firstly on the relationship between CII and NPD outcomes, and secondly on the relationship between CII and LTO.

Type of NPD is represented by a binary categorical variable and data was collected using question 2 on the postal survey. Having selected one specific close collaborative relationship in the context of NPD, respondents were asked to select the type of NPD undertaken during this collaboration. Two choices were given explorative (radical) or exploitative (incremental), respondents then ticked the relevant box. For data analysis explorative NPD was coded as 1 with exploitative NPD coded as 2. Survey analysis results show 71 respondent organisations are involved in exploitative NPD with 114 respondents being involved in explorative NPD. The original data file was then split into two groups based on the NPD type, the moderator variable. The difference is Chi-Square test between constrained and unconstrained models was used to analyse the moderation effect of NPD type. For moderation impact to be significant the difference between Chi-Squares generated by both models must be greater than 3.84. For this research, findings suggest that type of NPD does not moderate the relationship between CII and either NPD outcomes or LTO. Table 8.18 to Table 8.21 details the results generated using IBM AMOS 24. Table 8.18 reports the moderation effect of exploitative innovation on the relationship between CII and NPD Outcomes.

Table 8.18 Structural Model: Moderation Analysis, Exploitative Innovation (CII and NPD Outcomes)

Model	Constrained	Unconstrained	Chi-Square Difference	Hypothesis Result
Chi-Square	927.908	924.551	3.357	Not supported
Df	657	656	1	

Key: Model=Chi-Square Model, Constrained =constrained model, Unconstrained =unconstrained model, Chi-Square Difference=constrained model chi-square result minus unconstrained model chi-square result, Hypothesis Result= hypothesis supported if Chi-Square difference > 3.84, hypothesis not supported if < 3.84

Hypothesis H5a: Exploitative innovation moderates the relationship between CII and NPD outcomes, is not supported. Chi–Square test difference at 3.357 is less than 3.84 (one degree of freedom, 95% confidence level). Table 8.19 reports on the moderation effect of exploitative innovation on the relationship between CII and LTO.

Table 8.19 Structural Model: Exploitative Innovation, Moderation Analysis, (CII and LTO)

Model	Constrained	Unconstrained	Chi-Square Difference	Hypothesis Result
Chi-Square	926.324	924.551	1.77	Not Supported
Df	657	656	1	

Key: Model=Chi-Square Model, Constrained =constrained model, Unconstrained =unconstrained model, Chi-Square Difference=constrained model chi-square result minus unconstrained model chi-square result, Hypothesis Result= hypothesis supported if Chi-Square difference > 3.84, hypothesis not supported if < 3.84

Hypothesis H5b: Exploitative innovation moderates the relationship between CII and LTO, is not supported. Chi–Square test difference at 1.77 is less than 3.84 (one degree of freedom, 95% confidence level).Table 8.20 reports on the moderation effect of explorative innovation on the relationship between CII and NPD Outcomes.

Table 8.20 Structural Model: Moderation Analysis, Explorative Innovation, (CII and NPD Outcomes)

Model	Constrained	Unconstrained	Chi-Square Difference	Hypothesis Result
Chi-Square	1161.519	1161.373	.146	Not Supported
Df	657	656	1	

Key: Model=Chi-Square Model, Constrained =constrained model, Unconstrained =unconstrained model, Chi-Square Difference=constrained model chi-square result minus unconstrained model chi-square result, Hypothesis Result= hypothesis supported if Chi-Square difference > 3.84, hypothesis not supported if < 3.84

Hypothesis H5c Explorative innovation moderates the relationship between CII and NPD outcomes, is not supported. Chi–Square test difference at .146 is less than 3.84 (one degree of freedom, 95% confidence level). Table 8.21 reports on the moderation effect of explorative innovation on the relationship between CII and LTO.

Table 8.21 Structural Model: Moderation Analysis Explorative Innovation, (CII and LTO)

Model	Constrained	Unconstrained	Chi-Square Difference	Hypothesis Result
Chi-Square	1161.376	1161.373	.003	Not Supported
Df	657	656	1	

Key: Model=Chi-Square Model, Constrained =constrained model, Unconstrained =unconstrained model, Chi-Square Difference=constrained model chi-square result minus unconstrained model chi-square result, Hypothesis Result= hypothesis supported if Chi-Square difference > 3.84, hypothesis not supported if < 3.84

H5d: Explorative innovation moderates the relationship between CII and LTO is not supported. Chi-Square test difference at .003 is less than the 3.84 benchmark (one degree of freedom, 95% confidence level).

8.4.2.2 Market Turbulence

The second moderation analysis tests for the moderation effect of the variable market turbulence on the relationships between CII and NPD Outcomes and CII and LTO. Market Turbulence is a three-item first order measure. Moderation analysis was undertaken using the interaction model in AMOS 24 (Appendix F). Table 8.22 presents the analysis results.

Table 8.22 Structural Model: Moderation Analysis Market Turbulence (CII and Outcome Variables.)

Hypotheses	Estimate	S.E.	C.R.	p	Supported/ Not Supported
H5e: Market Turbulence moderates the relationship between CII and NPD Outcomes	.066	.059	.989	.322	Not Supported
H5f: Market Turbulence moderates the relationship between CII and LTO	.014	.055	.226	.821	Not Supported

Key: Estimate = Standardised Estimate, S.E = Standard Estimate, C.R. = Critical Ratio, p=level of marginal significance

P is not significant (.322 and .821), standardised regression weight loadings (.066 and .014) are very low, and therefore, market turbulence does not moderate the relationship between CII and NPD outcomes or LTO.

8.4.2.3 Technological Turbulence

The third moderation analysis tests for moderation effect of the variable technological turbulence and the relationship between CII and NPDOUTCOMES and CII and LTO. Technological Turbulence is a three-item first order measure. Moderation analysis is undertaken using the interaction model in AMOS 24 (Appendix G). Table 8.23 presents the analysis results.

Table 8.23 Structural Model: Moderation Analysis Technological Turbulence (CII and Outcome Variables)

Hypotheses	Estimate	SE	CR	p	
H5g: Technological turbulence moderates the relationship between CII and NPD Outcomes	-.09	.060	-1.357	.175	Not Supported
H5h: Technological turbulence moderates the relationship between CII and LTO	.07	.055	1.135	.256	Not Supported

Key: Estimate = Standardised Estimate, S.E = Standard Error, C.R. = Critical Ratio, p=level of marginal significance

p is not significant (.175 and .256), standardised estimates of (-.09 and.07) are very low, therefore, technological turbulence does not moderate the relationship between CII and NPD outcomes or LTO.

8.4.3 Discriminant Levels of CII and Outcomes

The impact of discriminant levels of CII on the NPD outcomes and LTO was tested by creating a high low group of CII and then running an ANOVA test in SPSS 24. A CII mean < 2.22 was treated as high intensity for this research 50.8% of respondents generated a mean of below 2.22 with all means above 2.22 treated as low intensity. The One-Way Anova Tests results for both NPD outcomes and LTO were both significant, with the means plot showing the greater the intensity of CII the greater the predictor value for both NPD outcomes and LTO. (See Appendix H).

8.5 Estimation of an Alternative Structural Model (TCE)

The finding that a model has acceptable fit does not equate to absolute proof that this model is the best possible model. It has been found that, for any given model, other models can be found that are indistinguishable from the original model in terms of goodness-of-fit to sample data. Possible model variations can be formulated based in alternative theoretical perspectives and for this research an alternative model is estimated based on the TCE theoretical framework. In order to formulate an alternative structural model, cognitive commitment, benevolent trust and senior management support were removed from the model and replaced with the

antecedent variables, dependency and asset specificity. Both scales were tested for composite reliability and average variance extracted. Both scales are within guidelines as per Hair et al. (2010). Table 8.24 details the results of CR and AVE for asset specificity and dependency.

Table 8.24 Structural Model TCE Lens: First Order Factors Composite Reliability and Average Variance Extracted

TCE Variables	Composite Reliability	Average Variance Extracted
Asset Specificity	.83	.74
Dependency	.91	.64

Key: TCE variables= Transaction Cost Economics theory lens variables, Composite Reliability= reliability for a set of scale items, Average Variance Extracted= Amount of variance extracted from variable scales versus that can be attributed to measurement error.

The first order factor standardised regression weight loadings between unobserved latent factor and relevant scale indicators for both asset specificity and dependency were tested and reported. All loadings were greater than .6. Multiple squared correlation reports by indicator were also tested. Table 8.25 details the regression weight loadings and squared multiple correlations result for each indicator. All results were significant at the .001 level (two tailed).

Table 8.25 Structural Model TCE Lens: First Order Factors Standardised Regression Weight Loadings and Squared Multiple Correlations

First Order Latent Factor to Indicator	Standardised Regression Weights	R^2
ASPEC- asset1	.64	.41
ASPEC- asset2	.60	.36
ASPEC- asset3	.65	.43
ASPEC- asset4	.62	.38
DEPEND-depend1	.68	.46
DEPEND-depend2	.85	.72
DEPEND-depend3	.81	.66
DEPEND-depend4	.67	.49
DEPEND-depend5	.67	.45
DEPEND-depend6	.83	.69

Key: ASPEC=Asset specificity, asset1 to asset4 =indicators, DEPEND= DEPENDENCY, Depend1 to depend1 to depend6 = indicators, Regression weights = Standardised Regression weight loadings, R^2 = Squared multiple correlations

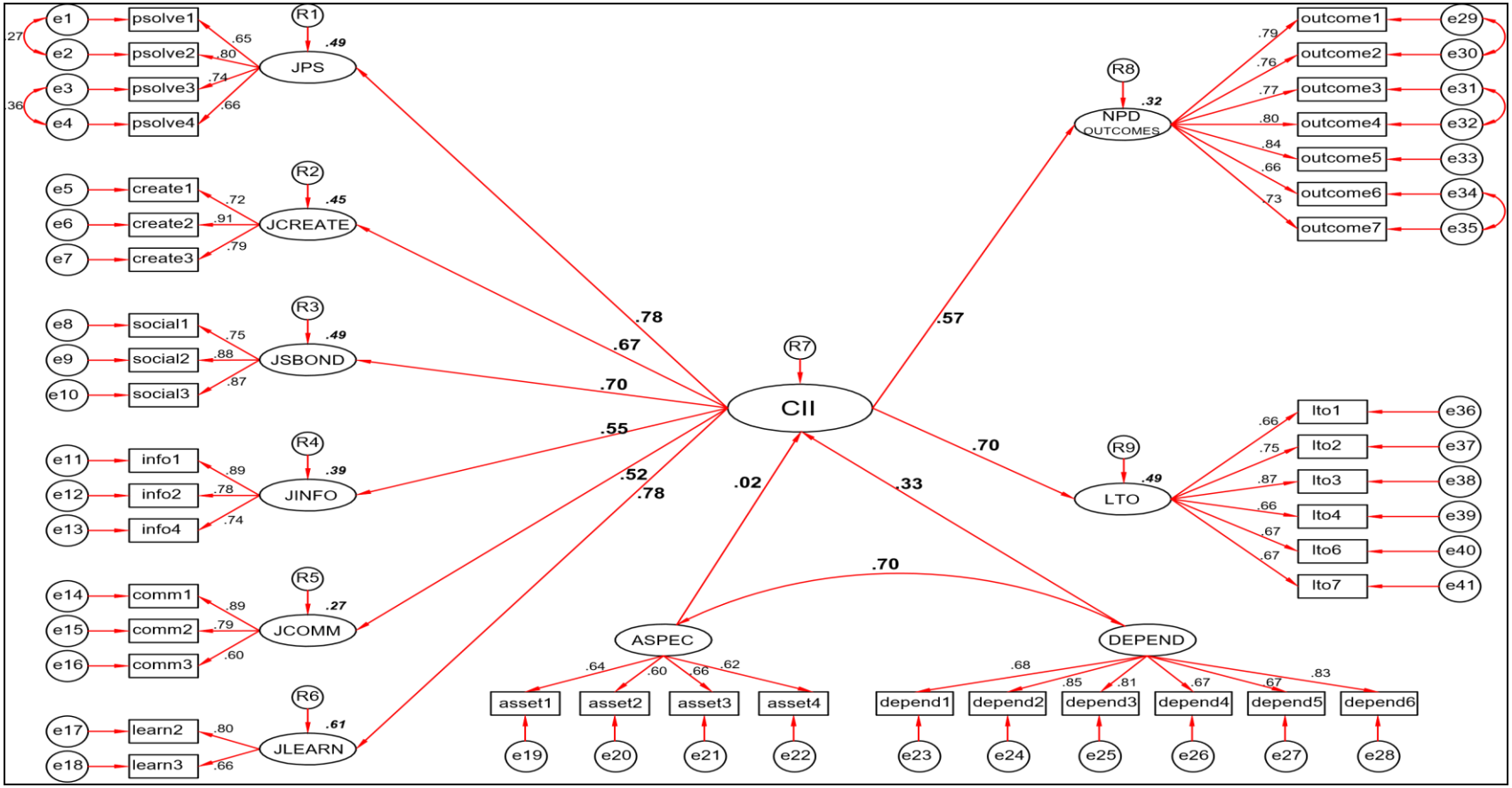
Table 8.26 details the statistical relationships between asset specificity CII, dependency and CII and asset specificity and dependency.

Table 8.26 Structural Model TCE: Statistical Relationships

Construct Relationships	Regression Weight Loadings	Co-variance	p-value
Asset Specificity-CII	.018		.902
Dependency-CII	.325		.023
Asset specificity-Dependency		.334	.000

Key: Construct Relationships, Asset specificity to CII, Dependency to CII and asset specificity to dependency, Regression weight loadings =standardised regression weight loadings, p= level of marginal significance

As expected, the relationship between Asset Specificity and CII although positive has a very low standardised regression co-efficient of .018, and statistically is not significant at the .05 level (two tailed) p=.902, . In effect, asset specificity has very little if any predictor value in this model. The relationship between dependency and CII is much higher at .325 and is statistically significant at the .05 level (two -tailed) (p=.023). However, at less than .5, this is still low and therefore would not be considered to have a strong predictor relationship with CII. At .334 the co-variance measure between the two antecedents was expected as both variables are theoretically related (TCE). The covariance metric is used to indicate the extent to which two variables change in tandem. With both variables being part of TCE framework the correlation loading of .703 was expected and indicates that both variables are closely related. CFI at .905, GFI at .778 and SRMR at .081 all demonstrate acceptable model fit with CMIN/DF at 1.517, RMSEA at .053 and PCLOSE at .210 demonstrating excellent model fit (based on Hair et al. 2010). In fact these goodness-of-fit indices are close to the SET model. However, this model clearly demonstrates that the TCE variables do not have a predictor or antecedent value with CII. This speaks to the literature on close collaborative relationships in the B2B sector. This will be further discussed in chapter 9.



Key: ***CII=collaborative innovation intensity, JPS=joint problem solving, JCREATE=joint creativity, JSBOND=joint social bonding, JINFO=joint information exchange, JCOMM=joint communication, JLEARN=joint learning*****. Goodness-of-fit indices Results: CMIN 1152.42, DF 761, CMIN/DF 1.514, GFI .778, CFI .906, SRMR .081 RMSEA .053 PCLOSE .220**

Figure 8.4 Structural Model TCE Lens

8.6 Chapter Summary

The findings chapter specifies the measurement model and the structural model. It reports the goodness-of-fit indices for both models. It carries out moderation analysis on the three hypothesised moderators and reports model findings. Finally, it specifies an alternative structural model developed through the TCE lens.

Chapter 9 Discussion

9.1 Introduction

Despite the long-standing literature on collaborative innovation, the conceptual work on CII is scarce and offers little in the area of construct development or measurement. An established conceptualisation and measurement was needed to promote academic discourse on the subject as well as to advance managerial practices. In response to this gap, this research has successfully developed a multi-dimensional measure of CII, applying rigorous scale development procedures (chapter 3). To achieve the secondary research objectives, again a far reaching literature review was undertaken (chapter 2). This led to the development of an antecedents-process-outcomes model identifying benevolent trust, cognitive commitment, and senior management support as antecedents, with NPD outcomes and LTO being identified as outcomes (chapter 4). The comparison of high and low intensities of CII generated results mirroring expectations in the literature, being that high levels of CII deliver improved innovation outcomes in comparison with lower levels. Having presented the statistical findings with respect to both the measurement model and the structural model in chapter 8, this chapter endeavours to explore the implications of these findings within the context of the relevant literature. It is anticipated that the findings and discussion presented in this chapter will make a significant contribution to the literature in this area leading to a dialogue that is both helpful to academics and practitioners alike. In addition to providing the reader with an up-to-date discussion on CII, this chapter should identify the existence of any research gaps. The following sections discuss the findings of this research in the context of the literature review.

9.2 Measurement Model

In developing and testing the CII measurement scale, the research followed the methodological approach as outlined by Churchill (1979), Hinkin (1995), and Anderson and Gerbing (1988). This approach has been well established in published

research, indeed the majority of marketing papers using scales in four star journals, (as ranked by the Association of Business Schools, United Kingdom) adopt it. The methodological approach was expanded to include CFA. The CFA approach is now accepted as being far more rigorous in the context of scale development than EFA. In truth, if one were to review all published papers in any of the high impact journals, for example, "The Journal of Product Innovation Management", one would find it difficult to find a study not using CFA. IBM AMOS 24, (SEM software), was used to check the goodness-of-fit of the measurement model. This approach has been used to check the psychometric properties of measurement models in a number of previous NPD studies (Calantone 2003, and Stanko, Bonner, and Calantone 2007) and is recommended by (Montoya-Weiss and Calantone 1994).

This research study corroborates and expands on the work undertaken by Gruner and Homburg (2000) and in particular, Lynch et al. (2016). However, for this research, it is argued that CII should be conceptualised at a higher level of abstraction as opposed to previous research where either single item measures (Gruner and Homburg 2000) or multi-item measures were used (Lynch et al. 2016) for similar conceptualisations. This fits with the established scale development view that second order factor approaches are more effective in this context. However, it has been demonstrated in the literature that the correct specification of second order factor models (either reflective or formative) is critical to successful scale development specifically regarding type 1 and type 11 errors. Consequently, two seminal papers Diamantopoulos and Siguaw (2006) and MacKenzie et al. (2005) were central to the decision to specify CII as a reflective model. In specifying the scale as a reflective measurement model, it mirrors several previous marketing scale development research studies in the IOR context, for example, Alegre et al. (2006).

This research provides a more comprehensive definition of CII from both the process and relational perspective. The new definition demonstrates a more in depth understanding of the construct. It is a cross-sectional view and identifies six dimensions that reflect CII. In developing this conceptualisation, the literature review was deep including: teams, NPD, knowledge management, and business relationship literature.

All hypothesised dimensions for CII were supported in this research with regression weight loadings between CII and each dimension being greater than .5. Each of the goodness-of- fit indices for the measurement model demonstrated good to excellent model fit. This is not surprising as the detailed literature review undertaken in chapter 3 finds that all six are related. For example, joint learning is defined by Selnes and Sallis (2003) as a joint activity between organisations in which the two parties share information which is then jointly interpreted and integrated into a shared relationship specific memory. This information exchange is related to ongoing communication between the organisations. In the knowledge management literature, much has been written regarding the relationships between communication, joint information exchange and joint learning. Here, it is suggested that information exchange is linked to the sharing of tacit, critical information and knowledge (Kogut and Zander 1992). In the creativity literature, it has been argued that creativity especially in collaborative new product groups is not an individual trait but a product of complex interpersonal interactions within a system (Albrecht and Ropp 1984, and Nemiro 2002). Furthermore, research suggests that these complex interactions are characterised by communication, information exchange, learning, problem solving and social bonding. These processes are all intense and running in parallel in CII. A further discussion will now ensue regarding each dimension in the context of the CII measure.

9.2.1 Joint Communication (Hypothesis 1a)

With a factor loading of .52, this research demonstrates statistically that joint communication is a dimension of CII. As a consequence, hypothesis 1a is supported. The three-item scale measuring joint communication that was borrowed and adapted from previous research including Mohr et al. (1996) and Gruner and Homburg (2000) also resulted in strong factor loadings ranging from .60 to .89.

While CII is a new scale that has not been defined in the literature prior to now, the link between inter-organisational communication and effective collaborative relationships has always been of keen interest to researchers. Indeed, as early as 1990, Mohr and Nevin, described communication as the “social glue” that holds relationships together. The research during the intervening years including this

project has only reaffirmed this view (Soosay, Hyland, and Ferrer 2008). But more interestingly, through the development of the CII measure, this research has demonstrated that it is the presence of intense communication collectively with the other five dimensions that reflect CII at a moment in time. However, joint communication at .52 shows the lowest regression weight loading in this model, compared to joint learning at .78, joint problem solving at .78 and joint creativity at .67. Bearing in mind the large body of research that has been published in the IOR literature demonstrating the importance of communication to successful collaboration, this result is somewhat surprising. On reflection one could tentatively suggest that perhaps the items measuring joint communication may need refinement in the specific context of the CII construct in future research.

9.2.2 Joint Information Exchange (Hypothesis 1b)

With a factor loading of .55, this research confirms statistically that joint information exchange is a dimension of CII, leading to hypothesis 1b being supported. The three-item measure used for joint information exchange in this research was borrowed and adapted from Heide and Miner (1992) with further operationalisation of the scale undertaken in research studies by McEvily and Marcus (2005) and Schleimer and Shulman (2011). Factor loadings for the scale are strong and range from .74 to .89. It was of course expected that joint information exchange be supported as a dimension of CII, due to the general consensus in the open innovation, user involvement and general partnership literature that information exchange is reflective of collaborative innovation. However, what is of interest in this research is the fact that once again the factor loading is relatively low in comparison to some of the other CII dimensions, for example, joint problem solving at .78 or social bonding at .70. However, it should be noted that it does mirror the result for joint communication which as previously outlined has a comparatively low factor loading of .52. For future research both dimensions may need new items developed to better reflect intense collaboration than the items borrowed for this research. The lower factor loadings in comparison to the other dimensions may also indicate that joint communication and joint information exchange although key dimensions of CII, do not in fact reflect intense collaborative innovation to the same level as the higher factor loading dimensions.

With further research, this may prove of interest to practitioners by suggesting key behaviour process areas for resource allocation during collaborative innovation.

9.2.3 Joint Learning (Hypothesis 1c)

With a very strong factor loading of .78, this research has statistically confirmed that joint learning is a dimension of CII. As a result, hypothesis 1c is supported. This finding is not unexpected, indeed, the importance of joint learning through knowledge exchange in the collaborative NPD setting has been confirmed in several fields of study including supplier collaboration (Rosell, Lakemond, and Melander 2017), customer collaboration (Cui and Wu 2016), networking (Kogut 2000) and R & D alliances (Berchicci 2013). The two-item measure used for joint learning in this research was borrowed and adapted from Bstieler and Hemmert (2010), and Dyer and Singh (1998). Each of these items focuses on interaction, sharing, and the generation of new knowledge. Factor loadings for the items are strong at .77 and .69. This once again mirrors previous research in both the knowledge management and learning literature (Cousins et al. 2011, and Hult et al. 2004).

The statistical results also show positive correlations between joint learning and the other five dimensions of CII (.376 to .614). The highest scores relate to joint creativity, joint social bonding and joint problem solving. Interestingly, the highest score relates to the relationship between joint learning and joint problem solving. This speaks to a large body of literature where the transfer of tacit knowledge in turn underpinning joint learning, is aided by joint problem solving (learning by doing) (Bogers and Horst 2014, Bstieler and Hemmert 2010, and Lin Wang and Kung 2015).

9.2.4 Joint Problem Solving (Hypothesis 1d)

With a statistical factor loading of .78, this research confirms that joint problem solving is a dimension of CII. As a result hypothesis 1d is supported. As discussed in chapter 3, joint problem solving for this research is defined as being reflected by a number of sub-processes including joint participation (McEvily and Marcus 2005), joint responsibilities (Selnes and Sallis 2003), and joint decision making (Bstieler and Hemmert 2010). The focus is on the achievement of joint goals, supporting each other's objectives, engaging in joint planning and engaging in joint decision making.

The factor loadings for the items were strong and range from .68 to .80. These statistical results unreservedly underpin a large body of previous research that has focused on the importance of joint participation in collaborative undertakings (Bstieler and Hemmert 2010, McEvily and Marcus 2005, and Schleimer and Shulman 2011).

9.2.5 Joint Creativity (Hypothesis 1e)

The findings of this research clearly demonstrate that joint creativity is a dimension of CII with a strong factor loading of .67. This outcome is probably not surprising and to some extent is intuitive because there is a well-established link between creativity and innovation in previous academic literature. Interestingly, many researchers believe the central role of creativity is in the provision of core ideas that may ultimately lead to innovation (van den Ende, Frederiksen, and Prencipe 2015). The strong factor loading in this research mirrors this view.

Finding a measure in the literature for the joint creativity construct proved extremely difficult. Much has been written in the marketing, sociology and management literature about individual creativity which has given rise to definitions, motivations and outcomes. However, it appears that nearly sixty years of academic creativity research has not yet yielded a generally accepted operationalisation of even the individual creativity construct, let alone one that measures joint creativity. But, there is very high level of interest in the literature in team creativity, specifically in the intra-organisational context, (Leenders et al. 2003, and Im and Workman 2004). Team creativity implies that team members generate new ideas, creatively process them, discard those ideas that seem useless and implement the ones which have promise. In the innovation area much focus on team creativity has surrounded cross functional teams (CFT) (McDonough 2000). It is believed that the multi-disciplinary character of CFTs enables teams to integrate diverse knowledge sets and skills allowing for the creation of rich novel combinations of ideas (Alves et al. 2007). The extant literature in this area recognises that the success of team creativity is dependent on a number of organisational practices including: open frequent and accurate communication, organisational slack and top management support (Sethi et al. 2001).

Having failed to identify a measure for joint creativity in the literature to date, the measure used for this research was adapted from Leenders et al. (2003) and Im and Workman (2004). Both of these original measures were formulated in the context of team creativity research. This is not believed to present a conceptual difficulty because the evidence in the literature suggests that inter-organisational joint creativity generally also takes place in the context of a CFT, with the only difference being that the team is not only comprised of actors from different functions but also from different organisations. The findings for this research back this up with factor loadings being very strong ranging from .71 to .92. It is interesting to note that the highest factor loading relates to the item that "new ideas are created when we work together", this combines the generation of new ideas (the core of the majority of creativity definitions in the literature) with togetherness (the core of joint creativity). To the author's knowledge, this is the first time that a specific measure for joint creativity has been used in research of this kind. In the context of this research's contribution to the measurement literature, this may be a first tentative step to operationalising a joint creativity (in the context of IORs) construct.

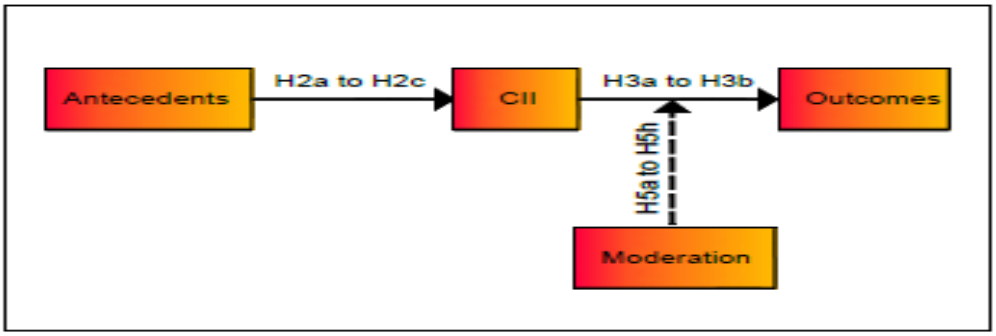
9.2.6 Joint Social Bonding (Hypothesis 1f)

The findings of this research demonstrate that social bonding is a dimension of CII with a strong factor loading of .70. The research supports the importance of ongoing personal relationships as a reflection of intense collaborative innovation and underpins the relational view that strong inter-personal relationships provide access to information, ideas, and products residing in one's partner organisation (Inkpen and Tsang 2005, and Hanghϕj and Mols 2015). However, it would have to be said that there is some discourse with regard to the role of social bonding in collaborative relationships in the literature, which may be attributable to a cultural divide. Indeed, there is evidence that while American managers fully back the concept of inter-organisational collaboration, it is apparent that these same managers view social bonding as being "unimportant" and having "no purpose" in this context (Rodriguez and Wilson 2002). In contrast, researchers have found that managers in Japan believe that social bonding and the quality of relationships is critical to the closeness of IORs in the context of innovation (Yli-Renko et al. 2001). The findings here indicate a

leaning more towards the Japanese organisational thinking and clearly demonstrate that social bonding during inter-organisational collaboration reflects CII.

However, most of the research in this area to date is qualitative with little empirical research being undertaken. Consequently, the three-item measure for the first-order construct of social bonding is conceptual as it proved impossible to find a fully operationalised measure in the literature. The items are of course grounded in published research, are steeped in SET and are closely related to the friendship construct. Factor loadings for this first order factor range from .74 to .88 indicating a valid measure.

9.3 Structural Model



Key: Antecedents = Benevolent Trust, Cognitive Commitment and Senior Management Support. Outcomes= NPD outcomes and LTO. Moderation=Type of NPD, Market Turbulence and Technological Turbulence

Figure 9.1 Schematic Diagram of Hypothesised Structural Model

The second research objective of this study was the development of an antecedents-CII-outcomes model. Based on an overarching literature review in chapter four, this model is conceptualised as having three antecedent variables: benevolent trust, cognitive commitment and senior management support. Two outcome variables are conceptualised including NPD outcomes and LTO. A structural model (a multi-variate technique) was used to test these hypothesised structural relationships. The structural model was once again developed and tested using IBM Amos 24. The final

structural model demonstrates a strong covariation between the three antecedents, benevolent trust, cognitive commitment and senior management support, a positive relationship between all three antecedent variables and CII and finally a positive relationship between CII and the two outcome variables NPD outcomes and LTO. However, none of the hypothesised moderation relationships were supported. This is somewhat in contrast to expectation and would seem to indicate that close collaborative relationships provide some insulation against the impact of the type of NPD which the organisations are engaged in, and to external disturbances including market and technological turbulence. Of course, it has also been suggested in the literature that the moderation impact of environmental may be either project or country specific. This is further explored in the moderation section that follows. The control variables included in the structural model also generated some unexpected results. Once again, this research is suggesting based on statistical results that a close IOR negates the impact that the size of the firm or the type of partner (supplier of customer) has on the relationships. When the control variables were included in the structural model, the goodness-of-fit indices did not change. The following paragraphs will discuss these findings in more detail.

9.3.1 Antecedents of CII (H2a, H2b, H2c)

In line with sociology, socio-psychological and the relationship marketing literature on the development and maintenance of close inter-personal relationships, there is a general consensus by IOR scholars that both benevolent trust and cognitive commitment are pivotal to the development of close collaborative relationships (Dwyer Schurr and Oh 1987, Hibbard et al. 2001, Jap and Ganesan 2000, Jap and Anderson 2007, Johnson and Selnes 2004, Morgan and Hunt 1994, Palmatier et al. 2006, Ring and Van de Ven 1994, Rousseau et al. 1998, and Wilson 1995). Other authors suggest that these constructs are actually precursors for not only the establishment of but also for the maintenance of close relationships (Mpinganjira, Bogaards, Svensson, Mysen and Padín 2013, and Palmatier et al. 2006). Overall the results for this research, confirm the importance of both benevolent trust and cognitive commitment in the relationship marketing context, especially in the field of close collaborative relationships. Firstly, the effect of benevolent trust and

cognitive commitment on CII is entirely direct and positive, with benevolent trust showing a coefficient of .35 and commitment a coefficient of .54. This speaks to previous literature. However, it is somewhat surprising that the benevolent trust coefficient score is so much less than the commitment coefficient score. This is especially noteworthy, as several authors in the relational marketing area have suggested that trust is the cornerstone of close collaborative relationships, and that consequently, trust contributes significantly to the establishment of commitment (Blau 1964 and Homans 1958). The findings once again confirm the positive relationship between benevolent trust and cognitive commitment, showing a positive coefficient of .60, but for this research, both variables are co-varied indicating it is not possible to establish which variable, if any, predicts the other.

The relationship between the third antecedent variable senior management support and CII at .19 although positive, was certainly lower than expected. Many authors have stressed that successful customer involvement and/or supplier involvement is dependent on the support of senior management (McIvor and Humphreys 2004, and McIvor, Humphreys, and Cadden 2006).The suggestion is that senior management must be committed to the collaboration demonstrated by its willingness to allocate resources to the implementation effort (Zu, Fredendall, and Douglas 2008). This statistical finding therefore required reflection. Perhaps senior management support is at arms-length? It is obviously necessary to the establishment and continuance of the collaborative relationship, but in reality because these senior managers are not involved in the ongoing daily interactions between the organisations, one could suggest that they have only a limited impact on the intensity level of collaborative innovation. In contrast the coefficient loadings between senior management support and cognitive commitment (.43), and benevolent trust (.34) are much higher. This was expected being that senior management support is crucial in ensuring that trust and commitment evolve between both organisations through their championing of the relationship.

9.3.2 Outcomes of CII

Two outcome variables of CII were included in the structural model for this research, including NPD outcomes and long term orientation. The NPD outcome variable is a

combined measure representing both financial and relational outcomes. The combined NPD outcomes construct is measured by a 7-item scale, factor loadings for the items are strong and range from .68 to .83. Five of these items measure financial performance. Financial IOR performance refers to how well the IOR fulfils its financial goals. While previous research links inter-organisational collaboration in the NPD context directly to financial goals (Ignatius et al. 2012, and Petersen et al. 2005), to date, the implications of the intensity of the collaboration have not been considered. Consequently, while this research speaks to the established view that suggests that collaborative innovation and financial outcomes are positively linked, it also expands the literature to date by linking CII to financial performance as part of an empirical study.

In the same way, there is a consensus in the literature that IOR collaboration is positively related to relationship satisfaction (Anderson and Narus 1990, Bstieler 2006, and Svensson, Mysen and Payan 2010). This research mirrors this view and again expands previous research by linking CII to relationship satisfaction. Going forward with more research and modelling, this finding may allow for a specific level of CII to be identified for an individual IOR that generates an optimum level of both financial and relational outcomes.

The analysis demonstrates a positive and significant relationship between CII and long term orientation (LTO) with a strong factor loading of .82. The scale measure for LTO was borrowed and adapted from Ganesan (1994), with factor loadings for each item ranging from .66 to .82. These findings, in demonstrating the positive relationship between CII and LTO (at .81), speak to a body of literature who define long term relationship orientation as being an indicator of the closeness of the relationship (Ganesan 1994 and Kelley 1983).

9.3.2.1 Type of NPD

The statistical findings of this research suggest that neither explorative nor exploitative NPD moderate the relationship between CII and the two outcome variables (NPD outcomes and LTO). These findings are of note and are surprising

when viewed in the context of previous literature, for example, Belderbos, Faems, Leten and van Looy (2010) and Laursen and Salter (2006). This deserves reflection.

For example, the sample size n=185, although adequate for the measurement model may be somewhat less so for the nomological validity testing in the structural model, although statistically this is difficult to prove or disprove (Iacobucci 2010, and Wong 2016). Indeed, this sample size is one factor that could explain the finding that the type of NPD does not moderate the relationship between CII and NPD outcomes. However, this is a legitimate statistical finding that cannot be rejected because it was not expected. To remove any suspicion around sample size and statistical findings, it is suggested that future research maximises sample size at least 200.

Secondly, the operationalisation of the term "innovativeness" may provide further explanation as to the above unexpected finding. Currently, in the academic literature there is a plethora of definitions relating to the type of innovation. This has resulted in an ambiguity in the way that the term "innovativenesss" is operationalised in the NPD literature. The terms radical, really new, incremental, exploitative and explorative are used ubiquitously to classify innovation. One must question what the difference is between these classifications? As the term "innovativeness" has not been clearly operationalised in the literature to date, it may be that the comparison of research results surrounding "innovativeness" is questionable as one can never be sure if the same classification for the construct is being used.

If this proves to be the norm with further investigation, it would incentivise more firms to become involved in close collaboration for innovation.

9.3.3.2 Market and Technological Turbulence

Turbulent environments are characterised by frequent and dramatic changes, impeding accurate prediction and timely response. Existing knowledge resources become obsolete, consumers have difficulty in articulating their needs and/or wants, and competitors may revolutionise the value proposition by introducing new products. A recent stream of studies developing NPD performance models has included environmental turbulence constructs as moderation variables, for example, Calantone et al. (2003). This research decomposes environmental turbulence into

technological turbulence and market turbulence and hypothesises that both moderate the relationship between CII and NPD performance outcomes. However, in the context of this research the findings indicate no moderation effect on this relationship. These findings contrasted with what had been expected and are not reflective of some previous research findings (Calantone et al. 2003, and Hung and Chou 2013). To understand these results, further investigation of the literature was undertaken which has given rise to some suggestions. For example, Buganza Dell'Era and Verganti (2009), as a result of their research in the telecommunications industry in Italy, suggest that the moderating effect of environment turbulence is project specific as opposed to company or industry specific. In addition, Bstieler (2006) as a result of his research (undertaken in both Canada and Australia) suggests that the moderating effect may be country specific. The findings of both of these research studies may provide some explanation for the findings here. For example, this research is country specific (Ireland), it may well be that if the study was undertaken in a different country environmental turbulence may show as a moderation construct in the analysis.

9.4 Alternative Structural Model

The statistical findings of the alternative model (TCE) were in line with expectations. The relationship between asset specificity and CII was positive but at .02 is very low. Asset specificity implies that organisations enter an IOR for economic reasons only. This is not the foundation for a close collaborative relationship and the statistical findings here speak to that view. The relationship between dependency and CII was once again positive but at .32, much higher. This may imply that when dependency exists within an IOR, collaboration will exist but not the close intense collaboration that is the foundation of this research. The correlation coefficient between both constructs was high at .70. As both constructs are underpinned by TCE, high correlation between them was expected. The goodness-of-fit indices for both the TCE and SET models were not dramatically different, but it has been noted in the literature that acceptable goodness-of-fit indices can be obtained for a model that is not theoretically correct. Taking all of the statistical findings into consideration and

reviewing them in the context of close collaborative relationships; it is believed that the original structural model is more representative of the data for this research.

9.5 Chapter Summary

This chapter revisits the study's findings in the context of the literature to date. The next chapter, the final chapter of the thesis outlines the theoretical and practice contribution of this study, discusses research limitations and outlines future research opportunities in the area.

Chapter 10 Conclusions and Implications of the Research

10.1 Introduction

Based on the findings and discussion outlined in the previous two chapters, this final chapter restates the research objectives, and gives a summary of the research outcomes. Subsequently, it provides a comprehensive outline of the key contributions in the context of both theory, measurement, and practice. This is followed by an outline of the limitations of the study, with the chapter concluding by suggesting future research directions.

10.2 Restatement of the Research Objectives

As has been previously discussed, Ireland's future competitiveness is closely linked to its innovation success. Consequently, the Irish government has placed huge emphasis on the development of an innovation strategy in its research policy (Horizon, 2020). Inherent in this strategy is a shift from the closed traditional model of innovation to a more open approach (Bogers, Chesbrough, and Moedas 2018). However, success within the open innovation context has proven difficult to achieve. As a consequence of striving to understand the open innovation process, the closeness of the IOR has been recognised by both academia and practice as one of the vehicles that delivers successful NPD outcomes. Despite this recognition, few attempts have been undertaken to capture the depth or strength of this collaboration (see, chapter 2). Consequently, prior to this research, the concept of CII had not been fully defined or operationalised formally in the literature (Lynch, et al. 2016). Because of this gap in our understanding, empirical studies to date have provided only limited insight.

The main objective of this study was to address this gap in the literature, by providing a comprehensive understanding of the construct of CII, leading to the development and operationalisation of a multi-dimension scale of same. The secondary objective

was to develop a structural model using SEM, linking CII to NPD outcomes using SET assumptions.

10.3 Research Contributions

10.3.1 Theoretical Contribution

Previous research suggests that inter-organisational collaboration during innovation is important with a substantial body of research being undertaken in the area including: Bstieler and Hemmert (2010), Faems et al. (2005), Gruner and Homburg (2000), and Lynch et al. (2016). However, little empirical work has been undertaken in the area of CII in the B2B context. As a result, prior attempts to capture what really constitutes this intensity in collaborative innovation have resulted in widely varying conceptualisations, leading to a considerable level of confusion in terms of its operationalisation (Lynch et al. 2016).

This study advances research on close collaborative relationships in the innovation context in a number of important ways. Firstly, this research uses SET (Homans 1958 and Blau 1964) as a theoretical framework for CII. In the context of SET, inter-organisational collaborative relationships are characterised by a recognition of interdependencies, long term relationship orientation, loosely specified terms and conditions, and high levels of trust and commitment. These collaborative relationships involve both ongoing economic and social exchanges with the exchanges incorporating such social factors as friendship, closeness, commitment and trust. In using social exchange as a framework for understanding collaborative relationships during NPD, this research extends previous research, for example, Lynch et al. (2016) who also adopted SET as the theoretical framework during the development of a multi-item measure for user involvement in NPD. The findings from this research mirror Lynch et al. in finding support for the basic tenet of SET, that being that IOR innovation interactions are embedded in a social structure.

For this research, CII is treated as a second order construct (meaning that it is reflected in other constructs). The six constructs that reflect CII are the degree of joint communication, joint information exchange, joint learning, joint problem

solving, joint creativity, and joint social bonding. To this author's knowledge, this research represents the first time that ongoing social interactions or joint social bonding has been included in any measure related to close collaborative relationships.

Thirdly, the key constructs included in the SEM structural model that is the antecedents: benevolent trust, cognitive commitment, and outcomes: NPD outcomes and long term relationship relate directly to the tenets of SET. Once again to this author's knowledge this is the first time that a model has been developed using these concepts. This not only expands on previous literature but further confirms the adequacy of this theoretical perspective for the study of not only close collaborative relationships in the context of innovation but also for the study of the intensity of the collaboration in this context.

10.3.2 Measurement Contribution

This is the first known empirical investigation of the construct CII and it has resulted in the development and operationalisation of a second order, multi-dimensional scale. It has six dimensions including the degree of: joint communication, joint information exchange, joint learning, joint problem solving, joint creativity and joint social bonding combined in this specific way for CII measurement is a first in the context of collaborative NPD. While five of the six dimension's first order scales were borrowed and/or adapted from prior literature, it was not possible to find a previously operationalised first-order scale for joint social bonding. Consequently, the joint social bonding first order scale was conceptualised as having three items. During CFA, the three items resulted in strong standard regression weight loadings, all three higher than .70, a CR of .875 and an AVE of .70. In future research, further reliability and validity testing is required regarding the joint social bonding scale, however it is believed that this is a good starting point for this endeavour. In finalising the CII measure, three alternative measurement models were developed. Following CFA, it was found that the second order model was the best representation of the CII construct. This was based on rigorous scale development methodology including all tests relating to construct validity and reliability using both EFA and CFA, and including all standard goodness-of-fit measures.

The resulting six dimensions go far beyond previous measurement attempts. The empirical study is well designed, delivers a large sample, incorporates a rigorous scale development process including appropriate analysis and testing. It is the first attempt at developing a multi-dimensional measure of CII. Although the results should be interpreted with some caution (see future research directions), it is perceived that the study provides a good starting point. It is hoped by the author that other researchers will use this measure for any future research in the CII area.

10.3.3 Scale Contribution

The present study uses a second-order six dimensional scale to measure CII in an industrial dyadic IOR. This second order six dimensional scale builds on both the existing composite measure scale (Lynch et al., 2016) and single item scales (Gales and Masour-Cole, 1995 and Gruner and Homburg 2000) used to measure comparable conceptualisations of intensity.

The existing single item and the multi-item scales were developed following procedures outlined by Churchill (1979) and Hinkin (1995). However, following EFA, no further statistical analysis was undertaken. Consequently, where the CII scale makes a contribution is that unlike the previous scales further statistical testing is undertaken using CFA. Of the two factor analytic approaches CFA is by the far the more rigorous procedure, particularly in the areas of factor correlation, measurement error quantification, and guidance on the areas of the model that are contributing most to the misfit. This allows for the development of a model with good model fit. Model fit in CFA refers to the ability of a model to reproduce the data (i.e., usually the variance-covariance matrix). A good-fitting model is one that is reasonably consistent with the data. The CII scale developed in this research generated good model fit based on a number of fit measures thereby adding an extra layer of rigour.

10.3.4 Practice Contribution

Much has been written in the practice literature recognising that innovation is not just an intra-organisational matter but is increasingly generated through collaboration between organisations. Consequently, there has been an explosion of

research in the open innovation and co-innovation areas (Bogers, Chesbrough and Moedas 2018). As a result, in 2019, there is nearly universal acceptance by practitioners that collaborative innovation augments the opportunity for success. However, in reality, many of these collaborations fail, mainly, because there is no clear roadmap to guide these firms to success.

The findings of this research are therefore of keen interest to practice in a number of ways. Because of the modelling approach applied it provides a comprehensive overview of all of the variables that need to be in place to achieve successful innovation outcomes. The author of the research does not claim that these variables are new and in fact would agree that many of them have been included in previous academic and practice research (Lynch O'Toole and Biemans 2016). However, to the best of the author's knowledge this is the first time that they have all been included in one statistical model. This modelling will allow for the development of a detailed roadmap for successful collaborative innovation in the context of IORs. The following paragraphs will outline the contribution of this research in more detail.

Firstly, although it is generally accepted in the practice literature that the higher the intensity of collaborative innovation, the better the innovation outcomes tend to be. To date, this has not been proven. This research has proven this hypothesis statistically. This is important because it speaks to the importance of undertaking a high intensity approach and also demonstrates that the effort/cost required by organisations to achieve this level of intensity is worthwhile.

Secondly, this research has successfully developed a scale for CII which outlines the dimensions of the construct. These dimensions in themselves are not new and appear in previous research in the context of collaboration intensity. However, to the best of the author's knowledge, it is a first time that they have been presented as dimensions of CII. Given that the measurement assessment confirms that CII is reflected by these six dimensions, collaborative innovation partnerships, which operate in the B2B market, need to consider and plan and engage in their relationships based on these. Consequently, these six dimensions are the cornerstone of the practice roadmap.

The results of this research demonstrates that the joint learning and joint problem solving dimensions are most reflective of CII, with an equal factor loading of .78. The joint social bonding dimension, has the next highest factor loading with a score .70. In finding that joint social bonding is a dimension of CII, it is envisioned that this research will prompt a move from the sometimes current mechanistic approach to collaborative NPD, to a more relational one. This finding focuses on the importance of ongoing inter-personal relationships between both organisations and in particular between boundary-spanners. This expands on previous research undertaken by Gruner and Homburg (2000) and Lynch O'Toole and Biemans (2016). Their findings demonstrate the importance of inter-personal relationships to the continuity of the inter-organisational relationships. This study goes further and demonstrates that joint social bonding reflects the intensity of the inter-organisational relationship. As this research also finds that higher levels of CII are indicative of better performance outcomes, it is of huge strategic importance that the contribution of inter-personal relationships is recognised by senior management when developing a practice roadmap.

Thirdly, included in the model are two antecedent variables. The author does not claim that these are only two antecedents but rather that these are the most important. The two modelled antecedents: cognitive commitment and benevolent trust resulted in high factor loadings. These findings suggest that the existence of cognitive commitment and benevolent trust in a dyadic relationship have an impact on CII. Therefore, both need to be developed in collaborative relationships leading to high intensity levels of CII and consequently better innovation outcomes.

In summary, from a managerial perspective, this research stresses the value of planning and developing an effective collaborative innovation strategy and investing in it. The development of the practice roadmap is key to this.

10.4 Research Limitations

As with all research, results of this study should be analysed by the reader in conjunction with several research limitations which are presented below.

In common with the majority of other IOR researchers, the findings reported in this research involved the perceptions of one key informant for each organisation that participated. For this research the key informants were either NPD managers or managing directors. This could lead to biased results as findings are based on the perceptions of one individual (potential common method bias. The shortcomings of this approach are not just methodological, therefore, this approach may have other implications for the research findings, for example it does not take into consideration that collaborative innovation between partners is an interaction process where both parties influence each other. In addition, concentrating on one side of the dyad implicitly assumes that the contributions of partners are symmetric which generally does not apply. Furthermore, empirical research has consistently demonstrated that single informant bias (same informant for independent and dependent variables) has resulted in higher correlations between two variables because the residuals are not independent. Although procedural and statistical remedies were used to control for method bias, it cannot be completely ruled out. Classically, Kumar et al. (1993), suggest that a more rigorous approach would be to collect data from more than one key informant per organisation. However, they also accept that to do this requires overcoming two practical problems that are inherent in any postal survey data collection approach: (1) respondent selection problem, that is being able to identify multiple respondents in any one organisation with sufficient competency in the specific research area; (2) the perceptual agreement problem, which points out that frequently the data collected from multiple correspondents within the same organisation does not correlate. A key challenge with obtaining more than one key informant in this research relates to the fact that 70.3 percent of the industries included in the analysis are in fact SMEs, hence the probability of there being more than one key informant in the firm is low. In an effort to counterbalance this problem, extra efforts were made to ensure that the people that did return completed surveys were in fact key informants. To achieve this, the surveys were initially addressed to NPD managers, and if this was not possible to the managing director of the company. As an additional check for competency, the author asked respondents to return their business cards in order to obtain results for the study- in total 78 percent of respondents returned their cards and a review of these cards indicated that 65

percent were managing directors with the 13 percent holding senior NPD or innovation roles within their company.

Another issue with regard to respondents in the type of data collection method applied in this research, although not directly addressed by Kumar et al. (1993), is that ideally respondents from both sides of a dyad should participate. If the aforementioned issues were to be addressed in this research, at least two competent informants from each side of a dyad would have been required to participate. Even with huge efforts being made, in view of the resources that were consumed in this research in obtaining just one competent key informant from one side of a dyad, involving more than one such person presented a challenge that in the end proved insurmountable for this study. Therefore, as a future research direction, a study involving two or more key respondents from both sides of the dyad could be undertaken.

In addition, it should be noted that with reference to the team processes addressed in this research, in particular the joint-problem solving process, only one respondent per team was represented in the data analysis. In current research it has become a standard to include a number of respondents from each team in order to get a more valid measure for these team joint processes. Consequently, as a future research direction, a study involving more than one member of the IOR teams could be undertaken.

Finally, this study limited its research to a study involving industrial users in collaborative innovation in Ireland only. This research could be extended different samples in other geographical locations.

10.5 Directions for Future Research

The objective of this research was to create a measure of CII that demonstrated validity and reliability in relation to the dimensions and items in the measure. This is where the scale development of CII currently stands. However, assessing the reliability or stability of the measure over time and increasing confidence in the construct validity is a key part of a future research agenda. The researcher is currently

in the early planning stages of administering the CII scale to a significantly larger European sample (approx. 2000).

This research has statistically demonstrated that higher levels of CII deliver more effective outcomes. However, in future research, more testing should be carried out allowing for firstly, the measurement of discrete levels of CII and secondly, the modelling of these discrete levels against NPD outcomes. This would prove beneficial for both academics and practice because it would identify an optimum measure of CII for the most effective NPD outcomes.

This research has never claimed that all of the existing CII related constructs are included in the SEM model, but rather that the most important constructs are part of the model. Therefore, results of this study could be further tested and expanded through more rigorous testing by adding further constructs for example testing the moderation roles of virtual teams and information technology between CII and NPD outcomes.

The “trust” construct is reduced to only one aspect of trust that is “benevolent”. This was deliberate within the research as previous research suggests that benevolent trust is the most important driver of close relationships. For future nomological validity testing, other aspects of the trust construct be included could be added. The “commitment” construct is also reduced to one aspect of commitment that is “cognitive”. This was also deliberate within the research however as with the trust construct, for future nomological validity testing other aspects of commitment could be included.

In addition, it is suggested that the single item ”senior management support” construct used in this research, be replaced by a multi-item scale, for example, Cooper and Kleinschmidt (1995) in any future research that is undertaken.

There is a case for expanding the current research to include institutes and/or universities. The CII scale development and the additional nomological validity testing was carried out in the context of the dyad for this research. A natural follow-up would be to test the nomological validity of the scale in the context of both a

research institute and organisation innovation collaboration, and a network collaboration.

Future research should consider the possibility of including respondents from both sides of the dyad relationship. Even more importantly it would be beneficial for accurate and complete statistical analysis (to prevent inflated correlations between independent and dependent variables) if nomological testing was undertaken with two samples from the same population, one sample for independent variables and one sample for dependent variables.

Finally, the SEM model could be tested during different phases of the NPD project. This would expand on the work of Lynch et al. (2016) who when testing their multi-item scale of user involvement found that the phase of an NPD project moderates the relationship between user involvement and outcomes.

10.6 Summary

The final chapter of this research restates the research objectives and outlines the academic and practice contributions specific to this study. The work has high relevance for research and practice. Indeed, it has real significance for cumulative research in several disciplines such as technology and innovation management, industrial marketing, supply chain management, project management and science-industry collaboration. Other fields like international management, multi-party collaborations or innovation-oriented collaborations with state owned public utilities, may also profit from this work.

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Appendices

Appendix A Postal Survey

School of Business, Department of Management and Organisation

Measuring the Impact of Business to Business (B2B) Cooperation on New Product Development (NPD) Outcomes: A National Survey

Ms Helen O'Keeffe PhD Candidate

ACMA MBS

Telephone 085 161 6255

Email:okeefeh@eircom.net

The questionnaire is designed to gain insight into the collaboration process that exists between your organisation and your partner in a new product development project of your choice.
Next, the survey investigates the impact (if any), that the choice of this partner has on the depth of the collaboration process.
Finally, the survey examines the impact that this depth has on the NPD outcomes of the project.

The questionnaire is directed at senior management only.

Please read all questions carefully. The survey has been designed to facilitate ease of completion. To indicate your response to a question, please tick (✓) the appropriate box or circle (O) whichever best option describes the situation. All information provided will be kept **CONFIDENTIAL** and used only for academic research. Only the researcher sees and processes the questionnaire: no person or company will be identified in the findings. Please answer as many questions as you can.
If you are not involved in NPD, please return the blank survey. This will ensure that I do not contact you again.

Please return in the PRE-PAID, SELF ADDRESSED ENVELOPE

1

Section A: Your Organisation and NPD

Start Here: Think of the **closest relationship your** organisation has with another company in the context of collaborative new product development (NPD); the relationship should involve a very high level of collaboration. Except for Section A and F all of the following questions involve your perception from your organisation's perspective of this specific relationship. You may find that the statements are repetitive – this is due to the nature of surveys that are being used for statistical analysis, hence your patience is much appreciated.

Please tick ☑ as appropriate

Q1. **Is your company involved in New Product Development (NPD)?**

Yes ❒

No ❒

Q2. **Describe the type of NPD**

Radical (New) ❒ **Incremental (Improving existing products)** ❒

Q3. **Is your company involved in collaboration with another company during the NPD process?**

Yes ❒ **No** ❒

Q4. **Is the chosen partner a supplier or a customer?**

Supplier ❒ **Customer** ❒

Other ❒ **Please Specify:** _____

Q4. **If this partner is a customer, please indicate the value of this account to your business**

❒ **Top 1-2** ❒ **Top 3-4** ❒ **Top 5-6** ❒ **Top 7-8** ❒ **9+**

Q5. **What is the approximate length of time that your company has had a relationship with the partner that you are in collaboration with in the new product development project that you are going to report on for this questionnaire?**

Less than one year ❒ **1-3 years** ❒

4-6 years ❒ **7 years or more** ❒

Section B: Collaborative Innovation Process

Through these statements we are trying to identify the depth of collaborative innovation between you and your partner in comparison to your average collaborative relationship.

Please circle as appropriate

	Strongly Agree				Strongly Disagree
The frequency of meetings between us is high	1	2	3	4	5
People from both organisations regularly meet face to face	1	2	3	4	5
Communication takes place both formally and informally	1	2	3	4	5
Information is shared freely between us	1	2	3	4	5
We provide information if it helps our partner	1	2	3	4	5
Proprietary information is shared between our organisations	1	2	3	4	5
Our partners provide us with information freely	1	2	3	4	5
We can contact anybody in our partner organisation as and when we please	1	2	3	4	5
We have developed a common vocabulary that is unique to this relationship	1	2	3	4	5
Through interaction we generate new knowledge	1	2	3	4	5
We adopt unique knowledge sharing routines for joint learning	1	2	3	4	5
We become closer when working together throughout the process	1	2	3	4	5
We get enjoyment out of working together	1	2	3	4	5
We become friendlier throughout the process	1	2	3	4	5
We apply joint goals	1	2	3	4	5
We support each other's objectives	1	2	3	4	5
We engage in joint planning	1	2	3	4	5
We engage in joint decision making	1	2	3	4	5
Problems that arise throughout the project are treated as joint problems	1	2	3	4	5
Both partners make suggestions regarding the NPD project	1	2	3	4	5
We are creative	1	2	3	4	5
New ideas are created as we work together	1	2	3	4	5
Novel solutions are generated through working together	1	2	3	4	5

Section C: Understanding Partner Choice

Through these statements we are trying to understand why you chose this partner for this NPD project.

Please circle as appropriate

	Strongly Agree				Strongly Disagree
This partner is crucial to our future performance	1	2	3	4	5
It would be difficult for us to replace this partner	1	2	3	4	5
We are dependent on this partner	1	2	3	4	5
We do not have a good alternative to this partner	1	2	3	4	5
This partner is important to our business	1	2	3	4	5
If our relationship was discontinued we would have difficulty in replacing this partner	1	2	3	4	5
The relationship that we have with this partner is: Something that we are very committed to	1	2	3	4	5
The relationship that we have with this partner is: Something that we intend to maintain indefinitely	1	2	3	4	5
The relationship that we have with this partner: Deserves our maximum effort to maintain	1	2	3	4	5
We trust that our partner's decisions will be beneficial to our business	1	2	3	4	5
We feel that we get a fair deal from our partner	1	2	3	4	5
The relationship is marked by a high degree of harmony	1	2	3	4	5
A large number of people are involved from both organisations	1	2	3	4	5
We believe that over the long-run our relationship with this partner will be profitable	1	2	3	4	5
Maintaining a long term relationship with this partner is important to us	1	2	3	4	5
We focus on long-term goals in this relationship	1	2	3	4	5
We are willing to make sacrifices to help this partner from time to time	1	2	3	4	5
We are only concerned with our outcomes in this relationship	1	2	3	4	5
We expect this partner to be working with us for a long time	1	2	3	4	5
Any concessions that we make to help this partner will even out in the long run	1	2	3	4	5

Section C: Understanding Partner Choice

Through these statements we are trying to understand why you chose this partner for this NPD project.

Please circle as appropriate

	Strongly Agree				Strongly Disagree
If we switched from this partner to an alternative partner, we would lose substantial investments	1	2	3	4	5
We have invested substantially in personnel dedicated to this partner	1	2	3	4	5
If we switched from this partner to an alternative partner, we would lose knowledge related to the processes of this partner	1	2	3	4	5
Investments in this partner could not be reversed in the case of this partner switching	1	2	3	4	5
This NPD project was strongly supported by senior management	1	2	3	4	5
Our company is often the first to market with new products	1	2	3	4	5
Our new product introduction has increased over the last 5 years	1	2	3	4	5

Section D: Collaborative Innovation Outcomes

Through these statements we are trying to understand the outcomes of this relationship

Please circle as appropriate

	Strongly Agree				Strongly Disagree
This NPD collaboration exceeded overall senior management expectations	1	2	3	4	5
This NPD collaboration exceeded our customer expectations	1	2	3	4	5
This NPD collaboration exceeded profit expectation	1	2	3	4	5
This NPD collaboration exceeded return on investment expectations	1	2	3	4	5
This NPD collaboration exceeded our market share expectations	1	2	3	4	5
This NPD collaboration has met our expectations	1	2	3	4	5
This NPD collaboration has been successful	1	2	3	4	5
Compared to our competitors, our NPD cycle time is shorter	1	2	3	4	5
Compared to our competitors, our new product quality is higher	1	2	3	4	5
Our organisation is satisfied with this relationship	1	2	3	4	5

Section E: Environmental Issues

Through these statements we are trying to understand if any environmental (external) issues impact the collaborative NPD relationship

Please circle as appropriate

	Strongly Agree				Strongly Disagree
We cater to many of the same customers as in the past	1	2	3	4	5
In general, in our industry, market share is stable amongst the same competitors	1	2	3	4	5
Demand and taste are fairly easy to forecast	1	2	3	4	5
The technology in our industry is changing rapidly	1	2	3	4	5
A large number of new product ideas have been made possible through technological breakthroughs in our industry	1	2	3	4	5
In our industry the modes of production and service change often	1	2	3	4	5
In our industry, virtually no research and development is done	1	2	3	4	5
In our industry, the modes of production and service change in major ways, as opposed to slowly evolving	1	2	3	4	5

Section F: General Company Classification

Please tick ☑ as appropriate

Q1. From the following categories please estimate the gross sales of your company (euro million,2015)

☐ < €2 ☐ > €2 ≤ €20 ☐ >€20 ≤ €50.

☐ >€50 ≤ €100 ☐ >€100 ≤ €200 ☐ >€200 ≤ €300

☐ > €300 ≤ €400 ☐ >€400 ≤ €500 ☐ >€500

Section F: General Company Classification

Q2. **Is your company Irish owned?**

☐ **Yes** **50% or more Irish owned**

Q3. **Please select the appropriate industry category**

☐ **Pharmaceutical /Chemical**

☐ **Electrical/Electrical Engineering**

☐ **Industrial Machinery**

☐ **Telecommunications**

☐ **Other** **Please Specify:** _____

The number shown in the above box is a unique reference number that applies to your organisation. This ensures you receive only one copy of the survey.

If interested in receiving research results, please add your address

(business card or written) in the box below

Once again I assure you of the strict confidentiality of your responses.

I sincerely thank you for taking the time to complete this survey.
Your help is very much appreciated

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Appendix B Cover Letter

RE: Measuring the Impact of Business to Business (B2B) Cooperation on New Product Development (NPD) Outcomes: A National Survey

Dear

Due to your experience with partners in NPD projects, I am asking for your help. I am a PhD student at Waterford Institute of Technology, and the enclosed survey is a major component of my PhD. This study is the first of its kind, *anywhere,* as it will develop an international standard measure of collaborative innovation and link this to business outcomes. After 25 years in industry, and returning to education, I am really excited about developing this new NPD knowledge with your cooperation.

Absolute confidentiality is assured. I am the only researcher that will see individual responses. A FREEPOST envelope for the survey's return is enclosed. Please return the completed survey **within the next two weeks**. Thank you for your time and consideration, it is very much appreciated.

Yours Sincerely

Helen O'Keeffe
PhD Candidate
ACMA MBS

Appendix C Pilot Study Statistics

Appendix C (i): Joint Communication

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
pcomm1	63	1.75	.647	.664	.302	1.181	.595
pcomm2	63	1.71	.728	1.020	.302	1.436	.595
pcomm3	63	1.60	.583	.339	.302	-.704	.595
Valid N (listwise)	63						

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.664
Bartlett's Test of Sphericity	Approx. Chi-Square	44.752
	df	3
	Sig.	.000

Communalities

	Initial	Extraction
pcomm1	1.000	.682
pcomm2	1.000	.743
pcomm3	1.000	.577

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.003	66.759	66.759	2.003	66.759	66.759
2	.605	20.162	86.921			
3	.392	13.079	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
pcomm1	.826
pcomm2	.862
pcomm3	.760

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.750	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
pcomm1	3.32	1.285	.596	.646
pcomm2	3.35	1.070	.649	.582
pcomm3	3.46	1.510	.507	.744

Appendix C (ii): Pilot Joint Information Exchange

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
pinfo1	63	2.63	1.140	.566	.302	-.492	.595
pinfo2	63	2.44	1.104	.665	.302	-.034	.595
pinfo3	63	3.02	1.114	.040	.302	-.746	.595
pinfo4	63	2.41	.891	.484	.302	.165	.595
pinfo6	63	2.48	.877	.519	.302	.863	.595
Valid N (listwise)	63						

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.522
Bartlett's Test of Sphericity	Approx. Chi-Square	32.095
	df	10
	Sig.	.000

Communalities

	Initial	Extraction
pinfo1	1.000	.504
pinfo2	1.000	.544
pinfo3	1.000	.729
pinfo4	1.000	.704
pinfo6	1.000	.504

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.728	34.566	34.566	1.728	34.566	34.566
2	1.256	25.122	59.689	1.256	25.122	59.689
3	.926	18.512	78.200			
4	.628	12.554	90.754			
5	.462	9.246	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
pinfo1	.554	.444
pinfo2	.524	-.519
pinfo3	.059	.852
pinfo4	.820	-.179
pinfo6	.686	.180

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.436	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
pinfo1	10.35	5.070	.352	.275
pinfo2	10.54	6.252	.128	.458
pinfo3	9.97	6.741	.034	.526
pinfo4	10.57	5.700	.395	.274
pinfo6	10.51	6.093	.304	.336

Appendix C (iii): Pilot Joint Problem Solving

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
pjps1	63	2.46	.839	.298	.302	.405	.595
pjps2	63	2.49	.948	.023	.302	-.339	.595
pjps3	63	2.48	1.030	.570	.302	-.300	.595
pjps4	63	2.78	.991	.262	.302	-.730	.595
pjps5	63	2.38	.869	.532	.302	.393	.595
pjps6	63	2.44	.963	.442	.302	-.323	.595
Valid N (listwise)	63						

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.728
Bartlett's Test of Sphericity	Approx. Chi-Square	136.371
	df	15
	Sig.	.000

Communalities

	Initial	Extraction
pjps1	1.000	.765
pjps2	1.000	.670
pjps3	1.000	.596
pjps4	1.000	.809
pjps6	1.000	.626
pjps5	1.000	.672

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.132	52.205	52.205	3.132	52.205	52.205
2	1.005	16.742	68.948	1.005	16.742	68.948
3	.680	11.338	80.286			
4	.621	10.346	90.632			
5	.343	5.725	96.357			
6	.219	3.643	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
pjps1	.718	-.500
pjps2	.794	-.198
pjps3	.629	-.447
pjps4	.786	.437
pjps6	.576	.542
pjps5	.800	.176

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.809	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
pjps1	12.57	12.281	.573	.779
pjps2	12.54	11.285	.655	.759
pjps3	12.56	11.928	.473	.803
pjps4	12.25	11.063	.654	.759
pjps5	12.65	11.683	.659	.761
pjps6	12.59	12.504	.429	.810

Appendix C (iv): Pilot Joint Learning

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
plearn1	63	2.79	1.065	.180	.302	-.420	.595
plearn2	63	2.22	.906	.345	.302	-.590	.595
plearn3	63	2.62	.851	.832	.302	.531	.595
Valid N (listwise)	63						

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.591
Bartlett's Test of Sphericity	Approx. Chi-Square	17.768
	df	3
	Sig.	.000

Communalities

	Initial	Extraction
plearn1	1.000	.645
plearn2	1.000	.598
plearn3	1.000	.378

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.622	54.057	54.057	1.622	54.057	54.057
2	.815	27.182	81.240			
3	.563	18.760	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
plearn1	.803
plearn2	.773
plearn3	.615

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.573	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
plearn1	4.84	1.878	.452	.355
plearn2	5.41	2.343	.421	.414
plearn3	5.02	2.790	.288	.599

Appendix C (v): Pilot Joint Creativity

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
pcreate1	63	2.92	1.112	.379	.302	-.636	.595
pcreate2	63	2.22	.941	.614	.302	.165	.595
pcreate3	63	2.78	1.054	.037	.302	-.823	.595
Valid N (listwise)	63						

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.635
Bartlett's Test of Sphericity	Approx. Chi-Square	49.363
	df	3
	Sig.	.000

Communalities

	Initial	Extraction
pcreate1	1.000	.500
pcreate2	1.000	.769
pcreate3	1.000	.733

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.002	66.739	66.739	2.002	66.739	66.739
2	.669	22.310	89.049			
3	.329	10.951	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
pcreate1	.707
pcreate2	.877
pcreate3	.856

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.738	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
pcreate1	5.00	3.323	.446	.798
pcreate2	5.70	3.246	.659	.554
pcreate3	5.14	3.028	.607	.599

Appendix C (vi): Pilot: Joint Social Bonding

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
psocial1	63	2.14	.965	.929	.302	1.018	.595
psocial2	63	2.06	.859	.664	.302	.063	.595
psocial3	63	2.24	.995	.309	.302	-.933	.595
Valid N (listwise)	63						

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.672
Bartlett's Test of Sphericity	Approx. Chi-Square	56.615
	df	3
	Sig.	.000

Communalities

	Initial	Extraction
psocial1	1.000	.648
psocial2	1.000	.789
psocial3	1.000	.677

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.114	70.477	70.477	2.114	70.477	70.477
2	.550	18.342	88.819			
3	.335	11.181	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
psocial1	.805
psocial2	.888
psocial3	.823

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.784	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
psocial1	4.30	2.795	.573	.763
psocial2	4.38	2.788	.714	.621
psocial3	4.21	2.650	.596	.741

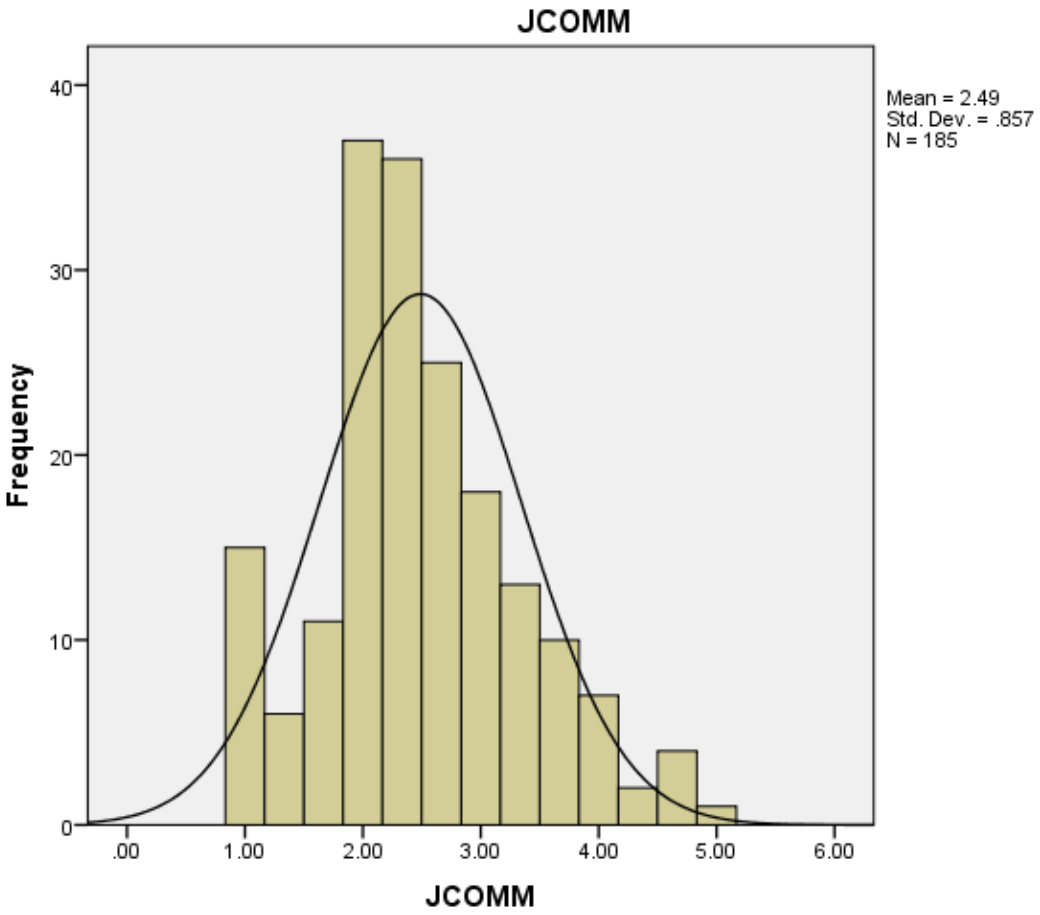
Appendix D Normal Distribution Tests for CII Survey Data

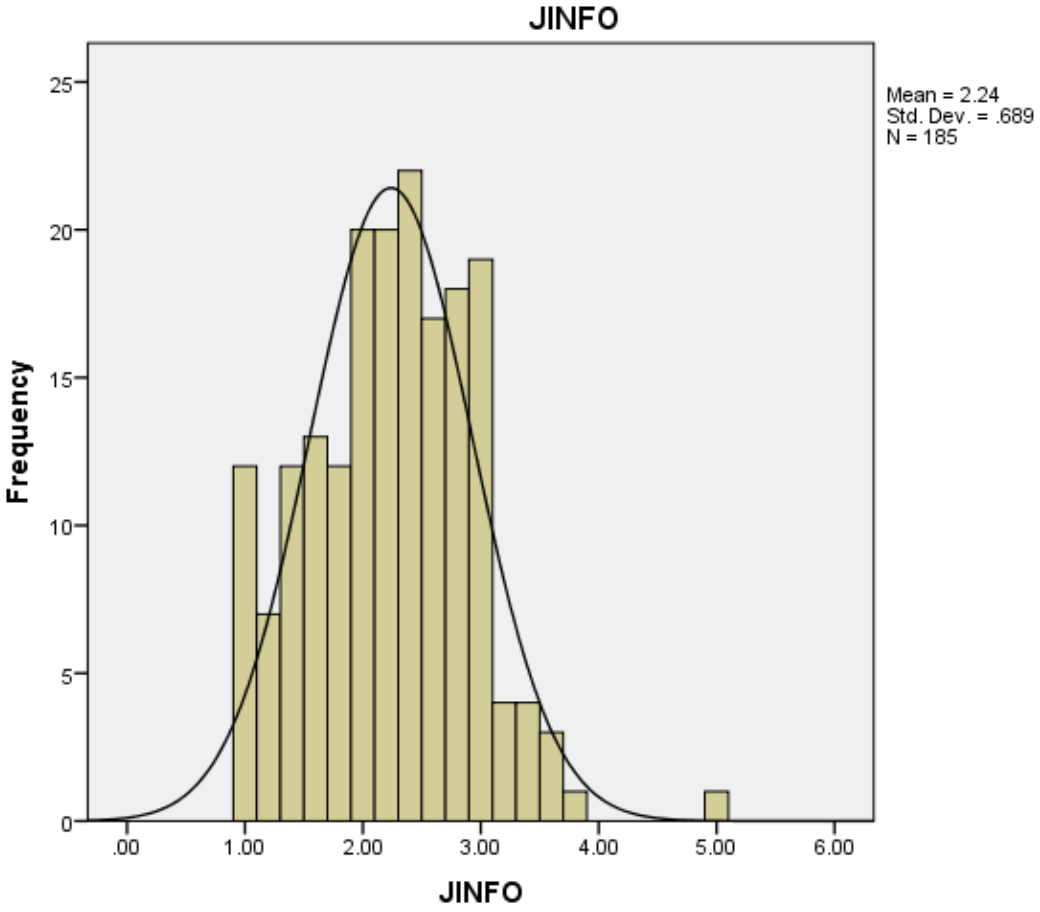
Appendix D (i): Skewness and Kurtosis Testing

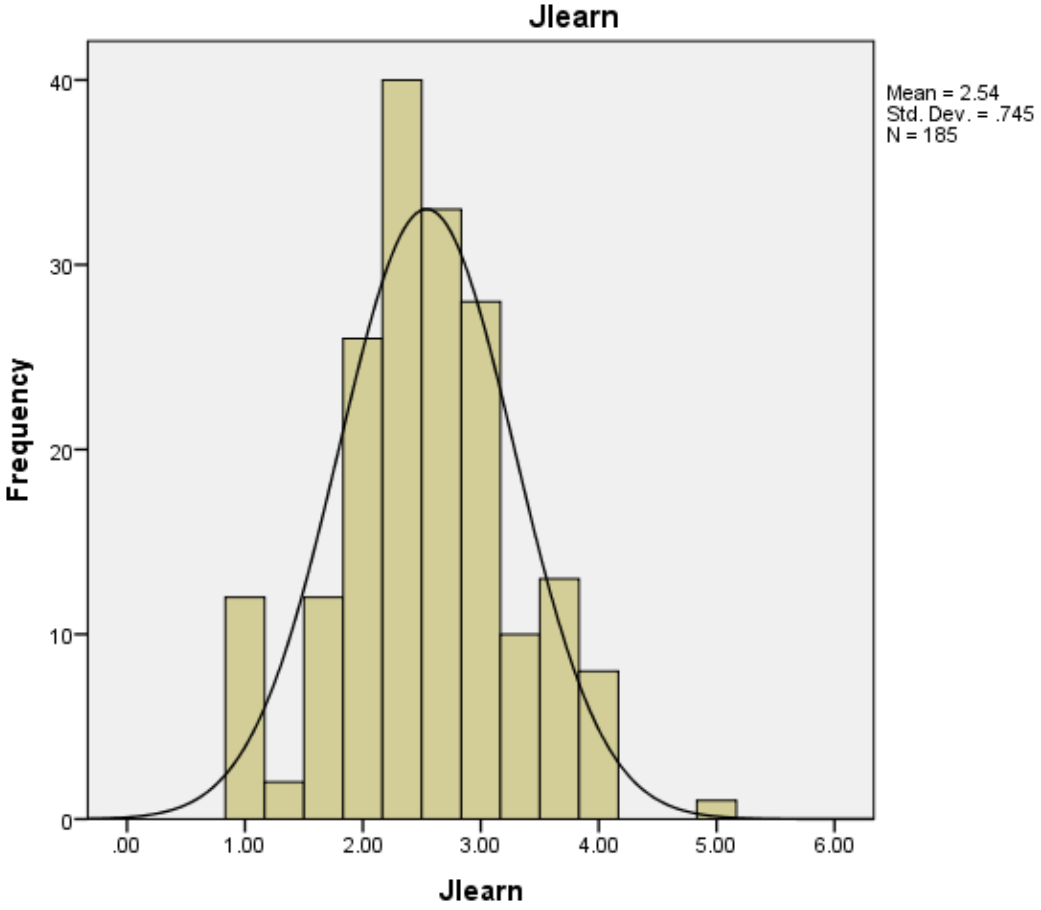
Statistics

		JCOMM	JINFO	Jlearn	JSBOND	JPS	JCREATE	CII
N	Valid	185	185	185	185	185	185	185
	Missing	0	0	0	0	0	0	0
Skewness		.449	.210	.083	.563	-.016	.293	-.170
Std. Error of Skewness		.179	.179	.179	.179	.179	.179	.179
Kurtosis		.160	.402	.231	.501	-.412	.118	-.276
Std. Error of Kurtosis		.355	.355	.355	.355	.355	.355	.355

Appendix D (ii) Normal Distribution Data Test: Histogram Plots by Variable




JINFO
Mean = 2.24
Std. Dev. = .689
N = 185
Frequency
25
20
15
10
5
0
.00
1.00
2.00
3.00
4.00
5.00
6.00
JINFO


Jlearn
Mean = 2.54
Std. Dev. = .745
N = 185
Frequency
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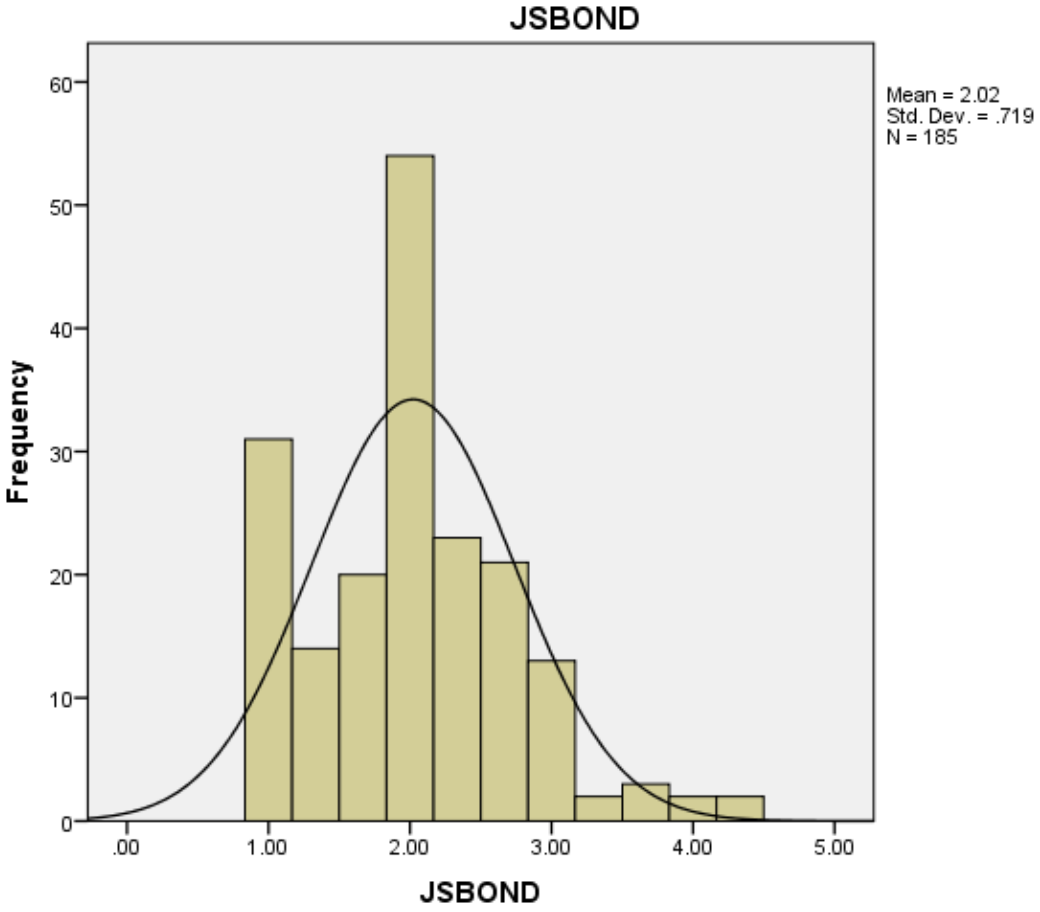
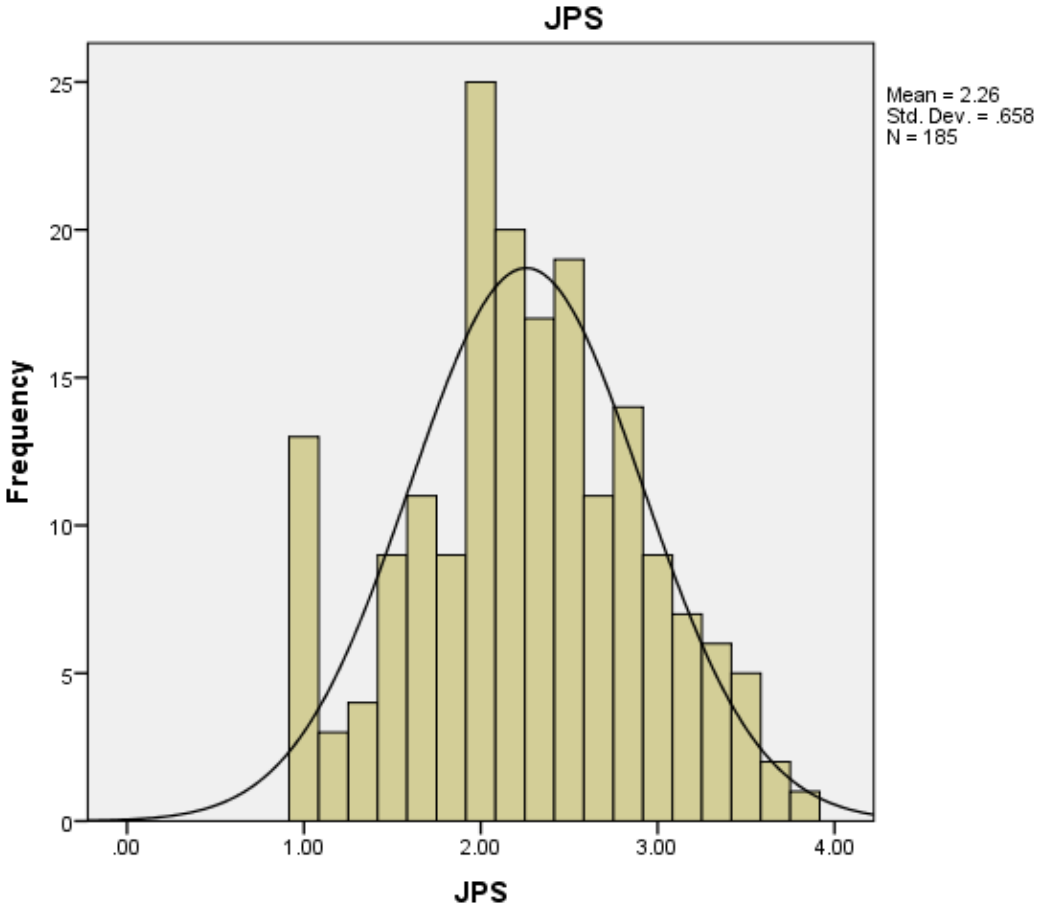
30
20
10
0
.00
1.00
2.00
3.00
4.00
5.00
6.00
Jlearn


JSBOND
Mean = 2.02
Std. Dev. = .719
N = 185
Frequency
60
50
40
30
20
10
0
.00
1.00
2.00
3.00
4.00
5.00
JSBOND


JPS
Mean = 2.26
Std. Dev. = .658
N = 185
Frequency
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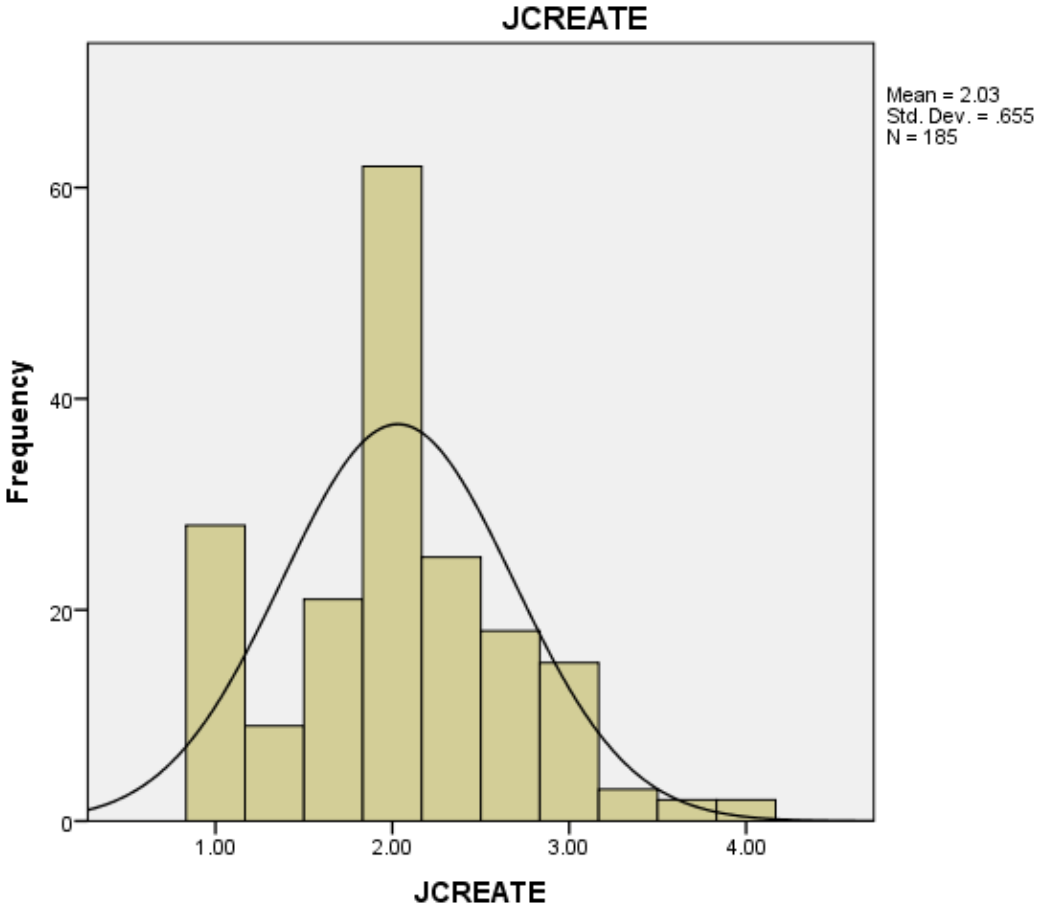
20
15
10
5
0
.00
1.00
2.00
3.00
4.00
JPS


JCREATE
Mean = 2.03
Std. Dev. = .655
N = 185
Frequency
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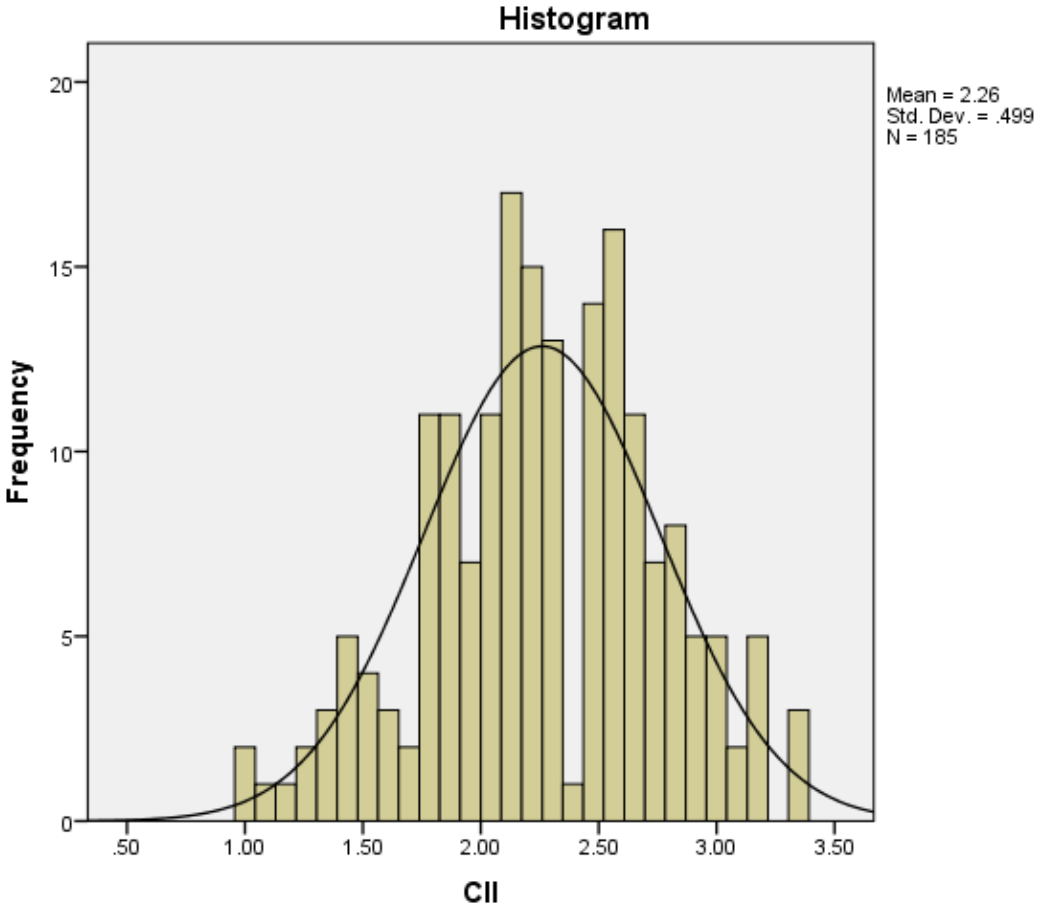
40
20
0
1.00
2.00
3.00
4.00
JCREATE


Histogram
Mean = 2.26
Std. Dev. = .499
N = 185
Frequency
20
15
10
5
0
.50
1.00
1.50
2.00
2.50
3.00
3.50
CII

Appendix E Postal Survey EFA Statistics.

Appendix E (i) Joint Communication

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Comm1	185	1	5	2.64	1.050	.456	.179	-.055	.355
Comm2	185	1	5	2.68	1.094	.385	.179	-.353	.355
Comm3	185	1	5	2.15	.888	.792	.179	.957	.355
Valid N (listwise)	185								

Communalities

	Initial	Extraction
Comm1	1.000	.803
Comm2	1.000	.754
Comm3	1.000	.587

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.143	71.446	71.446	2.143	71.446	71.446
2	.576	19.185	90.632			
3	.281	9.368	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
Comm1	.896
Comm2	.868
Comm3	.766

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.799	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Comm1	4.83	2.883	.736	.623
Comm2	4.78	2.877	.683	.686
Comm3	5.32	3.936	.535	.832

Appendix E (ii) Joint Information Exchange

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Info1	185	1	5	2.21	.879	.556	.179	.421	.355
Info2	185	1	5	1.85	.734	.903	.179	1.758	.355
Info3	185	1	5	2.34	1.020	.672	.179	.226	.355
Info4	185	1	5	2.29	.884	.406	.179	.190	.355
Info5	185	1	5	2.50	1.128	.337	.179	-.719	.355
Valid N (listwise)	185								

Communalities

	Initial	Extraction
Info1	1.000	.692
Info2	1.000	.652
Info3	1.000	.428
Info4	1.000	.685
Info5	1.000	.384

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.841	56.812	56.812	2.841	56.812	56.812
2	.791	15.819	72.632			
3	.606	12.116	84.748			
4	.501	10.016	94.764			
5	.262	5.236	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Info1	.832
Info2	.807
Info3	.654
Info4	.827
Info5	.620

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.786	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Info1	8.98	7.853	.659	.716
Info2	9.34	8.518	.657	.728
Info3	8.85	8.129	.464	.781
Info4	8.90	7.708	.689	.706
Info5	8.69	7.814	.441	.799

Appendix E (iii) Joint Learning

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Learn1	185	1	5	2.82	1.040	.188	.179	-.392	.355
Learn2	185	1	5	2.14	.793	.680	.179	1.059	.355
Learn3	185	1	5	2.66	1.009	.360	.179	.018	.355
Valid N (listwise)	185								

Communalities

	Initial	Extraction
Learn1	1.000	.516
Learn2	1.000	.669
Learn3	1.000	.678

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.863	62.101	62.101	1.863	62.101	62.101
2	.670	22.330	84.431			
3	.467	15.569	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
Learn1	.718
Learn2	.818
Learn3	.824

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.681	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Learn1	4.80	2.498	.431	.682
Learn2	5.49	2.903	.543	.554
Learn3	4.96	2.324	.538	.528

Appendix E (iv) Joint Social Bonding

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Social1	185	1	5	1.90	.770	.901	.179	1.407	.355
Social2	185	1	5	2.17	.820	.457	.179	.438	.355
Social3	185	1	5	2.00	.828	.582	.179	.183	.355
Valid N (listwise)	185								

Communalities

	Initial	Extraction
Social1	1.000	.720
Social2	1.000	.816
Social3	1.000	.847

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.383	79.442	79.442	2.383	79.442	79.442
2	.405	13.504	92.945			
3	.212	7.055	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Social1	.849
Social2	.903
Social3	.921

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.871	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Social1	4.17	2.423	.681	.879
Social2	3.90	2.125	.773	.798
Social3	4.06	2.050	.807	.765

Appendix E (v) Joint Problem Solving

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PSolve1	185	1	5	2.18	.878	.607	.179	.282	.355
Psolve2	185	1	4	2.05	.743	.316	.179	-.185	.355
Psolve3	185	1	5	2.25	.899	.487	.179	-.223	.355
Psolve4	185	1	5	2.56	.988	.321	.179	-.264	.355
Psolve5	185	1	5	2.49	.939	.183	.179	-.692	.355
Psolve6	185	1	4	2.00	.745	.399	.179	-.090	.355
Valid N (listwise)	185								

Communalities

	Initial	Extraction
PSolve1	1.000	.607
Psolve2	1.000	.650
Psolve3	1.000	.661
Psolve4	1.000	.624
Psolve5	1.000	.528
Psolve6	1.000	.390

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.461	57.683	57.683	3.461	57.683	57.683
2	.831	13.846	71.528			
3	.702	11.702	83.230			
4	.450	7.496	90.726			
5	.324	5.407	96.134			
6	.232	3.866	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
PSolve1	.779
Psolve2	.806
Psolve3	.813
Psolve4	.790
Psolve5	.727
Psolve6	.624

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.850	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PSolve1	11.36	11.013	.649	.822
Psolve2	11.49	11.534	.690	.818
Psolve3	11.29	10.643	.702	.811
Psolve4	10.98	10.304	.676	.817
Psolve5	11.05	10.894	.611	.830
Psolve6	11.54	12.413	.495	.849

Appendix E (vi) Joint Creativity

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Create1	185	1	4	1.92	.744	.532	.179	.105	.355
Create2	185	1	5	2.08	.765	.450	.179	.433	.355
Create3	185	1	4	2.09	.742	.415	.179	.100	.355
Valid N (listwise)	185								

Communalities

	Initial	Extraction
Create1	1.000	.694
Create2	1.000	.841
Create3	1.000	.748

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.283	76.086	76.086	2.283	76.086	76.086
2	.470	15.670	91.756			
3	.247	8.244	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
Create1	.833
Create2	.917
Create3	.865

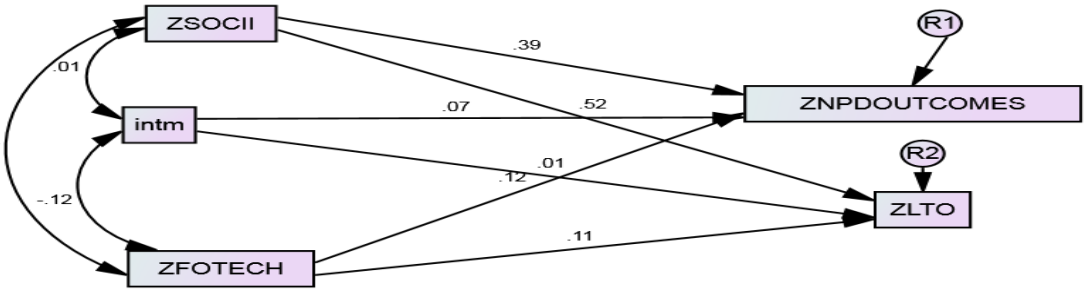
Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Reliability Statistics

Cronbach's Alpha	N of Items
.842	3

Appendix F Moderation Effect of Market Turbulence: Interaction Model



Un-standardised Regression Weight Loadings

			Estimate	S.E.	C.R.	P	Label
ZNPDOUTCOMES	<---	ZSOCII	.391	.067	5.809	***	
ZNPDOUTCOMES	<---	ZFOTECH	.119	.068	1.751	.080	
ZLTO	<---	ZFOTECH	.112	.063	1.774	.076	
ZLTO	<---	ZSOCII	.517	.063	8.268	***	
ZNPDOUTCOMES	<---	intm	.059	.059	.989	.322	
ZLTO	<---	intm	.012	.055	.226	.821	

Standardized Regression Weight Loadings

			Estimate
ZNPDOUTCOMES	<---	ZSOCII	.391
ZNPDOUTCOMES	<---	ZFOTECH	.119

			Estimate
ZLTO	<---	ZFOTECH	.112
ZLTO	<---	ZSOCII	.517
ZNPDOUTCOMES	<---	intm	.066
ZLTO	<---	intm	.014

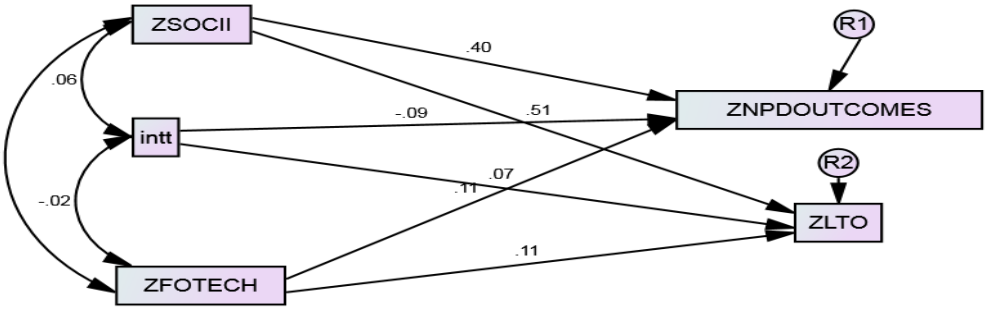
Co-variances

			Estimate	S.E.	C.R.	P	Label
ZSOCII	<-->	ZFOTECH	.142	.074	1.913	.056	
ZSOCII	<-->	intm	.006	.083	.069	.945	
ZFOTECH	<-->	intm	-.133	.084	-1.586	.113	

Correlations

			Estimate
ZSOCII	<-->	ZFOTECH	.142
ZSOCII	<-->	intm	.005
ZFOTECH	<-->	intm	-.118

Appendix G: Moderation Effect of Technological Turbulence: Interaction Model



Un-standardised Regression Weight Loadings

			Estimate	S.E.	C.R.	P	Label
ZNPDOUTCOMES	<---	ZSOCII	.398	.067	5.916	***	
ZNPDOUTCOMES	<---	ZFOTECH	.108	.067	1.611	.107	
ZLTO	<---	ZFOTECH	.112	.062	1.796	.072	
ZLTO	<---	ZSOCII	.513	.062	8.220	***	
ZNPDOUTCOMES	<---	intt	-.081	.060	-1.357	.175	
ZLTO	<---	intt	.063	.055	1.135	.256	

Standardized Regression Weight Loadings

			Estimate
ZNPDOUTCOMES	<---	ZSOCII	.398
ZNPDOUTCOMES	<---	ZFOTECH	.108
ZLTO	<---	ZFOTECH	.112
ZLTO	<---	ZSOCII	.513
ZNPDOUTCOMES	<---	intt	-.090
ZLTO	<---	intt	.070

Co-variances

			Estimate	S.E.	C.R.	P	Label
ZSOCII	<-->	ZFOTECH	.142	.074	1.913	.056	
ZFOTECH	<-->	intt	-.021	.082	-.254	.799	
ZSOCII	<-->	intt	.062	.082	.763	.446	

Correlations

			Estimate
ZSOCII	<-->	ZFOTECH	.142
ZFOTECH	<-->	intt	-.019
ZSOCII	<-->	intt	.056

Appendix H Discriminant CII Intensity Results

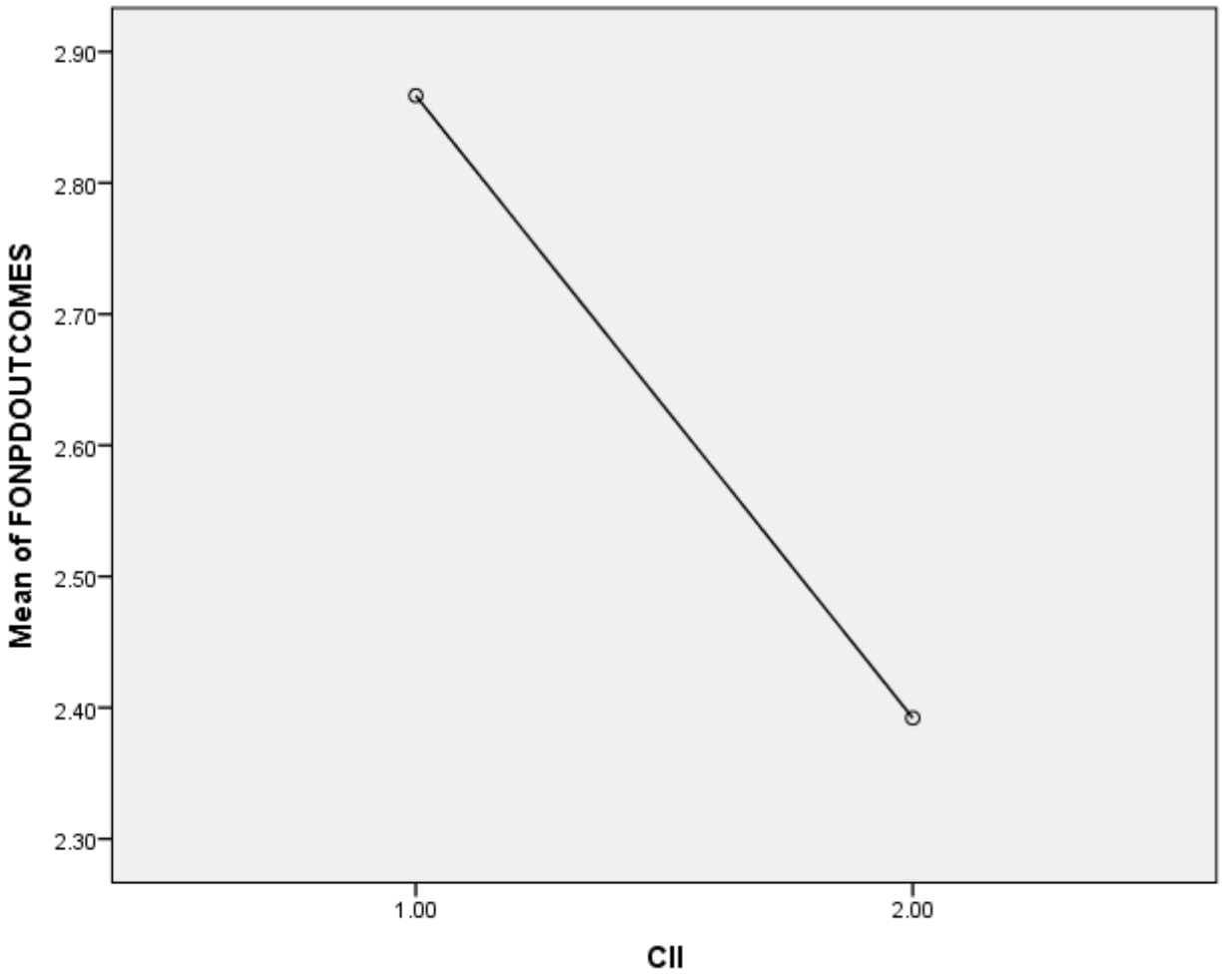
ANOVA

FONPDOUTCOMES

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10.409	1	10.409	28.830	.000
Within Groups	66.071	183	.361		
Total	76.480	184			

Key: There is a significant difference in Means

Means Plots



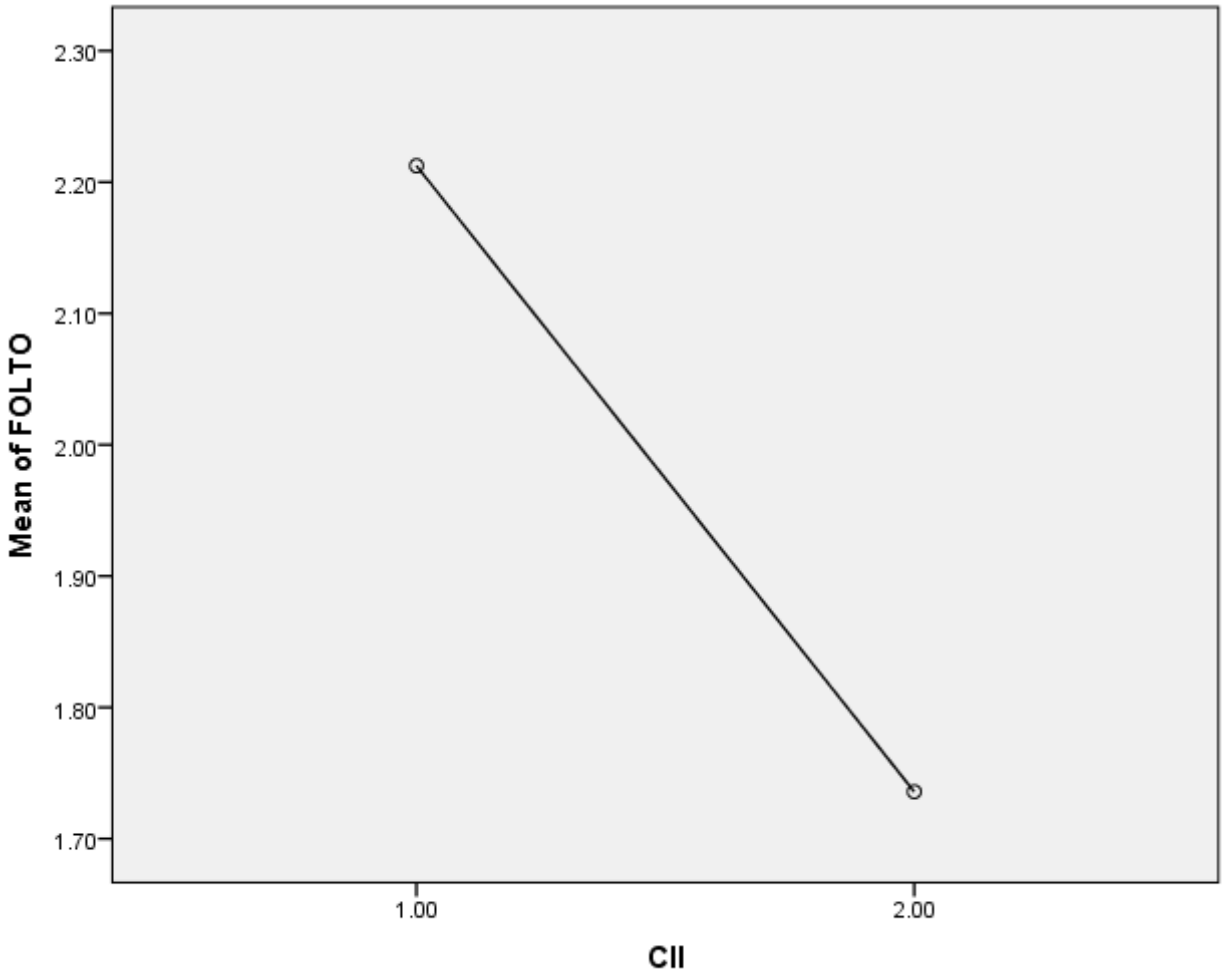
The higher the intensity of CII, the greater the predictor value.

ANOVA

FOLTO

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10.505	1	10.505	36.405	.000
Within Groups	52.804	183	.289		
Total	63.309	184			

Means Plots



The higher the intensity of CII, the greater the predictor value.