Aligning internal and external collaboration systems
to improve
new product development performance

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ABSTRACT

A majority of today’s product and service innovations call for firms to engage in collaborative activity within and simultaneously collaborate with entities outside their boundaries. In many circumstances, this requires firms to align their internal collaborative activities with their external collaborative activities. However, while collaboration within the firm (internal collaboration) and between firms (external collaboration) both have received much attention in a variety of research domains in the last 25 years, they have remained fairly disconnected research streams. Little is known about how internal and external collaboration activities align to improve innovative performance. I present a series of five inter-linked core papers that attempt to address this question of alignment.

Based on a literature review of 119 studies in core paper 1, a multi-attribute conception of collaboration emerges. This forms the basis for my definition of a collaboration system. The latter is then used in subsequent core papers 2, 3, 4, and 5 to empirically examine the configurations of and alignments between internal and external collaboration systems and how they jointly impact on 134 innovation alliances. In core paper 2 (Chapter 4), I find that a mediation effect of internal collaboration systems on external collaboration systems matters more than the effect of external collaboration on innovation performance alone. The findings of core paper 3 (Chapter 5) suggest that internal and external collaboration systems are differently configured and that external collaboration systems still account for value to innovation performance through multiplicative relationships amongst external collaborative activities. In core paper 4 (Chapter 6), I find that internal collaboration systems also moderate the relationship external collaboration systems have with new product development performance. In core paper 5 (Chapter 7), I compare internal and external collaboration systems as predictors of performance in service developments versus new product developments. The findings suggest that internal collaboration systems look and impact in a similar way, independently of whether a new service or a new product is being developed. However, in an examination of NSD versus NPD, attributes of external collaboration systems reveal significantly different relationships with performance.
Together, the findings of each of the five core papers of this thesis add to the current body of collaboration research in different ways. The alignments within and across both collaboration systems, captured in terms of the relationships among a number of attributes, highlight the need to investigate collaboration as coordinated systems. Both systems are distinct in terms of their components and add different value for different types of innovation. Albeit being different, their interactive nature is essential to understand in order to align them for successful new product and service innovations.

In the Conclusion and Future Research Chapter (Chapter 8), I first integrate the findings of the five preceding core papers into a number of key implications before shifting to suggestions for future research. This future research part focuses on aligning collaboration systems over time. I raise a ‘stability-flexibility paradox’ that guides future research into managing collaboration systems. I use and expand upon current dynamic capability theory to address this paradox.
Statement of Originality

This work has not previously been submitted for a degree or diploma in any University. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Signature:..........................................................................

Stephanie Schleimer

Date:.............................................................................
Table of Contents

Abstract ................................................................................................................................. i
Statement of Originality ......................................................................................................... iii
Table of Content .................................................................................................................... iv
List of Figures ........................................................................................................................ x
List of Tables ........................................................................................................................ xi
Acknowledgements ................................................................................................................. xii
Statement of Contributions by Others .................................................................................... xiv
List of Publications ............................................................................................................... xiv

CHAPTER 1: Introduction ................................................................................................ 1
1.1 Setting the Stage ...................................................................................................... 1
1.2 Theoretical Background ........................................................................................... 2
1.2.1 Internal Collaboration ............................................................................................. 3
1.2.2 External Collaboration ............................................................................................ 4
1.2.3 Collaboration: A Multi-Attribute System ............................................................... 4
1.2.4 The Possibility of Alignment .................................................................................. 5
1.3 Thesis Contributions ................................................................................................ 6
1.3.1 Core Paper 1 ............................................................................................................ 6
1.3.2 Core Paper 2 ............................................................................................................ 7
1.3.3 Core Paper 3 ............................................................................................................ 8
1.3.4 Core Paper 4 ............................................................................................................ 9
1.3.5 Core Paper 5 ............................................................................................................ 11
1.3.6 An Integrated Picture: Chapter 8 ............................................................................. 11
1.4 A Roadmap of the Thesis ........................................................................................ 12

CHAPTER 2: Core Paper 1 “How Researchers Study Collaboration Matters – An
Analysis on the Differences of Internal and External Collaboration” ......................... 17
Preface ................................................................................................................................... 17
Abstract ................................................................................................................................. 18
2.1 Introduction ............................................................................................................... 19
2.1.1 Why is this research important? ............................................................................... 20
2.2 Research Approach ..................................................................................................... 21
2.2.1 Conceptualizations of Collaboration ....................................................................... 22
2.2.2 Underlying Theoretical Models of Collaboration .................................................... 24
2.2.3 Time of Publication ................................................................................................. 26
2.2.4 Content of Collaboration – Collaborative Attributes ................................................. 27
2.2.5 Intensity Levels of Collaboration ............................................................................. 29
2.2.5.1 Intensity Levels of Process and Ownership Attributes ........................................... 30
4.2 Theory and Hypotheses ........................................................................................................ 86
4.2.1 Toward a Common Definition of a Collaboration System ............................................ 87
4.2.2 Intensity Levels of Internal versus External Collaboration Systems .............................. 88
4.2.3 The Impact of Focal Firms’ Internal Collaboration Systems on New Product Development Performance in Innovation Alliances .......................................................... 90
4.2.4 The Influence of External Collaboration Systems on Internal Collaboration Systems .... 91
4.2.5 The Influence of External Collaboration Systems in the Product Development Alliance ................................................................................................................................. 92
4.3 Method .................................................................................................................................. 93
4.3.1 Sample and Procedures .................................................................................................... 93
4.3.2 Measurement .................................................................................................................... 95
Dependent variable .................................................................................................................. 95
Independent variables ............................................................................................................ 96
Control variables .................................................................................................................... 98
4.4 Analyses and Results ............................................................................................................ 99
4.5 Discussion ............................................................................................................................ 105
4.6 Limitations .......................................................................................................................... 110
4.7 Implications and Conclusion .............................................................................................. 111
4.7.1 Research on Collaboration ............................................................................................ 111
4.7.2 Research on Strategic Alliances .................................................................................... 111
4.7.3 Collaboration Systems Alignment in a Dynamic Environment ....................................... 112
4.8 References .......................................................................................................................... 114

CHAPTER 5: Core Paper 3 “Value-Adding Configurations of Internal and External Collaboration Systems in New Product Development” .......................................................... 119
Preface ....................................................................................................................................... 119
Abstract ..................................................................................................................................... 120
5.1 Introduction .......................................................................................................................... 121
5.2 Theory and Hypotheses ....................................................................................................... 121
5.2.1 Toward a Common Definition of a Collaboration System ........................................... 122
5.2.2 Independent Configurations of Internal Collaboration and New Product Development Performance .................................................................................................................. 124
5.2.3 Interactive Configurations of External Collaboration System Attributes and New Product Development Performance ................................................................. 125
5.3 Method ............................................................................................................................... 128
5.3.1 Sample and Procedures ................................................................................................. 128
5.3.2 Measurement .................................................................................................................. 130
Dependent variable .................................................................................................................. 130
Independent variables................................................................. 131
Control variables ........................................................................ 133
5.4 Analyses and Results............................................................... 134
5.5 Discussion .............................................................................. 140
5.6 Limitations ............................................................................ 146
5.7 Contributions and Future Research ........................................ 146
5.8 References ............................................................................. 148

CHAPTER 6: Core Paper 4 “Navigating the Confluence of Internal and External Collaboration for New Product Development Performance” ............................................... 153
Preface .......................................................................................... 153
Abstract ........................................................................................ 154
6.1 Introduction ............................................................................. 155
6.2 Theory and Hypotheses ........................................................... 157
6.2.1 Toward a Common Definition of a Collaboration Systems ...... 158
6.2.2 Confluence among Internal and External Collaboration ....... 160
6.2.2.1 Confluence by Maximizing the Intensity of Internal and External Collaboration .... 160
6.2.2.2 Confluence by Maximizing the Intensity of Internal or External Collaboration ...... 163
6.3 Method .................................................................................... 167
6.3.1 Sample and Procedures ....................................................... 167
6.3.2 Measurement ....................................................................... 170
Dependent variable ....................................................................... 170
Independent variables ................................................................. 170
Control variables ........................................................................ 172
6.4 Analysis and Results ............................................................... 173
6.5 Discussion .............................................................................. 179
6.6 Contributions and Implications for Future Research ................ 187
6.7 Limitations ............................................................................. 189
6.8 Conclusion .............................................................................. 190
6.9 References ............................................................................. 191

Preface .......................................................................................... 201
Abstract ........................................................................................ 202
7.1 Introduction ............................................................................. 203
7.2 Theoretical argument and Hypotheses .................................... 204
7.2.1 Toward a Common Definition of a Collaboration System ...... 204
7.2.2 Conceptual Model ............................................................... 206
7.2.3 The Nature of Firms’ Collaboration Systems in NSD versus NPD ......... 206
7.2.3.1 Intensity of Internal Collaboration Systems in NSD versus NPD ........................................ 207
7.2.3.2 Intensity of External Collaboration Systems in NSD versus NPD .................................. 208
7.2.4 Value of Internal and External Collaboration Systems for NSD versus NPD Performance ......................................................................................................................... 210
7.2.4.1 Value-Adding Nature of Internal Collaboration Systems for NSD versus NPD Performance .......................................................................................................................... 211
7.2.4.2 Value-Adding Nature of External Collaboration Systems for NSD versus NPD Performance .......................................................................................................................... 213
7.3 Method .................................................................................................................................... 218
7.3.1 Sample and Procedures ..................................................................................................... 218
7.3.2 Measurement ................................................................................................................... 220
Dependent variable ............................................................................................................. 221
Independent variables ....................................................................................................... 221
Control variables ............................................................................................................. 223
7.4 Analysis and Results ......................................................................................................... 224
7.5 Discussion ......................................................................................................................... 234
7.6 Implications and Future Research Directions ...................................................................... 240
7.7 Limitations and Conclusion .............................................................................................. 241
7.8 References ......................................................................................................................... 243

CHAPTER 8: Overall Conclusion and Future Research ........................................................... 251
Abstract ................................................................................................................................... 251
8.1 Overall Implications of the Core Papers’ Findings on Collaboration Research.............. 252
8.1.1 A Multi-Attribute Conceptualization of Collaboration ..................................................... 252
8.1.2 Mediating and Moderating Linkages between Internal and External Collaboration Systems for Innovation Performance ........................................................................................................ 252
8.1.3 Different Configurations of Internal versus External Collaboration Systems ........ 253
8.1.4 Aligning Collaboration Systems across Different Forms of Innovation ....................... 254
8.1.5 Aligning Collaboration Systems for Successful Strategic Alliances ......................... 255
8.2 The Alignment of Internal and External Collaboration over Time .................................... 256
8.2.1 The Paradox of Dynamic Organizational Capabilities ................................................. 258
8.2.2 The Nature of Collaboration Systems: Addressing the Stability-Flexibility Paradox ................................................................. 260
8.2.2.1 Firm Internal Collaboration Systems: A ‘Dynamic’ Capability? ................................. 261
8.2.2.2 External Collaboration Systems – A Dynamic Capability? ....................................... 262
8.2.3 Managing Internal and External Collaboration through a ‘Dynamic Mutual Feedback System’ ............................................................................................................................. 263
8.2.4 Properties of a ‘Dynamic Mutual Feedback System’ ..................................................... 265
8.3 Planned Future Research ................................................................. 266
8.4 Concluding Remarks .................................................................. 268

APPENDICES ...................................................................................... 271

Appendix A: Table A1. All Studies (Core Paper 1) ....................... 271
Appendix B: Table B1. Collaborative Processes of Firm Collaboration (Core Paper 1) .... 273
Appendix B: Table B2. Collaborative Ownership of Firm (Core Paper 1) ........ 275
Appendix C. Figures 1a-1e Graphical Models comparing studies’ findings (Core Paper 1) ................................................................. 276
Appendix D. Questionnaire Items (Core Papers 2, 3, 4, and 5) .......... 278

Aggregated Reference List ................................................................. 279
CHAPTER 1: Introduction

Figure 1.1 Conceptual Framework of this Thesis ................................................................. 3
Figure 1.2 Core Paper 2 - Conceptual Model ................................................................. 7
Figure 1.3 Core Paper 3 - Conceptual Model ................................................................. 9
Figure 1.4 Core Paper 4 - Conceptual Model ................................................................. 10
Figure 1.5 Core Paper 5 - Conceptual Model ................................................................. 11

CHAPTER 2: Core Paper 1

Figure 2.1 Trends of Publications in last 25 years ......................................................... 27
Figure 2.2 Collaborative Process Attributes and Intensity Levels ................................. 32
Figure 2.3 Collaborative Ownership Attributes and Intensity Levels ............................. 33
Figure 2.4 Collaboration Studies and Performance Outcomes ......................................... 35

CHAPTER 3: Method

Figure 3.1 Overall Conceptual Model of Core Papers 2, 3, and 4 ................................. 71

CHAPTER 4: Core Paper 2

Figure 4.1 Conceptual Model .......................................................................................... 86
Figure 4.2 Summary of Results ..................................................................................... 105

CHAPTER 5: Core Paper 3

Figure 5.1 The Conceptual Model ................................................................................... 122
Figure 5.2 Two-Way Interaction between Internal Relationship Commitment and Mutual Trust ............................................................................................................... 138
Figure 5.3 Two-Way Interaction between External Mutual Communication and Mutual Trust ............................................................................................................... 139
Figure 5.4 Two-Way Interaction between External Relationship Commitment and Joint Engagement ........................................................................................................ 139
Figure 5.5 Summary of Key Findings of Core Papers 2 and 3....................................... 142

CHAPTER 6: Core Paper 4

Figure 6.1 Overall Conceptual Model for Core Papers 2, 3, and 4 ............................... 158
Figure 6.2 Interaction Effect between Internal and External Mutual Trust ................. 178
Figure 6.3 Interaction Effect between Internal and External Joint Engagement .......... 179
Figure 6.4 Summary of Main Findings of Core Papers 2, 3, and 4 .............................. 180

CHAPTER 7: Core Paper 5

Figure 7.1 The Conceptual Model ................................................................................... 206
Figure 7.2 Interaction Effects of Internal Mutual Communication in NSD versus NPD .... 229
Figure 7.3 Interaction Effects of External Joint Engagement in NSD versus NPD ......... 231
Figure 7.4 Interaction Effects of External Sharing Responsibilities in NSD versus NPD .... 232
Figure 7.5 Interaction Effects of External Relationship Commitment in NSD versus NPD ......................................................................................................................... 233
# List of Tables

**CHAPTER 1: Introduction**
- Table 1.1 Summary of Core Papers ...................................................................................... 15

**CHAPTER 2: Core Paper 1**
- Table 2.1 Sets of Collaborative Attributes............................................................................ 28

**CHAPTER 3: Method**
- Table 3.1 Data Collection for Pilot Study ........................................................................... 59
- Table 3.2 Main Data Collection ............................................................................................ 61
- Table 3.3 Operational Definition of New Product Development Performance ............... 64
- Table 3.4.1 Operational Definition of Internal Mutual Communication.......................... 65
- Table 3.4.2 Operational Definition of External Mutual Communication ......................... 66
- Table 3.5.1 Operational Definition of Internal Joint Engagement ...................................... 66
- Table 3.5.2 Operational Definition of External Joint Engagement ..................................... 66
- Table 3.6.1 Operational Definition of Internal Sharing Responsibilities .......................... 67
- Table 3.6.2 Operational Definition of External Sharing Responsibilities .......................... 67
- Table 3.7.1 Operational Definition of Internal Relationship Commitment ....................... 68
- Table 3.7.2 Operational Definition of External Relationship Commitment ...................... 68
- Table 3.8.1 Operational Definition of Internal Mutual Trust ............................................ 68
- Table 3.8.2 Operational Definition of External Mutual Trust ........................................... 69
- Table 3.9 Control Variables .................................................................................................. 69

**CHAPTER 4: Core Paper 2**
- Table 4.1 Descriptive Statistics and Pearson Correlation Matrix ....................................... 99
- Table 4.2 T-Test Statistics .................................................................................................. 100
- Table 4.3 Results of Canonical Correlation Analysis ....................................................... 102
- Table 4.4 Results of Hierarchical Regression .................................................................... 103

**CHAPTER 5: Core Paper 3**
- Table 5.1 Descriptive Statistics and Pearson Correlation Matrix ....................................... 135
- Table 5.2 Results of Hierarchical Regression .................................................................... 136

**CHAPTER 6: Core Paper 4**
- Table 6.1 Descriptive Statistics and Pearson Correlation Matrix ....................................... 174
- Table 6.2 Results of Hierarchical Regression .................................................................... 175

**CHAPTER 7: Core Paper 5**
- Table 7.1 Descriptive Statistics and Pearson Correlation Matrix ....................................... 225
- Table 7.2 T-Test Statistics ................................................................................................. 226
- Table 7.3 Results of Hierarchical Regression .................................................................... 227
- Table 7.4 Summary of Results against Hypotheses ......................................................... 234
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Statement of Contributions by Others

Two refereed conference papers, which present amended versions of core papers 2 and a related version of core paper 5, were co-authored with Professor Arthur Shulman. The candidate was the principal author of these papers (responsible for the intellectual content and the majority of writing of the text). Professor Shulman provided advisory assistance in formulating the propositions and in editing the final submissions of these papers. The papers were produced under supervision and during the period of candidature.

List of Publications

Refereed conference papers:


Papers under review:


Additional publications by the candidate during her candidature, which do not form part of this thesis:


CHAPTER 1

Introduction

1.1 Setting the Stage

The theme of collaboration is at the centre of theories of the firm (Eisenhardt & Martin, 2000; Grant, 1996) and is also highlighted in recent depictions of our current era as one of open innovation (Chesbrough, 2003). Collaboration has been argued by some to hold the key for firms seeking to gain or maintain a competitive advantage (Hansen & Nohria, 2004). It has also been described by others as a ‘meta-capability’ in that it encompasses skills and knowledge that build the foundation of capability-building itself (Liedtka, 1996). Within the firm, collaboration is necessary to create and maintain linkages between otherwise specialized activities in order to produce complex outcomes such as products and services (Griffin & Hauser, 1996; Gupta, Tesluk, & Taylor, 2007; Kahn, 2005). At the same time, speed to market (Rothaermel & Deeds, 2004), technological complexity (Tiwana, 2008), and risk sharing (Doz, 1996) have increased to make inter-firm collaboration a strategic imperative.

Both research streams, collaboration within the firm (internal collaboration) and between firms (external collaboration) have received much attention in a variety of research domains in the last 25 years. However, these streams have remained fairly disconnected and the possibility of exchanges among internal and external collaboration have been largely untouched. This is surprising considering that throughout its life, it is most likely that firms engage in many different forms of collaborative activity within and also with other firms (Barki & Pinsonneault, 2005). In fact, the majority of today’s product and service innovations require a firm to take on collaborative activity within the firm and simultaneously collaborate with entities outside the firm (Hillebrand &
In many circumstances, this requires firms to align their internal collaborative activities with their external collaborative activities. However, with a few notable exceptions (Hillebrand & Biemans, 2004; Sanders & Premus, 2005; Stank et al., 2001; Takeishi, 2001), there is little discussion in the existing literature about such alignments and their influence on the innovative performance of firms. Therefore, considering the importance of innovation, understanding how internal and external collaboration activities align becomes the overall research question of this thesis:

*How do internal and external collaborative activities align to improve innovative performance?*

Within the thesis, I specifically look at new product and service development as forms of innovation. Alignment in this thesis is foremost concerned with how the configurations within and possible interactions between internal and external collaboration affect one another and ultimately impact on their relationship with innovation performance.

**1.2 Theoretical Background**

Figure 1.1 sketches the conceptual framework of interest. In this section, I outline the key variables of interest and the core hypotheses being proposed. I also highlight the relevance of the research question to both theory and practice.
1.2.1 Internal Collaboration

From the inception of the resource-based view of the firm (Penrose, 1959), researchers have explored and outlined the importance of collaboration within the firm for its long-term survival (Barney, 1991, 1997). In fact, as a form of economic organization, the distinctive feature of firms may lie in their ability to co-habit and integrate specialized activities such as R&D, marketing, manufacturing, or even strategy with operations (Grant, 1996).

Collaboration within the firm has been broadly referred to as how different departments, functional units, and/or subunits within a firm work together and how intensive their joint activities are (Barki & Pinsonneault, 2005; Frishammar & Hoerte, 2005; Gupta & Govindarajan, 2000). Theoretically, the theme of collaboration within the firm is being treated as important, as a growing number of organizational frameworks and models embrace firm internal collaboration as a key element impacting on success (Grant, 1996; Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece, & Winter, 2007). Furthermore, empirical studies have found that internal collaborations are central particularly to new product and/or service development and help to create the efficiencies in operating activities that underpin timely and cost-effective new product and/or service development (Barki & Pinsonneault, 2005; Frishammar & Hoerte, 2005; Kahn, 2005).
1.2.2 External Collaboration

The importance of inter-firm relations go as far back as Adam Smith’s theory (1776) where he theorized about the division of labour between firms for production efficiencies. Subsequently, inter-firm collaboration (external collaboration) has been a central focus of numerous research domains including economic (Coase, 1937), strategic (Gulati, Nohria, & Zaheer, 2000; Pfeffer & Salancik, 1978), and sociology-based theories (Burt, 1992; Granovetter, 1973). External collaboration has been broadly defined as relationships between separate organizations (Ahuja, 2000; Gulati, 1998; Teece, 1992). It may vary in the intensity of exchange between participants from simple licensing arrangements to ongoing co-development relationships and joint ventures (Osborn and Hagedoorn, 1997).

The decision to collaborate with other firms appears to be driven by more than one need. Previous research has identified such needs as: Access to complementary resources and capabilities (Eisenhardt & Schoonhoven, 1996); the need for cost minimization through transaction efficient governance arrangements (Williamson, 1991) and the need to manage environmental uncertainty and risk as asserted by resource dependence theories (Pfeffer & Salancik, 1978). In order for external collaboration to occur, however, such needs must be combined with opportunities for collaboration (Ahuja, 2000).

1.2.3 Collaboration – a Multi-Attribute System

In its most general definition, collaboration can be understood as two or more parties working together toward common goals (Simpson & Weiner, 1989). In both internal and external collaboration, this working together can comprise multiple attributes (Barki & Pinsonneault, 2005; Frishammar & Hoerte, 2005). In a literature review for this thesis of over 100 studies (core paper 1), I find that a majority of these attributes include (1)
mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust.

Thus, in any one collaboration, whether within or between firms, different intensity configurations of these attributes may result. Therefore, I call any particular configuration of these attributes a ‘collaboration system’. The term ‘system’ recognises that each attribute is a distinct entity, yet when coordinated with the others, it results in a particular configuration of collaboration. The notion of ‘collaboration system’ thus becomes a way to explore alignment between internal and external collaborative activities.

1.2.4 The Possibility of Alignment

The importance of the need for conjointly managing internal and external collaboration has been raised by some (Barki & Pinsonneault, 2005; Barratt, 2004; Hillebrand & Biemans, 2004; Sanders & Premus, 2005; Stank et al., 2001). However, most of the existing work has merely suggested possible arrangements between internal and external collaboration without empirically testing their nature and impact. Exceptions to this are few (Sanders & Premus, 2005; Stank et al., 2001). The findings of these two studies by Stank et al. (2001) and Sanders and Premus (2005) are, however, merely a starting point, given a number of differences between them and the focus of inquiry in this thesis.

For instance, respondents in both studies (Sanders & Premus, 2005; Stank et al., 2001) were not asked to focus on any particular context or relationship, but on ongoing supply chain relationships in general. Their choice of measurements of collaboration composed different items attributable to internal versus external collaboration and both studies differed on these items. Also, because both studies tested only composite measures of a limited set of processes, they did not include relational/behavioural
attributes - such as relationship commitment and mutual trust- that other studies have frequently attributed to collaborative activity (Frishammar & Hoerte, 2005; Hoegl, Weinkauf, & Gmuenden, 2004; Liedtka, 1996; Spekman et al., 1998).

1.3 Thesis Contributions

The contributions of this thesis to the research question and the theoretical framework are developed in a series of five inter-linked core papers. Table 1.1 shows the research question of each core paper, a brief description and how the paper relates to the overall thesis topic. The various papers make both a distinct, as well as integrated contribution to the overall research question. This paper-based format has been preferred as it allows for the clear delineation and exploration of a series of sub-questions to the main research question. Using Table 1.1 as a platform, I will now outline in more detail the scope and contribution of each core paper to the overall thesis topic.

1.3.1 Core Paper 1

The objective of core paper 1 is to review conceptualizations of both collaboration within the firm (internal collaboration) and inter-firm collaboration (external collaboration). Based on a literature review of 119 studies, a multi-attribute conception of collaboration emerges. These attributes include (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. This forms the basis for my conception of a collaboration system. The latter is then used in subsequent papers to empirically test various hypotheses relating to and stemming from the theoretical framework presented in Figure 1.1.
1.3.2 Core Paper 2

It is possible that the ways two collaborating firms engage along the five attributes that define collaboration can affect the ability of the collaboration to meet its stated objectives. According to most previous studies, collaborative new product development is one such scenario where increases in mutual communication, joint engagement, sharing responsibilities, relationship commitment, and increases in mutual trust lead to improved performance. In core paper 2, I build on two previous studies (Sanders & Premus, 2005; Stank et al., 2001), which examined the combined impact internal and external collaboration for logistics performance. In both studies, the researchers propose, and their findings confirm that internal collaboration mediates the impact external collaboration has on performance outcomes. Thus, the central focus of core paper 2 is to investigate this possibility of mediation in the context of innovation.

Figure 1.2 below captures the theoretical framework. Using paired sample t-tests, canonical correlations, and hierarchical regression analysis of data from 134 strategic alliances, I find broad support for a mediating relationship of focal firms’ internal collaboration on their external collaboration systems. This means that the ways firms align their internal collaboration systems affect the relationship between external collaboration systems and new product development performance. The evidence also supports the contention that the mediation effect of internal collaboration on external collaboration matters more than the effect of external collaboration alone.

**Figure 1.2 Core Paper 2 – Conceptual Model**
1.3.3 Core Paper 3

Building on the findings of the five collaboration system attributes from core paper 2, the aim of core paper 3 (Chapter 5) is to investigate the predictive power of the configurations of attributes of internal collaboration systems and the configurations of attributes of external collaboration systems on new product development. Figure 1.3 below illustrates the conceptual framework of this paper. Using hierarchical regression analysis of data from 134 dual partner strategic alliances, I find that significant, positive interactions amongst external collaboration system attributes account for innovation performance, albeit being mediated by their internal collaboration systems (core paper 2). The positively reinforcing relationships that external collaboration systems attributes share account for different value than the additive contributions of internal collaboration system attributes.

The findings thus add insights into the different nature of internal versus external collaboration systems and provide initial suggestions for differentiating internal and external collaboration systems in terms of their degree of modularity.
1.3.4 Core Paper 4

Building upon the patterns found in core papers 2 and 3, in core paper 4 (Chapter 6), I raise the possibility that each of the internal collaboration system attributes determines the strength and direction of the relationship of ‘like’ external collaboration system attributes and new product development performance. For instance, it may be possible that the ways collaborating units within the focal firm mutually communicate, directly affect the ways they communicate with the partnering firm and thus influences the impact mutual communication with the partnering has on innovation performance.
I test this possibility on data from 134 strategic innovation alliances. The relationships tested are depicted in Figure 1.4 below. The findings broadly confirm a moderation mechanism of internal on external collaboration system attributes in terms of joint engagement and mutual trust. This means that the ways functional units within the focal firm engage with one another and trust one another affects the impact of the engagement and trust they share with the partnering firm, but in different ways.

Therefore, a focal firm’s internal collaboration system (in form of the five system attributes) largely mediates (core paper 2) and also moderates (core paper 4) the relationship its external collaboration system has with new product development performance. The uncovering of complex, value-adding relationships between (core papers 2 and 4) and within both collaboration systems (core paper 3) for innovation raise major theoretical issues and add practical contributions to collaboration theory, strategic alliance and new product development theories and practice, and wider strategic theory development.

**Figure 1.4 Core Paper 4 – Conceptual Model**
1.3.5 Core Paper 5

In core paper 5 (Chapter 7), I aim at advancing the current understanding of how focal firms’ internal and external collaboration systems are predictors of performance when the innovative context is based around a new service development (NSD) versus when the context is a new product development (NPD). The theoretical framework for this paper is illustrated in Figure 1.5 below. I use hierarchical regression analysis on data from 100 new product development alliances and 34 new service alliances to advance my inquiry.

The findings suggest that focal firms’ internal collaboration systems (in terms of the intensity of each of the attributes) look and impact in a similar way, independently of whether a new service or a new product is being developed. However, in the examination of NSD versus NPD, focal firms’ external collaboration systems reveal significantly different levels of intensity along a majority of collaboration system attributes and their relationship with innovation performance. These findings provide a basis for advancing our understanding of the different nature of internal versus external collaboration systems for different types of innovations.

Figure 1.5 Core Paper 5 - Conceptual Model

1.3.6 An Integrated Picture: Chapter 8

Taking the findings of core papers 2 to 5 into consideration, it is likely that the ways functional units communicate, engage within one another, share responsibilities, commit, and trust one another, are independently and differently related to innovation
success. In their product or service development collaborative relationship with the partnering firm, however, mutual communication, engagement, sharing responsibilities, relationship commitments, and trust look and impact on innovation performance rather differently. Specifically, the influence of external collaboration occurs through the synergistic relationships among the attributes (core paper 3) and is mediated (core paper 2) and moderated (core paper 4) by the ways the units collaborate within the firm.

In the concluding chapter of this thesis (Chapter 8), I first integrate the findings of the five preceding core papers into a number of key implications for research on collaboration. I then shift away from the implications of an alignment of internal and external collaboration for a particular new product or service development to suggestions for further research that focuses on their alignment over time. I raise the possibility of a ‘stability-flexibility paradox’. This paradox highlights the challenges of managing the relatively stable internal collaboration systems in the much more dynamic external collaborative environment. I use and expand upon current dynamic capability theory to address this paradox. Lastly, I identify future planned research and provide concluding remarks.

1.4 A Roadmap of this Thesis

The order of the core papers reflects the incremental growth in my journey researching the issue of how firms align their internal and external collaboration systems for improving new product and service development performance. As an incremental advance, each of the papers builds upon those proceeding to reflect new ideas and solutions to conceptual and empirical problems encountered through discussions with colleagues and feedback gained from conference review processes. Within each paper, as well as in the discussion section of the thesis (Chapter 8), I provide implications of
the developments for theory and practice. Table 1.1 summarizes the focus and order of the five core chapters including the discussion and conclusion chapter.

Following the art of journal article writing, each of the five core papers as well as the Discussion and Conclusion Chapters retain the writing and reference style of academic journals. The particular journal destinations are indicated in a preface occurring before each core paper. Some of the academic journals, for which the papers are intended to be submitted, adopt a different writing and reference style. However, in order to remain consistency throughout the thesis, these styles were standardized to that of the Academy of Management Journal. All chapters adopt the conventional numbering format for headings. References used in the thesis are located in two places. First, resembling the journal-article design of the core papers, references occur at the end of each chapter. Additionally, I have aggregated all references in a final section at the back of the thesis. References for the ‘Introduction’, ‘Overall Method’ and ‘Conclusion and Future Research’ chapters can be found in this aggregated Reference section. The aggregated reference section also adopts the referencing style of the Academy of Management Journal.

The thesis adopts the first person based on this being accepted practice within the Academy of Management Journal. Some core papers reflect the collaborative work of a second author. However, in the section titled: ‘Statement of Originality’ the co-investigator has declared that his contributions do not reduce the contribution of the principle author in a manner inconsistent with thesis submission and examination guidelines.

Following this Introduction section (Chapter 1), Chapter 2 presents an analysis, in which I examine the diverse ways with which researchers have understood and conceptualized firm collaboration. Following this analysis is Chapter 3, which has embedded the methods used in the Chapters 4 to 7 (core papers 2 to 5). The four
empirical papers, based on the survey study are then presented (Chapter 4 to 7). They are linked via prefaces that aim at describing the logic advanced in each paper in relation to the previous paper and the overall inquiries of the thesis. Chapter 8 is conceptual in nature. It integrates in its discussion all the main findings of the preceding core papers 1 to 5. It also links collaboration to dynamic capability theory and outlines a structured linkage idea to align collaboration systems for long-term firm performance. Lastly, Chapter 8 concludes with a considerable effort in outlining a planned future research agenda.
<table>
<thead>
<tr>
<th>PAPER TITLE</th>
<th>RESEARCH QUESTIONS</th>
<th>DESCRIPTION</th>
<th>RELATES TO CORE THESIS ISSUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORE PAPER 1 How Researchers Study Firm Collaboration Matters - A Meta-</td>
<td>How have researchers conceptualized and measured collaboration?</td>
<td>Theoretical paper. I conduct an analysis of 119 studies published between 1982 and 2007 that examined</td>
<td>In order to be able to empirically address the core thesis issue about the alignment of a firm’s internal and external collaboration systems, this review of the literature forms the basis for my conception of a collaboration system.</td>
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<tr>
<td>Analysis</td>
<td></td>
<td>collaboration. The goal of the analysis is to provide a clearer picture of the ways researchers understand and define collaboration at the level of the firm.</td>
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<tr>
<td>CORE PAPER 2 The mediating influence of internal collaboration on the</td>
<td>Does a firm’s internal collaboration system mediate the effect of its external</td>
<td>Empirical paper. I test, via survey data of 134 dual partner strategic alliances whether and if so</td>
<td>A mediation mechanism as proposed means that the relationship between internal and external collaboration matters more for innovation success than the effect of external collaboration alone.</td>
</tr>
<tr>
<td>contributions of alliances to new product development success</td>
<td>collaboration system?</td>
<td>how the intensity of a focal firm’s internal collaboration system acts as a mediating mechanism</td>
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<td></td>
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<td>on the firm’s external collaboration system in new product development alliances.</td>
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<tr>
<td>CORE PAPER 3 Value-adding configurations of collaboration systems</td>
<td>How should a focal firm configure its internal and external collaboration systems?</td>
<td>Empirical paper. As I have defined collaboration both within and between the focal and partnering</td>
<td>This paper allows insights into the different, value-adding configurations of a focal firm’s internal versus its external collaboration systems and thus offers another insight into their different alignments for new product development success.</td>
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<td>firm as two systems, in this study, I examine the configurations among the attributes within each</td>
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<td>system for new product development performance in 134 dual partner alliances.</td>
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<td>CORE PAPER 4 Best-performing combinations of firm internal and external</td>
<td>Does internal collaboration moderate the effect of external collaboration?</td>
<td>Empirical paper. I examine the confluence of internal and external collaboration systems along the</td>
<td>This paper provides insights into the interactions across a firm’s internal and external collaboration systems for new product development success and thus adds to the overall research question about the nature and impact of their alignment.</td>
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<td>collaboration</td>
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<td>same internal and external attributes. Their confluence can be additive or multiplicative in</td>
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<td>nature. I utilize the empirical data of 134 dual partner strategic alliances.</td>
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<td>CORE PAPER 5 Comparing value-adding collaboration systems in NSD versus</td>
<td>How does a focal firm align internal and external collaboration in NSD versus NPD?</td>
<td>Empirical paper. I explore how a firm aligns its internal and external collaboration systems in</td>
<td>This paper adds valuable knowledge to the overall core thesis issue as it explores how internal and external collaboration systems are predictors of performance for new services versus new product developments.</td>
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<td>NPD</td>
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<td>new service development versus new product development. I utilize survey data collected from 100</td>
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<td>dual partner product innovation and 34 service innovation alliances.</td>
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<tr>
<td>CONCLUSION AND FUTURE RESEARCH Addressing the stability-flexibility</td>
<td>How can firms align internal and external collaboration systems for performance over</td>
<td>Theoretical paper. I summarize the findings of core papers 1 to 5. I raise the possibility of a</td>
<td>I firstly summarize key contributions of the five core papers. I move away from the study of alignment of collaboration systems at a specific point in time to the inquiry of aligning internal and external collaboration systems over time. I raise the possibility of a stability-flexibility paradox of internal collaboration systems and address this paradox with a system-linking tool.</td>
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<td>paradox</td>
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<td>‘stability-flexibility’ paradox of internal collaboration systems. I address this paradox by</td>
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How Researchers Study Collaboration Matters –

An Analysis on the Differences of Internal and External Collaboration

Preface

The first core paper is a review and interpretation of existing literature on collaboration. The aim of this paper is (1) to provide a clearer picture of the different ways researchers portray and define collaboration within the firm (internal collaboration) and collaboration between firms (external collaboration) and (2) to examine how these different definitions of collaboration are linked with measures of performance. The ways previous studies have conceptualized collaboration are intended to lay the platform for a definition of collaboration for the subsequent four empirical core papers.

An amended version of this paper has been presented as a full paper presentation at the Academy of Management Annual Meeting, Philadelphia/U.S. in 2007. This amended version is currently under review at the ‘International Journal of Management Reviews’.
How Researchers Study Collaboration Matters –
An Analysis on the Differences of Internal and External Collaboration

Abstract
I conducted an analysis of 119 studies published between 1982 and 2007 that examined collaboration. The goals of the analysis were (1) to provide a clearer picture of the diverse ways researchers understand and conceptualize collaboration within the firm (internal collaboration) and collaboration between firms (external collaboration) and (2) to examine how these different conceptualizations of collaboration are linked with performance. The studies were classified according to five collaborative attributes that were grouped into two sets (a) collaborative processes and (b) the state of collaborative ownership. Each collaborative attribute was further categorized according to different intensity levels. I find that most studies examine collaboration along both sets of collaborative attributes and at similar intensity levels, with some notable exceptions. I further find that researchers’ reporting of performance is related to the location of collaboration (within or between separate entities) and intensity levels on both sets of collaborative attributes. External collaboration, although more often described at a lower intensity than internal collaboration, is associated more frequently with positive measures of performance outcomes than internal collaboration. I provide a number of interpretations of the patterns found and give directions for future research.
2.1 Introduction

In today’s economies, exploiting collaborative possibilities has been identified as a key for firms seeking to gain or maintain leads over their competitors (Hansen and Nohria, 2004, p. 30). In the last 25 years, within the firm, studies have focused their attention on who should interact with whom, how often and through which processes, mechanisms, and how firms should arrange their internal structures to maximize collaboration among different members and/or parts of a firm (Barki and Pinsonneault, 2005, Glouberman and Mintzberg, 2001, Griffin and Hauser, 1992, Gupta, Raj, and Wilemon, 1985, Souder, 1988, Stank, Daugherty, and Ellinger, 1999). Collaboration, however, has not been limited to firm internal discussion. Researchers and practitioners have recognized that innovation breakthroughs are so broadly distributed that no single firm has all the internal capabilities to succeed (Powell, Koput, and Smith-Doerr, 1996) and firms need to source resources and capabilities from ‘outsiders’ (Hillebrand and Biemans, 2004, Prahalad and Ramaswamy, 2004, Rothaermel and Deeds, 2004, Sveiby, 2001, Takeishi, 2001). Collaborative relationships with external entities have therefore become a critical means of adding on to existing corporate strengths and covering weaknesses (Dyer and Singh, 1998, Lane and Lubatkin, 1998, Simonin, 1997, Teece, Pisano, and Schuen, 1997).

Despite the increased recognition of the importance of collaboration within and between firms, little is known about the similarities and differences between them. That is, with some notable exceptions (Barki and Pinsonneault, 2005, Hillebrand and Biemans, 2004, Sanders and Premus, 2005, Stank, Keller, and Daugherty, 2001, Sveiby, 2001, Takeishi, 2001, Truman, 2000), collaboration within the firm (internal collaboration) has been examined separately from collaboration between firms (external collaboration). It remains unclear, if this tendency to study each separately reflects that they are different in their composition. Furthermore, it is uncertain, how differences in
the conceptualization and operationalization of internal and external collaboration impact on the ways they have been linked to performance.

2.1.1 Why is this research important?

Although the 119 collaboration studies that were selected for review are situated in different domains and are associated with a variety of theoretical frameworks, they all reinforce the significance of collaboration. Despite its widespread importance, there does not appear to be a coherent, accumulative advancement in the existing literature about the concept and role collaboration plays according to whether collaboration is examined within or between firms. This paper attempts to advance the current understanding of collaboration by systematically drawing out the similarities and differences in the ways that researchers have investigated internal and external collaboration in their publications between 1982 and 2007.

This paper makes several contributions to the current body of collaboration literature and other domains concerned with collaboration:

1. It provides a clearer picture of the conceptualizations collaboration studies use to define internal and/or external collaboration

2. It identifies collaboration studies according to the theoretical framework scholars use to explain internal and/or external collaboration

3. It reports collaboration studies according to the content of their examinations on internal and/or external collaboration and proposes a categorization for the collaboration attributes

4. It sheds light on collaboration studies in terms of whether and if so how they associate internal and/or external collaboration with different measures of performance
The rest of this paper is structured into four major parts. The first part briefly introduces the methodology used to categorize the different ways with which researchers define collaboration. The second part examines the conceptualizations, frameworks used, times of publications and content of collaboration studies. Furthermore, it explores the studies according to their investigations of collaboration and reported associations with performance. The third part of the paper discusses the study’s reported findings, and the last part provides future research directions.

2.2 Research approach

To gain insight into the different ways scholars have described collaboration both within and between different firms, I conducted a literature search. Consistent with prior content methodologies (Knoben and Oerlemans, 2006), scholarly articles were chosen using a keyword search in a number of major library search engines (including Proquest, Blackwell Synergy, Emerald, Informit, JSTOR, Science Direct, and SMEAL Search). The search was limited to research articles published in the last 25 years – only those published between 1st of January 1982 and 31st of December 2007 were selected. All research articles, which explored internal and/or external relationships and activities using terms such as “collaboration”, “inter-unit/cross-departmental” and/or “inter-firm” “interaction”, “integration”, “coordination”, “cooperation”, “knowledge transfer”, and/or “ongoing communication” within and/or between firms were examined by myself and subsequently reviewed by a second coder to see, if collaboration (or defined as one of the other terms above) was discussed. To identify additional studies, the reference section of each article was also examined. Studies were selected independently of their research backgrounds, research approach, and whether they explored collaboration within and/or between separate entities. Only studies that contained information on collaboration were included. Those that mention collaboration
as a passing point only were not included. The search yielded 119 studies from peer-reviewed research journals (see table A1, Appendix A1). Of these, 50 studies exclusively explored collaboration within a firm, 51 studies focused on collaboration between firms only, and 18 studies investigated both internal and external collaboration within the same study.

### 2.2.1 Conceptualizations of Collaboration

An initial analysis of the 119 studies leads to the assumption that collaboration, in general, has been used, together with a number of other terms, as an umbrella term to portray the nature and management of different activities and relationship ties among collaboration partners within and/or between different entities. Authors in several domains, such as product/service innovation, strategy, management, production/logistics, and information systems attached different labels such as ‘interaction’ (Ghoshal and Bartlett, 1990, Souder, 1988), ‘integration’ (Barki and Pinsonneault, 2005, Glouberman and Mintzberg, 2001, Gupta et al., 1985, Gupta and Wilemon, 1988, Petersen, Handfield, and Ragatz, 2003, Truman, 2000), ‘cooperation’ (Goh, 2002, Griffin and Hauser, 1996, Hillebrand and Biemans, 2004, Li, 2005), ‘coordination’ (Hoegl, Weinkauf, and Gmuenden, 2004, Kogut and Zander, 1996, Tsai, 2002), and ‘collaboration’ (Ahuja, 2000b, Barratt, 2004, Horvath, 2001, Jassawalla and Sashittal, 1998, Knoben and Oerlemans, 2006, Powell et al., 1996, Stank et al., 2001, Von Stamm, 2004) when describing similarly extensive relationship ties and activities within a firm and/or between firms. With this, some researchers referred interchangeably to cooperation, integration, and collaboration (De Luca and Kwaku, 2007, Takeishi, 2001) and it was even suggested that “cooperation within and between firms is identical to collaboration and integration” (Hillebrand and Biemans, 2004: 111).

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1 Appendix A for this paper is located on page 271 at the end of this thesis.
Other scholars defined the above-listed terms as different linkage processes and activities and attributed different, sometimes contradictory, properties to each term. The following comparisons are used to illustrate the inconsistencies and ambiguities in the use of key terms such as interaction, integration and collaboration. In internal collaboration studies, for example, Kahn (1996) defined well structured and coordinated activities between different functional units within a firm as inter-unit ‘interactions’. Other researchers (Gupta et al., 1985, Gupta and Wilemon, 1988, Kim, Park, and Prescott, 2003, Maltz, Souder, and Kumar, 2001) called the same activities inter-unit ‘integration’. Further, while Glouberman and Mintzberg (2001) described integration as the coordination of activities or the management of the dependencies between them, Kahn (1996: 139) defined integration as more than coordinated activities; he proposed that it is a multi-dimensional, synergistic activity that “is a composite process comprizing interdepartmental interaction and interdepartmental collaboration”.

Other scholars also suggested that interaction and collaboration together build and maintain successful inter-unit integration (Frishammar and Hoerte, 2005). In the same way, Barki and Pinsonneault (2005: 177), who examined both internal and external collaboration, argued that “integrated processes require the close collaboration of individuals”. Other scholars in the strategic alliance literature also suggested that integration entails collaborative dimensions (Stank et al., 2001). A number of researchers of internal collaboration studies argued differently again and recommended interaction to be a subset of integration and integration to be a subset of collaboration (Frishammar and Hoerte, 2005, Jassawalla and Sashittal, 1998, Kahn, 1996). They suggested that while interaction and integration represent more structured activities, collaboration is more affective in nature. It resembles continuous relationships between parties, rather than timely-limited transactions or restricted operational information exchange via interaction or integration.
In brief, although there is a large amount of internal and external collaboration literature that has examined ‘collaborative’ relationships, there is no common conceptualization of the term internal collaboration or external collaboration, as almost every study seems to have a different perspective on the subject matter. This leads to the conclusion that collaboration, as used by researchers, is a rather subjective term that resembles a rich, multi-faceted and complex phenomenon. In order to better understand this phenomenon, I examined each of the 51 internal collaboration studies, 50 external collaboration studies, and 18 studies that looked at both internal and external collaboration in terms of theoretical frameworks used, content (attributes) of collaboration, and time of publication.

2.2.2 Underlying Theoretical Models of Collaboration Studies


Other theoretical frameworks, however, were used exclusively for depicting internal collaborative relationships, such as sociology perspective (Bresnen, Edelman, Swan, Laurent, Scarbrough, and Newell, 2002, Granovetter, 1983, Ruekert and Walker, 1987, Thiem, Song, and Geon-Cheol, 2003), agency theory (Bjoerkman, Barner-Rassmusen, and Li, 2004), and activity theory (Brady, Marshall, Prencipe, and Tell, 2002). A number of other theoretical frameworks were also applied solely to describe external collaborative relationships such as the strategic management framework (Appleyard, 1996, Darr and Kurtzberg, 2000, Gulati et al., 2000), transaction cost theory (Dyer, 1996, Hoyt and Huq, 2000, Subramani, 2004), and strategic alliance view (Deeds and

In summary, internal and external collaboration have been partly explained using the same theoretical frameworks (i.e. social network theory, resource-based view, and dynamic capability perspective) and partly with different frameworks (i.e. transaction cost theory, agency-, and activity theory). This leads to conclude that, in terms of theoretical frameworks, there are no shared visions on the differences or apparent similarities of internal versus external collaboration. In order to help understand the choice of conceptual framework, I next explored whether the variance of frameworks could be explained by the time the studies were published, acknowledging the possibility that the similarities and differences might be simply a choice of ‘flavor of the month’. Therefore, in what follows, I examine whether different time periods of publication reveal a noticeable similar or different trend for internal and/or external collaboration studies.

2.2.3 Time of Publication

All 119 studies were assigned to three approximately even time periods in which the articles were published (1982-1991, 1992-2000, and 2001-2007). The location of where collaboration was examined in the studies revealed a significant difference in the three assigned periods ($x^2 = 14.1$, df = 4, $p < .01$, 2-tailed). The patterns are illustrated in Figure 2.1. In the period of 1982-1991, there were only a small number of studies on internal collaboration or external collaboration, with a majority of these studies focusing on internal collaboration only. In the period of 1992-2000, there was a general raise in the number of collaboration studies published in the sample. The largest increase in the number of external collaboration studies occurred in the 1990’s. In most recent years (2001-2007), the overall number of collaboration studies in the sample has risen again
since the 1990’s. In these last years, there is especially a large increase in the number of studies that examined both internal and external collaboration within the same study.

**Figure 2.1 Trends of Publications in the last 25 Years**

The relatively recent increase of studies that examined internal and external collaboration within the same study perhaps reflects a more sophisticated recognition of the co-existence of internal and external collaboration. This supposition leads me to use another set of tools to account for the similarities and differences between internal and external collaboration as studied by researchers. Therefore, in the following section, all studies are examined according to how researchers described the content (attributes) of collaboration. This examination enables a further estimation whether the attributes attached to collaboration are consistent across locations of where it is observed.

### 2.2.4 Content of Collaboration - Collaborative Attributes

I examined a sub-sample of 60 out of the 119 studies for the content used by their authors to describe collaboration. A composite list of attributes, researchers used to explain collaboration, was developed and the attributes were sorted for similarity and frequency. This sorting was repeated until an overall pattern of five attributes emerged that was stable and parsimonious. I was able to place these five attributes into two
macro sets, namely (1) collaborative processes and (2) state of collaborative ownership.

**Collaborative processes** were referred to as those mechanisms and processes that researchers frequently report in collaborative relationships within and/or between firms. These collaborative process attributes include: (1) Mutual communication, (2) joint engagement, and (3) sharing responsibilities for decisions and outcomes. The attributes belonging to the set of collaborative processes are listed by author and by location of collaboration in Table B1 (Appendix B²).

Attributes that represent the **state of collaborative ownership** were categorized as those describing how collaboration partners within and between firms are taking ownership of the collaboration: The collaborative ownership attributes include: (1) Relationship commitment and (2) mutual trust among collaborating parties. All attributes representing the state of collaborative ownership are listed in table B2 (Appendix B).

Following the development of this classification system in the sub-sample of 60 studies, I then applied it to the remaining 59 studies. Overall, 95 out 119 studies described collaboration with at least one attribute belonging to each of the two sets within the same study. A list of all attributes and their respective macro sets is provided in Table 2.1 below.

### Table 2.1 Sets of Collaborative Attributes³

<table>
<thead>
<tr>
<th>Collaborative attributes</th>
<th>Set of collaborative attributes</th>
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<tbody>
<tr>
<td>Mutual communication</td>
<td>Collaborative processes</td>
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<tr>
<td>Joint engagement</td>
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<tr>
<td>Sharing responsibilities</td>
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<tr>
<td>Relationship commitment</td>
<td>Collaborative ownership</td>
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<tr>
<td>Mutual trust</td>
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</tr>
</tbody>
</table>

Source: Developed for this research

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² Appendix B of this paper is located on page 273 (table B1) and page 275 (table B2) at the end of the thesis.

³ Originally, I classified collaboration into seven attributes. Due to their similar context, I was able to collapse two attributes into the remaining five collaborative attributes.
Although a majority of scholars have attached similar collaborative attributes to internal and external collaboration, it became clear that many studies examined collaborative process and ownership attributes at different intensity levels. Therefore, before making any pre-empting assumptions about the commonality of attributes attached, the studies were re-examined in terms of the intensity levels with which they observed collaboration.

### 2.2.5 Intensity Levels of Collaboration

In the internal collaboration literature, a number of researchers have suggested that certain collaborative attributes are inherent only in more intensive collaborative relationships, not in less intensive ties (Frishammar and Hoerte, 2005, Kahn, 1996). While interactions between different functional units can entail different types of information exchange, they argued, ‘true’ collaboration between units include common goals, mutual understanding, shared ideas and resources, teamwork, and a common vision. Similarly, Jassawalla and Sashital (1998) suggested that although high levels of integration bring about certain levels of trust and commitment among collaborating units within a firm, only high levels of collaboration entail high levels of relationship commitment, trust, mindfulness and at-stakeness.

In the external collaboration literature, some studies used the term collaboration for any form of external agreement with entities outside the firm, independently of their relationship intensity (Ahuja, 2000a, Ahuja, 2000b, Powell et al., 1996, Simonin, 1997). Other researchers, however, made a distinction between different intensity levels of inter-firm collaborative relationships. Jaspers and Van den Ende (2006: 824ff), for example, argued that differently intensive forms of inter-firm relationships represent different configurations that ‘integration’ can take, varying from arm’s length
relationships to full integration (equivalent to acquisition). Spekman et al. (1998) similarly presented a list of descriptors of inter-firm relationships that differ in terms of intensity levels from open market negotiations, cooperation, coordination, to collaboration. While open market negotiations at one end reflect solely price-based information exchange and adversarial relationships between collaboration partners, collaboration on the other end include high levels of collaborative processes and ownership attributes.

Other researchers, such as Ghoshal and Bartlett (1990), argued similarly to Spekman et al. (1998). By adjusting an earlier established typology by Warren (1967) of inter-firm relationships, they distinguish four ways in which firms interact with one another: Unitary, federative, coalitional, and social choice. Ghoshal and Bartlett (1990) suggested that only unitary interactions between collaboration partners are characterized by inclusive goals, joint decision-making, high collectivism, high commitment and trustworthiness. Federative relationships have only some, and coalitional no elements of joint goals, collective decision-making, and commitment and trust. They also advocated that collaboration within a firm generally varies in intensity between unitary and federative relationships.

In order to codify the intensity levels used by researchers, I took an approach similar to Spekman et al. (1998) and Ghoshal and Bartlett (1990). I labelled (1) exchange intensity levels among collaborators as those low in intensity of ownership and process attributes. (2) Integrative intensity levels were classified as those entailing moderate levels of intensity of collaborative processes and ownership attributes. (3) Synergistic intensity levels were categorized as those relationships that entailed highly intensive collaborative processes and ownership attributes.

2.2.5.1 Intensity Levels of Collaborative Process and Ownership Attributes
Each article was re-examined for the intensity levels that researchers used to portray collaborative process attributes and/or collaborative ownership attributes. Within each set, where different levels of intensity for collaborative attributes were referred to in the same study, the respective process and/or ownership set was classified under the higher intensity level of the attribute(s) belonging to that set. I was able to identify the levels of intensity of collaborative processes in 106 out of 119 studies. In the remaining 13 studies, it was not possible to obtain an indication of the intensity of collaborative processes and/or only ownership attributes. Also, I was able to classify the intensity level of collaborative ownership in 108 out of the 119 studies in the sample. In the remaining 11 studies, it was not possible to obtain an indication of the intensity of collaborative ownership and/or only process attributes were investigated.

The patterns suggest that while process and ownership attributes can be conceptually differentiated, 95 out of 119 studies (80%) include representative attributes of both sets. Furthermore, of these 95 studies, 71 studies (75%) appeared to use intensity descriptors that place both sets of attributes at the same level of intensity. Prior models by Jassawalla and Sashittal (1998) and Frishammar and Ake Hoerte (2005) have suggested that whilst collaborative processes can be at high levels of intensity, ownership attributes are not necessarily high. However, in situations where ownership attributes are at high intensity levels, collaborative processes are also expected to be at high levels. 82 out of the 95 studies (86%) suggested a pattern that does not contradict these models. The remaining 13 studies (14%), however, revealed a different pattern that is not consistent with the models. In these 13 studies, collaborative ownership attributes were at higher levels of intensity than collaborative processes. Implications of this observation are considered in the discussion section.

*Intensity levels of collaborative processes and location.* Taking into account the location of collaboration, I compared the intensity levels of collaborative processes
measured by internal collaboration studies, versus external collaboration studies, versus those that examined both internal and external collaboration. The patterns found are illustrated in Figure 2.2. A Pearson’s chi-square test suggests significant differences between the studies ($x^2 = 13.89$, df = 4, $p < .01$, 2-tailed). Studies that focused on external collaboration only were more likely to focus on lower intensity levels of collaborative attributes than those studies that examined internal collaboration only, or studies that explored both internal and external collaboration.

**Figure 2.2 Collaborative Process Attributes and Intensity Levels**

Intensity of collaborative ownership and location. The patterns of results for collaborative ownership attributes were similar to those observed for collaborative processes. The patterns found are depicted in Figure 2.3. Pearson’s chi-square test also revealed significant differences between the location of where collaboration has been studied ($x^2 = 18.65$, df = 4, $p \leq .001$, 2-tailed). Studies that solely examined internal collaboration were more likely to use descriptors of collaborative ownership attributes that reflect higher levels of intensity than studies that investigated external collaboration only. Studies, which explored internal and external collaboration within the same article, followed the patterns of internal collaboration studies.
In summary, whilst a majority of external collaboration studies examined collaborative processes and ownership attributes on an integrative intensity level and less on a lower (exchange) or higher (synergistic) intensity, internal collaboration studies and studies that explored both internal and external collaboration observed both sets of attributes mainly on integrative and synergistic levels of intensity and much less on low (exchange) intensity level. Therefore, although internal and external collaboration are similar in terms of the attributes researchers have attached to them, internal collaboration studies attached higher intensity levels to the collaboration under examination than did researchers of external collaboration studies.

Given the similarities in attributes and differences in intensity, the important question remains as to how researchers’ conceptualizations of internal and/or external collaboration are linked to the impact collaboration has on performance. Therefore, in what follows, I re-examined all studies according to whether internal versus external collaboration was (1) associated with measures of performance and where measured, (2) whether it was a predictor of performance outcomes.
2.2.6 The Association between Collaboration and Performance

The sample revealed 20 internal collaboration studies, 30 external collaboration studies, and five studies that explored both internal and external collaboration that reported a relationship between collaboration and measures of performance. The studies that reported a relationship with performance versus those that did not are illustrated in Tables B1 and B2 in Appendix B. However, most studies tested the relationship between collaboration with a variety of measures resembling new product, service, firm, market, financial, and/or project performance outcomes.

A Chi-square test revealed a significant statistical difference between the location where collaboration was studied and whether a relationship between collaboration and measures of performance was examined ($x^2 = 6.50$, df = 2, $p < .05$, 2-tailed). Specifically, external collaboration studies (30 out of 51 studies) were more likely than expected to examine the relationship between collaboration and different measures of performance compared to studies that examined internal collaboration only, which were less likely than anticipated to explore the relationship between collaboration and performance outcomes (20 out of 50 studies). Studies that explored both internal and external collaboration were less likely than expected to study the relationship between collaboration and performance (5 out of 18 studies).

Of the 55 studies that tested and reported a relationship between collaboration and measures of performance, 40 reported a ‘positive’ association with performance. No study reported a significantly negative relationship only and 15 studies found ‘mixed results’ between measures of collaboration and performance outcomes. Findings of studies were categorized under ‘mixed results’ where a combination of positive and negative and/or a null relationship were reported between the attributes and performance outcomes. Results of a Chi-square test revealed a significant difference between the patterns ($x^2 = 12.41$, df = 2, $p < .05$, 2-tailed). The trends found are
illustrated in Figure 2.4 below. The tendency to report only positive findings between collaboration and performance outcomes was pronounced more than expected in external collaboration studies compared to internal collaboration studies. Internal collaboration studies were more likely than expected to report mixed results. Only one out of the five studies that examined both internal and external collaboration revealed ‘mixed’ results with performance, while the other four revealed a positive relationship pattern.

**Figure 2.4 Collaboration Studies and Performance Outcomes**

An examination of the relationship between performance outcomes and the intensity level of collaborative attributes within each of the three types of studies (internal collaboration studies, external collaboration studies, studies that examined both) did not reveal any reliable statistical patterns. Also, the time period of publication and theoretical camps used in internal versus external collaboration studies revealed no relationship with whether performance was measured and performance outcomes. Given the variety of research designs used, the different measures of performance and the small sample size within each sub-sample, these null findings are not surprising.

In sum, the location of where collaboration was studied differed in terms of the association of collaboration and measures of performance. Specifically, studies that
investigated external collaborative relationships were more likely than expected to focus on performance compared to studies that examined internal collaboration only or those that investigated both. Further, a larger number than expected of external collaboration studies reported a positive relationship between collaboration and performance compared to internal collaboration studies, which reported more mixed- and less positive performance outcomes than anticipated. This opposing pattern is explained in the following discussion section.

2.3 Discussion

Although the significance of collaboration is well established in the theoretical literature and verified in the empirical literature, the findings of this analysis raise several new insights about how collaboration is understood and conceptualized. I found that most studies examined collaboration along similar intensity levels of both process and ownership attributes within the same study, which is in line with patterns suggested in prior models of collaboration by Frishammar and Hoerte (2005) and Jassawalla and Sashittal (1998). Researchers herewith argued that collaborating parties can have high levels of process attributes, but do not necessarily share high levels of ownership attributes. They further argued that high levels of ownership attributes are usually associated with high intensity levels of process attributes. In 82 studies, where high intensity levels of ownership attributes were observed, they were also associated with high intensity levels of process attributes.

In 13 studies of the sample, however, intensity levels of ownership attributes were higher than those described of process attributes. An explanation for this pattern could be related to what Anderson and Jap (2005) termed as the dark side of social ties. Relationships that are characterized by high levels of trust and commitment can resemble relationship ties among collaborators that linger in a relationship for the lack
of better alternatives and therefore do not necessarily include high intensity levels of collaborative processes among the collaborators (Poppo et al., 2008). A different interpretation for this pattern is associated with the level of independency among collaborators. Whilst collaborating parties within and/or between firms may trust one another and are highly committed to one another, they can still enjoy a high level of autonomy and therefore do not necessarily need to engage in high levels of information exchange and joint engagement with one another (Andersson et al., 2002, Granovetter, 1983, Minbaeva, Pedersen, Bjoerkman, Fey, and Park, 2003). However, further empirical research is needed to tease out, if either explanation is suitable to explain the patterns found.

The main insight about collaboration gained in this study is associated with three differences found between internal and external collaboration studies. The first difference is that despite the similarities in how researchers identify collaborative process and ownership attributes to describe internal and external collaboration, they generally indicated much higher intensity levels on both sets of collaborative attributes (collaborative processes and collaborative ownership) within the firm compared to when scholars looked at collaborative relationships between different firms. This may occur, not as a coding artefact, but because intensity levels are indeed higher in collaborative relationships within the firm. They are higher because of the path dependence of internal collaboration (Arthur, 1989).

That is, internal collaboration usually has past decisions and underlying patterns imprinted, which are relevant for its gestalt (Schreyoegg and Kliesch-Eberl, 2007). Collaborative relationships within the firm are believed to evolve over time and over multiple activities and agendas, as they integrate past experiences into complex routines by combining collective skills among different functional units and/or subunits (Zollo and Winter, 2002). Thus, this ‘excess baggage’ of the past and the gradual evolvement
of collaboration over time may largely determine why collaboration is more intensive within the firm than between firms.

The second difference between internal and external collaboration studies in the sample is that external collaboration studies were more likely than internal collaboration studies to focus on the relationship between collaboration and performance. This observed pattern is consistent with the ‘discriminating alignment hypothesis’ (Williamson, 1991) in that collaboration between different firms is examined primarily in terms of minimizing transaction costs and maximizing productivity. That is, external collaborative agreements between firms are usually reported as contracts, which are timely limited and include set agendas to reach specific objectives – usually to increase performance (Reuer and Arino, 2003). Scholars, who study internal collaboration, seemed much more concerned about increasing the intensity of collaboration itself as the ultimate objective. Therefore, researchers in internal collaboration studies generally examined collaboration as an ongoing process that needs constant refining, serves as a platform for future external collaboration, and therefore may not always have a specified, ultimate objective.

The third difference between internal and external collaboration studies is that although more often described at a lower intensity level than internal collaboration on both sets of collaborative attributes, external collaboration studies associate collaboration more frequently with positive performance outcomes than internal collaboration studies.

One out of four possible explanations for this pattern could be that external collaborative relationships are likely to be less constraint by dependent, intertwined, and emotionally laden relationships that often exist within the same firm (Gupta and Wilemon, 1990). For example, different functional units within a firm can be characterized by diversity in knowledge, perspectives, and backgrounds (Sherman,
Souder, and Jenssen, 2000). Empirical research has long stressed that disharmony between different functional units within a firm is the rule rather than the exception (Gupta et al., 1985, Souder, 1988). Therefore, it is believed that for different functional units and/or subunits to collaborate, it depends largely on the perception of the quality of information, qualifications, and behavioural characteristics that managers hold for one another (Gupta and Wilemon, 1988, Maltz et al., 2001, Monteiro, Arvidsson, and Birkenshaw, 2008).

A second possible explanation is in line with scholars of the social network literature. They stressed that relationships, which are low in intensity are less likely to provide redundant information and lead to more efficient interactions (Granovetter, 1973; Burt, 1992; Gulati et al., 2000). Their arguments rested on the premise that the costs to build and maintain direct relationship ties may outweigh the benefits of using those relationships (Burt, 1992). Within a firm, relationship ties are generally more intensive than in the collaborative environment between firms (Ghoshal and Bartlett, 1990). Thus, scholars argued, arm’s length transactions and those low in collaboration intensity can provide partners with all the benefits they aim for (Spekman, Kamauff, and Myhr, 1998).

A third explanation for the different patterns could be that higher intensity levels of collaboration, which are more often found within the firm, may not necessarily lead to better performance outcomes. Scholars, predominantly those examining internal collaboration, associated a curvilinear relationship between the intensity level of collaboration and performance outcomes (Gavetti and Warglien, 2007, Lievens and Moenaert, 2000, Schippers, Den Hartog, Koopman, and Wienk, 2003, Smith, Smith, Olian, O’Bannon, and Scully, 1994). For example, it has been stressed that once collaboration partners surpass a critical threshold, high levels of communication may not only signify redundant information transfer (Hansen, Nohria, and Tierney, 1999),
but may also indicate a certain level of conflict and problems among collaborating parties (Schippers et al., 2003). Further, scholars recently argued that high intensity levels of communication and shared recognitions among collaborating groups within a firm may lead them towards any arbitrary configuration and therefore, this conformism and need for perfect consensus may erode performance outcomes (Gavetti and Warglien, 2007, Lievens and Moenaert, 2000). A previous line of arguments based on ‘groupthink’ (Janis, 1972, Katz, 1982, Katz and Allan, 1982) and ‘over-identification’, caused by high levels of commitment to a group (McEvily, Perrone, and Zaheer, 2003), led to similar conclusions.

A fourth possible explanation is in line with research on dynamic capability. Schreyoegg and Kliesch (2007) recently argued that capabilities, such as internal collaboration, contain an inherent risk of rigidity in the face of changing conditions. This is due to the very nature of the evolvement of collaboration within a firm, which takes the form of certain routines and practices that often become ‘locked’ in that they are prone to become fixed to the constellation in which they proved to be successful in the past (Schreyoegg and Kliesch-Eberl, 2007). Collaboration among different firms may not be as prone to this rigidity, as the relationship between firms is comparably less bound to path dependence and organizational routines.

Lastly, attention is drawn to the patterns of those few studies, which examined both internal and external collaboration. Although some researchers suggested a relationship between internal and external collaboration (Barki and Pinsonneault, 2005, Barratt, 2004, Hillebrand and Biemans, 2004, Subramani, 2004, Vickery, Jayaram, Droge, and Calantone, 2003), I only found five studies, which empirically tested the nature of this relationship with performance (Sanders and Premus, 2005, Stank et al., 2001, Sveiby, 2001, Takeishi, 2001, Truman, 2000). The measures of collaboration, the proposed and confirmed and/or not confirmed relationships are depicted in the Figures C1a-C1e in
Appendix C. Of these five studies, three studies measured internal and external collaboration as a single dimensional construct (Sveiby, 2001, Takeishi, 2001, Tushman, 2000) and only two studies measured it along multiple items (Sanders and Premus, 2005, Stank et al., 2001). Takeishi (2001) and Truman’s (2000) studies, which measured internal and external collaboration along measures of communication, found a direct positive relationship leading from internal collaboration to external collaboration and from external collaboration to performance (see Figures C1a and C1b in Appendix C). Findings of the studies by Stank et al. (2001) and Sanders and Premus (2005), who, to the best of my knowledge, represent the only studies that have tested the relationship between multi-dimensional measures of collaboration and performance, suggested an opposing pattern to that found by Truman (2000) and Takeishi (2001). Stank et al. (2001) empirically found and later Sanders and Premus (2005) assumed that the impact of external collaboration on performance is not direct, but associated with the impact that external collaboration has on internal collaboration, with internal collaboration having a direct impact on performance outcomes. However, Stank et al.’s (2001) and Sanders and Premus’ (2005) choice of measurements of collaboration composed solely processes attributable to internal versus external collaboration and both studies differed on these items (see Figures C1c and C1d in Appendix C). Neither of the two studies included collaborative ownership attributes in their measures of collaboration - such as relationship commitment and mutual trust- that other studies have frequently attributed to collaborative activity (Frishammar and Hoerte, 2005, Hoegl et al., 2004, Liedtka, 1996, Spekman et al., 1998).

Lastly, Sveiby’s (2001) case study findings were different again. His results suggest a direct and positive relationship between internal collaboration and performance and also

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4 Appendix C of this core paper is located on page 276-277 at the end of the thesis.
between external collaboration and performance (see Figure C1e in Appendix C⁴). In this study, collaboration was measured according to whether knowledge was transferred.

Therefore, in these five studies, there seems no consistent pattern in terms of how collaboration was measured, the relationships the researchers investigated, and measures of performance. This limits any efforts for a substantive interpretation of the relationships between internal collaboration, external collaboration, and measures of performance. Larger scale studies that measure collaboration along multiple dimensions are needed for a more sophisticated supposition on the combined relationship internal and external collaboration share with performance.

Summarizing the findings, despite the similarity of attributes attached to collaboration, the difference in intensity levels and relationship with performance indicate that there are differences in what is studied and how it is studied in internal versus external collaboration. Given that differences do exist, it is likely that they need to be managed differently, that is, it is possible that they require different sets of capabilities. Both internal and external collaboration are developed in the context of resource allocation and are embedded in distinctive social structures within and/or between firms that vary according to a firm’s environment, strategy, structure, and processes (Barki and Pinsonneault, 2005). However, the common attributes that internal and external collaboration share may be fungible in the sense that the efficacy of a particular collaborative attribute within and/or between collaborating firms affects the nature and impact of the other attributes. Taking the argument further, future research that examines collaborative endeavours where internal and external collaboration co-exist could measure the unique and conjoint value they have according to the difference in intensity levels of their common collaborative attributes.
2.4 Conclusion

In this paper, a categorization of the diverse ways researchers have conceptualized collaboration has been put forward. The emerging patterns revealed that over the past 25 years, there are differences in terms of where collaboration is situated, the intensity of its content, and if and how collaboration is linked to different measures of performance. Whilst scholars explored collaborative processes and ownership attributes between firms at lower intensity levels compared to internal collaboration studies, they were able to link it more often to positive performance outcomes. The few studies that examined both internal and external collaboration tested their combined relationship with performance outcomes in a different manner and revealed dissimilar results in terms of the relationship internal and external collaboration have with performance. Consequently, the proposed explanations above for internal versus external collaborative patterns are initial and vague suggestions to a phenomenon that deserves extensive future attention.

The findings of the analysis and their interpretations must also be understood against the backdrop of a number of methodological and conceptual limitations. First, a different and/or an extended research approach may have revealed additional studies, books and book chapters. Second, the lack of specificity of the term collaboration limited the key word search and some articles may have been missed that used yet another term than one of those searched for to describe collaboration. Third, I am aware that there is a researcher’s bias in terms of how I (1) categorized the collaborative attributes into two macro sets, and (2) divided the collaborative intensity according to three levels. Other categorizations may have resulted in different findings than theirs. Lastly, there were only a small number of studies that have started to examine the relationship between internal and external collaboration with performance; and these studies were not consistent in their research methodologies or their findings. It therefore
remains a central question for future research to systematically explore whether and at what intensity levels internal and external configurations of collaboration together reach highest performance levels in specific settings.

Although the results give some insight into what scholars have collectively explored, the real differences and conjoint nature of internal and external collaboration still remain undiscovered. This study is therefore only an initial effort that hopefully gives impetus to future research in advancing a better understanding of this important, yet largely under-researched phenomenon. Consequently, the patterns found in the analysis need to be re-examined empirically. Extensive further research that explores, how internal and external collaboration might best be configured and combined at any particular time and over time is therefore not only warranted, but incontestably required.
2.5 References


51


CHAPTER 3

Overall Method

Abstract

In this chapter, I elaborate on key aspects and procedures of the research methods used in the empirical papers of this thesis. In the first part of this chapter, I begin with conveying the general, underlying metaphysical position adopted in the thesis. In the second part, I outline the methodologies used in the different core papers. Specifically, I describe the research method of the empirical core papers 2, 3, 4, and 5 in terms of the survey design, data collection, and constructions of measures. Following from that, I introduce data analysis tools used for each empirical core paper. Subsequently, I address threats to reliability and validity of the empirical core papers and outline the limitations of the methods used in all core papers of this thesis. This chapter finishes by outlining important ethical consideration under which I conducted the research.
3.1 Introduction

In the following section, I discuss and justify the underlying metaphysical position adopted in this thesis. I first describe the ontological and epistemological basis of this thesis. From this discussion, I outline the methodologies used in the empirical core papers that follow this chapter.

3.2 Ontology

Ontology encompasses the establishment of the defining features and boundaries of reality (Tsoukas, 1989). In the series of studies that compose this thesis, I have taken a logical positivist view. That is, while the context of discovery in this thesis is scientific and hypotheses are therefore not only built upon logical inquiry, it uses rational justification to assess the findings (Bechtel, 1988). This justification is based on laws of probability. Thus, the inductive evidence of the findings in this thesis may not represent definitely the truth of any general claim. What can be known is therefore restricted to the observation of empirical phenomena and it is always possible that there might be counter-evidence that was not discovered. However, in this thesis, it is assumed that the confirmation of hypotheses and rejection of null hypotheses should increase the confidence in its probable truth. In doing so, the limitations in terms of symbolic logic used to generalize the findings are understood.

3.3 Epistemology

The epistemology, meaning the characteristics of knowledge believed to be attained, is a modified objectivism, as it aims to attain findings, which are probably true (Rossman and Wilson, 1985). An objectivist epistemological view asserts that there is objective truth and meaning, recognizing that meaning is the discovery of what has already been there. Objectivity is seen as a regulatory ideal (Guba, 1990), which this research aims to
achieve reasonably closely by striving to be as neutral as possible. However, although
this thesis strives for objectivity, it is in itself influenced by the background I bring as a
researcher to the thesis. Especially in the previous core paper 1, a neutral foundation in
the observations is not given. Classifications were based upon a framework that was
brought to the situation by the researcher and therefore inherits a bias. Another
researcher may have build rationale and findings on a different set of frameworks.

My methods and subsequent interpretations of results in each of the following
empirical core papers are concurrent with the arguments made. In the interpretations of
the statistical analyses, however, I follow a constructionist position in that I believe that
there is a reality, but my perceptions and interpretations are bounded by reality in that
they are likely to represent only some out of a range of possible interpretations. The
findings of each paper are highlighted and described in terms of boundary conditions of
probability. The interpretations of these findings thus reflect my academic knowledge
gained through research, and through discussions with participants and fellow
researchers. But, ultimately, they represent my biases associated with the membership I
have of a particular society, culture, and species.

3.4 Research Method

The following sections focus on the design of the survey, data collection procedures
and population sampled, and the construction and validation of indices to measure the
main constructs that form the basis of the data pool used in the empirical core papers 2,
3, 4, and 5 (Chapters 4 – 7). Whilst each of these four empirical core papers are built
upon the same data set, the analytical techniques used varied depending on the research
questions raised within each respective paper. The overall research method and the
specific questions raised and instruments used to answer these questions are outlined in
detail in the following sections.
3.4.1 Survey Construction

The questionnaire development involved three stages. During the first stage, the literature review in core paper 1 provided evidence that there was a need for examining the relationship between internal and external collaboration as, according to existing studies in the literature, they each impact largely on the success of different measures of performance. The review also identified a large number of studies that have measured collaboration and the variables that seemed most relevant to investigate. The items used within the existing literature led me to the second stage, a preliminary questionnaire design. This preliminary questionnaire was then evaluated by 28 product managers in terms of its relevance to new product and service development, its layout, and the content was assessed in terms of clarity, aptitude, relevance, and shortcomings. In the third stage, the revised questionnaire was electronically mailed to 3620 product managers that were likely to have recently been involved in new product or service development alliances. An overview of each of the two post literature analysis stages of instrument development are provided below.

3.4.1.1 The Pilot Study

The pilot survey was divided into interviewer-administered surveys and self-administered surveys. The interviewer-administered surveys were in-office surveys or telephone interviews. The 28 participants were all managers, who had been previously involved in the development of new products and/or services. The pilot questionnaire package contained a cover letter, the survey questions, a separate review sheet relating to the overall assessment of the questionnaire, and room for additional comments. Through this process, I was able to test, if the appropriate language of the questions was well understood by the respondents (Cooper and Schindler, 2003).
### Table 3.1 Data Collection for Pilot Study

<table>
<thead>
<tr>
<th>Organization</th>
<th>Method of data collection</th>
<th>No. of respondents</th>
<th>Position</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managers from different product and service industries</td>
<td>Survey was handed to and completed by managers during MBA class at Griffith University. Suggestions were given in written form.</td>
<td>11</td>
<td>Managers that have previously been involved in product development</td>
<td>21.10.2006</td>
</tr>
<tr>
<td>Thiess</td>
<td>Survey was sent via email. In-depth discussion during follow-up phone call</td>
<td>2</td>
<td>Product development managers</td>
<td>25.10.2006</td>
</tr>
<tr>
<td>Westpac</td>
<td>Survey was sent via email. In-depth discussion during follow-up phone call</td>
<td>2</td>
<td>Product development managers</td>
<td>25.10.2006</td>
</tr>
<tr>
<td>Australian Bureau of Statistics</td>
<td>Survey was sent via email. Various in-depth discussion regarding the questionnaire design were made during follow-up phone calls</td>
<td>2</td>
<td>Statisticians and research design professionals</td>
<td>26.10.2006</td>
</tr>
<tr>
<td>Managers from different product and service industries</td>
<td>Survey was handed to and completed by managers during MBA class at Griffith University.</td>
<td>4</td>
<td>Full-time managers</td>
<td>26.10.2006</td>
</tr>
<tr>
<td>ING bank Australia</td>
<td>Survey was sent via email. In-depth discussion during follow-up phone call</td>
<td>1</td>
<td>Service development manager</td>
<td>27.10.2006</td>
</tr>
<tr>
<td>BMW/Germany</td>
<td>Survey was sent via email. In-depth discussion during follow-up phone call</td>
<td>3</td>
<td>2 Senior executives, 1 senior manager</td>
<td>27.10.2006</td>
</tr>
<tr>
<td>University of Queensland</td>
<td>In-depth discussion regarding the questions’ intellectuality, fit with model, and scales.</td>
<td>1</td>
<td>Statistician</td>
<td>18.10., 23.10., 27.10., and 6.11.2006</td>
</tr>
<tr>
<td>Terry White Chemist</td>
<td>Survey was completed online and suggestions were added and e-mailed back to the researcher.</td>
<td>1</td>
<td>Head chemist</td>
<td>6.11.2006</td>
</tr>
<tr>
<td>Wattly Paints Australia</td>
<td>Survey was completed online and suggestions were added and e-mailed back to the researcher.</td>
<td>1</td>
<td>R&amp;D director</td>
<td>7.11.2006</td>
</tr>
<tr>
<td>AEEMA (Australian Electronics &amp; Electrical Association)</td>
<td>In-depth discussion about the questions’ fit with member firms</td>
<td>3</td>
<td>Director and Chief Executive</td>
<td>13.11., 21.11.2006</td>
</tr>
</tbody>
</table>

Feedback was also provided on the comprehensiveness and applicability of the items asked for advancing an understanding of the nature of collaboration in product development and its relationship to performance. This feedback led to minor but important changes in what was asked and how it was asked. The respondents suggested a number of questions to be changed as they were worded too complex. Scales were
generally well understood, however for three items, the respondents suggested a different Likert-type scale than the one provided. The time to complete the survey averaged between 28 and 34 minutes. The survey was also distributed and discussed with three statisticians in order to assess its intellectuality and its fit with the proposed research models and scales.

Next, in order to test whether all processes were working and questions were understood, the survey was electronically mailed to 230 member firms of the Australian Electrical and Electronic Manufacturers Association (AEEMA) in November 2006 and an identical printout was also distributed by myself with a pre-paid envelope to 45 managers at the Telematics conference (in Melbourne) in December 2006. The survey received a response rate of 20 fully completed online surveys (9% response rate) and 15 printed surveys, which were sent back via mail (33% response rate). Data from these 35 completed surveys were not included in the final survey sample. I performed a series of tests to examine the reliability and validity of the instrument. A description of the composition, reliability and construct validity of each construct and is presented in sections 3.5-3.8 of this chapter.

3.4.1.2 Main Data Collection Participants

For the main data collection, 29 national industry associations, industry bodies from the Australian Competition and Consumer Commission directory, and other Australian government sources were initially selected on the basis that they represent the largest industry sectors in Australia. Of those contacted, eleven industry associations/industry bodies agreed to distribute the survey invitation to managers in their member firms via an electronic mail (one mail-out, followed by two reminder e-mails) and where available, as an electronic link in their monthly e-newsletters (Table 3.2). The criterion given to the industry associations/bodies for choosing the respondents in the respective
sample was that the managers had (at least some) responsibility overseeing a recent product or service development that involved collaboration with at least one key partnering firm located anywhere in the focal firm’s value chain. Of the 3620 survey invitations to complete the anonymous electronic (online) survey that industry associations/government bodies send to managers involved in product and/or service innovation, 359 responses were received, which is a response rate of 9.9%. Of these, 109 surveys were only partially answered, which left fully completed survey data from 250 focal firms across 10 industry associations (see Table 3.2 below).

Table 3.2 Main Data Collection

<table>
<thead>
<tr>
<th>Association</th>
<th>Number of firms survey was sent to</th>
<th>Survey link in e-newsletter</th>
<th>Fully completed surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AEEMA (Australian Electrical and Electronics Industry Association) and Telematics cluster</td>
<td>1410</td>
<td>YES</td>
<td>107</td>
</tr>
<tr>
<td>2. AIDN (Australian Industry Defence Network)</td>
<td>80</td>
<td>YES</td>
<td>10</td>
</tr>
<tr>
<td>3. AIIA (Australian Information Industries Association)</td>
<td>250</td>
<td>NO</td>
<td>22</td>
</tr>
<tr>
<td>4. ALMA (Australian Laboratory Managers Association) &amp; SIA (Science Industry Australia)</td>
<td>300</td>
<td>NO</td>
<td>53</td>
</tr>
<tr>
<td>5. AUSinnovation</td>
<td>500</td>
<td>YES (newsletter only)</td>
<td>0</td>
</tr>
<tr>
<td>6. AMTIL (Australian Manufacturing Technology Institute Limited)</td>
<td>200</td>
<td>NO</td>
<td>5</td>
</tr>
<tr>
<td>7. Materials Australia</td>
<td>120</td>
<td>NO</td>
<td>2</td>
</tr>
<tr>
<td>8. MIAA (Medical Industry Association Australia)</td>
<td>120</td>
<td>NO</td>
<td>1</td>
</tr>
<tr>
<td>9. TFIA (Textile and Fashion Industry Australia)</td>
<td>200</td>
<td>NO</td>
<td>4</td>
</tr>
<tr>
<td>10. WSITC (Western Sydney Information Technology Cluster)</td>
<td>220</td>
<td>YES</td>
<td>24</td>
</tr>
<tr>
<td>11. CSIRO (Commonwealth Scientific and Industrial Research Organization)</td>
<td>200</td>
<td>YES</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3620</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

Of these 250 firms, 56 developed a product/service with a partnering firm, however, at the time of the survey, the product was not released to the market and questions concerning its development performance could not be answered. The final sample therefore included data from 194 product development managers that responded on their
alliance between their own firms with a key partnering firm for a product or service that was released to the market. However, 82 alliances were answered by product managers in focal firms, which only had a single business unit involved in the alliance. Thus, they did not engage in collaboration among units within the firm during their chosen product development, which was a predictor variable in each of these three papers. Therefore, for the empirical core papers 2, 3, 4, and 5, the data screening resulted in a sample of 134 alliances that also entailed detailed information about the collaborative activities among functional units involved within the focal firms from the viewpoint of product managers.

3.5 Overview of Survey Questionnaire

The survey contained an introductory/consent page followed by four major parts. A short summary of these four major parts follows:

Part A required respondents to choose the most recent product or service development that they were responsible for. As part of this selection, they were also asked to nominate one key partnering firm that was involved in the development of the product or service. They were then asked a number of questions about the product/service itself, its development length, and its development performance and market success.

Section B of the questionnaire was aimed at assessing internal collaboration within the focal firms among different functional units that were involved in the product/service project. Respondents were asked to provide information regarding the frequency of different types of information exchange; the intensity of different joint inter-unit engagement activities; the intensity of their shared responsibilities of decisions and outcomes; and their opinion in terms of relationship commitment and degree of inter-unit trust. In case the respondents indicated that there was only one unit
involved in the product/service development, the survey automatically skipped to Part C.

**Part C** asked the respondents a very similar set of questions to those asked in Part B. The questions referred to the same product/service development with the only difference that it now focused on the activities that units of the focal firm had with those of the nominated partnering firm. Respondents were asked to provide information regarding the frequency of different types of information exchange between the focal and the partnering firm; the intensity of different joint inter-firm engagement activities; the intensity of their shared responsibilities of decisions and outcomes; and their opinion in terms of relationship commitment and the degree of trust they shared with the partnering firm.

**Part D** required respondents to provide general information about themselves, their firm, and their chosen key partnering firm. Most of these questions acted as control variables (see section 3.6.2 below). Respondents were asked a number of questions such as the size of their firm, whether they were located in the firm’s headquarters or subsidiary, and the industry sector their firm was located. They were also asked a number of questions regarding the partnering firm and details about the alliance for the chosen product/service innovation. Questions included those about the size and industry sector of the partner, and the form and length of agreement, and prior experience the focal firm had shared with the partner firm. In the following section, I outline the multi-dimensional core constructs and their items for each part of the survey.

### 3.6 Measures

Multi-item scaling techniques were applied in this research to improve reliability and validity of measurement. All scales consisted of newly generated items and items that have been used previously in the literature. When a new scale was developed, it was
done based on suggestions and findings in the existing literature. All of the main constructs were measured using multiple items requiring an indication of intensity on a five point Likert-typed scale for each item. For measurement consistency, I calculated the coefficient alpha. Reliability values of all constructs met Nunnally’s (1978) criterion of acceptability of 0.70 or above. Construct validation was assisted through the use of exploratory factor analyses. Each construct loaded cleanly onto one factor.

**New product (service) development performance.** Due to the variety of industries and firm sizes included in the sample, and because the objectives and performance criteria of the firms varied, a multi-dimensional performance measure was considered most appropriate (Narasimhan and Das, 2001). The index was comprised of five items from measures of previous studies (see Table 3.3). Each item had high loading coefficients, an Eigenvalue of over 50% variance explained by the first component, and thus validated the appropriateness of the items constituting this construct in each of the four core papers. A five-point Likert scales at “1 = met no performance goals”, “2 = met some performance goals”, “3 = met most performance goals”, “4 = met all performance goals”, and “5 = exceeded performance goals” was adopted for the five items.

**Table 3.3 Operational Definition of new Product Development Performance**

<table>
<thead>
<tr>
<th>Items</th>
<th>Used in existing studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Product development costs</td>
<td>Dyer (1996); Handfield et al. (1999); Hoegl et al. (2004); Sanders &amp; Premus (2005); Spekman et al. (1998)</td>
</tr>
<tr>
<td>2. Product quality</td>
<td>Dyer (1996); Handfield et al. (1999); Hoegl et al. (2004); Sanders &amp; Premus (2005); Narasimhan &amp; Das (2001); Scannell et al. (2000); Takeishi (2001)</td>
</tr>
<tr>
<td>3. Achieving customer satisfaction</td>
<td>Bailetti and Litva (1995); Handfield et al. (1999); Thieme et al. (2003); Vickery et al. (2003)</td>
</tr>
<tr>
<td>5. Attracting new customers</td>
<td>Homburg and Pflesser (2000); Spekman et al. (1998)</td>
</tr>
</tbody>
</table>
3.6.1 Collaborative Attributes of Collaboration System

Findings from the analysis in core paper 1 form the basis of the multi-attribute conceptualization of a collaboration system for the empirical core papers 2, 3, 4, and 5. In each of these papers, collaboration within the focal firm was measured with an almost identical set of constructs as collaboration between both firms. Each of the five collaborative attributes measures consisted of multiple items. Identical five-point Likert scales at “1 = never”, “2 = seldom”, “3 = occasionally”, “4 = often”, and “5 = quite frequently” were adopted for all items in order to capture the different intensity levels of collaborative activity.

**Mutual communication.** The items to measure mutual communication were taken from a larger set of measures by Kahn (1996) and Frishammar and Hoerte (2005). The chosen six items were originally designed by Van den Ven and Ferry (1980), who measured inter-unit information flow. The authors of these studies reported a coefficient score of at least 0.73 for all items and therefore the items appear to have sound measurement properties and appropriately reflect the conceptual definition of this construct. All items loaded cleanly onto one factor and appeared to be a reliable indicator of collaboration in all four papers.

**Table 3.4.1 Operational Definition of Internal Mutual Communication**

<table>
<thead>
<tr>
<th>During the development of Product X, to what degree did the involved units within your firm interact with one another through…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in meetings</td>
</tr>
<tr>
<td>Participation in committees/task forces</td>
</tr>
<tr>
<td>Phone conversations</td>
</tr>
<tr>
<td>Exchange of mail and fax</td>
</tr>
<tr>
<td>Exchange of internal reports</td>
</tr>
<tr>
<td>Exchange of electronic mail</td>
</tr>
</tbody>
</table>
Table 3.4.2 Operational Definition of External Mutual Communication

<table>
<thead>
<tr>
<th>During the development of Product X, to what degree did the involved units of your firm interact with the partnering firm through….</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in meetings</td>
</tr>
<tr>
<td>Participation in committees/task forces</td>
</tr>
<tr>
<td>Phone conversations</td>
</tr>
<tr>
<td>Exchange of mail and fax</td>
</tr>
<tr>
<td>Exchange of firm internal reports</td>
</tr>
<tr>
<td>Exchange of electronic mail</td>
</tr>
</tbody>
</table>

(2) Joint engagement. All five items that measure the intensity of joint engagement were taken from existing scales used by Mohr and Spekman (1994), who measured characteristics of partnership success. The findings reported by Mohr and Spekman (1994) show the items to be highly reliable (coefficient score of 0.84). The items loaded cleanly on one and had a high overall coefficient alpha score and thus appeared as reliable indicators for the construct.

Table 3.5.1 Operational Definition of Internal Joint Engagement

<table>
<thead>
<tr>
<th>What was the level of engagement among the involved units of your firm during Product X’s development in terms of the following…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Advice and counsel was sought by each other</td>
</tr>
<tr>
<td>2. Units helped each other in their planning activities</td>
</tr>
<tr>
<td>3. Suggestions by one unit was encouraged by other units</td>
</tr>
<tr>
<td>4. Units shared unit-specific information with one another</td>
</tr>
<tr>
<td>5. In this relationship it was expected that any information was provided that might help the other units</td>
</tr>
</tbody>
</table>

Table 3.5.2 Operational Definition of External Joint Engagement

<table>
<thead>
<tr>
<th>During Product X’s development, what was the level of engagement between involved units of your firm with the partnering firm in terms of the following…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Advice and counsel was sought by each other</td>
</tr>
<tr>
<td>2. Both firms helped each other in their planning activities</td>
</tr>
<tr>
<td>3. Suggestions by one firm was encouraged by other firm</td>
</tr>
<tr>
<td>4. Both firms shared proprietary information with one another</td>
</tr>
<tr>
<td>5. In this relationship it was expected that any information was provided that might help the other firm</td>
</tr>
</tbody>
</table>
(3) Sharing responsibilities. All four items of this measure are taken from a larger construct developed and measured by Hoegl et al. (2004), who explored the nature and impact of group collaboration. The authors reported a coefficient score between 0.70 and 0.89 for all items and therefore the items appear to have sound measurement properties and appropriately reflect the conceptual definition of this construct. The measures loaded cleanly on one factor, had a high overall coefficient score and were therefore retained in the analysis for all four empirical papers.

Table 3.6.1 Operational Definition of Internal Sharing Responsibilities

<table>
<thead>
<tr>
<th>Please describe how evenly the involved units within your firm engaged in joint activities and decision-making processes with each other for Product X. All units involved…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Were engaged equally in decision-making processes</td>
</tr>
<tr>
<td>2. Contributed equally to the development of Product X</td>
</tr>
<tr>
<td>3. Complemented one another as best as they could</td>
</tr>
<tr>
<td>4. Shared collective responsibility for all results of the development of Product X</td>
</tr>
</tbody>
</table>

Table 3.6.2 Operational Definition of External Sharing Responsibilities

<table>
<thead>
<tr>
<th>Please describe how evenly involved units within your firm engaged in joint activities and decision-making processes with the partnering firm for Product X. They…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Were engaged equally in decision-making processes</td>
</tr>
<tr>
<td>2. Contributed equally to the development of Product X</td>
</tr>
<tr>
<td>3. Complemented one another as best as they could</td>
</tr>
<tr>
<td>4. Shared collective responsibility for all results of the development of Product X</td>
</tr>
</tbody>
</table>

(4) Relationship commitment. Four items were taken from a seven-item measure of relationship commitment developed and used by Morgan and Hunt’s (1994). The findings reported by Morgan and Hunt (1994) show the items to be highly reliable (coefficient score of 0.90). Morgan and Hunt adapted all items from an earlier study by Mowday, Steers and Porter (1979). Three items from Morgan and Hunt’s study (1994) were dropped due to their low Cronbach alpha scores during the internal consistency test in the pilot phase of the study. The remaining four items loaded cleanly into one factor and appeared to be a reliable indicator of collaboration.
Table 3.7.1 Operational Definition of Internal Relationship Commitment

<table>
<thead>
<tr>
<th>The relationship that involved units within your firm had with one another throughout the development of Product X…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was a relationship they were very committed to</td>
</tr>
<tr>
<td>2. Was very important to them</td>
</tr>
<tr>
<td>3. Deserved maximum efforts to maintain</td>
</tr>
<tr>
<td>4. Was a relationship they intended to maintain indefinitely</td>
</tr>
</tbody>
</table>

Table 3.7.2 Operational Definition of External Relationship Commitment

<table>
<thead>
<tr>
<th>The relationship that involved units of your firm had with the partnering firm throughout the development of Product X…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was a relationship they were very committed to</td>
</tr>
<tr>
<td>2. Was very important to them</td>
</tr>
<tr>
<td>3. Deserved maximum efforts to maintain</td>
</tr>
<tr>
<td>4. Was a relationship they intended to maintain indefinitely</td>
</tr>
</tbody>
</table>

(5) Mutual trust. All items for this construct were also taken from existing scales by Morgan and Hunt (1994). Research findings by Morgan and Hunt suggested that the indicators are reliable measures of trust based in the coefficient alpha (0.95). The measures were originally developed by Larzelere and Huston (1980), who explored close interpersonal relationships. However, in the piloting of this measure satisfactory internal consistency levels were not achieved for three of the original seven items. Therefore, mutual trust was measured only with four of the seven-items developed by Morgan and Hunt (1994). These four items loaded cleanly on one factor, had a overall coefficient score above 0.7 and were therefore retained as adequate measurement properties in the analysis of all three papers.

Table 3.8.1 Operational Definition of Internal Mutual Trust

<table>
<thead>
<tr>
<th>In their relationship during the development of Product X, involved units within your firm…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Were perfectly honest and truthful with one another</td>
</tr>
<tr>
<td>2. Were able to have great confidence in each other</td>
</tr>
<tr>
<td>3. Could be counted on to do what was right</td>
</tr>
<tr>
<td>4. Had high integrity</td>
</tr>
</tbody>
</table>
Table 3.8.2 Operational Definition of External Mutual Trust

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In their relationship during the development of Product X, involved units within your firm and the partnering firm…</td>
<td></td>
</tr>
<tr>
<td>1. Were perfectly honest and truthful with one another</td>
<td></td>
</tr>
<tr>
<td>2. Were able to have great confidence in each other</td>
<td></td>
</tr>
<tr>
<td>3. Could be counted on to do what was right</td>
<td></td>
</tr>
<tr>
<td>4. Had high integrity</td>
<td></td>
</tr>
</tbody>
</table>

3.6.2 Control Variables and Description

To reduce potential confounding effects in each of the four empirical core papers, I controlled for several variables known to correlate with firm internal and external collaboration. They are listed in the table below.

Table 3.9 Control Variables

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PREVIOUS STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative experience</td>
<td>Simonin (1997), Zollo et al. (2002), Cavusgil et al.; Handfield et al. (1999);</td>
</tr>
<tr>
<td>Industry average</td>
<td>Echeverri-Carroll (1999)</td>
</tr>
<tr>
<td>Length of collaboration</td>
<td>Echeverri-Carroll (1999); Li (2005); Santoro (2000); Schulze and Hoegl (2006)</td>
</tr>
<tr>
<td>Industry sector</td>
<td>Sanders and Premus (2005); Schulze and Hoegl (2006)</td>
</tr>
<tr>
<td>Firm size</td>
<td>Bastos (2001); Collins and Smith (2006); Faems et al. (2005); Gupta and Wilemon (1985); Lord and Ranft (2000); Santoro (2000); Simonin (1997); Stuart (2000)</td>
</tr>
<tr>
<td>Number of units involved (from focal firm and partner firm)</td>
<td>Schulze and Hoegl (2006)</td>
</tr>
<tr>
<td>Type of functional unit involved (from focal firm and partner firm)</td>
<td>Gupta et al. (1985); Song et al. (1998)</td>
</tr>
<tr>
<td>MNC headquarters or subsidiary</td>
<td>Faems et al. (2005); Li (2005)</td>
</tr>
<tr>
<td>Number of firms involved</td>
<td>Garcia-Canal et al. (2003)</td>
</tr>
<tr>
<td>Form of alliance agreement</td>
<td>Reuer and Arino (2002; 2003)</td>
</tr>
<tr>
<td>Type of innovation (NSD or NPD)</td>
<td>Nijssen et al. (2006)</td>
</tr>
<tr>
<td>Radicalness of new product or service innovation</td>
<td>Nijssen et al. (2006)</td>
</tr>
<tr>
<td>Length of the new product development</td>
<td>Bartzzaghi et al. (Bartzzaghi, Corso, and Verganti, 1997)</td>
</tr>
<tr>
<td>Length of the strategic alliance</td>
<td>Reuer et al. (2002); Gulati and Singh (1998)</td>
</tr>
</tbody>
</table>

Further details on sampling bias and issues of measurement are discussed within the context of the specific hypothesis being tested and reported on in each of the subsequent chapters 4, 5, 6, and 7. In addition, further details on sampling bias, and issues of
measurement are discussed within the context of the specific hypothesis being tested and reported on in each of these chapters.

3.7 Statistical Tools for Testing the Hypotheses

Each of the four empirical core papers aimed at answering different research questions and thus different analytical tools were used to making different comparisons but albeit from the same data set. By using the same data set and partitioning it into different studies (core papers 2, 3, 4, and 5), I recognize that the comparisons tested are therefore subject to pyramiding errors (Furchtgott, 1984, Neher, 1967). Against this limitation is that the data is used to test different conceptual models rather than simply repeating tests until a significant result is obtained by chance (type 1 error). In the following sections, I outline the different data analyses tools used within each core paper. I used two-tail tests for all probability testing in the empirical core papers, even where I predicted the direction of the difference in advance. This minimized type 1 errors and allowed to examine whether any differences, even against the predicted direction, existed. Core papers 2, 3, and 4 examine a number of different relationships between internal and external collaboration systems for a new product development. I have illustrated the relationships tested as one larger model below in Figure 3.1.
3.7.1 Data Analysis Tools: Core Paper 2 (Chapter 4)

Core paper four was concerned with two major research questions. The first question aimed at finding the difference in intensity between the focal firms’ internal collaboration systems versus their external collaboration systems. I chose a paired-sample t-test (two-tailed) comparing the means as the statistical tool to answer this
research question. The second and main research question of core paper 2, in form of three propositions, was whether the focal firm’s internal collaboration system mediates the relationship its external collaboration system has with new product development performance. The hypothesised relationships were tested similarly to Tiwana (2008), but following the full mediation regression guidelines outlined by Baron and Kenny (1986). These guidelines firstly required establishing a relationship between the independent variables (external collaboration system) with the mediator variables (internal collaboration system). I did so by using canonical correlation analysis (CCA), which determines whether relationships exist between sets of variables (Tabachnick and Fidell, 1989). CCA tests remaining functions/variates by statistically removing variance attributable to the first variate (Alpert and Peterson, 1972).

Secondly, the mediation guidelines by Baron and Kenny (1986) required a relationship between the mediator (internal collaboration system) and the dependent variable (product development performance). Thirdly, the guidelines required testing for a direct relationship between the independent variable (external collaboration system) and the dependent variable (new product development performance). I tested these two relationships using hierarchical regression analysis. I used a stepwise regression approach in which the control variables were entered first (step 1), followed by external collaboration variables in step 2. Finally, in step 3, the mediating variables (internal collaboration system) were introduced.

3.7.2 Data Analysis Tools: Core Paper 3 (Chapter 5)

I developed the idea that within a focal firm, configurations among differently intensive collaborative attributes add value to new product development performance. I also proposed that external collaboration, albeit being mediated by internal collaboration (findings from core paper 2), still has a positive relationship with new product
development performance through synergistic configurations among its collaborative attributes. In order to test these two propositions, hierarchical regression analysis was used. I used a stepwise regression approach in which the control variables were entered first (step 1) followed by the five external collaboration variables in step 2. Next, I entered the five internal collaboration variables. In step 4, the interaction effects among the external collaboration variables and among the internal collaborative attributes were introduced. Where significant interactions were found, I plotted the interactions using Aiken and West’s (1991) simple slope analysis to gain further information about the nature of the interactions.

3.7.3 Data Analysis Tools: Core Paper 4 (Chapter 6)
Based on the findings of core papers 2 and 3, in this paper, I raise the question, whether internal collaboration system attributes moderate the impact external collaboration system attributes have on new product development performance. Again, I use hierarchical regression analysis to test the research question. I entered ‘nuisance’ variables (the control variables) first. All ten main effects of internal and external collaboration system attributes were entered in step 2. This step was used to verify the individual effect of each collaborative attribute. Model 3 included all relevant two-way interactions between identical firm internal and external predictor variables. In order to find out more about the nature of the interactions, where significant, I subsequently performed a simple slope analysis (Aiken and West, 1991).

3.7.4 Data Analysis Tools: Core Paper 5 (Chapter 7)
This paper takes the same multi-attribute approach of collaboration as the previous empirical papers and utilises the same survey data collected from 134 alliances. It firstly compares internal and external collaboration systems as predictors of successful new
service developments (NSD) versus successful new product developments (NPD). It firstly predicts that NSD partnerships differ from NPD relationships on their intensity of engaging in the five collaborative activities (both within the focal firm and between the focal and the partnering firm) and tests this proposition with paired sample t-tests (two-tailed). This study then predicts how the success of a new service versus a new product is differentially impacted by the intensity of the internal and external collaboration attributes. To test the contribution of each internal and external collaborative attribute toward the development success of NSD versus NPD, a hierarchical regression was performed. Product versus service development was included as a dummy variable in an additive and a multiplicative form (Gujarati, 1970, Terawatanavong, Whitwell, and Widing, 2007). By including the variable for NSD versus NPD (service = 0; product = 1), it was possible to test whether the difference between NSD and NPD lies in the intercept, the slope, or both. In the hierarchical regression, control variables were entered first, followed by the independent contributions of each collaborative attribute. Step 3 includes all relevant two-way interactions between the product versus service variable and each of the five internal and five external collaboration variables.

3.8 Ensuring the Quality of the Data Analyses

Each of the four empirical core papers in this thesis are potentially affected by threats to reliability and validity. Following are several methods that were used in order to increase reliability and validity within each of the papers.

3.8.1 Common Method Bias

The same respondent was used to gather information on the independent and dependent variables, which can cause common method bias to occur. Following the procedure used by Poppo et al. (2008), this potential concern was addressed by performing a
Harman one-factor test that loaded the variables into a principal component factor analysis. According to this test, if either a) a single factor emerges from the factor analysis, or b) several factors emerge, but factor 1 accounts for the majority of the variance, then common method bias is a concern. Each of the major analyses performed for the empirical core papers 2, 3, 4, and 5 revealed a solution, which accounted for over 50% of the total variance and factor 1 accounted for less than 50% of the variance in each of the core papers 2, 3, 4, and 5. Therefore, because no single factor emerged in any of the four studies and factor 1 did not explain a majority of the variance, common method bias was not likely to be a major concern in the data.

3.8.2 Reliability

Reliability is concerned with the accuracy and consistency of the measurements and procedures of the research conducted, so the study can be repeated by other researchers (Robson, 2002, Scholz and Tietje, 2002). I have provided a detailed description of all steps involved in the research process so that all steps can be replicated at a later point in time. Consistent with its wide-spread use (Deng and Dart, 1994), the Cronbach alpha test was chosen to determine the items reliability to the construct. A commonly used standard for the Chronbach alpha is 0.7 (DeVellis, 1991, Nunnally, 1978). All composite indices used in this thesis met or exceeded this standard. In addition, all component constructs used in core paper 2, 3, 4, and 5 to measure collaboration have been conceptually defined, operationalized and tested by previous researchers, however, not in conjunction with each other.

Whilst internal consistency can be determined with the split-half test, Peter (1979) has raised doubts about the “real” reliability coefficient when splitting scale items into half.
3.8.3 Validity

The concept of validity is used to describe the best available approximation to the trust or falsity of propositions (Cooper and Schindler, 2003, Hair, Bush, and Ortinau, 2003). That is, validity means the ability to produce research findings that are in agreement with theoretical or conceptual values (Sarantakos, 1998: 78). While there are different ways to classify validity, this study concentrates on internal validity, construct validity, and external validity (Cooper and Schindler, 2003, Creswell, 2003, Robson, 2002, Sekaran, 2000, Zikmund, 2003).

3.8.3.1 Internal Validity refers to the degree of validity of judgements about the relationships among variables (Robson, 2002). In this thesis, it refers to the legitimate interpretation of a causal relationship between various independent variables and the dependent variable. In order to establish credibility, papers 2, 3, 4, and 5 test the relationship between various variables as hypothesised and find out, if their relationship persists when other possibilities, such as controlling for mediating variables, are eliminated. The aim is to achieve a valid comparison and increased confidence in the relationship between independent and dependent variables and reaching internal logic of the research process and its findings (Punch, 1998). A threat to internal validity is multicollinearity, which is claiming that two independent concepts are related, when such a relationship is due to the fact that in actuality the same thing was being measured as the predictor and the criterion (Cooper and Schindler, 2003). Each of the major analyses in papers 2, 3, 4, and 5 include interaction effects among independent variables and all independent variables were centred to reduce nonessential multicollinearity among interaction terms and their individual components (Aiken and West, 1991).
3.8.3.2 *Construct Validity* seeks agreement between a theoretical concept and a specific measuring device or procedure. It is mainly concerned with how well the measures employed in the research fit the theories for which the study was initially designed (Sarantakos, 1998, Sekaran, 2000). It also aims for objectivity in the research, especially in the process of data collection and analysis (Lincoln and Guba, 1985). In the empirical core papers, construct validity was assessed and ensured by using exploratory factor analysis (Anderson and Gerbing, 1988). Each empirical core paper reports estimated variance inflation factors for all predictor and control variables in order to test multicollinearity among them and to minimize poor discriminant validity (Neuman, 2003).

3.8.3.3 *External Validity* refers to how generalizable across times, settings, and individuals the research findings are to a population beyond the targeted one (Yin, 1994). It is also concerned with the extent to which research findings are applicable to other research settings and/or groups (Lincoln and Guba, 1985). In this thesis, I aim for statistical generalization by using survey data of a large sample and generalize the findings to broader theory. Transferability is achieved by using participants located in different functional departments, representing differently sized firms in different industry sectors. However, threats to external validity always persist, as the patterns reported in this data set may not hold in firms operating at different locations at different times and with different partners.

3.9 *Methodological Limitations*

Limitations are outlined in the limitation sections located at the end of each of the five core papers. The following section comprises a summary of major methodological limitations.
3.9.1 Limitations of the Methodology used in Core Paper 1

1. A different and/or an extended research approach may have revealed additional studies, books and book chapters.

2. There is a researcher bias in terms of how they (1) categorised the collaborative attributes into two macro sets, and (2) divided the collaborative intensity according to three levels. Other categorizations may have resulted in different findings.

3. There were only a small number of studies that have started to examine the relationship between firm internal and external collaboration with performance and these studies were not consistent in their methodologies or their findings. This leaves the question as to whether and at what intensity levels alignments of internal and external collaboration reach performance.

3.9.2 Limitations of the Methodology used in Core Papers 2, 3, 4, and 5

1. One methodological issue concerns the scope of the data collected. The data is based from the viewpoint of focal firms about themselves and about their partner. It does not include direct data from the partnering firm. Nor does it include information about collaboration practices with other partnering firms or their respective positions and responsibilities in the value chain.

2. Albeit testing different relationships, different conceptual models, and employing two-tailed tests to minimise type 1 errors, the data is subject to probability pyramiding, as the same data set is partitioned into separate empirical core papers.

3. The data is obtained from one individual within each focal firm and thus raises concern as to whether the respondents give an accurate portrayal of the focal firm.

4. Although it can be assumed that the different stages of a new product (and new service) development were reflected by the different functional units involved from
the focal and partnering firm, I did not specifically ask, what stage in the product
development the alliance took place.

5. Other commonly known drivers of the propensity of new product and/or service
development, such as the organizational structure and culture of both the focal and
the partnering firm, were not included as controlling or mediating variables. Their
inclusion may lead to more conclusive patterns of results and interpretations.

6. I collected data on collaboration at a specific point in time for one innovation
alliances. The findings therefore do not provide insights into the nature of internal
and external collaboration over time and/or along a number of strategic partnerships.

3.10 Ethical Considerations

I ensured that every part of the research was conducted in accordance to the ‘Australian
standard on ethical conduct in research involving humans’. The primary intention of
research ethics is to protect individual participants and organizations from harm, danger
or other negative consequences from research activities (Emory and Cooper, 1991).
Ethical clearance has been obtained for this thesis from the Griffith University Ethical
Committee prior to proceeding with the data collection process. Ethical considerations
in this research address all key ethical issues related to the research process including
ensured industry associations and individual participants that privacy and confidentiality
were guaranteed in an information page at the beginning of the survey. On this
introduction page I also clearly pointed out my intent of research, the objectives,
purpose and expected research benefits. All participants agreed on informed consent
prior to entering the online survey. Participants were under no obligations to take part in
the survey or fully complete the survey and were provided with contact details of the
research team and the Griffith University Ethics Committee.
The chance to link specific data with specific respondents was minimised in a number of ways. Firstly, I did not obtain the names and contact addresses of any of the potential survey respondents. Rather, the respective industry associations and government bodies took responsibility in contacting potential respondents themselves with an invitation to participate in the questionnaire. Second, throughout the questionnaire, I ensured that individual comments or data could not be attributed to individual participants or organizations. Providing their e-mail addresses was left optional for those firms that were not contacted by their respective association, but that requested a management report. The addresses were not used for any other purpose.

3.11 Conclusion

This chapter identified that this research thesis is implemented in the positivist tradition. A summary of the applications of its research methods was provided in this chapter. The data collection method was identified, major constructs and variables were defined, the analyses instruments for each paper were introduced, and the procedures for establishing validity and reliability of the different studies were summarised. Finally, limitations of the method and ethical considerations were provided.
CHAPTER 4

Core Paper 2

The mediating influence of internal collaboration on the contributions of alliances to new product development success

Preface

This core paper builds on core paper 1, where I found secondary evidence that the intensity levels and impact of three collaborative process attributes (mutual communication, joint engagement, sharing responsibilities) and two collaborative ownership attributes (relationship commitment, mutual trust) on performance depend largely on the location (within the firm or between firms) researchers chose to examine collaboration. Due to the general tendency of the 119 studies to focus on either internal or external collaboration but not both, it remains uncertain, whether the patterns found in core paper 1 also apply to situations, where a firm engages simultaneously in collaboration within (internal collaboration) and firm to firm (external) collaboration. In this paper, I focus on the five collaboration attributes that were revealed in core paper 1 and firstly build an overall definition of a firm’s collaboration system. I then argue that the influence of firms’ external collaboration systems on new product development performance is mediated by their internal collaboration systems. I test the three conditions of mediation using primary data from 134 dual partner alliances.

An amended version of this paper will be submitted to the Strategic Management Journal.
The mediating influence of internal collaboration on the contributions of alliances to new product development success

Abstract

Research on collaboration within the firm (internal collaboration) and that on inter-firm collaboration (external collaboration) represent two largely disconnected streams. Recognizing that internal and external collaboration often occur together, this study examines the under-explored relationships between focal firms’ internal and external collaboration activities on product development success. I conceptualize collaboration as an organizational system that entails five collaboration attributes: (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. Based on the existing literature, I first develop the idea that firms’ internal collaboration systems are generally more intensive than their external collaboration systems due to their richer historic content. I then argue that the influence of firms’ external collaboration systems on new product development performance is accounted for by their internal collaboration systems. I test the three conditions of mediation using data from 134 dual partner alliances. The findings provide strong support for the proposed mediation of internal collaboration on external collaboration. The contributions of alliances to product development success are thus dependent upon the firms’ internal collaboration structures and processes. I conclude the paper with a discussion of its contributions and its relevant implications for collaboration and strategic alliance research, and the alignment of collaboration systems over time.
4.1 Introduction

Collaboration both within the firm (internal collaboration) and between separate entities (external collaboration) is a central theme in strategic and innovation domains (Barki & Pinsonneault, 2005; Gerwin, 2004; Hillebrand & Biemans, 2004; Takeishi, 2001). However, while the benefits of both firm internal and external collaboration are widely touted in the literature, there is equally widespread evidence that the relationship of each with firm performance is problematic (Barki & Pinsonneault, 2005; Goodman, 2000). For instance, firms often find themselves in a dilemma, where increases in the intensity of internal collaborative activities and performance may positively affect goals and objectives at one organizational or system level, but do not have any effect or even have negative consequences on another organisational or system level (Das & Teng, 2004; Goodman, 2000; Janis, 2004; McEvily, Perrone, & Zaheer, 2003). Similarly, empirical studies found that maximizing the intensity of external collaboration alone may not necessarily lead to increased firm performance levels (Das & Teng, 1998; Kale & Anand, 2006).

The majority of today’s product and service innovations require a firm to engage in collaboration within the firm and simultaneously collaborate with entities outside the firm through strategic alliances and other forms of strategic partnerships (Spekman, Kamauff, & Myhr, 1998; Takeishi, 2001). Yet for the most part, researchers have chosen to treat each as separate, independent entities. That is, research on internal collaboration and that on external collaboration represent two largely disconnected streams, ignoring the possibility that the relationships between a firm’s internal and external collaboration systems may be more important for innovation performance than the alignment of either alone. This possibility has also been noted by Hillebrand and Biemans (2004), Sanders and Premus (2005), and Stank, Keller, and Daugherty (2001).
For instance, Hillebrand and Biemans (2004: 118) argue that “good internal cooperation is required for good external cooperation”. Takeishi (2001: 419) further stresses that while collaborating with suppliers may bring a manufacturing firm some benefits, internal capabilities have to be developed and constantly improved to effectively coordinate activities with a supplier and simultaneously manage those within the firm (Takeishi, 2001: 418). Similarly, Vickery et al. (2003: 526) also point out that successful supply chain integration involves “balancing” intra-firm and inter-firm collaboration.

However, approaches to test these alignments have, for the most part, only correlated a composite measure of internal collaboration with that of external collaboration (Larson & Rogers, 1998; Vickery, Jayaram, Droge, & Calantone, 2003) without examining the nature of their relationship as a predictor of performance. Exceptions to this are two studies by Sanders and Premus (2005) and Stank et al. (2001). Stank et al.’s (2001) study confirmed and Sanders and Premus’ (2005) study later assumed that the combined contribution of a firm’s internal and external collaboration activities is one where the impact of external collaboration on performance is mediated by internal collaborative activity.

It is difficult to make generalizations from these two studies about the specific nature and impact of an alignment of a firm’s internal with its external collaboration activities on innovation. This is mainly because both studies examined the impact of firms’ general internal and external collaboration practices on logistics service performance as part of ongoing - and generalized - supply chain activity. Moreover, because both studies used limited and different sets of components to measure internal collaboration versus external collaboration, it is difficult to compare and contrast internal versus external collaboration structures and practices. In addition, neither of the two studies include relational/behavioural attributes in their measures of collaboration - such as
Based on my analysis in core paper 1, I use the five most frequently occurring descriptors of collaboration (collaborative attributes) that capture a range of activities that 119 previous collaboration studies have used in their theory development and empirical examinations. These collaborative attributes, each of which can vary in their intensity are: (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. This multi-dimensional nature of collaboration leaves the possibility that a firm may engage in different collaborative configurations or ‘systems’ in its internal collaborations and in its external collaborations. Based on this multi-attribute definition of collaboration systems, I introduce a number of propositions that are aimed at gaining insights into the relationship and alignment between focal firms’ internal and external collaboration systems that are associated with innovation success. Specifically, based on the previous findings by Stank et al. (2001) and Sanders and Premus (2005), I consider the possibility that internal collaboration mediates the impact of external collaboration in the context of new product development.

This paper contributes to existing research efforts in a number of ways. First, it conceptualizes collaboration, independently of whether it takes place within and/or between collaborating firms, as a multi-dimensional, organizational system. Second, it highlights, along the same collaborative activities, possible differences in the nature of firm internal versus external collaboration. Third, it empirically shows that the influence of focal firms’ external collaboration systems on innovation performance is accounted for by their internal collaboration systems. These findings raise new questions about
both measuring and managing firm internal and external collaborative activity during product innovation.

The remainder of the paper is organized as follows. The next section develops the idea that the intensity levels of firms’ internal collaboration system attributes are likely to be higher than the intensity of their external collaboration system attributes due to the richer path dependency of firm internal collaborative activity. I then put forward a number of propositions to test the possibility that firms’ internal collaboration systems mediate the relationship their external collaboration systems have with product innovation success. I conduct an empirical test of these arguments using survey data from 134 focal firms involved in dual-partner innovation alliances. I conclude with a discussion of the implications.

4.2 Theory and Hypotheses

Following a conceptualization of collaboration systems, I develop four hypotheses that focus on the relationships between internal and external collaboration systems and innovation performance. These hypothesized relationships are illustrated in Figure 4.1 below.

![Figure 4.1 The Conceptual Model](image-url)
4.2.1 Toward a Common Definition of a Collaboration System

The concept of collaboration is defined and used in many different ways in social sciences. Collaboration, in general, has been used, together with a number of other terms (i.e. integration, cooperation, interaction), as an umbrella term to portray the nature and management of similar activities among collaborating parties engaged with one another for a common purpose within and/or between different firms (Schleimer, 2007). Collaboration has usually been understood not as a single entity, but as a phenomenon comprised of multiple attributes, which vary in intensity (Barki & Pinsonneault, 2005; Frishammar & Hoerte, 2005; Schleimer, 2007). In the previous core paper 1, I was able to identify a number of collaborative attributes that consistently appear as descriptors of collaboration in over 100 studies, independently of whether the study’s focus was on collaboration within the firm or collaboration among separate entities.

The five attributes, which capture most of the activities among collaborating parties at different intensity levels include: (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. In collaboration studies, *mutual communication* usually captures the intensity level to which collaborating parties within and between firms share information with one another via different communication tools and mechanisms (Frishammar & Hoerte, 2005; Kahn, 1996). *Sharing responsibilities* reflects the intensity to which collaborating parties contribute equally in decision-making, complement one another, and share responsibilities for outcomes (Hoegl et al., 2004; Sanders & Premus, 2005; Zollo, Jeffrey, & Singh, 2002). *Joint engagement* reflects the intensity with which collaborators plan and assist each other to achieve goals of all involved parties (Mohr & Spekman, 1994; Petersen, Handfield, & Ragatz, 2003). *Relationship commitment* comprizes the intensity of an exchange partner believing that an ongoing relationship
with one another is so important as to warrant maximum efforts at maintaining it (Hoegl et al., 2004; Morgan & Hunt, 1994). Lastly, *mutual trust* represents the intensity of positive assumption about the motives and intentions collaborating parties hold for one another (Das & Teng, 1998; McEvily et al., 2003; Morgan & Hunt, 1994).

This multi-dimensional nature of collaboration presents the possibility that a firm may engage in different ‘collaborative configurations or systems’ in its internal collaborations and in its external collaborations. The term ‘system’ recognizes that each attribute is a distinct entity, yet when coordinated with the others, it results in a particular configuration of collaboration. The notion of ‘collaboration systems’ thus becomes a way to explore alignment between internal and external collaborative activities.

### 4.2.2 Intensity Levels of Internal versus External Collaboration Systems

Over two decades ago, Jay Galbraith (1983) proposed that firms learn and crystallize different lessons associated with the stage of vertical chain in which they began operating. The lessons learned at this initial stage, the “center of gravity” influence a firm’s successive values, business lessons, management systems, succession path, organization, and mindsets. A decade after Galbraith’s propositions, Ilinitch and Zeithaml (1995) provided evidence that firms that operate close to their historical centers of gravity were able to successfully apply the values and routines that contributed to their initial success. More recently, scholars (Marsh & Stock, 2003) have argued that collaborative patterns among parties within a firm also have inherited a content that stems from their historical centers of gravity. Firm internal collaboration has embedded routines that evolve over time and are based upon and embedded in successful past organizational routines and practices of a firm (Gupta, Tesluk, & Taylor, 2007).
The influence of a historic content on the future as such has been called the “shadow of the past” (Poppo, Zhou, & Ryu, 2008), and also referred to as “path dependency” (Schreyoegg & Kliesch-Eberl, 2007). The intensity of collaboration among functional units in any particular new product development may therefore have embedded rich, but sometimes inappropriate, excess baggage of past decisions and collaborative patterns that have shaped its current nature.

On the contrary, it has also been argued that the historic content of collaboration does not necessarily convey high intensity levels because collaborative activities within the firm can become semi-automated routines over time (Brusoni & Prencipe, 2001; Chesbrough, 2003). That is, a new strategic partnership, where partnering firms cannot rely on routinized processes, may require comparably higher intensity levels in order to successfully develop complex new products and services (Gerwin, 2004). However, in my examination of 119 collaboration studies in core paper 1, I found that a majority of studies that examined collaboration within the firm reported higher intensity levels on all collaborative attributes than those studies that explored collaborative activity between separate entities.

The collaborative practices between focal and their partnering firms can also carry a historic content of previous relationships between them. This historic content can shape future partnerships between these entities. Researchers have found a positive relationship between experience accumulation of a firm with another firm and the intensity with which they collaborate with one another (Santoro, 2000; Simonin, 1997; Zollo et al., 2002). However, the scope and depth of collaborative relationships within the firm may be much richer than that between different firms due to the longer and richer historic path of collaborative activity. That is, different functional units usually have shared task assignments that existed well before and extend well beyond those for any particular product development (Xie, Song, & Stringfellow, 2003). This historic
path is usually not as rich between partnering firms who may not necessarily have shared or will share collaborative relationships before or after any particular development.

Extrapolating from this, in general, one would expect that the historic content of collaboration is stronger internally than externally and that it is manifested in the presence of more intensive collaboration within a firm than in the collaborative environment between partnering firms.

I therefore argue:

**H1: In innovation alliances, the intensity levels of collaboration systems among functional units within focal firms will be higher than the intensity level of collaboration systems between the focal firms and their partnering firms.**

4.2.3 The Impact of Focal Firms’ Internal Collaboration Systems on Performance in Product Development Alliances

Numerous internal collaboration studies have empirically linked the intensity of collaboration among functional units within firms to new product development performance (Frishammar & Hoerte, 2005; Hoegl et al., 2004). Studies that examined internal collaboration together with firm to firm collaboration have furthermore pointed out that firms need to engage in high intensity levels of internal collaboration before initiating collaborative arrangements with other firms (Sanders & Premus, 2005; Stank, Keller, & Daugherty, 2001). In addition, Hillebrand and Biemans (2004, p.119) put forward that organizational cultures that stimulate high intensity levels of communication, long-term commitment, sharing of information and resources are “prerequisites” for developing these attributes in partnerships with other firms.
Similarly, Stank et al. (2001) argued that the inability to engage in intensive collaboration among functional units within the firm is a leading cause of strategic alliance failure. Specifically, in their empirical studies on collaboration in the supply chain, Stank et al. (2001) and Sanders and Premus (2005) both found that in the presence of external collaboration, the intensity of internal collaboration has a direct positive relationship with logistics performance.

Therefore, in line with these previous findings, I argue that:

\[ H2: \text{In innovation alliances, the intensity of collaboration systems among functional units within focal firms has a direct positive influence on innovation performance.} \]

4.2.4 The Influence of External Collaboration Systems on Internal Collaboration Systems

Recent studies point out that by engaging in external collaboration, firms force higher intensity levels of collaboration among their internal functional units (Sanders & Premus, 2005; Stank et al., 2001). However, these studies do not specify as to why external collaboration intensity influences internal collaboration. Researchers point out that a focal firm, in general, has less control over its external collaborative environment than over collaboration within its own boundaries (Inkpen & Currall, 2004; Takeishi, 2001). This may occur, because in a partnership with another firm, changes in intensity to the collaboration may be initiated by the partnering firm, or forced upon by other market influences that the focal firm has little control over (Reuer & Arino, 2002; Reuer, Zollo, & Singh, 2002). Within the firm, however, the intensity of collaboration is usually a product of purposeful coordination and changes in the intensity of collaboration usually resemble a deliberate decision by the firm.
Following from this, the focal firm may be more likely to adjust its internal collaborative systems to adapt to changes in its external collaboration systems than vis-à-vis. If the patterns would be reversed and internal collaboration would influence external collaboration intensity, it may indicate that the firm is not adaptive to changing demands stemming from the dynamic external collaborative environment (Stank et al., 2001).

I therefore argue:

**H3**: In innovation alliances, the intensity of the focal firms’ external collaboration systems influences the intensity of their internal collaboration systems.

### 4.2.5 The Influence of External Collaboration Systems in the Product Development Alliance

The supply chain management studies by Stank et al. (2001) found, and later Sanders and Premus (2005) assumed that internal collaboration mediates the influence external collaboration has on logistic service performance. Stank et al. (2001, p.40) explained these patterns in that “a firm can still drop the ball internally after receiving positive input and directions from external partners”. Recently, Subramani (2004) also found that collaboration among buyer and supplier firms is directly constrained by the communication within the supplier firm. That is, internal collaboration mediates buyer-supplier collaboration.

Following from these arguments, it is possible that a firm is able to adjust the intensity of its internal collaborative systems toward changes in the external collaborative systems and that internal collaboration intensity has a direct relationship with performance. It may therefore be possible that the intensity of the internal
collaboration systems mediates the impact the intensity of the external collaboration systems has on innovation performance. Put in another way, the potential contributions of external partnerships are dependent upon the firms’ internal collaboration systems.

I hypothesize:

\[ H4: \text{In innovation alliances, the effect of the intensity of focal firms’ external collaboration systems on new product development performance is mediated by the intensity of their internal collaboration systems.} \]

### 4.3 Method

#### 4.3.1 Sample and Procedures

I tested the hypotheses utilizing survey data collected on a sample of 134 dyadic innovation alliances. The survey was developed from interview results and pre-existing scales of numerous collaboration studies that were part of a pilot survey. The pilot survey was done in form of a person-administered survey on 30 managers in several industry sectors that reflected a similar orientation to those, who subsequently completed the main questionnaire. The face validity of the survey was further assessed by pre-testing the instrument with a convenience sample of 30 product managers of one industry association (none of whom were included in the final dataset).

For the main data collection, I initially selected 29 national industry associations and other industry bodies from the Australian Competition and Consumer Commission directory and other Australian government sources. 13 industry associations/industry bodies agreed to distribute the survey invitation to their member firms via an electronic mail and/or their monthly newsletter. The criteria for choosing the sample respondents were as follows: The managers had (at least partly) overseen a recent product development that involved collaboration with at least one key partnering firm located
anywhere in the focal firm’s value chain. Furthermore, the manager had to be located in a firm, which had at least one major subunit (e.g. subsidiary and/or headquarters) situated in Australia. Of the 3620 surveys e-mailed, I received 359 responses, which is a response rate of 9.9%. Although this response rate is low, it is similar to previous surveys sampling senior product managers (Sanders & Premus, 2005).

109 surveys were only partially answered (less than 60% of the survey questions), which left me with fully completed survey data from 250 firms. Of these, 82 firms were engaged in a collaborative agreement with a partnering firm; however, they only had a single business unit involved in this joint collaboration. Thus, they did not engage in collaboration among units within the firm during their chosen product development. Of the remaining 168, 34 alliances had successfully developed a product, however, the product was not released to the market as yet and questions concerning its success could not be answered. This left data of 134 alliances that also entailed collaboration among functional units within focal firms from the viewpoint of product managers located in these firms. The respective focal firms belonged to 11 different industry sectors. 73.2% of the respondents were located in their firm’s headquarters. Over 75% of the respondents have been involved in product development for at least three years and a vast majority of them held positions of either senior managers (38.1%) or managing directors (23.8%). On average, the respondents had been working in the development of products for at least 6 years. Of the respondents, a majority were located in the marketing department (39), R&D department (29), sales department (20), manufacturing (13), or design department (12) in their respective firms.

Because I did not obtain data from different managers within the firm, but only a single person located in a single functional unit, I checked for bias in terms of the location of the functional unit the managers were from by splitting the sample into functional specialisation such as marketing, R&D, manufacturing, design and others.
The findings revealed no significant difference in terms of the type of unit (p > .10). The involvement of specific functional units within the focal and the partnering firms in the new product development process has also often been attributed with different stages in the development (Song, Thieme, & Xie, 1998). Considering the non-significance, I therefore assume that the impact of intensity of collaboration is not related to the stage of the innovation process during which the alliance took place.

I also checked for non-response bias on the basis of the recorded information about member firms from the respective industry associations. The mean differences between responding and non-responding firms along firm attributes, such as firm size and location, were contrasted using a t-test; all statistics were non-significant. Moreover, I implemented a series of logistic regressions, measuring whether the time at which the respondents answered the survey had a significant impact on the variables such as size of the firms, their respective industry sector, and gender. The analyses yielded insignificance for all regressions (p > .10).

4.3.2 Measurement

Scales for the study consisted of newly generated items and items that have been used previously in the literature. When a new scale was developed, it was based on suggestions and findings in the existing literature. All of the main constructs were measured using multiple items requiring an indication of intensity on a five point Likert-typed scale for each item. For measurement consistency, I calculated the coefficient alpha. Reliability values of all constructs met Nunnally’s (1978) criterion of acceptability of 0.70 or above. Construct validation was assisted through the use of exploratory factor analyses.
Dependent Variables

New product development performance. Consistent with prior work on performance measures, due to the variety of industries and firm sizes included in the sample, and because the objectives and performance criteria of the firms varied, a multi-dimensional measure of performance was considered most appropriate. The index was comprised of five items (1) product development costs, (2) product quality, (3) customer satisfaction, (4) providing value for existing customers, and (5) attracting new customers. These items were taken from measures of new product development in previous studies (Homburg & Pflesser, 2000; Sanders & Premus, 2005; Scannell, Vickery, & Droege, 2000). Each item had a high loading coefficient of above 0.64 and an Eigenvalue of over 53% variance, explained by the first component. They therefore validated the appropriateness of individual items constituting this construct.

Independent Variables

In accordance to the previous research findings in core paper 1, I measured the collaboration system within the focal firm and between the focal and partnering firm along two sets of five collaborative attributes that each can vary in their intensity. All five collaborative attributes contained multiple items. They were slightly altered depending on the respective context of questions about collaboration within the focal firm or collaboration between both firms (see Appendix D at the end of the thesis for the differences in the wordings of the items for internal versus external collaboration). Identical five-point Likert scales at “1 = never”, “2 = seldom”, “3 = occasionally”, “4 = often”, and “5 = quite frequently” were adopted for all items.

(1) Mutual communication. The items to measure ‘mutual communication’ were taken from a larger construct by Kahn (1996) and Frishammar and Hoerte (2005), who measured inter-unit information flow. All items loaded cleanly onto one factor (loadings
for internal collaboration: 0.64-0.74; loadings for external collaboration: 0.56-0.79). In combination with the other measures, this measure appeared to be a reliable indicator of internal collaboration (Cronbach’s alpha = 0.79) and external collaboration (Chronbach’s alpha = 0.80).

(2) Sharing responsibilities. All four items of this measure are taken from a larger construct developed and measured by Hoegl et al. (2004). The authors reported a coefficient score between 0.70 and 0.89 for all items and therefore the items appear to have sound measurement properties and appropriately reflect the conceptual definition of this construct. The measure loaded cleanly on one factor (loadings for internal collaboration: 0.78-.0.82; loadings for external collaboration: 0.82-0.88), had an overall coefficient score of 0.81 (for internal collaboration) and 0.88 (for external collaboration) and was therefore retained in the analysis in this study.

(3) Joint engagement. The level of joint engagement between collaborating parties refers to the extent to which partners jointly plan, set goals, advice, and assist each other (Mohr & Spekman, 1994). All five items were taken from two scales used by Mohr and Spekman (1994). The items loaded cleanly on one factor (loadings for internal collaboration: 0.77-0.84; loadings for external collaboration: 0.65-0.80), and had an overall coefficient alpha score of 0.87 for internal collaboration and 0.82 for external collaboration.

(4) Relationship commitment. I chose to take four items from the seven-item measure of relationship commitment developed and used by Morgan and Hunt (1994). The findings reported by Morgan and Hunt (1994) show the items to be highly reliable (coefficient score of 0.90). Morgan and Hunt adapted all items from an earlier study by Mowday et al. (1979). I decided to drop three items from Morgan and Hunt’s study (1994) due to their low Cronbach alpha scores during the internal consistency test in the pilot phase of the study. The remaining four items loaded cleanly into one factor
(loadings for internal collaboration: 0.84–0.89; loadings for external collaboration: 0.87-0.92), appeared to be a reliable indicator of internal collaboration (overall coefficient score 0.89) and external collaboration (overall coefficient score 0.91) and therefore soundly reflected the conceptual definition of this construct.

(5) Mutual trust. All items were taken from existing scales in a study by Morgan and Hunt (1994). Research findings by Morgan and Hunt suggested that the indicators are reliable measures of trust based in the coefficient alpha (0.95). The measures were originally developed by Larzelere and Huston (1980), who explored close interpersonal relationships. Following, in the piloting of this measure satisfactory internal consistency levels were not achieved for three of the original seven items. I therefore decided to measure trust only with four of the seven-item scale developed by Morgan and Hunt (1994). These remaining four items loaded cleanly on one factor (loadings for internal collaboration: 0.82-0.91; loadings for external collaboration: 0.90-0.92), had an overall coefficient score of 0.90 for internal collaboration, 0.92 for external collaboration, and were therefore retained as adequate measurement properties in the analysis in this study.

Control variables. To reduce potential confounding effects, I controlled for several variables known to correlate with firm internal and external collaboration: Effect of firm size using the number of full-time employees (Stuart, 2000); accumulated collaborative experience (number of previous joint developments) both firms had with one another before the product development (Simonin, 1997; Zollo et al., 2002; Handfield et al., 1999); number of units involved from the focal and the partnering firm (Schulz and Hoegl, 2006); number of firms involved (Garcia-Canal, Valdes-Ilaneza, & Arino, 2003); form of agreement (1 = contractual, 0 = non-contractual) between the focal and partnering firm; and whether a product or service was developed (1 = product, 0 = service). I initially also controlled for the following additional factors known to correlate with collaboration: Industry sectors of the focal and partnering firm,
radicalness of the product innovation, the length of the product development in general, and the length of the alliance in specific. However, these factors were never significant and were therefore not included in the following report of the analyses.

4.4 Analyses and Results

Hypothesis 1 proposed that the intensity levels of collaboration among functional units within the firm will be higher than the intensity of collaboration between the focal and partnering firm. Table 4.1 depicts the bivariate correlation matrix and Table 4.2 presents the results from the paired sample t-test, which was used to assess Hypothesis 1.

Table 4.1 Descriptive Statistics and Pearson Correlation Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Internal mutual communication</td>
<td>3.58</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. External mutual communication</td>
<td>3.41</td>
<td>.68</td>
<td>.40**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Internal sharing responsibilities</td>
<td>3.35</td>
<td>.71</td>
<td>.49**</td>
<td>.20*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. External sharing responsibilities</td>
<td>3.35</td>
<td>.82</td>
<td>.10</td>
<td>.54**</td>
<td>.22*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Internal joint engagement</td>
<td>3.48</td>
<td>.71</td>
<td>.62**</td>
<td>.32**</td>
<td>.69**</td>
<td>.23**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. External joint engagement</td>
<td>3.48</td>
<td>.69</td>
<td>.15</td>
<td>.50**</td>
<td>.27**</td>
<td>.67**</td>
<td>.33**</td>
<td></td>
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<tr>
<td>7. Internal relationship commitment</td>
<td>3.62</td>
<td>.73</td>
<td>.39**</td>
<td>.13</td>
<td>.63**</td>
<td>.08**</td>
<td>.51**</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. External relationship commitment</td>
<td>3.86</td>
<td>.77</td>
<td>.10</td>
<td>.36**</td>
<td>.20*</td>
<td>.56**</td>
<td>.27**</td>
<td>.57**</td>
<td>.30**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Internal mutual trust</td>
<td>3.83</td>
<td>.70</td>
<td>.28**</td>
<td>.16</td>
<td>.48**</td>
<td>.25**</td>
<td>.51**</td>
<td>.30**</td>
<td>.69**</td>
<td>.47**</td>
<td></td>
</tr>
<tr>
<td>10. External mutual trust</td>
<td>3.75</td>
<td>.74</td>
<td>.12</td>
<td>.40**</td>
<td>.25**</td>
<td>.59**</td>
<td>.25**</td>
<td>.62**</td>
<td>.24**</td>
<td>.78**</td>
<td>.47**</td>
</tr>
</tbody>
</table>

a n = 134; two-tailed; ** p < .01, * p < .05

As predicted and summarized in Table 4.2, the intensity levels for mutual communication among functional units within the focal firms were significantly higher than the intensity of mutual communication between the focal and partnering firms.
(mutual communication: \( t = 2.59, p<.05 \)). Also, the intensity levels of mutual trust and sharing responsibilities among units within the focal firms were higher than between the focal and partnering firms; yet, these differences were not significant (mutual trust: \( t = 1.28, \text{n.s.} \); sharing responsibilities \( t = .045, \text{n.s.} \)). Contrary to what I expected, the intensity levels of relationship commitment were significantly higher (\( t = -3.10, p<.01 \)) in the relationship between the focal and partnering firms than among units within the focal firms. Thus, Hypothesis 1 is supported only in terms of mutual communication, but not for the other four collaborative attributes.

### Table 4.2 T-Test Statistics

<table>
<thead>
<tr>
<th>Intensity of collaborative attributes</th>
<th>Mean</th>
<th>S.d.</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal: 3.58</td>
<td>external: 3.41</td>
<td>internal: .70</td>
<td>2.59</td>
<td>.014</td>
<td>.17</td>
</tr>
<tr>
<td>Joint engagement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal: 3.48</td>
<td>external: 3.48</td>
<td>internal: .71</td>
<td>-.04</td>
<td>.97</td>
<td>-.002</td>
</tr>
<tr>
<td>Sharing responsibilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal: 3.35</td>
<td>external: 3.34</td>
<td>internal: .71</td>
<td>.05</td>
<td>.96</td>
<td>.004</td>
</tr>
<tr>
<td>Relationship commitment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal: 3.62</td>
<td>external: 3.86</td>
<td>internal: .73</td>
<td>-3.10</td>
<td>.002</td>
<td>-.24</td>
</tr>
<tr>
<td>Mutual trust</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal: 3.83</td>
<td>external: 3.75</td>
<td>internal: .70</td>
<td>1.28</td>
<td>.20</td>
<td>-.08</td>
</tr>
</tbody>
</table>

\( a \) \( n = 134 \); two-tailed

The three remaining hypothesized relationships were tested similarly to Tiwana (2008), but following the full mediation regression guidelines outlined by Baron and Kenny (1986). Baron and Kenny’s (1986) guidelines required establishing a relationship between the independent variables (external collaboration systems) with the mediator variables (internal collaboration systems) (Table 4.3). It also required a relationship between the mediator (internal collaboration systems) and the dependent variable (product development performance) (Step 3 in Table 4.4). In addition, I tested for a direct relationship between the independent variable (external collaboration system) and the dependent variable (new product development performance) (Step 2 in Table 4.4).
For ease of presentation, and following Baron and Kenny’s (1986) recommended tests for examining mediation effects, the analysis that addresses hypotheses 2 and 4 is presented after the presentation of the canonical correlation analysis addressing Hypothesis 3.

In order to test for the hypothesized relationship (Hypothesis 3) between the external collaboration systems and internal collaboration systems, I used canonical correlation analysis (CCA), which determines whether relationships exist between sets of variables (Tabachnick & Fidell, 1989). CCA tests remaining functions/variates by statistically removing variance attributable to the first variate (Alpert & Peterson, 1972). After removing variance attributable to the first variate (F (5.58) = 2.34, p < .001; Wilk’s lambda = .49)), I found that the second canonical variate was also significant (F (4.55) = 2.02, p = .001; Wilk’s lambda = .68)). I inspected one- to four- variate solutions for optimal data fit. A two-variate solution described the data structure best. All of the variables that loaded high on the third solution also loaded high (above .30) on the first or second variate. A loading of .30 is deemed high enough for saliency (Alpert & Peterson, 1972).

Table 4.3 summarizes the results for the two-variate solution and indicates which sets of internal and external collaborative attributes are associates. The results of the canonical correlation analysis suggest canonical correlation values of .55 (first variate) and .43 (second variate). Thus, together with the consistent canonical loadings above .30 for the internal and external collaboration variables in the two variates (see Table 3), the results suggest that there is a significant relationship between the independent variable (external collaboration systems) with the mediator (internal collaboration systems). Therefore, variations in intensity levels of external collaboration systems significantly account for variations in intensity of internal collaboration systems, which support my propositions made in Hypothesis 3.
Hierarchical regression was used to test Hypotheses 2 and 4 and is presented in Table 4.4. I used a stepwise regression approach in which the control variables were entered first (step 1), followed by external collaboration variables in step 2. Finally, in step 3, the mediating variables (internal collaboration system) were introduced. Hypothesis 2 proposed a positive relationship between the internal collaboration system and new product development performance. The $R^2$ increase attributable to adding internal collaboration attributes was statistically significant at the 5 percent level ($F$–change = 2.72, $p < .05$), thereby suggesting the predictive relevance of internal collaboration to the regression. The intensity of mutual communication ($\beta = 0.21$, $p < .10$), and mutual trust ($\beta = 0.29$, $p < .05$) among the units within the focal firm revealed a significant positive relationship with performance.

### Table 4.3  Results of Canonical Correlation Analysisa

<table>
<thead>
<tr>
<th>Variables</th>
<th>Variate 1</th>
<th></th>
<th>Variate 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Canonical</td>
<td>Canonical</td>
<td>Canonical</td>
<td>Canonical</td>
</tr>
<tr>
<td></td>
<td>loading</td>
<td>weights</td>
<td>loading</td>
<td>weights</td>
</tr>
<tr>
<td>Predictor set – external collaboration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External communication</td>
<td>-.27</td>
<td>-.81</td>
<td>-.89</td>
<td>-.83</td>
</tr>
<tr>
<td>External engagement</td>
<td>.49</td>
<td>.19</td>
<td>-.58</td>
<td>-.08</td>
</tr>
<tr>
<td>External sharing responsibilities</td>
<td>.48</td>
<td>.32</td>
<td>-.45</td>
<td>.35</td>
</tr>
<tr>
<td>External commitment</td>
<td>.60</td>
<td>.16</td>
<td>-.69</td>
<td>-.47</td>
</tr>
<tr>
<td>External trust</td>
<td>.73</td>
<td></td>
<td>-.60</td>
<td>-.10</td>
</tr>
<tr>
<td>Variance explaineda</td>
<td>28.6%</td>
<td></td>
<td>43.1%</td>
<td></td>
</tr>
<tr>
<td>Redundancy index</td>
<td>8.5%</td>
<td></td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Criterion set – internal collaboration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal communication</td>
<td>-.48</td>
<td>-.77</td>
<td>-.83</td>
<td>-.67</td>
</tr>
<tr>
<td>Internal engagement</td>
<td>.09</td>
<td>.02</td>
<td>-.70</td>
<td>-.09</td>
</tr>
<tr>
<td>Internal sharing responsibilities</td>
<td>.29</td>
<td>.41</td>
<td>-.60</td>
<td>.13</td>
</tr>
<tr>
<td>Internal commitment</td>
<td>.37</td>
<td>.21</td>
<td>-.71</td>
<td>-.34</td>
</tr>
<tr>
<td>Internal trust</td>
<td>.71</td>
<td>.83</td>
<td>-.67</td>
<td>-.32</td>
</tr>
<tr>
<td>Variance explainedb</td>
<td>19.3%</td>
<td></td>
<td>50.1%</td>
<td></td>
</tr>
<tr>
<td>Redundancy index</td>
<td>5.7%</td>
<td></td>
<td>9.3%</td>
<td></td>
</tr>
<tr>
<td>Canonical correlation</td>
<td>.55</td>
<td></td>
<td>.43</td>
<td></td>
</tr>
<tr>
<td>Eigenvalue R²c</td>
<td>.27</td>
<td></td>
<td>.19</td>
<td></td>
</tr>
</tbody>
</table>

*a*=134
*b*=Proportion of variance of actual observed value explained by its own underlying canonical variates.

Note: Canonical loadings .30 or greater are presented in bold.
However, relationship commitment among the units within the focal firms revealed a significantly negative relationship with performance \((\beta = -0.31, p<.05)\). The intensity of joint engagement and sharing responsibilities among units within the focal firms did not reveal any relationship with development performance. Therefore, Hypothesis 2 is only supported in terms of the intensity of mutual communication and trust among units within the focal firms. The negative relationship between commitment among the units within the focal firms and new product development performance is contrary to what I proposed.

Table 4.4  Results of Hierarchical Regression

<table>
<thead>
<tr>
<th>Control variables</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of units involved from focal firm</td>
<td>.22*</td>
<td>.23*</td>
<td>.16†</td>
</tr>
<tr>
<td>Number of units involved from partner firm</td>
<td>.08</td>
<td>.04</td>
<td>.05</td>
</tr>
<tr>
<td>Focal firm size</td>
<td>-.16†</td>
<td>-.13</td>
<td>-.19*</td>
</tr>
<tr>
<td>Partner firm size</td>
<td>.17†</td>
<td>.13</td>
<td>.19*</td>
</tr>
<tr>
<td>Number of other firms involved</td>
<td>-.15</td>
<td>-.20*</td>
<td>-.19*</td>
</tr>
<tr>
<td>Form of alliance</td>
<td>.08</td>
<td>.12</td>
<td>.13</td>
</tr>
<tr>
<td>Accumulated experience with partner</td>
<td>.09</td>
<td>.04</td>
<td>.05</td>
</tr>
<tr>
<td>Product or service development</td>
<td>-.06</td>
<td>-.02</td>
<td>.03</td>
</tr>
</tbody>
</table>

*Independent variables - collaboration between focal firm and partner.*

| Mutual communication (between firms)     | .086   | .05    |
| Joint engagement (between firms)         | .21†   | .20†   |
| Sharing responsibilities (between firms) | -.19   | -.19   |
| Relationship commitment (between firms)  | .12    | .12    |
| Mutual trust (between firms)             | .25†   | .14    |

*Mediating variables – collaboration within the focal firm*

| Mutual communication (within firm)       | .21†   |
| Joint engagement (within firm)           | -.08   |
| Sharing responsibilities (within firm)    | .20    |
| Relationship commitment (within firm)     | -.31*  |
| Mutual trust (within firm)               | .29*   |

\(R^2\) | .10 | .28 | .36 | .10 | .18 | .08 |

Hierarchical F change | 1.66 | 6.08*** | 2.72* |

Note. Dependent variable: Product success.

† All coefficients presented are standardized coefficients.

| All coefficients presented are standardized coefficients. \(p < 0.10; *p < 0.05; **p < 0.01; ***p < .001\) (two-tailed)

Hypothesis 4 predicted that the relationship between external collaboration systems and new product development performance is mediated by the internal collaboration
systems. Pre-requisites for the mediating role are that external collaboration systems influence internal collaboration intensity (which I tested and confirmed through the canonical correlation in table 3) and that internal collaboration systems are directly related to product development performance (table 4, step 3). Step 2 in the hierarchical regression (table 4) shows that the relationship of the intensity of engagement ($\beta = 0.21$, $p<.10$) and mutual trust ($\beta = 0.25$, $p<.10$) between the focal and partnering firm is marginally significantly positively related to new product development performance. The significant relationship of these variables with performance in step 2 indicates that internal collaboration systems do not fully mediate external collaboration systems (Baron and Kenny, 1986).

With the inclusion of internal collaborative attributes in step 3, however, the relationship between mutual engagement and performance is slightly reduced (step 2: $\beta = .21$, $p=.087$; step 3: $\beta = .20$, $p=.091$) and the relationship between mutual trust and performance is largely reduced and not significant anymore (step 2: $\beta = .25$, $p=.075$; step 3: $\beta = .14$, n.s.). These patterns suggest that the intensity of joint engagement and mutual trust among the focal and partnering firm is mediated by internal collaboration systems intensity. Therefore, Hypothesis 4 is supported in terms of these two collaborative attributes, but not for the other three attributes.

Also noteworthy in the regression are the significant values for the number of units involved within the focal firm, the opposing patterns for firm size of the focal versus that of the partnering firm, and the negative relationship between the numbers of other firms involved in the partnership and performance. I examine the possible implications of these correlations in the context of the discussion of the major results of this study.
4.5 Discussion

The objective of this study was to gain insights into how a focal firm aligns its internal and external collaboration systems in a new product development alliance in order to optimize new product development performance. A multi-attribute measure of collaboration was used to conduct data on 134 innovation alliances. The findings reveal a number of major results with considerable theoretical and empirical implications for collaboration and strategic alliances research. The findings confirmed that increases in the intensity levels of focal firms’ external collaboration system attributes bring out an increase in the intensity of their internal collaboration system attributes, which have a direct impact on the success of a new product development (see Figure 4.2 for a summary of the study’s findings).

Figure 4.2  Summary of Results

Note: Only significant results are reported.

\( \beta \) (t-statistic from regression), \( t \) (paired sample t-test; two-tailed), \( p \) (CCA Wilk’s lambda)

\( ^* p < 0.10; ^*^* p < 0.05; ^*^*^* p < 0.01; ^*^*^*^* p < .001 \)
The major contribution of this paper is capturing the complex mediating role that internal collaboration systems have on the relationship between external collaboration systems and new product development. In accounting for this pattern, I suspect that the mediation effect occurs because focal firms adapt towards the much more dynamic external collaborative environment and integrate new information into their own, controllable collaborative systems, albeit within parameters that are historically emanating from their centers of gravity. This interpretation is in line with resource-dependency theory in that a focal firm’s collaborative system becomes externally influenced, because it attends to external changes and demands (Pfeffer & Salancik, 1978). However, caution has to be exercised with this interpretation, as I tested the common collaborative activities that are prominent in both collaboration systems but did not examine the distribution of these activities. Increases in the intensity of internal collaboration patterns may not necessarily impact on the alliance activities, as they may be unrelated tasks. Future research is likely to gain a much clearer insight into this pattern by examining the specific activities/tasks in the internal versus external collaboration environment during a particular innovation alliance.

I theorized, but could not confirm that the intensity of the focal firms’ internal collaboration systems is higher than that of their external collaboration systems in a new product innovation. It has been argued that because collaborative activities within the firm can become semi-automated routines, the shadow of the past does not necessarily convey high intensity levels (Gerwin, 2004). The nature of a focal firm’s internal collaborative routines and processes may therefore have little to do with their intensity level. That is, the ‘centre of gravity’ with which a focal firm aligns its internal collaboration systems may be more a complex balancing act rather than a simple maximization of the intensity of its collaboration system attributes.
The intensity of a majority of internal collaboration systems attributes had a direct, yet different relationship with performance. The intensity of mutual communication, relationship commitment, and mutual trust among involved units within the focal firms was each directly related to new product development performance. However, the directions of these relationships varied. The positive relationships of the intensity levels of mutual communication and mutual trust among the units within the focal firms and new product development performance may be carried by well-established collaborative routines. For instance, researchers have argued that intensive communication patterns among different functional units can only be established over time (Gupta & Wilemon, 1988). Similarly, it has been argued that mutual trust is the outcome of prior history of frequent transactions among collaborators (Poppo et al., 2008). Sharing information across different functional units of a firm has been pointed out to be a crucial part of successful firm collaboration (Cooper & Kleinschmidt, 1986) and so has the intensity of mutual trust (Gupta & Wilemon, 1988; McEvily et al., 2003). With high levels of communication exchange, functional units often provide each other with sensitive information as a way of showing both goodwill and intimacy (Das & Teng, 1998). As this reciprocal process of information exchange evolves, mutual trust is created (Poppo et al., 2008) and along with trust, the content of these communication patterns may become unique and represents a hard to imitate capability (Hoopes & Postrel, 1999).

The negative relationship between commitment among involved units within the focal firms and new product development performance was surprising but can be explained by the nature of relationship commitment. High intensity of relationship commitment stands for high effort towards the relationship among the units. It may be possible that high levels of effort cause insufficient allocations of critical reflections. That is, functional units may be so caught up in making the relationship work that they fail to critically evaluate processes and the relationship itself. It may also be likely that
too much effort on the relationship among specific units hinders their collaboration with other units outside the project. That is, studies found that although commitment among members of a team fosters communication and psychological safety among its members, those teams, which also collaborated with outsiders, outperformed those that were solely oriented on making the team itself work (Ancona & Bresman, 2007). The negative pattern may, however, also be due to the nature of task assignments. Units are often engaged in different projects simultaneously (Pinto, Pinto, & Prescott, 1993). High levels of commitment into one task/relationship may hinder the units’ efforts to collaborate with individuals and groups on other projects and/or product developments (Thomas, 2000). Testing these alternative explanations represent interesting future research avenues.

The analyses also suggest that the impact of the intensity of joint engagement and mutual trust in the alliance relationship on performance is partly mediated by the intensity of the focal firm’s internal collaboration system. This pattern is consistent with the explanation advanced by Stank et al. (2001). They justified a mediation effect as such in that although a firm may have a ‘good’ external collaborative relationship with a partnering firm, ‘poor’ internal collaborative relationships can still eliminate potential benefits gained through external collaboration. More specifically, the ways firms align their internal collaboration systems may largely determine how much value they can exploit from the collaboration with their partners. The focal firm thus needs to adapt its internal collaboration systems in order to exploit the maximum value of the changing demands of its external collaborative environment.

Lastly, a further appreciation of the complex ways in which properties of the firm’s collaboration systems impact on new product performance can be gleaned from examining the significant relationships of the control variables with new product development performance. For instance, the regression results revealed a significantly
positive relationship between the number of units involved within the focal firms and new product development performance. An explanation for this pattern could be that, with an increasing number of units involved in the development of a new product development, the focal firm devotes increasing efforts into the development of a new product, which, in turn leads to better performance. Also, the size of the focal firms was significantly negatively related to development performance (β = -.19, p<0.05) and the partnering firm’s size significantly positively related with development performance (β = .19, p<0.05). These patterns seem surprising and unusual at first glance. Previous research has, however, found that focal firms, which collaborate with larger sized partners, perform better than otherwise comparable firms that lack such partners (Stuart, 2000). In accounting for this pattern, Stuart (2000: 806) has suggested that because large firms are recognized for their reliability and track record, the alliance with the smaller firm signals that the smaller firm has something unique, such as quality or innovativeness. Therefore, an alliance between a small focal and small partnering firm does little to promote an outstanding product compared to when a larger firm chooses to be in the alliance with a much smaller firm.

I also found a negative relationship between the number of firms involved in the alliance and new product development success (β = -.19, p<0.05). This finding is contrary to some previous studies, which have argued from a resource-based perspective, that a larger number of firms involved potentially leads to a larger pool of resources that can be shared among collaboration partners (Lane, Salk, & Lyles, 2001). However, other studies have found that with an increasing number of firms involved, potential partner redundancy (Baum, Calabrese, & Silverman, 2000), excess renegotiations throughout the life of the collaboration (Reuer et al., 2002), increased coordination costs (Garcia-Canal et al., 2003; Gong, Shenkar, Luo, & Nyaw, 2007; Park & Ungson, 2001), decreased opportunities for rigorous communication (Baum et al.,
decreased levels of relationship commitment (Gong et al., 2007) and increased rivalry among collaboration partners (Kogut, 1988) may occur. Consistent with the findings that internal collaboration mediates external collaboration, future research might explore, whether firms, which have a larger number of collaborating partners are more constrained in their ability to mediate each external relationship.

4.6 Limitations

Despite its strengths, a number of limitations of this study merit further discussion. Although I aimed at testing a variance model by using cross-sectional data, longitudinal data would have provided different insights into the mediating nature of internal collaboration over a number of external collaborative endeavours. Second, the data is based from the viewpoint of focal firms about themselves and about their partner. It does not include direct data from the partnering firm. Nor does it include information about collaboration practices with other firms involved in the alliance and their respective positions and responsibilities in the value chain. Third, I only obtained data from a single respondent located in one functional unit within each focal firm. Fourth, although this study provided a test of a multi-dimensional definition of firm collaboration, the baseline model only used the five most commonly employed dimensions and did not include other dimensions of firm collaboration that other researchers may identify.

In addition, due to sample size constraints, I was not able test a full moderation model in addition to the mediation model between firm internal and external collaborative attributes. I suspect that the inclusion of interaction terms within and across the internal and external collaborative attributes will shed more light on the nature and impact of the association of firm internal and external collaboration beyond what I tested.
4.7 Implications and Conclusion

In the following sections, I summarize the implications of the findings for further research under three themes: research on collaboration; research on strategic alliances; and collaboration system alignment in a dynamic environment.

4.7.1 Research on Collaboration

With few exceptions, existing literature on collaboration has examined firm internal collaboration separately from external collaboration, although they are likely to occur at the same time (Hillebrand & Biemans, 2004). The patterns found in this study suggest that internal and external collaboration systems look and influence new product development performance differently. Therefore, a shift in focus from a one-dimensional or composite measure of collaboration to a system comprised of multiple attributes allowed me to gain initial insight into the complex relationship internal and external collaborative activities have with performance of a particular new product development.

This research aimed at providing a clearer understanding of the complex relationships between internal collaboration systems and external collaboration systems in an innovation context. As both represent different, complex systems, further research is needed to understand how the systems components interact within as well as between systems. In particular, the question arises as to whether internal collaboration systems also represent moderating mechanisms on the impact of external collaboration systems.

4.7.2 Research on Strategic Alliances

Although much innovation generation in strategic alliances occurs within each involved firm, the majority of prior alliance studies have focused on the strategic alignment of collaborative activities between partnering firms rather than within each firm. This
focus is appropriate for many routine and arm’s length inter-firm partnerships and entirely necessary for those partnerships where the collaborating firms only have a single functional unit involved. These situations, however, represent exceptions to the rule. That is, in most instances, where firms engage in collaborative partnerships with outsiders, collaboration simultaneously takes place within the firms. Where collaboration within and between firms occurs simultaneously, this research has shown that the mediating influence of internal on external collaboration is more important than the impact of the strategic alliance on innovative performance alone. Therefore, researchers who focus on alliances must build into their models and frameworks firm internal collaboration practices. Failure to include them is likely to lead to incomplete platforms for advancing theory and practice on strategic partnerships.

4.7.3 Collaboration Systems Alignment in a Dynamic Environment

Although the inquiry into the alignment of collaboration systems in this study was for a specific point in time, it is realistic to assume that as people and externalities change, collaboration systems also change over time. Such changes are likely to occur more frequently in external collaboration systems, where there are more changing choices of collaboration partners than in internal collaboration systems. Within the firm, it may be more likely that collaboration practices and routines are developed, partly due to path dependency and structural inertia. Therefore, although internal collaboration systems may change over time, this change may be more gradual than that of external collaboration systems. Furthermore, it is possible that a firm needs to be stable, yet simultaneously flexible in order to be responsive to changes in its external environment. This assumption views collaboration within the firm as a possible stability-flexibility paradox and represents another interesting future line of research.
As innovation alliances become increasingly important in the developments of new products and services, this study has demonstrated the need for researchers to look beyond the alliance relationship when determining alliance success. A crucial step for future internal/external collaboration research and theory development is therefore to abandon the existing ‘either/or’ thinking and adopt a ‘both/and’ approach when exploring innovation-focused alliances that also include collaboration among functional units within the involved firms.
4.8 References


CHAPTER 5
Core Paper 3

Value-Adding Configurations of Internal and External Collaboration Systems in New Product Development

Preface

Core paper 2 revealed that firms’ internal collaboration systems mediate the impact their external collaboration systems have on innovation performance. Building on the independent contributions of the five collaboration system attributes to innovation performance found in core paper 2, this paper investigates how focal firms’ internal and external collaboration systems are configured in new product development. It does so by examining whether interactive relationships among the firm’s internal collaboration system attributes add additional value to their independent contributions (as was found in core paper 2). In addition, it explores the possibility that external collaboration systems, albeit being largely mediated by the internal collaboration systems (found in core paper 2), also lead to new product development performance through synergistic interactions among the collaboration system attributes.

A modified version of this paper has been presented at the Academy of Management Annual Meeting, Los Angeles/U.S., August 2008.

An amended version of this paper will be submitted to the Journal ‘Business Strategy’.
Value-Adding Configurations of Internal and External Collaboration

Systems in New Product Development

Abstract

Recent research on innovation systems has put forward that internal and external collaboration are interrelated subsystems that need to be examined in the context of each other. In core paper 2, I found a mediating influence of firm internal collaborations systems on external collaboration systems for new product development performance. Building upon the independent contributions of the collaboration systems attributes found in core paper 2, I propose that different configurations among the attributes within the focal firms’ internal collaboration systems and within their external collaboration systems (identified in core paper 1 as mutual communication, joint engagement, sharing responsibilities, relationship commitment, and mutual trust) lead to new product development performance. Tests using data from 134 dual partner strategic alliances find broad support for the propositions.
5.1 Introduction

Systems concepts have been applied in different contexts, including firm internal collaborative activity (Schilling & Steensma, 2001; Von Hippel, 2001) and firm to firm (external) collaborative relationships (Hoetger, Swaminathan, & Mitchell, 2007; Schilling, 2000). In core paper 2, I defined collaboration within and between firms as systems comprizing intertwining strands of collaborative attributes each of which can vary in intensity. I tested and found broad support for a complex mediation effect of focal firms’ internal collaboration systems on their external collaboration systems in terms of the collaborative attributes during a new product development.

Whilst core paper 2 revealed insights into the relationships between internal and external collaboration systems, it did not investigate how internal and external collaboration systems are each configured in a new product development. Therefore, in this study, I investigate whether there are interactive configurations among firm internal collaboration system attributes that lead to performance over and above their independent contributions, as reported in core paper 2. In addition, I examine whether firms’ external collaboration systems lead to new product development performance through interactive configurations among their system attributes despite being mediated by internal collaboration systems (core paper 2).

In the body of the paper, I conduct an empirical test of these propositions using survey data from 134 focal firms involved in product innovation alliances with their key partners. In the final section of the paper, I discuss the implications and provide contributions, limitations and future research directions.

5.2 Theory and Hypotheses

A conceptual diagram that captures the focus of this study is provided in Figure 5.1 below. It also includes the relationships tested in core paper 2. In the following section,
I define a collaboration system. Subsequently, I introduce two hypotheses that focus on anticipated configurations among collaboration system attributes within the focal firms (H1) and between the focal and their key partnering firms (H2) for new product development performance.

Figure 5.1 The Conceptual Model

<table>
<thead>
<tr>
<th>Internal collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Mutual communication</td>
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<tr>
<td>7. Joint engagement</td>
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<tr>
<td>8. Sharing responsibilities</td>
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<tr>
<td>9. Relationship commitment</td>
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<tr>
<td>10. Mutual trust</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>External collaboration</th>
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</thead>
<tbody>
<tr>
<td>6. Mutual communication</td>
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<tr>
<td>7. Joint engagement</td>
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<td>8. Sharing responsibilities</td>
</tr>
<tr>
<td>9. Relationship commitment</td>
</tr>
<tr>
<td>10. Mutual trust</td>
</tr>
</tbody>
</table>

Note:  
- ➡ Relationships tested only in this paper
- ➡ Relationships tested in core paper 2 and this paper
- ➡ Relationships tested only in core paper 2

5.2.1 Toward a Common Definition of a Collaboration System

Collaboration has usually been understood not as a single entity, but as a phenomenon comprised of multiple attributes, which vary in intensity (Barki & Pinsonneault, 2005; [6]

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6 I have used the same definition of collaboration in core paper 2. This section is therefore identical.
Frishammar & Hoerte, 2005; Schleimer, 2007). For instance, in core paper 1, I was able to identify a number of collaborative attributes that consistently appear as descriptors of collaboration in over 100 studies, independently of whether the study’s focus was on collaboration within the firm or collaboration among separate entities.

The following five attributes capture most of the activities among collaborating parties at different intensity levels of (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. In collaboration studies, *mutual communication* usually captures the intensity level to which collaborating parties within and between firms share information with one another via different communication tools and mechanisms (Frishammar & Hoerte, 2005; Kahn, 1996). *Sharing responsibilities* reflects the intensity to which collaborating parties contribute equally in decision-making, complement one another, and share responsibilities for outcomes (Hoegl, Weinkauf, & Gmuenden, 2004; Sanders & Premus, 2005; Zollo, Jeffrey, & Singh, 2002). *Joint engagement* reflects the intensity with which collaborators plan and assist each other to achieve goals of all involved parties (Mohr & Spekman, 1994; Petersen, Handfield, & Ragatz, 2003). *Relationship commitment* comprizes the intensity of an exchange partner believing that an ongoing relationship with one another is so important as to warrant maximum efforts at maintaining it (Hoegl et al., 2004; Morgan & Hunt, 1994). Lastly, *mutual trust* represents the intensity of positive assumption about the motives and intentions collaborating parties hold for one another (Das & Teng, 1998; McEvily, Perrone, & Zaheer, 2003; Morgan & Hunt, 1994).

This multi-dimensional nature of collaboration presents the possibility that a firm may engage in different ‘collaborative configurations or systems’ in its internal collaborations and in its external collaborations. The term ‘system’ recognizes that each attribute is a distinct entity, yet when coordinated with the others, it results in a
particular configuration of collaboration. The notion of ‘collaboration systems’ thus becomes a way to explore alignment between internal and external collaborative activities.

5.2.2 Independent Configurations of Internal Collaboration System Attributes and New Product Development Performance

Numerous studies have reported positive relationships between the intensity of each of the five collaborative attributes within the focal firms and new product development performance (Frishammar & Hoerte, 2005; Gupta, Raj, & Wilemon, 1985; Gupta & Wilemon, 1988; Hoegl et al., 2004; Jassawalla & Sashittal, 1998; Kahn, 1996). In core paper 2, controlling for the other attributes (both internal and external), the findings revealed a direct, positive relationship between mutual communication among functional units within focal firms and product development performance. The findings of core paper 2 also suggested a direct and positive relationship between mutual trust among the units within the focal firms and new product development performance.

Findings of core paper 2 also suggested a negative relationship pattern between the intensity of relationship commitment and innovation performance. For instance, the intensity of relationship commitment among the units within the focal firms revealed a significantly negative relationship with innovation performance. I argued that the significantly negative patterns of relationship commitment among functional units may be due to an overemphasis on the relationship among them. The pattern may also be explained with the possibility that focusing all efforts on one product project, the dedication to conjoint collaboration in other projects may suffer.

It may also be possible that the independent impact of firm internal collaboration system attributes on innovation performance may be a product of their historic content. That is, with the ongoing collaborative activities of firms, certain collaborative patterns
and routines may develop. When examining collaboration among units for any particular new product development, it may be possible that one would find a similar pattern for other product developments and projects. For instance, it makes sense to assume that different, autonomous functional units have created high levels of trust for one another, without being highly committed to one another, because the nature of their activity is rather independent for a specific product development. Also, it may be possible that different functional units have created highly effective communication exchange patterns without having to be highly engaged with one another for a particular project. Consequently, the ‘optimal’ configuration of a focal firm’s internal collaboration system attributes may therefore simply contribute independent rather than synergistic value to performance.

Thus, I argue as follows:

**H1:** In innovation alliances, new product development performance is more positively related to the independent contributions rather than joint effects between high intensity levels of mutual communication, sharing responsibilities, and trust, and low intensity levels of joint engagement and relationship commitment among functional units within focal firms.

### 5.2.3 Interactive Configurations of External Collaboration System Attributes and New Product Development Performance

The empirical findings of Stank et al.’s (2001) study on the ongoing supply chain management activities indicated that, in general, external collaboration has no direct relationship with logistical service performance, as this relationship is mediated by internal collaboration. Sanders and Premus (2005) later suggest the same patterns. The results of analyses in core paper 2 more specifically reveal that without the inclusion of
internal collaboration system attributes, the intensity of joint engagement and mutual trust among the focal and partnering firm are positively related with performance. However, this direct relationship is reduced for joint engagement and eliminated for mutual trust, when internal collaboration is included in the examination. The findings in core paper 2, in addition, suggest that the intensity of mutual communication and relationship commitment between the focal and their partnering firms have a positive, however, not significant pattern, and that the intensity of sharing responsibilities between the collaborating firms has a negative, but not significant pattern with new product development performance.

However, core paper 2 did not test whether specific interactive configurations among external collaborative attributes lead to new product development performance despite being mediated by internal collaboration systems. Although configurations among external collaboration system attributes have, to my knowledge, not been tested, previous studies have often associated each of the five external collaborative attributes with one another. For instance, external collaboration studies have positively linked the intensity of mutual communication among partnering firms to the intensity of joint engagement (Mohr & Spekman, 1994), relationship commitment (Hart & Saunders, 1997) and mutual trust among partnering firms (Das & Teng, 1998; Hart & Saunders, 1997; Lievens & Moenaert, 2000; Mohr & Spekman, 1994; Poppo, Zhou, & Ryu, 2008). The intensity of joint engagement among collaborating firms has also been positively linked to the intensity of relationship commitment (Mohr & Spekman, 1994; Ross & Staw, 1993; Spekman, Kamauff, & Myhr, 1998), and mutual trust (Mohr & Spekman, 1994; Spekman et al., 1998) among the firms. Moreover, the intensity of relationship commitment among collaborating firms has been positively linked to mutual trust (Das & Teng, 1998; Moorman, Zaltman, & Desphande, 1992; Morgan & Hunt, 1994).
Based on the findings in core paper 2, the intensity levels of sharing responsibilities may be the only attribute that is negatively related to the other four attributes in the relationship between focal and their partnering firms. That is, equal sharing of responsibilities in an alliance requires a detailed contract at the beginning of the alliance that needs to be monitored throughout the life of the alliance (Reuer & Arino, 2002, 2003). Researchers have argued that sharing responsibilities thus often results in complexity and coordination problems, which negatively affect alliance performance (Park & Ungson, 2001; Parkhe, 1993). The bureaucratically induced complexity associated with sharing responsibilities between partnering firms may therefore weaken the performance-enhancing properties of the other attributes.

Compared to within the firm, I expect a firm’s historic path of collaborative activity with any given partnering firm to be less. Firm internal collaboration has embedded routines that evolve over time and are based upon and embedded in successful past organizational routines and practices of a firm (Gupta, Tesluk, & Taylor, 2007). This historic path is usually not as rich between partnering firms who may not necessarily have shared or will share collaborative relationships before or after any particular development. It may therefore be less likely that partnering firms have created independent collaborative routines and processes that dominate any given product development they jointly engage in. Therefore, in light of the findings in core paper 2 and considering the associations previous studies have suggested among the five collaboration system attributes in the relationship between the focal firms and their partnering firms, it may be possible that firm external collaboration system attributes only create value through particular configurations with one another. I argue:

\[ H2: \text{In innovation alliances, new product development performance is more positively related to the joint effects rather than the independent contributions of high intensity} \]
levels of mutual communication, joint engagement, relationship commitment, mutual trust, and low intensity levels of sharing responsibilities between the focal firms and their partners.

5.3 Method

5.3.1 Sample and Procedures

I tested the research hypotheses utilizing survey data collected on a sample of 134 dyadic innovation alliances. Before that, I used interview results and pre-existing scales of numerous collaboration studies to develop the measures for a pilot survey. The pilot survey was done in form of a person-administered survey on 30 managers in several industry sectors, who reflected a similar orientation to those, who subsequently completed the main questionnaire. The face validity of the survey was further assessed by pre-testing the instrument with a convenience sample of 30 product managers of one industry association (none of whom were included in the final dataset).

For the main data collection, I initially selected 29 national industry associations and other industry bodies from the Australian Competition and Consumer Commission directory and other Australian government sources. 13 industry associations/industry bodies agreed to distribute the survey invitation to their member firms via an electronic mail and/or their monthly newsletter. The criteria for choosing the sample respondents were as follows: The managers had (at least partly) overseen a recent product development that involved collaboration with at least one key partnering firm located anywhere in the focal firm’s value chain. Furthermore, the manager had to be located in a firm, which had at least one major subunit (e.g. subsidiary and/or headquarters) situated in Australia. Of the 3620 surveys e-mailed, I received 359 responses, which is a

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7 The method section of this paper is identical to the one in core paper 2. This is due to the same sample taken and the same measures of internal, external collaboration attributes, and new product development performance.
response rate of 9.9%. 109 surveys were only partially answered (less than 60% of the survey questions), which left fully completed survey data from 250 firms. Of these, 82 firms were engaged in a collaborative agreement with a partnering firm; however, they only had a single business unit involved in this joint collaboration. Thus, they did not engage in collaboration among units within the firm during their chosen product development. Of the remaining 168, 34 alliances had successfully developed a product, however, the product was not released to the market as yet and questions concerning its success could not be answered.

This left me with data of 134 alliances that also entailed collaboration among functional units within focal firms from the viewpoint of product managers located in these firms. The respective focal firms belonged to 11 different industry sectors. 73.2% of the respondents were located in their firm’s headquarters. Over 75% of the respondents have been involved in product development for at least three years and a vast majority of them held positions of either senior managers (38.1%) or managing directors (23.8%). On average, the respondents had been working in the development of products for at least 6 years. Of the respondents, a majority was located in the Marketing department (39), R&D department (29), sales department (20), manufacturing (13), or design department (12) in their respective firms.

Because I did not obtain data from different managers within the firm, but only a single person located in a single functional unit, I checked for bias in terms of the functional unit the managers were located in by splitting the sample accordingly. The findings revealed no significant difference in terms of the type of unit (p > .10). The involvement of specific functional units within the focal and the partnering firms in the new product development process has also often been attributed with different stages in the development (Song, Thieme, & Xie, 1998). Considering the non-significance, I
therefore assume that the impact of intensity of collaboration is not related to the stage of the innovation process during which the alliance took place.

I also checked non-response bias on the basis of the recorded information from the respective industry associations. The mean differences between responding and non-responding firms along firm attributes, such as firm size and location, were contrasted using a t-test; all statistics were non-significant. Moreover, I implemented a series of logistic regressions, measuring whether the time at which the respondents answered the survey had a significant impact on the variables such as size of the firms, their respective industry sector, and gender. The analyses yielded insignificance for all regressions ($p > .10$).

5.3.2 Measurement

Scales for the study consisted of newly generated items and items that have been used previously in the literature. When a new scale was developed, it was done based on suggestions and findings in the existing literature. All of the main constructs were measured using multiple items requiring an indication of intensity on a five point Likert-typed scale for each item. For measurement consistency, I calculated the coefficient alpha. Reliability values of all constructs met Nunnally's (1978) criterion of acceptability of 0.70 or above. Construct validation was assisted through the use of exploratory factor analyses, and confirmatory factor analyses. The items used in the following analyses are included in Appendix D of this thesis.

Dependent variables

New product development performance. Consistent with prior work on performance measures, due to the variety of industries and firm sizes included in the sample, and because the objectives and performance criteria of the firms varied, a multi-dimensional
A measure of performance was considered most appropriate. The index was comprised of five items: (1) product development costs, (2) product quality, (3) customer satisfaction, (4) providing value for existing customers, and (5) attracting new customers. These items were taken from measures of new product development in previous studies (Homburg & Pflesser, 2000; Sanders & Premus, 2005; Scannell, Vickery, & Droege, 2000). Each item had a high loading coefficient of above 0.64 and an Eigenvalue of over 53% variance, explained by the first component. They therefore validated the appropriateness of individual items constituting this construct.

**Independent variables**

Consistent with core paper 1 and 2, I measured collaboration within the focal firm and also between the focal and partnering firm along five collaborative attributes that each can vary in their intensity. All five collaborative attributes contained multiple items. They were slightly altered depending on the respective context of questions about collaboration within the focal firm and collaboration between both firms (see Appendix D at the end of the thesis for the differences in the wordings of the items for internal versus external collaboration). Identical five-point Likert scales at “1 = never”, “2 = seldom”, “3 = occasionally”, “4 = often”, and “5 = quite frequently” were adopted for all items.

(1) **Mutual communication.** The items to measure ‘mutual communication’ were taken from Kahn (1996) and Frishammar and Hoerte (2005). The chosen six items were originally designed by Van den Ven and Ferry (1980), who measured inter-unit information flow. All items loaded cleanly onto one factor (loadings for internal collaboration: 0.64-0.74; loadings for external collaboration: 0.56-0.79). In combination with the other measures, this measure appeared to be a reliable indicator of internal
collaboration (Cronbach’s alpha = 0.79) and external collaboration (Cronbach’s alpha = 0.80).

(2) **Sharing responsibilities.** All four items of this measure are taken from a larger construct developed and measured by Hoegl et al. (2004). The authors reported a coefficient score between 0.70 and 0.89 for all items and therefore the items appear to have sound measurement properties and appropriately reflect the conceptual definition of this construct. The measure loaded cleanly on one factor (loadings for internal collaboration: 0.78-0.82; loadings for external collaboration: 0.82-0.88), had an overall coefficient score of 0.81 (for internal collaboration) and 0.88 (for external collaboration) and was therefore retained in the analysis in this study.

(3) **Joint engagement.** The level of joint engagement between collaboration parties refers to the extent to which partners jointly plan, set goals, advice, and assist each other (Mohr & Spekman, 1994). All five items were taken from scales used by Mohr and Spekman (1994). The items loaded cleanly on one factor (loadings for internal collaboration: 0.77-0.84; loadings for external collaboration: 0.65-0.80), and had an overall coefficient alpha score of 0.87 for internal collaboration and 0.82 for external collaboration.

(4) **Relationship commitment.** I chose to take four items from the seven-item measure of relationship commitment developed and used by Morgan and Hunt (1994). The findings reported by Morgan and Hunt (1994) show the items to be highly reliable (coefficient score of 0.90). Morgan and Hunt adapted all items from an earlier study by Mowday et al. (1979). I decided to drop three items from Morgan and Hunt’s study (1994) due to their low Cronbach alpha scores during the internal consistency test in the pilot phase of the study. The remaining four items loaded cleanly into one factor (loadings for internal collaboration: 0.84-.89; loadings for external collaboration: 0.87-0.92), appeared to be a reliable indicator of internal collaboration (overall coefficient
score 0.89) and external collaboration (overall coefficient score 0.91) and therefore soundly reflects the conceptual definition of this construct.

(5) Mutual trust. All items were taken from existing scales in a study by Morgan and Hunt (1994). Research findings by Morgan and Hunt suggested that the indicators are reliable measures of trust based in the coefficient alpha (0.95). The measures were originally developed by Larzelere and Huston (1980), who explored close interpersonal relationships. Following, in the piloting of this measure satisfactory internal consistency levels were not achieved for three of the original seven items. I therefore decided to measure trust only with four of the seven-item scale developed by Morgan and Hunt (1994). These remaining four items loaded cleanly on one factor (loadings for internal collaboration: 0.82-0.91; loadings for external collaboration: 0.90-0.92), had an overall coefficient score of 0.90 for internal collaboration, 0.92 for external collaboration, and were therefore retained as adequate measurement properties in the analysis in this study.

Control variables. To reduce potential confounding effects, I controlled for several variables known to correlate with firm internal and external collaboration: Effect of firm size using the number of full-time employees (Collins & Smith, 2006); accumulated collaborative experience (number of previous joint developments) both firms had with one another before the product development (Simonin, 1997; Zollo et al., 2002; Cavusgil et al., 1997; Handfield et al., 1999); number of units involved from the focal and the partnering firm (Schulz and Hoegl, 2006); number of firms involved (Garcia-Canal, Valdes-Ilaneza, & Arino, 2003); form of agreement (1 = contractual, 0 = non-contractual) between the focal and partnering firm; and whether a product or service was developed (1 = product, 0 = service). I initially controlled for the following additional factors known to correlate with collaboration: Industry sectors of the focal and partnering firm, radicalness of the product innovation, the length of the product development in general, and the length of the alliance in specific. However, these
factors did not reveal significance and were therefore not included in the following report of the regression analysis.

5.4 Analyses and Results

Hierarchical regression was used to test both hypotheses and is presented in Table 5.2 together with the bivariate correlation matrix illustrated in Table 5.1. I used a stepwise regression approach in which the control variables were entered first (step 1) followed by the five external collaboration variables in step 2. A comparison of model 2 with model 1 suggests that the inclusion of the external collaborative attributes significantly adds to the model’s power to explain the variance of product development success (hierarchical F = 6.08, p < .001). Next, I entered the five internal collaboration variables. Again, the hierarchical F change suggests that including the internal collaborative attributes adds significantly to the model’s power (hierarchical F = 2.72, p < .05). In step 4, the interaction effects among the external collaboration variables and among the internal collaborative attributes were introduced. I centered all independent variables to reduce nonessential multicollinearity among interaction terms and their individual components (Aiken & West, 1991; Neter, Wasserman, & Kutner, 1989).

The R² increase attributable to adding the interaction effects among the collaborative attributes was statistically significant at the 5 percent level (F change = 2.72, p < .05), thereby suggesting the predictive relevance of the interaction effects to the regression.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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</thead>
<tbody>
<tr>
<td>1. Internal mutual communication</td>
<td>3.58</td>
<td>.70</td>
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<tr>
<td>2. External mutual communication</td>
<td>3.41</td>
<td>.68</td>
<td>.40*</td>
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<td></td>
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<tr>
<td>3. Internal sharing responsibilities</td>
<td>3.35</td>
<td>.71</td>
<td>.49**</td>
<td>.20*</td>
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<tr>
<td>4. External sharing responsibilities</td>
<td>3.35</td>
<td>.82</td>
<td>.10</td>
<td>.54**</td>
<td>.22*</td>
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<tr>
<td>5. Internal joint engagement</td>
<td>3.48</td>
<td>.71</td>
<td>.62**</td>
<td>.32**</td>
<td>.69**</td>
<td>.23**</td>
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<tr>
<td>6. External joint engagement</td>
<td>3.48</td>
<td>.69</td>
<td>.15</td>
<td>.50**</td>
<td>.27**</td>
<td>.67**</td>
<td>.33**</td>
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<tr>
<td>7. Internal relationship commitment</td>
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<td>.73</td>
<td>.39**</td>
<td>.13</td>
<td>.63**</td>
<td>.08**</td>
<td>.51**</td>
<td>.13</td>
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<td>8. External relationship commitment</td>
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<td>.77</td>
<td>.10</td>
<td>.36**</td>
<td>.20*</td>
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<td>.27**</td>
<td>.57**</td>
<td>.30**</td>
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<td>9. Internal mutual trust</td>
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<td>.70</td>
<td>.28**</td>
<td>.16</td>
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<td>.25**</td>
<td>.51**</td>
<td>.30**</td>
<td>.69**</td>
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<td>10. External mutual trust</td>
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<td>.40**</td>
<td>.25**</td>
<td>.59**</td>
<td>.25**</td>
<td>.62**</td>
<td>.24**</td>
<td>.78**</td>
<td>.47**</td>
</tr>
</tbody>
</table>

*a n = 134; two-tailed  
** p < .01, *p < .05
Table 5.2  Results of Hierarchical Regression\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
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<tbody>
<tr>
<td>\textit{Control variables}</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Number of units involved from focal firm</td>
<td>.22\textsuperscript{*}</td>
<td>.23\textsuperscript{*}</td>
<td>.16\textsuperscript{†}</td>
<td>.06</td>
</tr>
<tr>
<td>Number of units involved from partner firm</td>
<td>.08</td>
<td>.04</td>
<td>.05</td>
<td>.07</td>
</tr>
<tr>
<td>Focal firm size</td>
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<td>-.13</td>
<td>-.19\textsuperscript{*}</td>
<td>-.20\textsuperscript{*}</td>
</tr>
<tr>
<td>Partner firm size</td>
<td>.17</td>
<td>.13</td>
<td>.19\textsuperscript{*}</td>
<td>.24\textsuperscript{*}</td>
</tr>
<tr>
<td>Number of other firms involved</td>
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<td>-.20</td>
<td>-.19\textsuperscript{*}</td>
<td>-.10</td>
</tr>
<tr>
<td>Form of alliance</td>
<td>.08</td>
<td>.12</td>
<td>.13</td>
<td>.09</td>
</tr>
<tr>
<td>Accumulated experience with partner</td>
<td>.09</td>
<td>.04</td>
<td>.05</td>
<td>-.01</td>
</tr>
<tr>
<td>Product or service development</td>
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<td>-.02</td>
<td>.03</td>
<td>.03</td>
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<tr>
<td>\textit{Independent variables between focal firm and partner firm}</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mutual communication (between firms)</td>
<td>.09</td>
<td>.05</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>Joint engagement (between firms)</td>
<td>.21</td>
<td>.20\textsuperscript{†}</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>Sharing responsibilities (between firms)</td>
<td>-.19</td>
<td>-.19</td>
<td>-.23\textsuperscript{†}</td>
<td></td>
</tr>
<tr>
<td>Relationship commitment (between firms)</td>
<td>.12</td>
<td>.12</td>
<td>.17</td>
<td></td>
</tr>
<tr>
<td>Mutual trust (between firms)</td>
<td>.25</td>
<td>.14</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>\textit{Independent variables within focal firm}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual communication (within firm)</td>
<td></td>
<td>.21\textsuperscript{†}</td>
<td>.28\textsuperscript{*}</td>
<td></td>
</tr>
<tr>
<td>Joint engagement (within firm)</td>
<td></td>
<td>-.08</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Sharing responsibilities (within firm)</td>
<td>.20</td>
<td>.24\textsuperscript{†}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship commitment (within firm)</td>
<td>-.31\textsuperscript{*}</td>
<td>-.29\textsuperscript{*}</td>
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<td>Mutual trust (within firm)</td>
<td>.29\textsuperscript{*}</td>
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<td>\textit{Interaction term between the focal firm and partner firm}</td>
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<td>Shared communication x joint engagement</td>
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<td>Shared communication x relationship commitment</td>
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<td>Joint engagement x sharing responsibilities</td>
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<td>Joint engagement x relationship commitment</td>
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<td>Relationship commitment x mutual trust</td>
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<td>\textit{R}^2 \text{change}</td>
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<td>.10</td>
<td>.18</td>
<td>.26</td>
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<td>Hierarchical F change</td>
<td>1.66</td>
<td>6.08\textsuperscript{***}</td>
<td>2.72\textsuperscript{*}</td>
<td>1.78\textsuperscript{*}</td>
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\textsuperscript{a} n = 134;

Note: Dependent variable: New product development success.
All coefficients presented are standardized coefficients.
\textsuperscript{†} p < 0.10; \textsuperscript{*} p < 0.05; \textsuperscript{**} p < 0.01; \textsuperscript{***} p < .001; (two-tailed).
I first report the findings relevant to the firm internal collaboration system variables and thereby addressing the proposition made in Hypothesis 1. The intensity of mutual communication (β = 0.28, p<.05), and sharing responsibilities (β = 0.24, p<.10) among the units within the focal firms revealed a significant positive relationship with innovation performance. Both attributes shared no interactive relationship with other attributes. The patterns for mutual communication and sharing responsibilities among the units within focal firms are therefore as hypothesized. Interestingly, whilst the intensity of relationship commitment among units within the firm reveals a significant negative relationship as a main effect (β = -0.29, p<.05) and mutual trust has no independent effect on new product development performance, their interaction is significantly positive (β = .37, p < .05). To examine this interaction, I followed Aiken and West’s (1991) procedure of plotting the interaction.

The simple slope analysis (Figure 5.2) suggests that relationship commitment among the units involved from the focal firms at low levels of mutual trust (one standard deviation below the mean) is significantly negatively related to development success (β = -.52, p < .05). At high levels of mutual trust (one standard deviation above the mean), however, relationship commitment between the units within the focal has no relationship with new product development performance anymore (β = -.07, p = n.s.). The negative influence of commitment on development success among units within the focal firm is therefore conditional on the intensity level of mutual trust. The intensity levels of joint engagement (β = .28, p = n.s.) reveal no relationship at all with new product development performance. Thus, Hypothesis 1 is supported in terms of the independent contributions for the intensity of mutual communication and sharing responsibilities among the units within the focal firms. In terms of the other three attributes, although the directions of the patterns revealed are as proposed, the
relationships between either of them and new product development performance are not statistically significant and thus do not support the propositions made in Hypothesis 1.

**Figure 5.2 Two-way Interaction between Internal Relationship Commitment and Mutual Trust**

Next, I describe the findings about the configurations among external collaboration systems variables. In Hypothesis 2, I proposed that interactive configurations among the collaborative attributes evident in the alliance relationship are more positively related to performance than their independent contributions. The patterns of the regression analyses (Table 5.2) revealed that none of the main effects for external collaborative attributes reveal a significant direct relationship, except for the intensity level of sharing responsibilities, which was significantly negatively related with development success ($\beta = .23, p < .10$). The lack of a direct relationship of each of the other four external collaborative attributes and performance is consistent with the findings in core paper 2.

However, the results also reveal two positive, two-way interactions (step 4 in Figure 5.2), one of which is between the intensity levels of joint communication and mutual trust ($\beta = .61, p = .009$) between the focal and their partnering firms. To further test the nature of this relationship, I performed a simple slope analysis (Aiken & West, 1991). Findings (Figure 5.3) reveal that in relationships with low intensity levels of trust
between the focal and partnering firms, the intensity of joint communication is not related to development success (t = - .30, n.s.). However, in relationships, where there are high levels of trust between the collaborating firms, mutual communication is significantly and positively related to development success (β = .54, p = .009). The relationship between the intensity of joint communication and development success between the collaborating firms is therefore conditional on the intensity level of mutual trust.

Figure 5.3 Two-way Interaction between External Mutual Communication and Mutual Trust

![Graph showing the two-way interaction between external mutual communication and mutual trust.]

Figure 5.4 Two-way Interaction between External Relationship Commitment and Joint Engagement

![Graph showing the two-way interaction between external relationship commitment and joint engagement.]

139
The two-way interaction between the intensity of joint engagement and relationship commitment also reveals a significantly positive relationship with new product development success ($\beta = .58$, $p < .10$). A simple slope test (Figure 5.4) discloses that the intensity level of commitment between the firms is not related to development success at low intensity levels of joint engagement ($\beta = -.23$, n.s.). At high levels of joint engagement, however, relationship commitment is significantly and positively related with new product development success ($\beta = .55$, $p < .05$). Thus, the impact of commitment between the focal and their partnering firms on new product development success is conditional upon the intensity of positive engagement between them. Therefore, the findings broadly confirm Hypothesis 2 in that four of the five external collaboration system attributes are positively related to innovation performance through their interaction effects. An exception was the intensity of sharing responsibilities, which revealed an independent, negative impact on performance in the partnership between collaborating firms.

Also noteworthy in the regression are the significant differences between the patterns for the size of the focal firms ($\beta = -.20$, $p < .05$) versus that of their partnering firms ($\beta = .24$, $p < .05$). I will return to the major findings of the results in the discussion below.

5.5 Discussion

Although the potential benefits of internal and external collaborative activities are well established in the existing literature, our understanding of their combined impact on new product development performance is limited. Whilst a small number of previous studies have examined the combined influence internal and external collaboration have on performance, they have either focused their examination only on a single collaborative attribute (Takeishi, 2001; Truman, 2000) or single composite constructs of internal and external collaborative processes and done so in the context of asking for
answers that covered all supply chain relationships across all products or services
(Sanders & Premus, 2005; Stank, Keller, & Daugherty, 2001).

The findings in this study suggest that the value-adding configurations of focal firms’
internal collaboration systems for performance are independent rather than interactive.
An interpretation of the findings could be that for any particular new product
development, the intensity levels of collaborative attributes may not be specific to any
particular development, but rather reflect well-established internal collaboration
routines of the firm that are utilized throughout different product projects. The findings
also reveal that focal firms’ external collaboration systems add value through
synergistic interactions among the collaboration system attributes. Interestingly, these
interaction effects exist despite the mediating of firms’ internal collaboration systems
(core paper 2). The major findings of this study are illustrated together with those of
core paper 2 in Figure 5.5 and discussed in detail below.
The findings of this study reveal a positive, interactive relationship between the intensity levels of mutual trust and mutual communication between the focal firms and their partners. At low intensity of mutual trust, the intensity of mutual communication between the focal and partnering firms is not related to product development success. Researchers have suggested a pattern as such may indicate that communication exchange in a low trusting relationship is largely standardized and formally agreed upon (Reuer & Arino, 2003). In high trusting relationships, however, partnering firms are more likely to establish intensive communication patterns and provide each other with sensitive information as a way of showing both goodwill and intimacy (Das & Teng, 1998; Hart & Saunders, 1997; Lievens & Moenaert, 2000). Therefore, at high intensity
levels of trust, the intensity of communication may reflect the amount of valuable information transferred between the collaborating firms (Gruenfeld, Mannix, Williams, & Neale, 1996).

The results also reveal a positive interaction effect between the intensity level of joint engagement and relationship commitment between both firms. Joint engagement, as measured in this study, reflects efforts to jointly plan and achieve not only the focal firms’ goals, but also to assist the partnering firms in reaching their own objectives (Mohr & Spekman, 1994). At low intensity levels of mutual expectations and cooperative efforts among the focal and partnering firms, a commitment to working on and maintaining the collaborative relationships may have little impact on development success (Liedtka, 1996). Therefore, the intensity of relationship commitment from partnering firms will only have a positive impact on development success, when the collaborating firms exert high efforts to mutually plan and jointly attain their individual and shared goals.

The intensity with which the focal and their partnering firms share responsibilities for decisions and outcomes with one another was, as proposed, negatively related to new product development success. An explanation for this pattern could be indeed that sharing responsibilities for all decisions and outcomes can cause coordination problems due to increased complexity (Parkhe, 1993), and less efficient decision-making processes among partnering firms. The time and costs in establishing and maintaining a balance in sharing responsibilities among the firms may therefore outweigh the potential benefits of the alliance relationship (Park & Ungson, 2001).

In summary, the best-performing configuration of the focal firm’s external system is one of synergistic interactions among specific attributes. It may therefore be possible that this configuration is unique to a particular alliance and will appear differently in
another alliance. Testing this assumption, however, goes beyond the scope of this paper and thus represents an interesting future research avenue.

The lack of significant interactions suggest that internal collaboration systems differ from external collaboration systems in terms of their impact on new product development performance. The intensity of mutual communication and sharing responsibilities among the functional units involved within focal firms are individually and positively related to new product development performance. It may indeed be possible that their individual relationship with performance on any particular product development outcome is being carried by the long-term and multiple task relationships that units within a firm share with one another (Gupta & Govindarajan, 2000). High levels of mutual information exchange may thus resemble rich, ongoing information transfer among units that are well linked with one another through well-established routines. High intensity levels of sharing responsibilities across functional units within the focal firms may also resemble that the firm has established a system where its units evenly share responsibilities for tasks beyond those of a given product development (Pinto, Pinto, & Prescott, 1993).

The size of the focal firms was significantly negative ($\beta = -0.19, p<0.05$) and the partnering firms' size significantly positive ($\beta = 0.19, p<0.05$) related with product development performance. Previous research has found that focal firms, which collaborate with larger sized partners, perform better than otherwise comparable firms that lack such partners (Stuart, 2000). Therefore, an alliance between a small focal and small partnering firm does little to promote an outstanding product compared to when a larger firm chooses to be in the alliance with a much smaller firm. There may be other influences, which impact on these patterns that I was not able to capture in this study and future research could further investigate the relationship between firm size, partner choice, and product development outcomes.
In this study, I defined collaboration as a system. A system, in its general sense, is comprised of components. Each system has a certain degree of modularity, which is the degree to which a system’s components can be separated and recombined (Schilling & Steensma, 2001). Whilst the degree of modularity of focal firms’ internal versus their external collaboration systems was not a central theme in this study, the findings can be interpreted in the context of modularity. It has been argued that a system is modular, when its components have little loss of functionality when they are separated (Schilling & Steensma, 2001). Following from this, it may be possible that the focal firms’ internal collaboration systems are modular or loosely coupled in that their attributes do not lose their independent, value-adding contributions when they are separately examined.

The focal firm’s external collaboration systems, however, may be different in terms of their degree of modularity. A system is regarded as synergistic specific, when its “components achieve synergy through the specificity of individual components to a particular configuration” (Schilling, 2000, p.316). Synergistic specificity usually characterizes a low degree of modularity, as system components are tightly coupled and lose functionality when being separately examined (Brusoni & Prencipe, 2001). Thus, according to the findings in this study, focal firms’ external collaboration systems consist of attributes, which only add to performance through synergistic interactions, but lose their value-adding nature when they are examined independently. It may therefore be possible that the attributes in the external collaboration system are more tightly coupled and function only through specific configurations with one another. The degree of modularity of firms’ external systems may therefore be comparably low. However, as modularity can only be properly captured with longitudinal research, these assumptions should be merely treated as initial ideas for future research on comparing the modularity of firms’ internal and external collaboration systems.
5.6 Limitations

A number of limitations of this study merit further discussion. Although I aimed at testing a variance model by using cross-sectional data, longitudinal data would have provided much further insights into the configurations of internal and external collaboration systems. Second, the data is based from the viewpoint of focal firms about themselves and about their partner. It does not include direct data from the partnering firm. Nor does it include information about collaboration practices with other firms involved in the alliance and their respective positions and responsibilities in the value chain. Third, I only obtained data from a single respondent located in one functional unit within each focal firm. Fourth, I did not obtain information about the division of labour between the focal and the partnering firm on the new products in development. In addition, due to sample size constraints, I was not able test a full moderation model in addition to the mediation model between firm internal and external collaborative attributes and the within moderation model among internal collaborative attributes and among external collaborative attributes. I suspect that the inclusion of interaction terms across each internal and external collaborative attributes will shed more light on the nature and impact of the association within and across firm internal and external collaboration systems beyond what I tested. Lastly, a longitudinal study would have been able to capture the degree of modularity of both systems.

5.7 Contributions and Future Research

The successful alignments of firm internal and external collaboration systems for new product are therefore complex. They depend not only on the mediating relationships between both systems, but also on the unique configurations among system attributes within the collaboration systems. The results thus contribute additional value to what I found in core paper 2. They show that the focal firms’ internal collaboration systems
lead to performance through different configurations among the attributes than the external collaboration systems. Specifically, the interactive relationship among attributes in the focal firms’ external collaboration systems may provide novel explanations for some of the mixed and contradictory findings of past strategic alliance research. That is, the diverse benefits and drawbacks that past studies have uncovered about differently intensive collaborative endeavours may be unique to the specific attribute(s) that were used as measures of alliance activity (Barki & Pinsonneault, 2005). By including multiple collaborative attributes and measuring their independent as well as multiplicative configurations within each collaborative system to new product development performance, I was able to gain a much broader insight into the strategic complexity of successful collaboration configurations in a new product development.

The next logical step for future research is to examine whether and if so how each of the focal firm’s internal collaboration system attributes influence the relationship its external collaboration system attributes have with innovation success. According to a study by Hillebrand and Biemans (2004, p.116), how people interact with each other is embedded in their general behaviour and way of thinking and this is not going to change from one situation to another. Therefore, the extent to which functional units within a firm share mutual trust may have an impact on the extent to which they trust those of a partnering firm. It may therefore be possible that, in addition to being mediated (core paper 2) internal collaboration systems may also moderate the impact of their external collaboration systems for new product development success. The impact of independent and multiplicative relationships among external collaboration attributes on innovative performance may therefore be largely influenced by the intensity of specific internal collaboration system attributes.
5.8 References


CHAPTER 6

Core Paper 4

Navigating the Confluence of Internal and External Collaboration for New Product Development Performance

Preface

The previous core papers revealed insights into the mediating linkages between internal and external collaboration systems (core paper 2) and the unique configurations of internal collaboration systems and external collaboration systems (core paper 3) for successful new product developments. These previous two core papers revealed new insights into the relationships between internal and external collaboration systems as predictors of innovative performance along the five collaboration system attributes. It remains, however, uncertain whether firms’ internal collaboration system attributes also share an interactive relationship with those in the external collaboration systems. This paper attempts to address this moderating linkage question. It does so by building its main arguments on the key findings of core papers 2 and 3.

An amended version of this paper will be submitted to the ‘Journal of Product Innovation Management’.
Navigating the Confluence of Internal and External Collaboration for New Product Development Performance

Abstract

Scholars in the innovation and strategic research domains have suggested that a firm’s internal and external collaborative activities need to be balanced, coordinated, and even married with one another to achieve performance. In this paper, I argue that new product development performance is a function of the patterns of confluence of firms’ internal collaborative systems with their external collaborative systems. On the basis of the findings in core papers 2 and 3, predictions for the multiplicative relationship of internal and external intensity along each of the five collaborative attributes (mutual communication, joint engagement, sharing responsibilities, relationship commitment, and mutual trust) on new product development performance are presented. I test these predictions on a sample comprised of 134 firms involved in strategic innovation alliances. I find that the influence of the confluence of internal and external collaboration is complex. The patterns of independent and combined predictors of new product development performance are different for each collaboration system attribute. The general pattern for the impacts of internal collaboration system attributes (mutual communication and sharing responsibilities) on new product development performance is direct, whereas the impact of external joint engagement and external mutual trust is indirect and strengthened by different intensity levels of internal joint engagement and mutual trust. I discuss implications of the results, link them with those of core papers 2 and 3, and provide suggestions for future research.
6.1 Introduction

Although firms often aim at maximizing the intensity of both their internal and external collaborative practices to achieve competitive advantage (Lane & Lubatkin, 1998; Simonin, 1997; Von Stamm, 2004), many still do not reach performance levels they aim for (Hillebrand & Biemans, 2004; Spekman, Kamauff, & Myhr, 1998). Some of these arguments draw on the frameworks of the Yerkes-Dudson law (Gavetti & Warglien, 2007; Schippers, Den Hartog, Koopman, & Wienk, 2003; Singh, 1998) where increases in intensity after a certain threshold are no longer associated with performance increases. Other researchers base their arguments on the nature of the -often missing- linkages between internal collaboration systems and external collaboration systems (Goodman, 2000). Consistent with Goodman’s missing link concept, firms may find themselves in a dilemma, where increases in internal and/or external collaborative activities and performance may be positive for one unit, but do not positively flow on or affect activities and outcomes at another unit and/or level within the organization.

Other studies have argued along the principles underlying Herzberg’s hygiene model (Herzberg, 1987, 1968) that increases in the intensity of collaboration may not be related to increases in performance. That is, collaboration may sometimes act as a hygiene factor in that its presence is a necessary condition to avoid dissatisfaction and reduce risk but has no direct relationship with performance outcomes (Nijssen, Hillebrand, Vermeulen, & Kemp, 2006). Other studies again have pointed out that the conceptual ambiguity surrounding the definition and differences in testing collaboration may be responsible for a lack of collective understanding as to how internal and external collaboration should be configured (Barki & Pinsonneault, 2005; Schleimer, 2007; Smith, Carroll, & Ashford, 1995).
As introduced in the preceding core papers, a small number of recent studies in the product innovation and supply chain management literature have examined the combined nature of internal and external collaboration (Hillebrand & Biemans, 2004; Sanders & Premus, 2005; Stank, Keller, & Daugherty, 2001; Sveiby, 2001; Takeishi, 2001). Stank et al. (2001) found and Sanders and Premus (2005) later confirmed in the context of generalized supply chain transactions that the impact of external collaboration on performance is not direct, but associated with the impact that external collaboration has on internal collaboration, with internal collaboration having a direct and positive impact on performance outcomes.

Their findings are a starting point, given that respondents were not asked to focus on any particular product or relationship, but on supply chain relationships in general. Their choice of measurements of collaboration is also not directly comparable as both studies composed different items attributable to internal versus external collaboration and both studies differed on these items. In addition, because both studies tested only composite measures of internal and external collaborative processes, they did not examine the independent contribution and combined relationships of relational/behavioural attributes in their measures of collaboration that other studies have frequently attributed to collaborative activity (Frishammar and Hoerte, 2005; Hoegl et al., 2004; Spekman et al., 1998). Although core papers 2 and 3 revealed some interesting insights into the independent contributions and relationships between internal and external collaboration systems for innovation performance, they did not examine whether there is also a relationship between the ways focal firms collaborate within and the ways they collaborate with their key partnering firms.

The theoretical and empirical contribution of this paper is therefore to clarify the relationships of internal collaboration systems attributes with the external collaboration systems attributes and what impact a relationship between them may have on new
product development performance. It is therefore possible that the confluence between focal firms’ internal and external collaboration system attributes is additive or multiplicative in nature. That is, innovation success may be reached when focal firms maximize the intensity levels of both their internal and external collaboration system attributes. This logic implies that the intensity of internal and external collaboration systems share an additive and/or multiplicative relationship. Alternatively, new product development performance may be reached, when focal firms either maximize intensity levels of internal collaboration, whilst keeping the intensity of external collaboration below maximization or vis-à-vis. In the body of the paper, I conduct an empirical test of these arguments, using survey data from 134 organisations involved in product innovation alliances. In the final section of the paper, I discuss the implications of the findings for both theory and practice in light of the findings from core papers 2 and 3.

6.2 Theory and Hypotheses

A conceptual diagram that captures the focus of this core paper is provided in Figure 6.1 below. It also includes the previous relationships tested in core papers 2 and 3. In the following sections, I first define a collaboration system followed by five hypotheses that evolve around the confluence of firm internal and external collaboration system attributes for new product development performance.
6.2.1 Toward a Common Definition of a Collaboration System

The concept of collaboration is defined and used in many different ways in social sciences. Collaboration, in general, has been used, together with a number of other terms (i.e. integration, cooperation, interaction), as an umbrella term to portray the
nature and management of similar, yet differently intensive activities among collaborating parties within and/or between different firms (Schleimer, 2007). With this, researchers often differed in their descriptions of collaboration according to the intensity level of relationships among collaborating parties. For instance, whilst a number of researchers suggested that moderate intensity levels of mutual trust and commitment can exist in collaborative relationships that are not intensive, high intensity levels of trust and commitment are only found in more intensive collaborative relationships (Jassawalla & Sashittal, 1998; Spekman et al., 1998). Other researchers (Frishammar & Hoerte, 2005; Kahn, 1996) argued that while interactions between collaborators can entail different types of information exchange, they argued, ‘true’ collaboration includes common goals, mutual understanding, shared ideas and resources, teamwork, and a common vision.

Collaboration has usually been understood not as a single entity, but as a phenomenon comprised of multiple attributes, which vary in intensity (Barki & Pinsonneault, 2005; Frishammar & Hoerte, 2005; Schleimer, 2007). In a review of the collaboration literature in core paper 1, I was also able to identify a number of collaborative attributes that consistently appear as descriptors of collaboration in over 100 studies, independently of whether the study’s focus was on collaboration within the firm or collaboration among separate entities. The following five attributes capture most of the activities among collaborating parties at different intensity levels of (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. In collaboration studies, *mutual communication* usually captures the intensity level to which collaborating parties within and between firms share information with one another via different communication tools and mechanisms (Frishammar & Hoerte, 2005; Kahn, 1996). *Sharing responsibilities* reflects the intensity to which collaborating parties contribute equally in decision-
making, complement one another, and share responsibilities for outcomes (Hoegl, Weinkauf, & Gmuenden, 2004; Sanders & Premus, 2005; Zollo, Jeffrey, & Singh, 2002). *Joint engagement* reflects the intensity with which collaborators plan and assist each other to achieve goals of all involved parties (Mohr & Spekman, 1994; Petersen, Handfield, & Ragatz, 2003). *Relationship commitment* comprizes the intensity of an exchange partner believing that an ongoing relationship with one another is so important as to warrant maximum efforts at maintaining it (Hoegl et al., 2004; Morgan & Hunt, 1994). Lastly, *mutual trust* represents the intensity of positive assumption about the motives and intentions collaborating parties hold for one another (Das & Teng, 1998; McEvily, Perrone, & Zaheer, 2003; Morgan & Hunt, 1994).

Given the above, I expect that in any one collaboration, whether within and/or between firms, different intensity configurations of these five attributes may result. As a result, I call these configurations of the five attributes collaboration systems. The term ‘system’ recognizes that each attribute is an individual entity of the system, yet when examined in line with the others, it results in a particular configuration of collaboration.

### 6.2.2 Confluence among Internal and External Collaboration Systems

In the following sections, I develop a number of hypotheses whose logic is based upon the findings of the previous core papers 2 and 3. Although arguing with a similar logic as in the previous core papers 2 and 3, in the development of the propositions below, the linkages tested among the internal and external collaboration system attributes are unique to this analysis (Figure 6.1).

#### 6.2.2.1 Confluence by Maximizing the Intensity of Internal and External Collaboration
In the previous core papers, the intensity levels of mutual communication and mutual trust in firms’ internal and in external collaboration systems, revealed positive relationship patterns with new product development performance. Therefore, in what follows, I argue, in line with the interpretations of the findings of core papers 2 and 3 that new product development success is reached, when focal firms maximize internal and external intensity of collaborative attributes, mutual communication and mutual trust respectively. It is possible that a “best-performing” confluence of firms’ internal and external collaboration systems is a simple additive function of independent internal and external system attributes, or that it is multiplicative in nature.

**Mutual Communication**

Firm internal collaboration studies have usually reported that communication problems are the single most important barrier to successful collaboration among functional units within firms (Gupta, Raj, & Wilemon, 1985; Gupta & Wilemon, 1988; Ruekert & Walker, 1987). Sharing information across different functional units of a firm is therefore a crucial part of successful firm collaboration (Cooper, 1979; Cooper & Kleinschmidt, 1986; Kahn, 2001; Tsai, 2001). Numerous empirical studies further found that the frequent exchange of relevant information among functional units is directly and positively related to product development cycle time (Brown & Eisenhardt, 1995; Clark & Fujimoto, 1991; Griffin, 1997) and ultimately new product development performance (Griffin & Hauser, 1992; Katz & Allan, 1982; Kim, Park, & Prescott, 2003; Moenaert, Souder, De Meyer, & Deschoolmeester, 1994; Rein, 2004).

Researchers of external collaboration have also argued that without open and prompt communication, collaborative relationships among partnering firms tend to suffer (Spekman et al., 1998). According to a number of studies, high intensity levels of information exchange enable partnering firms to collect evidence about their partners’
trustworthiness and credibility (Hart & Saunders, 1997) and are a way of showing both goodwill and intimacy (Das & Teng, 1998; Hardy, Lawrence, & Grant, 2005; Hart & Saunders, 1997; Lievens & Moenaert, 2000). Other studies have shown that high intensity levels of communication also lead to successful joint innovations among partnering firms (Meyer & DeTore, 1999; Takeishi, 2001; Tushman, 2000; Von Hippel, 2001).

I therefore conclude:

**H1: New product development success will most likely occur when focal firms maximize intensity levels of mutual communication among their involved internal units and maximize the intensity levels of mutual communication between the focal and partnering firms.**

**Mutual Trust**

Scholars have found that functional units within a firm will not collaborate with one another, unless they perceive each other as credible and trustworthy (Gupta & Wilemon, 1988). High levels of mutual trust among functional units within a firm have been frequently linked to increased levels of information exchange (De Dreu & Van Vianen, 2001; Jarvenpaa & Leidner, 1999; Jassawalla & Sashittal, 1998), increased relationship commitment (Dirks & Ferrin, 2001; McEvily et al., 2003; Tsai, 2001), and product development performance (Ghoshal, Korine, & Szulanski, 1994; Jassawalla & Sashittal, 1998; Klein & Mulvey, 1995; Liedtka, 1996; Zaheer, McEvily, & Perrone, 1998).

Researchers of firm external collaboration have similarly stressed that for any collaborative relationship to be formed and to function, a minimum level of mutual trust has to exist among the involved firms (Cavusgil, Calantone, & Zhao, 2003; Das & Teng, 1998; Inkpen & Currall, 2004). Scholars have further found that high levels of
mutual trust among collaborating firms lead to the exchange of sensitive information (Bstieler, 2006; Cavusgil et al., 2003) and ultimately successful partnership (Bstieler, 2006; Gulati, 1995; Inkpen & Currall, 2004; Morgan & Hunt, 1994; Zaheer et al., 1998).

I therefore propose:

\[ H2: \text{New product development success will most likely occur when focal firms maximize intensity levels of mutual trust among their involved units and maximize the intensity levels of mutual trust between focal and partnering firms.} \]

6.2.2.2 Confluence by Maximizing the Intensity of Internal or External Collaboration

According to the findings in core papers 2 and 3 and in line with previous collaboration studies (Janis, 2004; McEvily et al., 2003), intensifying collaboration may not always lead to innovation success. A focal firm may reach confluence when either internal or external collaboration intensity is maximized whilst the other is not. For instance, it may be possible that only the intensity of specific internal or external collaboration system attributes is a predictor of performance, independently of the intensity of the other, which may not have a relationship with performance. This may be the case where the nature of activities in the internal collaboration is unrelated to that in the alliance relationship. Numerous studies of internal and external collaboration have also pointed out that there may be such a thing as too much collaboration (Gavetti & Warglien, 2007; McEvily et al., 2003; Schippers et al., 2003). Following from this, if the focal firm aims at maximizing the intensity of its internal and simultaneously external collaboration systems, it may spend excessive resources that may not lead to higher levels of performance or may even reduce performance levels. It may be possible that
both internal and external collaboration system attributes should not be at maximum intensity levels for new product development success. The findings of the previous core papers 2 and 3, however, revealed in terms of each of the five collaboration system attributes that either the internal or the external attribute (or both) revealed a general positive relationship with new product success. Consequently, for the remaining three collaborative attributes, I build upon the findings and rationales developed in core papers 2 and 3 and argue that their best performing relationship is when either internal or external collaboration intensity is maximized whilst the other is not.

**Sharing Responsibilities**

Findings in core papers 2 and 3 indicated that the intensity of sharing responsibilities among functional units within the focal firms has a positive relationship with new product development performance and the intensity of sharing responsibilities among the focal and partnering firms has a negative relationship with new product development performance. Within a firm, researchers found that functional units are often diverse in terms of their technical backgrounds and language (Gupta & Wilemon, 1990; Gupta & Wilemon, 1988). Consequently, sharing responsibilities for decisions and outcomes is believed to counteract negative effects caused by diversity, as different functions are pressured to accept their differences and find commonalities (Schippers et al., 2003). Sharing all responsibilities within and across different projects also promotes solidarity, enhanced information transfer (Gupta & Govindarajan, 2000), and ultimately lead to new product development performance (Frishammar & Hoerte, 2005; Hoegl et al., 2004; Kahn, 1996; Simonin, 1997).

Between collaborating firms, however, responsibilities for all decisions and outcomes are usually not spread across different projects or along different time periods. Instead, equal sharing of responsibilities in an alliance requires a detailed contract at the
beginning of the alliance that needs to be monitored throughout the life of the alliance (Reuer & Arino, 2002, 2003). Therefore, evenly sharing responsibilities for decisions and outcomes between the focal and partnering firms may reflect the complexity of contractual agreements rather than the nature of the collaborative relationships (Parkhe, 1993).

Thus, I propose:

\[ H3: \text{New product development success will most likely occur when focal firms maximize intensity levels of sharing responsibilities among their involved units, but engage in less than maximal intensity levels of sharing responsibilities with partnering firms.} \]

**Joint Engagement**

Core papers 2 and 3 reported negative relationship patterns between the intensity of joint engagement among units within the focal firms and new product development performance and positive patterns for the intensity of joint engagement among the focal and partnering firm and new product development performance. Within the firm, a number of scholars have reported a curvilinear relationship between the intensity levels of joint engagement among collaborating parties and performance outcomes (Gavetti & Warglien, 2007; Lievens & Moenaert, 2000; Schippers et al., 2003; Smith, Smith, Olian, O'Bannon, & Scully, 1994). These curvilinear relationships are usually relationships where measures in the intensity of engagement are associated with increases in performance, but only up to a certain point. Researchers argued that, once a certain threshold is surpassed, high intensity levels of joint engagement among collaborators may lead them toward a need for perfect consensus and the collaborating parties may experience "groupthink" (Froehle, Roth, Chase, & Voss, 2000; Janis, 1972),
which can wear away performance (Gavetti & Warglien, 2007; Lievens & Moenaert, 2000).

In the external collaboration literature, scholars have pointed out that due to higher levels of interdependencies among players in most supply chains, partnering firms increasingly focus on joint planning and on achieving success together rather than individually (Faems, Van Looy, & Debackere, 2005; Petersen et al., 2003). By jointly engaging with one another, collaborating firms construct themselves as parts of a collaborative framework, in which joint actions are significant and beneficial for all involved (Hardy et al., 2005). Empirical findings further suggest that high levels of joint engagement allow mutual expectations to be established, cooperative goals to be specified, and lead to partnership success (Devlin & Bleackley, 1988; Mohr & Spekman, 1994; Spekman et al., 1998).

I therefore conclude:

\( \text{H4: New product development success will most likely occur when focal firms engage in less than maximal intensity levels of joint engagement among their involved units, but engage in maximal intensity levels of joint engagement with partnering firms.} \)

**Relationship Commitment**

The findings of core papers 2 and 3 suggested a similar pattern for relationship commitment as for the intensity of joint engagement. The results revealed a negative relationship pattern between the intensity of relationship commitment among units within the firm and new product development performance and a positive relationship pattern between the intensity of commitment between the focal and partnering firms and performance. It is possible that within the firm, inflated levels of relationship commitment into one task may hinder the units’ ability to critically evaluate the
relationship. They may also limit efforts to collaborate with other individuals and
groups of the same or other projects and/or product developments (Lundin & Hartman,
2000; Thomas, 2000).

Scholars of external collaboration studies have stressed that relationship commitment
provides a context in which collaborating firms can achieve individual and joint goals
without having to fear opportunistic behaviour (Cummings, 1984). With increasing
levels of commitment for the joint relationship, partnering firms are also believed to
balance short-term problems with long-term achievements (Angle & Perry, 1981). Thus,
relationship commitment among exchange partners is “the key to achieving valuable
outcomes” (Morgan and Hunt, 1994: 23). Other studies have also empirically linked the
intensity of relationship commitment to product development performance (Faems et
al., 2005; Muthusamy & White, 2005; Santoro, 2000).

I therefore conclude:

**H5: New product development success will most likely occur when focal firms engage in
less than maximal intensity levels of relationship commitment among their involved
units, but maximize the intensity of relationship commitment between focal and
partnering firms.**

6.3 Method

6.3.1 Sample and Procedures

I tested the research hypotheses utilizing survey data collected on a sample of 134
dyadic innovation alliances. Before that, I used interview results and pre-existing scales
of numerous collaboration studies to develop the measures for a pilot survey. The pilot

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9 The method section of this paper is identical to the one in core papers 2 and 3. This is due to the same
sample taken and the same measures of internal, external collaboration attributes, and new product
development performance.
survey was done in form of a person-administered survey on 30 managers in several industry sectors, who reflected a similar orientation to those, who subsequently completed the main questionnaire. The face validity of the survey was further assessed by pre-testing the instrument with a convenience sample of 30 product managers of one industry association (none of whom were included in the final dataset).

For the main data collection, I initially selected 29 national industry associations and other industry bodies from the Australian Competition and Consumer Commission directory and other Australian government sources. 13 industry associations/industry bodies agreed to distribute the survey invitation to their member firms via an electronic mail and/or their monthly newsletter. The criteria for choosing the sample respondents were as follows: The managers had (at least partly) overseen a recent product development that involved collaboration with at least one key partnering firm located anywhere in the focal firm’s value chain. Furthermore, the manager had to be located in a firm, which had at least one major subunit (e.g. subsidiary and/or headquarters) situated in Australia. Of the 3620 surveys e-mailed, we received 359 responses, which is a response rate of 9.9%. 109 surveys were only partially answered (less than 60% of the survey questions), which left fully completed survey data from 250 firms. Of these, 82 firms were engaged in a collaborative agreement with a partnering firm; however, they only had a single business unit involved in this joint collaboration. Thus, they did not engage in collaboration among units within the firm during their chosen product development. Of the remaining 168, 34 alliances had successfully developed a product, however, the product was not released to the market as yet and questions concerning its success could not be answered.

This left a final data set of 134 alliances that also entailed collaboration among functional units within focal firms from the viewpoint of product managers located in these firms. The respective focal firms belonged to 11 different industry sectors. 73.2%
of the respondents were located in their firm’s headquarters. Over 75% of the respondents have been involved in product development for at least three years and a vast majority of them held positions of either senior managers (38.1%) or managing directors (23.8%). On average, the respondents had been working in the development of products for at least 6 years. Of the respondents, a majority was located in the Marketing department (39), R&D department (29), sales department (20), manufacturing (13), or design department (12) in their respective firms.

Because I did not obtain data from different managers within the firm, but only a single person located in a single functional unit, I checked for bias in terms of the functional unit the managers were located in by splitting the sample accordingly. The findings revealed no significant difference in terms of the type of unit (p > .10). The involvement of specific functional units within the focal and the partnering firms in the new product development process has also often been attributed with different stages in the development (Song, Thieme, & Xie, 1998). Considering the non-significance, I therefore assume that the impact of intensity of collaboration is not related to the stage of the innovation process during which the alliance took place.

I also checked non-response bias on the basis of the recorded information from the respective industry associations. The mean differences between responding and non-responding firms along firm attributes, such as firm size and location, were contrasted using a t-test; all statistics were non-significant. Moreover, I implemented a series of logistic regressions, measuring whether the time at which the respondents answered the survey had a significant impact on the variables such as size of the firms, their respective industry sector, and gender. The analyses yielded insignificance for all regressions (p > .10).
6.3.2 Measurement

Scales for the study consisted of newly generated items and items that have been used previously in the literature. When a new scale was developed, it was done based on suggestions and findings in the existing literature. All of the main constructs were measured using multiple items requiring an indication of intensity on a five point Likert-typed scale for each item. For measurement consistency, I calculated the coefficient alpha. Reliability values of all constructs met Nunnally’s (1978) criterion of acceptability of 0.70 or above. Construct validation was assisted through the use of exploratory factor analyses, and confirmatory factor analyses.

Dependent Variables

New product development performance. Consistent with prior work on performance measures, due to the variety of industries and firm sizes included in the sample, and because the objectives and performance criteria of the firms varied, a multi-dimensional performance measure was considered most appropriate. The index was comprised of five items from measures of previous studies (Homburg & Pflesser, 2000; Sanders & Premus, 2005; Scannell, Vickery, & Droege, 2000). Each item had high loading coefficients of above 0.64, and an Eigenvalue of over 53% variance, explained by the first component. They therefore validated the appropriateness of individual items constituting this construct. The items of this construct and of the independent variables are depicted in Appendix D at the end of the thesis.

Independent Variables

In accordance to core paper 1 and 2, I measured collaboration within the focal firm and also between the focal and partnering firm along five collaborative attributes that each can vary in their intensity. All five collaborative attributes contained multiple items.
They were slightly altered depending on the respective context of questions about collaboration within the focal firm and collaboration between both firms. Identical five-point Likert scales at “1 = never”, “2 = seldom”, “3 = occasionally”, “4 = often”, and “5 = quite frequently” were adopted for all items.

(1) Mutual communication. The items to measure ‘mutual communication’ were taken from Kahn (1996) and Frishammar and Hoerte (2005). The chosen six items were originally designed by Van den Ven and Ferry, (1980), who measured inter-unit information flow. All items loaded cleanly onto one factor (loadings for internal collaboration: 0.64-0.74; loadings for external collaboration: 0.56-0.79). In combination with the other measures, this measure appeared to be a reliable indicator of internal collaboration (Cronbach’s alpha = 0.79) and external collaboration (Cronbach’s alpha = 0.80).

(2) Sharing responsibilities. All four items of this measure are taken from a larger construct developed and measured by Hoegl et al. (2004). The authors reported a coefficient score between 0.70 and 0.89 for all items and therefore the items appear to have sound measurement properties and appropriately reflect the conceptual definition of this construct. The measure loaded cleanly on one factor (loadings for internal collaboration: 0.78-0.82; loadings for external collaboration: 0.82-0.88), had an overall coefficient score of 0.81 (for internal collaboration) and 0.88 (for external collaboration) and was therefore retained in the analysis in this study.

(3) Joint engagement. The level of joint engagement between collaboration parties refers to the extent to which partners jointly plan, set goals, advice, and assist each other (Mohr & Spekman, 1994). All five items were taken from scales used by Mohr and Spekman (1994). The items loaded cleanly on one factor (loadings for internal collaboration: 0.77-0.84; loadings for external collaboration: 0.65-0.80), and had an
overall coefficient alpha score of 0.87 for internal collaboration and 0.82 for external collaboration.

(4) Relationship commitment. I chose to take four items from the seven-item measure of relationship commitment developed and used by Morgan and Hunt (1994). The findings reported by Morgan and Hunt (1994) show the items to be highly reliable (coefficient score of 0.90). Morgan and Hunt adapted all items from an earlier study by Mowday, Steers and Porter (1979). I decided to drop three items from Morgan and Hunt’s study (1994) due to their low Cronbach alpha scores during the internal consistency test in the pilot phase of the study. The remaining four items loaded cleanly into one factor (loadings for internal collaboration: 0.84-.89; loadings for external collaboration: 0.87-0.92), appeared to be a reliable indicator of internal collaboration (overall coefficient score 0.89) and external collaboration (overall coefficient score 0.91) and therefore soundly reflects the conceptual definition of this construct.

(5) Mutual trust. All items were taken from existing scales in a study by Morgan and Hunt (1994). Research findings by Morgan and Hunt suggested that the indicators are reliable measures of trust based in the coefficient alpha (0.95). The measures were originally developed by Larzelere and Huston (1980), who explored close interpersonal relationships. Following, in the piloting of this measure satisfactory internal consistency levels were not achieved for three of the original seven items. I therefore decided to measure trust only with four of the seven-item scale developed by Morgan and Hunt (1994). These remaining four items loaded cleanly on one factor (loadings for internal collaboration: 0.82-0.91; loadings for external collaboration: 0.90-0.92), had an overall coefficient score of 0.90 for internal collaboration, 0.92 for external collaboration, and were therefore retained as adequate measurement properties in the analysis in this study.

Control variables. To reduce potential confounding effects, I controlled for several variables known to correlate with firm internal and external collaboration: Effect of firm
size using the number of full-time employees (Collins & Smith, 2006); accumulated collaborative experience (number of previous joint developments) both firms had with one another before the product development (Simonin, 1997; Zollo et al., 2002; Cavusgil et al., 1997; Handfield et al., 1999); number of units involved from the focal and the partnering firm (Schulz and Hoegl, 2006); number of firms involved (Garcia-Canal, Valdes-Illaneza, & Arino, 2003); form of agreement (1 = contractual, 0 = non-contractual) between the focal and partnering firm; and whether a product or service was developed (1 = product, 0 = service).

I initially also controlled for additional factors known to correlate with collaboration: Number of units involved from the focal and partnering firm, industry sectors of the focal and partnering firm, radicalness of the product innovation, and length of the product development in general and the alliance in specific. However, these factors did not account for significant variance and are therefore not included in the following report of the regression analysis.

6.4 Analysis and Results

In this study, hierarchical regression was used to test the five hypotheses. This allowed an examination of the independent and multiplicative contributions between the five internal and five external collaboration system attributes on new product development performance. Table 6.1 reports the descriptive statistics and Pearson correlation between all related variables. Table 6.2 presents the results of the regression analysis. I have chosen to enter ‘nuisance’ variables (the control variables) of lesser importance first (model 1) and enter variables of more importance last (Cohen & Cohen, 1983; Pedhauzer, 1997). This gives the opportunity to evaluate the main effects and interaction effects of the hypothesized variables for what they add to the prediction over and above the lesser set of variables (Tabachnick & Fidell, 1989). Thus, all ‘main
effects’ were entered in model 2 (Pedhauzer, 1997). Model 2 was used to verify the individual effect of each collaborative attribute. Estimated variance inflation factors (VIFs; 1.1-3.5) for all predictor and control variables suggested an absence of multicollinearity among them. Model 3 includes all relevant two-way interactions between identical firm internal and external predictor variables. I centered all independent variables to reduce nonessential multicollinearity among interaction terms and their individual components (Aiken & West, 1991; Neter, Wasserman, & Kutner, 1989).

Table 6.1 Descriptive Statistics and Pearson Correlation Matrixa

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Internal mutual communication</td>
<td>3.58</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. External mutual communication</td>
<td>3.41</td>
<td>.68</td>
<td>.40**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Internal sharing responsibilities</td>
<td>3.35</td>
<td>.71</td>
<td>.49**</td>
<td>.20*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. External sharing responsibilities</td>
<td>3.35</td>
<td>.82</td>
<td>.10</td>
<td>.54**</td>
<td>.22*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Internal joint engagement</td>
<td>3.48</td>
<td>.71</td>
<td>.62**</td>
<td>.32**</td>
<td>.69**</td>
<td>.23**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. External joint engagement</td>
<td>3.48</td>
<td>.69</td>
<td>.15</td>
<td>.50**</td>
<td>.27**</td>
<td>.67**</td>
<td>.33**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Internal relationship commitment</td>
<td>3.62</td>
<td>.73</td>
<td>.39**</td>
<td>.13</td>
<td>.63**</td>
<td>.08**</td>
<td>.51**</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. External relationship commitment</td>
<td>3.86</td>
<td>.77</td>
<td>.10</td>
<td>.36**</td>
<td>.20*</td>
<td>.56**</td>
<td>.27**</td>
<td>.57**</td>
<td>.30**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Internal mutual trust</td>
<td>3.83</td>
<td>.70</td>
<td>.28**</td>
<td>.16</td>
<td>.48**</td>
<td>.25**</td>
<td>.51**</td>
<td>.30**</td>
<td>.69**</td>
<td>.47**</td>
<td></td>
</tr>
<tr>
<td>10. External mutual trust</td>
<td>3.75</td>
<td>.74</td>
<td>.12</td>
<td>.40**</td>
<td>.25**</td>
<td>.59**</td>
<td>.25**</td>
<td>.62**</td>
<td>.24**</td>
<td>.78**</td>
<td>.47**</td>
</tr>
</tbody>
</table>

a n = 134; two-tailed
** p < .01;  * p < .05

For the hypotheses to be supported it required a statistically significant increase in variance explained from model 1 to model 2 and/or an increase in variance explained from model 2 to model 3 and significant two-way interactions between the same internal and external attributes as hypothesized in the propositions. A comparison of
model 2 to with model 1 suggests that the ten collaborative attributes add to the model’s
transfer to the model’s power to explain the variance of new product development success (model 2:
hierarchical $F = 5.00$, $p < .001$) and a comparison of model 3 with model 2 further
suggests that the inclusion of the five two-way interactions significantly explain
additional variance of new product development success (model 3: hierarchical $F =
2.88$, $p < .05$).

**Table 6.2 Results of Hierarchical Regression**

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focal firm size</td>
<td>-.14</td>
<td>-.19*</td>
<td>-.25*</td>
</tr>
<tr>
<td>Partner firm size</td>
<td>.12</td>
<td>.17†</td>
<td>.22*</td>
</tr>
<tr>
<td>Accumulated experience with partner</td>
<td>.07</td>
<td>.04</td>
<td>.07</td>
</tr>
<tr>
<td>Number of other firms involved</td>
<td>-.09</td>
<td>-.15†</td>
<td>-.18*</td>
</tr>
<tr>
<td>Form of alliance</td>
<td>.11</td>
<td>.14*</td>
<td>.19*</td>
</tr>
<tr>
<td><strong>Independent variables within focal firm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual communication (in focal firm)</td>
<td>.263</td>
<td>.22†</td>
<td></td>
</tr>
<tr>
<td>Joint engagement (in focal firm)</td>
<td>-.08</td>
<td>-.02</td>
<td></td>
</tr>
<tr>
<td>Sharing responsibilities (in focal firm)</td>
<td>.24</td>
<td>.23†</td>
<td></td>
</tr>
<tr>
<td>Relationship commitment (in focal firm)</td>
<td>-.33*</td>
<td>-.19</td>
<td></td>
</tr>
<tr>
<td>Mutual trust (in focal firm)</td>
<td>.27*</td>
<td>.08</td>
<td></td>
</tr>
<tr>
<td><strong>Independent variables between focal firm and partner</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual communication (between firms)</td>
<td>.03</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Joint engagement (between firms)</td>
<td>.22</td>
<td>.22†</td>
<td></td>
</tr>
<tr>
<td>Sharing responsibilities (between firms)</td>
<td>-.19</td>
<td>-.16</td>
<td></td>
</tr>
<tr>
<td>Relationship commitment (between firms)</td>
<td>.14</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>Mutual trust (between firms)</td>
<td>.12</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td><strong>Interaction terms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual communication (in focal firm) x mutual communication (between firms)</td>
<td>-.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing responsibilities (in focal firm) x sharing responsibilities (between firms)</td>
<td>.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint engagement (in focal firm) x joint engagement (between firms)</td>
<td>-.23*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship commitment (in focal firm) x relationship commitment (between firms)</td>
<td>-.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual trust (in focal firm) x mutual trust (between firms)</td>
<td>.32**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>.20</td>
<td>.57</td>
<td>.64</td>
</tr>
<tr>
<td>$R^2$ change</td>
<td>.04</td>
<td>.29</td>
<td>.08</td>
</tr>
<tr>
<td>Hierarchical $F$ change</td>
<td>.87</td>
<td>5.0***</td>
<td>2.88*</td>
</tr>
</tbody>
</table>

*a*=134; Note: Dependent variable: Product development success.
All coefficients presented are standardized coefficients.
† $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed)
I report the findings starting with Hypothesis 1, which proposed that mutual communication should be maximized both within and between the firms for new product development performance. The intensity levels of mutual communication among functional units within focal firms was significantly and positively related to new product development success ($\beta = .22, p < .10$; two-tailed). The intensity levels of mutual communication between focal and partnering firms, albeit in the hypothesized direction, was not a predictor of innovation performance (mutual communication: $\beta = .04$, n.s.). Also, the two-way interaction between firm internal and external mutual communication was not significant. The patterns therefore only weakly support Hypothesis 1 in terms of the patterns for internal mutual communication intensity among units within focal firms, but not for communication between the focal and partnering firms.

The intensity levels of mutual trust among units within focal firms ($\beta = .08$, n.s.) and between focal and partnering firms ($\beta = .18$, n.s.) were not directly related to product development performance. However, the results revealed a significant positive interaction between the intensity level of mutual trust among units involved within focal firms and mutual trust between focal and partnering firms ($\beta = .32, p < .01$). To further test the nature of this interaction, I performed a simple slope analysis (Aiken & West, 1991). Findings (Figure 6.2) reveal that mutual trust between focal and partnering firms at low levels of mutual trust among units within focal firms (one standard deviation below the mean) was not significantly related to product development success ($\beta = -.13$, n.s.). At high levels of mutual trust among the units within focal firms (one standard deviation above the mean), however, mutual trust between focal and partnering firms was significantly and positively related to product development success ($\beta = .47, p < .01$). This pattern supports the propositions made in Hypothesis 2 in that mutual trust
among units within the focal firms and among the focal and partnering firms share a synergistic relationship, where at high intensity level of mutual trust within the focal and also between the focal and partnering firms, highest product development performance is reached.

The intensity of sharing responsibilities among functional units within focal firms was significantly and positively related to new product development success ($\beta = .23$, $p < .10$). The intensity of sharing responsibilities in the relationship between focal and partnering firms revealed a negative, yet not significant relationship with development performance ($\beta = -.16$, n.s). The two-way interaction among firm internal and external sharing responsibilities was not a predictor of development performance. The patterns therefore only support Hypothesis 3 in terms of sharing responsibilities among units within the focal firms, but not between the firms, where there was no significant relationship with performance.

Whilst the intensity of joint engagement among units within the focal firms was not individually related to new product development performance, the intensity of joint engagement among the focal and partnering firm suggested a significant positive relationship with development success ($\beta = .22$, $p < .10$). Moreover, the results revealed a significant negative interaction between intensity levels of joint engagement among units within the focal firm and joint engagement between the focal and partnering firm ($\beta = -.23$, $p < .05$). To further examine this interaction, I plotted the interaction. The simple slope analysis (Figure 6.3) suggests that the level of joint engagement between both firms is significantly and positively related to product development success at low intensity levels of joint engagement among involved units within the focal firm (one standard deviation below the mean; $\beta = .42$, $p < .01$). At high levels of joint engagement among the involved units of the focal firm (one standard deviation above the mean), however, joint engagement between both firms is not significantly related with product
development success ($\beta = .02$, n.s.). The relationship between joint engagement among the focal and partnering firm and development success is therefore dependent upon the intensity of joint engagement among units within the focal firms. Product development success is reached, when intensity levels of external joint engagement are maximized, while the intensity of joint engagement among units within the focal firm is not. This supports the propositions made in Hypothesis 4.

Relationship commitment within the focal firm revealed a negative, yet not significant relationship with new product development performance ($\beta = -.19$, n.s.). Also, relationship commitment between the focal and partnering firms was not related to performance ($\beta = .09$, n.s.) and neither was their interaction ($\beta = -.15$, n.s.). Hypothesis 5 is therefore not supported.

**Figure 6.2 Interaction Effect between Internal and External Mutual Trust**
6.5 Discussion

Although the benefits of collaboration, in general, are well established and verified in the innovation literature, our understanding of the confluence of focal firms’ internal and external collaboration systems for a new product development is limited (Hillebrand & Biemans, 2004; Sanders & Premus, 2005). Such an understanding is important, because collaboration among units within focal firms often takes place simultaneously with collaboration among the focal and partnering firms for joint innovative endeavours. Unlike most collaboration studies, I conceptualize collaboration as a multi-attribute system, which evolves around configurations of five collaboration system attributes that capture ongoing activities within and between firms along different intensity levels.

The findings of this study broadly suggest that collaboration within the firm in part directly predicts new product development success and also partly moderates the impact external collaboration has on new product development performance. These findings add important, additional information to the previous findings in core paper 2 and 3. Therefore, in the following discussion, I examine and Figure 6.4 illustrate the findings of this study in combination with those of core paper 2 and core paper 3.
I start the discussion with the major findings of this core paper in terms of each collaborative attribute. The analyses suggest that the intensity of joint engagement and mutual trust among units within the focal firms directly affect the strength of the relationship between joint engagement and mutual trust between the focal and partnering firms and new product development performance, but in different ways.

**Figure 6.4 Summary of Main Findings of Core paper 2, 3, and 4**

**Joint engagement.** The intensity of joint engagement among the focal and partnering firms was significantly positively related to performance. This relationship, however, only held at low intensity levels of joint engagement among the units within the focal firms. These patterns support Hypothesis 4. In line with an earlier interpretation, within
the firms, units are often engaged in different projects simultaneously (Pinto, Pinto, & Prescott, 1993). By focusing their engagement on one project only, their dedication to conjoint collaboration in other projects may suffer. That is, “over-engagement” into one task may cause core rigidities to arise (McEvily et al., 2003), which can hinder the units’ willingness to collaborate with other individuals and groups outside the “in-group” members (Lundin & Hartman, 2000; Thomas, 2000). Intensive engagement among unit within the focal firm may therefore hinder the intensity of engagement that units are likely to put into the collaborative relationship with the partnering firm. Another explanation for this pattern, however, could be that low intensity levels of engagement among the involved units within the firm stand for routines collaboration practices that do not require high intensity levels to function well. Thus, where collaborative activity is routinized among the units within the firm, most efforts can be spent on jointly engaging into the alliance relationship.

In the collaborative relationship between the firms, efforts of engagement are mainly focused on the achievement of a single task – such as the successful development of the product or service. It may therefore be possible that there is only a certain overall amount of engagement that a focal firm is able to spend on a new product development in order to reach new product development success. This overall amount of joint engagement for any particular product development may be best distributed by economizing its intensity among units within the firm and by maximizing its intensity in the collaboration with the partnering firm.

**Mutual trust.** The intensity levels of mutual trust within and between the focal and partnering firms revealed a synergistic, positive interaction between internal and external intensity and thus supports the proposition made in Hypothesis 2 of this study. As all collaboration partners, whether within or between firms, remain vulnerable to their partners’ actions, a minimum level of mutual trust is believed to be essential for all
joint endeavors (Das & Teng, 1998; Inkpen & Currall, 2004) and represents a basic necessity for virtually all forms of exchange (Arrow, 1974). Within the firm, the intensity of mutual trust among different functional units has been outlined as crucial for successful collaboration (Frishammar & Hoerte, 2005; Hoegl et al., 2004; McEvily et al., 2003). High intensity levels of trust also resemble that sufficient value is being placed on future returns and on the expected time horizon for future exchange (Axelrod 1984, p.124). Trust is believed to evolve over time and is the outcome of prior history for parties engaged in frequent transactions in which expectation of continuity arises (Poppo et al., 2008, p.51). Therefore, it may be possible that unless functional units within the firm trust one another, they will not be able to establish a trusting relationship with the partnering firm (Hillebrand & Biemans, 2004).

In terms of the remaining three collaboration systems attributes (mutual communication, sharing responsibilities, and relationship commitment), there were no statistically significant relationships among the same internal and external collaboration systems attributes and their intensity levels may therefore have little impact on each other. Nevertheless, the patterns found for these collaboration system attributes in this paper as well as core papers 2, 3, suggest that they individually add valuable insights into the relationship between collaboration systems and new product development performance. I start reporting on the collaboration system attributes mutual communication and sharing responsibilities, as in the collaboration among the units within the focal firm, they each reveal a direct and positive relationship with new product development performance in core papers 2, 3, and this study.

**Mutual communication and sharing responsibilities.** It may be possible that their direct relationship with performance on a particular product development outcome is being carried by the long-term and multiple task relationships that units within a firm share with one another (Gupta & Govindarajan, 2000). Specifically, high intensity
levels of mutual communication among units within the firm may resemble well-established communication routines that entail rich information transfer among units well beyond a specific task assignment. Previous studies have outlined the difficulty in distributing responsibilities for decisions and outcomes across different functional units within a firm (Gupta & Wilemon, 1988). The patterns may therefore also resemble an organisational culture that has, over time, established equal distribution for tasks across functional units. Thus, high intensity levels of mutual communication and sharing responsibilities may resemble routines among well-integrated functional units and thus are directly and independently linked to new product development success.

The intensity levels of mutual communication and sharing responsibilities between the focal and partnering firms were not directly related to product development performance and reveal opposing patterns. The intensity of mutual communication between the focal and partnering firm revealed a positive, yet not significant relationship with new product development performance in this study. However, in core paper 3, I found that mutual trust among the focal and partnering firm has a positive moderating impact on the intensity of mutual communication among both firms. Therefore, when solely examining mutual communication patterns between the focal and partnering firm, they reveal little about their impact on new product development performance. It is only at high intensity levels of mutual trust between the focal and partnering firms that mutual communication leads to better performance outcomes. Future research may therefore examine the content of mutual communication (Schippers et al., 2003) rather than the intensity only, as it may give more insights into the patterns revealed. Thus, although the direction for mutual communication patterns for internal and external collaboration systems are as proposed in Hypothesis 1 of this study, they are not significant in the external collaborative relationship and therefore do not support the Hypothesis.
The intensity of sharing responsibilities between the focal and partnering firms revealed a negative pattern in all three studies, which was significant in core paper 3. Its impact on performance was not mediated or moderated by any other internal or external collaboration system attribute. It is thus likely that the balance of who carries how much responsibility in an alliance is formally established and not the product of collaborative history like it may be within the firm. Increases in sharing responsibilities may therefore indeed stand for a complex, detailed contractual agreement between collaborating firms (Reuer & Arino, 2002, 2003). It has been frequently argued that the costs of establishing and monitoring such contracts throughout the life of an alliance are high, as they add increased complexity to the partnership. They may therefore offset the potential benefits gained from the alliance relationship (Reuer & Arino, 2003). Although the patterns for external sharing responsibilities were in the proposed direction, they shared no relationship with performance and thus do not support the propositions made in Hypothesis 3.

**Relationship commitment.** The patterns for the intensity of firm internal and external relationship commitment in this study revealed a direction according to what was hypothesized in Hypothesis 5, however the patterns were not significant and therefore do not support Hypothesis 5. In all three papers relationship commitment among units within the focal firms revealed a negative impact on new product development performance (this impact was significant in core papers 2 and 3). In core paper 3, the findings additionally revealed that the negative relationship between commitment among functional units and new product development is moderated by mutual trust among the units. However, even under high intensity levels of trust among units within focal firms, relationship commitment is still not positively related to new product development performance. It is, however, up to future research to explore whether the patterns revealed can be explained with arguments of curvilinearity,
whether low intensity levels of relationship commitment for a specific new product
development resemble well-working collaborative routines, or whether other influences
determine this pattern.

In the partnership between the focal and partnering firms, relationship commitment
revealed a generally positive pattern in all three papers, but this pattern was not directly
related to new product development performance. Nevertheless, in paper 3, I found that
relationship commitment among the focal and partnering firms is positively related to
new product development performance at high levels of joint engagement between the
firms. Therefore, while relationship commitment among units within the focal firms
should not be maximized for any particular new product development, commitment
between the focal and partnering firms should be high, especially where partnering
firms trust one another.

**Control variables.** Lastly, a number of control variables revealed significant
relationships with new product development performance. The patterns were consistent
with those revealed in the analyses of core paper 2 and core paper 3. For instance, in all
three studies, the size of the focal firms was significantly negatively ($\beta = -.19, p<0.05$)
and the partnering firms’ size significantly positively ($\beta = .19, p<0.05$) related with
development performance. These patterns may be explained as follows\(^{10}\). Previous
research has, however, found that focal firms, which collaborate with larger sized
partners, perform better than otherwise comparable firms that lack such partners (Stuart,
2000). In accounting for this pattern, Stuart (2000: 806) has suggested that that because
large firms are recognized for their reliability and track record, an alliance with a
smaller firm signals that the smaller firm has something unique, such as quality or
innovativeness. Therefore, an alliance between a small focal and small partnering firm

\(^{10}\) An identical explanation was given for this pattern in core papers 2 and 3.
does little to promote an outstanding product compared to when a larger firm chooses to be in the alliance with a much smaller firm.

The patterns\(^{11}\) also revealed a negative relationship between the number of firms involved in the alliance and new product development success ($B = -0.19$, $p<0.05$). This finding is contrary to some previous studies, which have argued from a resource-based perspective that an increasing number of firms involved in a strategic partnership potentially leads to a larger pool of resources that can be shared among collaboration partners (Lane, Salk, & Lyles, 2001). However, other studies have found that with an increasing number of firms involved, potential partner redundancy (Baum, Calabrese, & Silverman, 2000), excess re-negotiations throughout the life of the collaboration (Reuer, Zollo, & Singh, 2002), increased coordination costs (Garcia-Canal et al., 2003; Gong, Shenkar, Luo, & Nyaw, 2007; Park & Ungson, 2001), decreased opportunities for rigorous communication (Baum et al., 2000), decreased levels of relationship commitment (Gong et al., 2007) and increased rivalry among collaboration partners (Kogut, 1988) may occur. Consistent with our findings that internal collaboration mediates and moderates external collaboration, future research might explore, whether firms, which have a larger number of collaborating partners are more constrained in their ability to mediate and moderate each external relationship.

Taken together, the findings of core papers 2, 3, and this study collectively suggest that the navigation of a best-performing confluence of internal and external collaboration systems during the same product development process is complex. The relationship of collaboration systems between focal and their partnering firms and new product development performance seem to be largely mediated and moderated by the alignment of collaboration system attributes within the focal firms. Turning the attention once more to the historic path of internal collaboration, it reflects routines that

\(^{11}\) The patterns are similar to those revealed in core paper 2 and are therefore explained in a similar fashion.
evolve over time and are based upon and embedded in organisational routines and practices. The nature of collaboration systems among functional units for any particular product development may therefore be a result of and is embedded in past collaborative activities among units within firms. It has been argued that firms may reach higher performance not due to better resources, but due to unique, accumulated interactions over time (Roberts & Amit, 2003). This “shadow of the past” (Poppo, Zhou, & Ryu, 2008) that collaboration among units inherits may therefore explain the direct relationship some internal collaboration system attributes (such as mutual communication and sharing responsibilities) have with new product development performance.

The historic path of internal collaboration system practices may also be responsible for their power to influence the relationship firm external collaboration has with innovation performance. Contrary to previous researchers in supply chain management collaboration (Sanders & Premus, 2005; Stank et al., 2001), who suggested that firms, wanting to improve performance through collaboration with external partners, need to enhance internal collaboration, the findings of this study and the previous core papers indicate that aligning rather than maximizing the intensity of all collaboration attributes within focal firms’ internal collaboration systems leads to innovation success.

6.6 Contributions and Implications for Future Research

Together with the findings of core papers 2 and 3, this study accounts for a number of aspects of collaboration not yet addressed in previous studies. The present study represents one of the first empirical efforts to take a multi-attribute approach of collaboration. This approach enabled a much more detailed measure of collaboration systems in terms of structural and relational collaboration systems attributes both within the focal firms and between the focal and their key partnering firms. By highlighting the
similar components of internal and external collaboration systems, I was able to compare their independent and joint contributions to product innovation performance along changes in the intensity levels of collaboration system attributes.

I was able to find two key organisational linkages between focal firms’ internal collaboration systems and their external collaboration systems that have, to the best of my knowledge, so far not been described or studied. The first linkage is that internal collaboration systems account for the relationship between the external collaboration system attributes and new product development performance (core paper 2). A mediation mechanism as such has been previously found for ongoing supply chain management collaboration (Stank et al., 2001), but not for alliances where there is innovation and therefore context-specific complexity. The second key linkage between firm internal and external collaboration systems I found is that certain internal collaboration system attributes also moderate the relationships external collaboration system attributes have with product innovation success – but in different ways (findings of this paper). Thus, the power of internal collaboration to both mediate and moderate the influence external collaboration has on new product development performance gives new insights into alignments of collaboration systems that have so far been, for the most part, un-researched. Tools for developing and managing linkages between organisational systems, similar to those suggested previously by researchers (Goodman, 2000; Schreyoegg & Kliesch-Eberl, 2007), may therefore build the basis of all future collaboration research.

In sum, according to the findings of this study and also those of core paper 2 and 3, value in a new product development alliance is created through the deliberate alignment of firm internal collaboration activities. The findings therefore collectively raise the question of how a firm can manage this internal “power” to coordinate external collaboration most effectively. As argued in each paper, collaboration within the firm is
likely to have embedded routines that evolve over time and are based upon and embedded in successful past organisational routines and practices of a firm (Gupta, Tesluk, & Taylor, 2007). For any particular task one may observe, collaborative patterns within the firm are likely to look similar. Therefore, future research may want to assess whether and if so how firms adjust collaboration routines among functional units within the firm over changing product development alliances.

6.7 Limitations

Together with core papers 2 and 3, this study provides a basis for further researching the alignment of a firm’s collaboration systems for new product innovation performance. Despite its contributions, this study, just like the previous core papers, is subject to a number of limitations that simultaneously can be viewed as further pathways for future research. One methodological issue concerns the scope of the data collected. The data is based from the viewpoint of focal firms about themselves and about their partner. It does not include direct data from the partnering firm. Nor does it include information about collaboration practices with other firms or their respective positions and responsibilities in the value chain. Further, I only obtained data from a single respondent located in a specific functional unit within each focal firm. Although this study provided a test of a multi-dimensional definition of firm collaboration, the baseline model only used the five most commonly employed dimensions and did not include other dimensions of firm collaboration that other researchers may identify. In addition, due to sample size constraints, I was not able test the interactive relationship between firm internal and external collaboration system attributes beyond that of the same variables. I suspect that the inclusion of interaction terms beyond those tested will lead to a number of additional insights that shed even more light on the nature and impact of the association of a focal firm’s internal and external collaboration systems.
Also, considering the centrality of internal collaboration in innovation alliances, a promising avenue for future research is to gather information about the alignments of collaboration systems within the partnering firm(s).

6.8 Conclusion

In sum, the results of this study suggest that the impact of internal collaboration on new product development performance is direct, whilst the impact of external collaboration is indirect and moderated by internal collaboration. In addition, the direction of the relationship between collaboration and innovative performance depends on the attribute(s) of collaboration that researchers choose to examine. Together with the previous two core papers, this study’s findings highlight largely un-researched relationship patterns between a focal firm’s internal and external collaboration systems in a new product development context. Further examinations into the so far largely missing linkages between internal and external collaboration over time may therefore represent an imperative for any future collaboration research.
6.9 References


Comparing Firm Internal and External Collaboration Systems for New Service versus New Product Development Performance

Preface

The findings of the three previous core papers revealed that firms’ internal collaboration systems have a different pattern in terms of their nature and impact on innovation performance than external collaboration systems on each of the five collaboration system attributes. The sample data used for this thesis included 100 new product development alliances and 34 new service alliances. When the type of innovation was entered as a control variable, the findings in the previous core papers suggested that it was not having a direct impact on performance. However, previous controversy in the literature about the differences between services versus product innovations leads to the expectation that the type of innovation influences the collaboration systems, which in turn impact on performance. Therefore, it may be possible that firms’ internal collaboration systems look and impact on performance differently across different types of innovation compared to external collaboration systems. I aim at investigating this possibility in core paper 5.

A related paper, concentrating on the differences in external collaboration systems, has been presented at the Academy of Management Meeting 2008 and is also accepted for publication in the Journal of Product Innovation Management.

An amended version of this paper will be submitted to ‘Organization Science’.
Comparing Firm Internal and External Collaboration Systems for New Service versus New Product Development Performance

Abstract
Collaboration both within and between firms for innovation has received considerable attention. However, little is known about how firms align their internal and external collaboration systems in new service development (NSD) versus new product development (NPD). This study takes a multi-dimensional approach and measures collaboration as a system comprised of five attributes: (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. It utilizes survey data collected from 100 new product development and 34 new service development alliances to examine how NSD and NPD differ on the intensity levels of these collaborative attributes in focal firms’ internal and external collaboration systems. It then explores the joint impact internal and external collaboration systems have on NSD versus NPD performance. The findings reveal that internal collaboration systems look and impact in a similar way, independently of whether a new service or a new product is being developed. However, in an examination of NSD versus NPD, external collaboration systems reveal significantly different levels of intensity along a majority of collaboration system attributes and their relationship with performance. Major implications of the findings are discussed in light of the previous three core papers and future research directions are provided.
7.1 Introduction

There is a widespread recognition of the importance firm internal and external collaboration have for both service and product innovations (Goerzen, 2007; Gupta, Tesluk, & Taylor, 2007; Menor & Roth, 2007). However, there have been few attempts to empirically compare the nature of collaboration in new service development (NSD) versus new product development (NPD) (Karniouchina, Victorino, & Verma, 2006; Menor & Roth, 2007; Menor, Tatikonda, & Sampson, 2002). The small number of studies that have aimed at doing so have focused primarily on comparing firm internal collaborative structures and processes within service- versus product-oriented firms (Drejer, 2004; Johne & Harborne, 1985; Johne & Storey, 1998; Nijssen, Hillebrand, Vermeulen, & Kemp, 2006; Vargo & Lusch, 2004).

In general, the most common distinction between NSD versus NPD voiced in studies that examined collaboration within firms is that service innovation is likely to involve more intensive collaboration than a typical NPD. The arguments used to defend this claim are similar in most studies and are usually based upon the unlike characteristics of services versus products (with services presumed to be of greater intangibility, heterogeneity, inseparability, and perishability) (Fitzsimmons & Fitzsimmons, 2000). However, internal collaboration studies generally did not examine different intensity levels of collaboration among different members within the firm as predictors of NSD versus NPD performance. The evidence for collaboration within the firm, being associated with performance outcomes in NSD versus NPD, remains therefore largely inconclusive.

Moreover, these studies of internal collaboration did not usually include external collaborative practices in their investigations. This is surprising, considering that a majority of today’s product and service innovations require a firm not only to engage in collaboration within the firm (internal collaboration), but also to collaborate with
entities outside the firm through strategic alliances and other forms of strategic partnerships (external collaboration) (Goerzen, 2007; Gupta et al., 2007; Menor & Roth, 2007). Using the same multi-attribute approach of a collaboration system as in the previous core papers, this study attempts to advance the current understanding of how focal firms’ internal and external collaboration systems are predictors of performance when the innovative context is based around a new service innovation versus when the context is a new product development. Specifically, it systematically compares internal collaboration systems with external collaboration systems along 100 NPD alliances and 34 NSD alliances.¹²

The remainder of this paper is organized into four main sections. The next section establishes a definition of a collaboration system. Following from that, a number of propositions are introduced in terms of the different intensity levels of firms’ internal and external collaboration systems attributes for NSD versus NPD. Subsequently, I advance ten propositions about the value-adding nature of internal versus external collaboration system attributes for NSD and NPD. After that, the research methodology is introduced to test the propositions. The third section reports on the results of the tests of these propositions, followed by a discussion of the findings. The article concludes with research implications and suggestions for future research.

7.2 Theoretical Argument and Hypotheses

7.2.1 Toward a Common Definition of a Collaboration System¹³

Collaboration is increasingly understood not as a single entity, but as a phenomenon comprised of multiple attributes, which vary in intensity (Barki & Pinsonneault, 2005; ¹² This study treats the type of innovation (as defined by the product managers of the respective innovation alliances) as the unit of analysis.

¹³ I have used the same definition of collaboration in core papers 2, 3, and 4. This section is therefore identical to those of the previous four core papers.
Frishammar & Hoerte, 2005; Schleimer, 2007). For instance, in core paper 1, I was able to identify a number of collaborative attributes that consistently appear as descriptors of collaboration in over 100 studies, independently of whether the study’s focus was on collaboration within the firm or collaboration among separate entities. The following five attributes capture most of the activities among collaborating parties at different intensity levels of (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. In collaboration studies, mutual communication usually captures the intensity level to which collaborating parties within and between firms share information with one another via different communication tools and mechanisms (Frishammar & Hoerte, 2005; Kahn, 1996). Sharing responsibilities reflects the intensity to which collaborating parties contribute equally in decision-making, complement one another, and share responsibilities for outcomes (Hoegl, Weinkauf, & Gmuenden, 2004; Sanders & Premus, 2005; Zollo, Jeffrey, & Singh, 2002). Joint engagement reflects the intensity with which collaborators plan and assist each other to achieve goals of all involved parties (Mohr & Spekman, 1994; Petersen, Handfield, & Ragatz, 2003). Relationship commitment comprizes the intensity of an exchange partner believing that an ongoing relationship with one another is so important as to warrant maximum efforts at maintaining it (Hoegl et al., 2004; Morgan & Hunt, 1994). Lastly, mutual trust represents the intensity of positive assumption about the motives and intentions collaborating parties hold for one another (Das & Teng, 1998; McEvily, Perrone, & Zaheer, 2003; Morgan & Hunt, 1994).

Therefore, in any one collaboration, whether within and/or between firms, different intensity configurations of these five attributes may result. As a result, I call any particular configuration of these five attributes a collaboration system. The term
‘system’ recognizes that each attribute is an individual entity of the system, yet when examined in line with the others, it results in a particular configuration of collaboration.

7.2.2 Conceptual Model

The conceptual model that captures the focus of this study is provided in Figure 7.1. In the following section, four hypotheses are developed that focus on anticipated differential effects of collaborative intensity in NSD versus NPD (H1 and H2a-2c). Subsequently, five propositions are made in terms of the value-adding nature of focal firms’ internal collaboration systems (H3a-3e) followed by five propositions about the impact of external collaboration systems on NPD versus NSD performance (H4a-4e).

Figure 7.1 The Conceptual Model

7.2.3 The Nature of Firms’ Collaboration Systems in NSD versus NPD

The findings in core papers 2, 3, and 4 collectively suggest that focal firms’ external collaboration systems, in general, look and add different value than internal collaboration systems in terms of the intensity levels of collaborative attributes. Accordingly, I develop two separate sets of propositions in order to determine the value-adding nature of internal and external collaboration system attributes respectively in NSD versus NPD.
7.2.3.1 Intensity of Internal Collaboration Systems in NSD versus NPD

The existing literature collectively argues that the intensity of collaboration within the firm is generally higher for NSD than a typical NPD context (Johne & Storey, 1998; Ross & Staw, 1986; Tatikonda & Zeithaml, 2001). According to existing studies, this difference exists mainly due to the specific characteristics of services (i.e. their intangibility, simultaneity, heterogeneity) (Fitzsimmons & Fitzsimmons, 2000). Thus, while in NSD there is a constant need for modified and new service features, as old ones become quickly obsolete, in NPD, product features are not as easily changed due to the characteristics of a product, such as its physical nature (Johne & Storey, 1998). Also, a new service is more easily modified throughout its development due to its intangibility compared to costly changes a physical product requires the further it has gone through its development (Ross & Staw, 1993).

In addition, the simultaneity for production and consumption in NSD forces higher intensity levels of communication (Johne & Storey, 1998), joint engagement (i.e. joint planning, sharing of important information) (Tatikonda & Zeithaml, 2001), and sharing responsibilities among front- and back-office (Menor et al., 2002) than in the collaboration among different functional units (i.e. Marketing and R&D) in a typical NPD context. Furthermore, although studies of NPD have outlined the importance of trust and commitment among different functional units (Frishammar & Hoerte, 2005; Gupta, Raj, & Wilemon, 1985; Gupta & Wilemon, 1990), their intensity is believed to be not as high as in a typical NSD (Johne & Storey, 1998). This is due to the much more dynamic environment in NSD, where front- and back-office units rely on each others’ actions to a much larger extent than in a characteristic NPD (Lievens & Moenaert, 2000).
I therefore propose:

\[ H1: \text{The intensity of internal collaboration systems of firms engaged in NSD (in terms of the five attributes) will be significantly higher than in firms engaged in NPD.} \]

7.2.3.2 Intensity of External Collaborative Systems in NSD versus NPD

Mutual Communication, Joint Engagement, Sharing Responsibilities

Similarly to within the firm, it is generally believed that in NSD alliances, the characteristics of the service itself carry an increased necessity for higher intensity levels of mutual communication (Meyer & DeTore, 1999; Von Hippel, 2001), joint engagement (Easingwood, 1986; Sunbo, 1997), and sharing responsibilities (Meyer & DeTore, 1999; Von Hippel, 1998) among collaborating firms compared to a typical NPD. This increased intensity is mainly due to the ease of and the need for constant modifications of service features throughout a new service development and due to the simultaneity of service innovation and service delivery (Meyer & DeTore, 1999). In NPD alliances, however, firms generally follow a more structured environment of resource and information exchange than in a typical NSD due to the clear separation of production and consumption (Johne & Harborne, 1985). This is mainly due to the comparably large resource commitments firms make in typical NPD alliances compared to NSD partnerships (Ross & Staw, 1993). Therefore, one would expect, in general, lower intensity levels of mutual communication, joint engagement, and sharing responsibility patterns in a typical NPD.

This leads to the following hypothesis:

\[ H2a: \text{The intensity of mutual communication, joint engagement, and sharing responsibilities between collaborating firms will be significantly higher for NSD than NPD.} \]
External Relationship Commitment in NSD versus NPD

In general, for both NPD and NSD, the further a new product and a new service have progressed through their development stages, the more committed firms are to one another (Ross & Staw, 1993). For most new product developments, this also means that with increased commitment, changes to the product itself become increasingly costly (Garland, 1990). Thus, scholars found that firms may be more committed to the relationship, when the joint development entails high modification and exit costs, which is more likely in NPD than NSD (Ross & Staw, 1986, 1993). Services, in comparison, can be more easily modified throughout the development process due to their relative intangibility (Easingwood, 1986). Even after the initial development has been completed, constant amendments are made in order to adjust and further customize service features (Meyer & DeTore, 1999). Therefore, if costs of alterations during a development process are lower, which is more likely to occur in NSD due to the characteristics of services, firms may be more likely to operate at lower intensity levels of relationship commitment compared to when costs for alterations are higher, which is more likely for NPD.

Therefore, I hypothesize that:

\[ H2b: The\ intensity\ of\ mutual\ relationship\ commitment\ between\ collaborating\ firms\ will\ be\ significantly\ higher\ for\ NPD\ than\ NSD. \]

External Mutual Trust in NSD versus NPD

Most new product developments have large resource commitments and collaborating firms often reach a state in their relationship where they rely on each other largely due to these commitments to one another (Ross & Staw, 1986, 1993). This relationship, based on resource obligations, creates a stable, controlled environment for the duration
of the collaboration (Parkhe, 1993) and may substitute the need for high levels of mutual trust (Inkpen & Currall, 2004). The role of mutual trust may be different for NSD partnerships, as firms do not create a relationship based on resource commitments to the extent they do in a typical NPD (John & Storey, 1998). Researchers argued that in these partnerships, mutual trust can operate as a source of confidence and as a sign of mutual reliability (Ring & Van de Ven, 1992). In the absence of resource commitments, mutual trust may therefore act as an alternative source of showing assurance in the partnership. Firms may therefore collaborate with higher levels of mutual trust in NSD than NPD.

This leads to the following hypothesis:

\[ H2c: \text{The intensity of mutual trust among collaborating firms will be significantly higher for NSD than NPD.} \]

7.2.4 Value of Internal and External Collaboration Systems for NSD versus NPD Performance

The existing innovation literature is rife with research about the importance of collaboration for NPD success (Faems, Van Looy, & Debackere, 2005; Hillebrand & Biemans, 2004; Santoro, 2000) and NSD performance (Edgett, 1994; Froehle, Roth, Chase, & Voss, 2000; Meyer & DeTore, 1999). However, studies have, to the best of my knowledge, not empirically tested how firms’ internal collaboration systems together with their external collaboration systems lead to a successful NPD versus a successful NSD. Thus, it is uncertain, how firms align their internal and external collaboration systems in order to achieve NSD versus NPD performance.
7.2.4.1 Value-Adding Nature of Internal Collaboration Systems for NSD versus NPD Performance

Internal Mutual Communication, Sharing Responsibilities and Performance

Previous studies have argued that compared to a new product development, a service innovation more often requires modified or new organizational practices (Atuahene-Gima, 1996). That is, when a new service is developed, there is usually greater incompatibility between the innovations and current organizational skills and procedures than in a typical NPD (Nijssen et al., 2006). In core papers 2, 3, and 4, I found that intensity levels of communication practices and sharing responsibilities among involved functional units are individually and positively related to new product development performance. I explained the patterns found by arguing that the intensity of communication and sharing responsibilities among functional units in any particular NPD are likely to have embedded baggage of past decisions and collaborative patterns that have shaped their current nature. Therefore, in a typical NPD, a firm may be able to take more advantage of established communication patterns and routines of sharing responsibilities among units than in a characteristic NSD, where units are not able to benefit from established practices as much.

I therefore argue:

*H3a*: Increases in the intensity of mutual communication between the units involved within focal firms will have a stronger, positive impact on performance in NPD than NSD.

*H3b*: Increases in the intensity of sharing responsibilities between the units involved within focal firms will have a stronger, positive impact on performance in NPD than NSD.
Internal Joint Engagement, Relationship Commitment and Performance

Core papers 2, 3, and 4 revealed that the intensity of joint engagement and relationship commitment among functional units within the focal firms have a negative relationship pattern with new product development performance. I explained the patterns found mainly with the frameworks of the Yerkes-Dudson law (Gavetti & Warglien, 2007; Schippers, Den Hartog, Koopman, & Wienk, 2003; Singh, 1998) and arguments of ‘groupthink’ (Gavetti & Warglien, 2007; Janis, 2004), where increases in intensity after a certain threshold are no longer associated with performance increases. Within a firm, it is most likely that different units are involved in a number of task assignments/project at any one time, independently of whether a new service or a new product is being developed (Lundin & Hartman, 2000). Therefore, in both NPD and NSD, it is likely that, if units focus their efforts into one product/service project, they run the risk of over emphasizing their efforts on this relationship and neglect other projects/assignments that also deserve collaborative efforts. If Hypothesis 1 is confirmed in that the intensity of joint engagement and relationship commitment among units within the focal firms is higher for NSD, it would follow that the intensity is closer to its threshold. Therefore a stronger, negative relationship may exist between the intensity of joint engagement and performance and relationship commitment and performance in NSD than NPD.

I therefore argue:

\textit{H3c}: Increases in the intensity of joint engagement between the units involved within focal firms will have a stronger, negative impact on performance in NSD than NPD.

\textit{H3d}: Increases in the intensity of relationship commitment between the units involved within focal firms will have a stronger, negative impact on performance in NSD than NPD.
Internal Mutual Trust and Performance

Scholars have found that functional units within a firm will not collaborate with one another, unless they perceive each other as credible and trustworthy (Gupta & Wilemon, 1988). Independently of the type of innovation, high levels of mutual trust among collaborating units within a firm have been frequently linked to increased product development performance (Ghoshal, Korine, & Szulanski, 1994; Jassawalla & Sashittal, 1998; Klein & Mulvey, 1995; Liedtka, 1996) and service development performance (Johne & Harborne, 1985; Lievens & Moenaert, 2000). Mutual trust, in general, evolves with time and is a result of accumulated satisfactory experience of gradually increasing efforts and expectations of continuity (Das & Teng, 2004; Poppo, Zhou, & Ryu, 2008).

As pointed out by Atuahene-Gina (1996), units are less able to rely on organizational routines in a typical NSD due to the changing demands of a new service in development and trust may therefore be more difficult to be established. Moreover, if Hypothesis 1 is confirmed and the intensity of mutual trust is higher among functions in NSD than NPD, it would follow that units in NSD, in the absence of organizational routines, rely on and benefit more from mutually trusting one another than in NPD.

I therefore argue:

H3e: Increases in the intensity of mutual trust between the units involved within focal firms will have a stronger, positive impact on performance in NSD than NPD.

7.2.4.2 Value-Adding Nature of External Collaboration Systems for NSD versus NPD Performance

External Mutual Communication and Performance

Information exchange is likely to be fairly standardized in a typical NPD alliance (Reuer & Arino, 2003). This is mainly because the nature and extent of physical
resource exchange is agreed upon though specific contractual or non-contractual agreements at the beginning of the alliance. The information exchange that follows is therefore largely tied to the resource commitments made at the beginning. In a characteristic NSD alliance, however, mutual communication is not tied to physical resource commitments and, if Hypothesis 2 is confirmed, is more intensive than in NPD alliances due to the simultaneity of development and modifications. Increases in communication intensity in NSD are therefore more likely than in NPD and resemble modifications in the service innovation rather than increases in performance. In a NPD, however, increases in communication exchange may stand for that partners provide each other with sensitive information as a way of showing both goodwill and intimacy (Das & Teng, 1998; Hart & Saunders, 1997; Lievens & Moenaert, 2000).

I therefore propose:

*H4a: Increases in the intensity of mutual communication between focal firms and their partnering firms will have a stronger, positive impact on performance in NPD than NSD.*

**External Joint Engagement and Performance**

In a typical NPD alliance, firms usually commit physical resources to the alliance. With increasing obligations toward the relationship, the commitments and simultaneously the vulnerability to one another also increase. With rising levels of joint engagements (i.e. advising one another, joint planning, sharing important information with one another), firms reduce the risk of opportunistic behaviour (Takeishi, 2001). However, whilst high intensity levels of joint engagement may have joint benefits for collaborating firms, inflated levels of engagement may also slow down their ability to respond to changes in their environment. This may negatively affect NSD generally more than NPD, as
collaborating parties have to be fast in responding to changes due to the simultaneity of production and consumption (Fitzsimmons & Fitzsimmons, 2000). Accordingly, at the lower end of joint engagement, which is likely to occur in NPD (Hypothesis 1), increases in intensity may be more associated with increases in performance than in NSD.

I conclude:

\[ H4b: \text{Increases in the intensity of joint engagement between focal firms and their partnering firms will have a stronger, positive impact on performance in NPD than NSD.} \]

**External Sharing Responsibilities and Performance**

Findings of core papers 2, 3, and 4 suggested that the intensity levels of sharing responsibilities between the focal and partnering firms are negatively related to new product development success. This pattern was explained in that sharing responsibilities for most decisions and outcomes in a typical new product development alliance mirrors a complex contract that is costly to establish and that needs to be monitored throughout the life of the alliance (Reuer & Arino, 2003). In service innovation alliances, the setup and impact of sharing responsibilities is likely to be different. This is due to the fact that little or no physical resources are exchanged between partnering firms and due to the likelihood of modifying service features throughout the development. Thus, if Hypothesis 2a is confirmed and there are habitually higher levels of sharing responsibilities for decisions and outcomes in NSD alliances, increases in these levels may resemble that firms are able to effectively develop and simultaneously modify new service features with one another.
I argue:

**H4c: Increases in the intensity of sharing responsibilities between focal firms and their partnering firms will have a stronger, negative impact on performance in NPD than NSD.**

**External Relationship Commitment and Performance**

In most new product innovations, the level of commitment to devote substantial expenditure into the development of physical objects and contracts around them is usually much larger than that spent on the development of a new service (Alic, 2001; Djellal & Gallouj, 2001). Research on escalation of commitment has found that increases in relationship commitment for a nearly completed physical structure were positively associated with higher closing costs and not with higher performance outcomes (Garland, 1990; Ross & Staw, 1986, 1993). Extrapolating from this, it is unlikely that one would find a positive relationship between inflated levels of relational commitment and performance in NPD. The same may not be the case for NSD. In NSD, partners can usually modify service features with relative ease throughout the development process as they are not bound to make decisions based on previous commitments made to the extent they are in a typical NPD (Ross & Staw, 1986, 1993). Therefore, in comparison to NPD, in NSD it is likely to be easier for collaborators to avoid unwarranted escalation of commitment. Where relationship commitment can be adjusted to the needs of the innovation, increases in commitment will be more likely to be positively associated with NSD performance.
This leads to the following hypothesis:

\textit{H4d: Increases in the intensity of relationship commitment between focal firms and their partnering firms will have a stronger, positive impact on performance in NSD than NPD.}

\textbf{External Mutual Trust and Performance}

As all collaboration partners remain vulnerable to their partners’ actions, a minimum level of mutual trust is essential for all joint endeavors (Das & Teng, 1998; Inkpen & Currall, 2004). Some researchers argued further that when it is possible to completely trust a partner, there is no need to set up any control mechanisms and regulations (Inkpen & Baemisch, 1997). However, other scholars have stressed that trust by itself does not guarantee partnership success (Shapiro, 1987) and that certain formal structures and processes are needed to create a stable or controlled collaborative environment (Shapiro, 1987). Researchers further argued that firms in collaborative alliances feel more confident about the collaboration when they perceive they have an adequate level of control over their partners, independently of whether they trust one another (Parkhe, 1993; Reuer & Arino, 2003).

Compared to NPD, NSD often exists in a more dynamic environment due to the simultaneity of production and consumption (Fitzsimmons & Fitzsimmons, 2000; Nijssen et al., 2006). Collaborating firms in NSD may find it more difficult to gain an adequate level of control over the alliance partner than in a typical NPD relationship, because they may endure a higher degree of difficulty in formalizing coordination and control mechanisms for intangible resources. Therefore, in the absence of alternative coordination mechanisms, which ensure a controlled collaborative environment, the intensity levels to which mutual trust exists among collaborating firms may play a more
significant role in the success for a new service development compared to a new product development.
Thus, it is hypothesized that:

\[ H4e: \text{Increases in the intensity level of mutual trust between focal firms and their partnering firms will have a stronger, positive impact on performance in NSD than NPD.} \]

7.3 METHOD

7.3.1 Sample and Procedures

I tested the research hypotheses utilizing survey data collected on a sample of 134 dyadic innovation alliances. Before that, I used interview results and pre-existing scales of numerous collaboration studies to develop the measures for a pilot survey. The pilot survey was done in form of a person-administered survey on 30 managers in several industry sectors, who reflected a similar orientation to those, who subsequently completed the main questionnaire. The face validity of the survey was further assessed by pre-testing the instrument with a convenience sample of 30 product managers of one industry association (none of whom were included in the final dataset).

For the main data collection, 29 national industry associations, industry bodies from the Australian Competition and Consumer Commission directory and other Australian government sources were initially selected. Eleven industry associations/industry bodies agreed to distribute the survey invitation to their member firms via an electronic mail and/or their monthly newsletter. The criterion for choosing the sample respondents in the respective sample was that the managers had (at least partly) overseen a recent

\footnote{The method section of this paper is identical to the one in core papers 2, 3, and 4. This is due to the same sample taken and the same measures of internal, external collaboration attributes, and new product development performance.}
product or service development that involved collaboration with at least one key partnering firm located anywhere in the focal firm’s value chain. Defining new services versus product developments by the nature of the industry (service versus manufacturing) the firms were located in may be misleading. Many physical products today have service components and similarly, service innovations have physical by-products. Thus, new services versus new product innovations were defined from the viewpoint of the development managers.

Of the 3620 surveys e-mailed, I received 359 responses, which is a response rate of 9.9%. 109 surveys were only partially answered (less than 60% of the survey questions), which left us with fully completed survey data from 250 firms. Of these, 82 firms were engaged in a collaborative agreement with a partnering firm; however, they only had a single business unit involved in this joint collaboration. Thus, they did not engage in collaboration among units within the firm during their chosen product development. Of the remaining 168, 34 alliances had successfully developed a product, however, the product was not released to the market as yet and questions concerning its success could not be answered. This left me with data of 134 alliances that also entailed collaboration among functional units within focal firms from the viewpoint of product managers located in these firms. The respective focal firms belonged to 11 different industry sectors. 73.2% of the respondents were located in their firm’s headquarters. Over 75% of the respondents have been involved in product development for at least three years and a vast majority of them held positions of either senior managers (38.1%) or managing directors (23.8%). On average, the respondents had been working in the development of products for at least 6 years. Of the respondents, a majority was located in the Marketing department (39), R&D department (29), sales department (20), manufacturing (13), or design department (12) in their respective firms.
Because I did not obtain data from different managers within the firm, but only a single person located in a single functional unit, I checked for bias in terms of the functional unit the managers were located in (ie. marketing versus manufacturing versus R&D versus Design). The findings revealed no significant difference in terms of the type of unit (p > .10). I also checked non-response bias on the basis of the recorded information from the respective industry associations. The mean differences between responding and non-responding firms along firm attributes, such as firm size and location, were contrasted using a t-test; all statistics were non-significant. Moreover, I implemented a series of logistic regressions, measuring whether the time at which the respondents answered the survey had a significant impact on the variables such as size of the firms, their respective industry sector, and gender. The analyses were not significant for all regressions (p > .10).

7.3.2 Measurement
Scales for the study consisted of newly generated items and items that have been used previously in the literature. When a new scale was developed, it was done based on suggestions and findings in the existing literature. All of the main constructs were measured using multiple items requiring an indication of intensity on a five point Likert-typed scale for each item. For measurement consistency, I calculated the coefficient alpha. Reliability values of all constructs met Nunnally’s criterion of acceptability of 0.70 or above (Nunnally, 1978). Construct validation was assisted through the use of exploratory factor analyses, and confirmatory factor analyses. The items used in the following analyses are included in the Appendix of this paper.
Dependent Variables

New product/service development performance. Consistent with prior work on performance measures, due to the variety of industries and firm sizes included in the sample, and because the objectives and performance criteria of the firms varied, a multi-dimensional performance measure was considered most appropriate. The index was comprised of five items from measures of previous studies (Homburg & Pflesser, 2000; Sanders & Premus, 2005; Scannell, Vickery, & Droege, 2000). Each item had high loading coefficients of above 0.64 and an Eigenvalue of over 53% variance, explained by the first component. They therefore validated the appropriateness of individual items constituting this construct. The items of this construct and of the independent variables are depicted in Appendix D at the end of the thesis.

Independent Variables

In accordance to core paper 1 and 2, I measured collaboration within the focal firm and also between the focal and partnering firm along five collaborative attributes that each can vary in their intensity. All five collaborative attributes contained multiple items. They were slightly altered depending on the respective context of questions about collaboration within the focal firm and collaboration between both firms. Identical five-point Likert scales at “1 = never”, “2 = seldom”, “3 = occasionally”, “4 = often”, and “5 = quite frequently” were adopted for all items.

(1) Mutual communication. The items to measure ‘mutual communication’ were taken from Kahn (1996) and Frishammar and Hoerte (2005). The chosen six items were originally designed by Van den Ven and Ferry, who measured inter-unit information flow. All items loaded cleanly onto one factor (loadings for internal collaboration: 0.64-0.74; loadings for external collaboration: 0.56-0.79). In combination with the other
measures, this measure appeared to be a reliable indicator of internal collaboration (Cronbach’s alpha = 0.79) and external collaboration (Chronbach’s alpha = 0.80).

2) **Sharing responsibilities.** All four items of this measure are taken from a larger construct developed and measured by Hoegl et al. (2004). The authors reported a coefficient score between 0.70 and 0.89 for all items and therefore the items appear to have sound measurement properties and appropriately reflect the conceptual definition of this construct. The measure loaded cleanly on one factor (loadings for internal collaboration: 0.78-.0.82; loadings for external collaboration: 0.82-0.88), had an overall coefficient score of 0.81 (for internal collaboration) and 0.88 (for external collaboration) and was therefore retained in the analysis in this study.

3) **Joint engagement.** The level of joint engagement between collaboration partners refers to the extent to which partners jointly plan, set goals, advice, and assist each other (Mohr & Spekman, 1994). All five items were taken from scales used by Mohr and Spekman (1994). The items loaded cleanly on one factor (loadings for internal collaboration: 0.77-0.84; loadings for external collaboration: 0.65-0.80), and had an overall coefficient alpha score of 0.87 for internal collaboration and 0.82 for external collaboration.

4) **Relationship commitment.** I chose to take four items from the seven-item measure of relationship commitment developed and used by Morgan and Hunt (1994). The findings reported by Morgan and Hunt (1994) show the items to be highly reliable (coefficient score of 0.90). Morgan and Hunt adapted all items from an earlier study by Mowday, Steers and Porter (1979). I decided to drop three items from Morgan and Hunt’s study (1994) due to their low Cronbach alpha scores during the internal consistency test in the pilot phase of the study. The remaining four items loaded cleanly into one factor (loadings for internal collaboration: 0.84-.89; loadings for external collaboration: 0.87-0.92), appeared to be a reliable indicator of internal collaboration.
(overall coefficient score 0.89) and external collaboration (overall coefficient score 0.91) and therefore soundly reflects the conceptual definition of this construct.

(5) Mutual trust. All items were taken from existing scales in a study by Morgan and Hunt (1994). Research findings by Morgan and Hunt suggested that the indicators are reliable measures of trust based in the coefficient alpha (0.95). The measures were originally developed by Larzelere and Huston (1980), who explored close interpersonal relationships. Following, in the piloting of this measure satisfactory internal consistency levels were not achieved for three of the original seven items. I therefore decided to measure trust only with four of the seven-item scale developed by Morgan and Hunt (1994). These remaining four items loaded cleanly on one factor (loadings for internal collaboration: 0.82-0.91; loadings for external collaboration: 0.90-0.92), had an overall coefficient score of 0.90 for internal collaboration, 0.92 for external collaboration, and were therefore retained as adequate measurement properties in the analysis in this study.

Control variables. To reduce potential confounding effects, this study controlled for several variables known to correlate with firm collaboration: Effects of firm size of the focal and partnering firm using the number of full-time employees (Collins & Smith, 2006); accumulated collaborative experience (number of previous joint developments) both firms had with one another before the development (Simonin, 1997; Zollo et al., 2002; Handfield et al., 1999); number of other firms involved in the development process (Baum, Calabrese, & Silverman, 2000); and the form of agreement (1 = contractual, 0 = non-contractual) between the focal and partnering firm (Reuer & Arino, 2003).

I initially controlled for the following additional factors known to correlate with collaboration: Industry sectors of the focal and partnering firm, radicalness of the product innovation, the length of the product development in general, and the length of
the alliance in specific. However, these factors did not account for a significant amount of variance and are not included in the following report of the regression analysis.

7.4 Analysis and Results

Table 7.1 depicts the bivariate correlation matrix and Table 7.2 presents the results from the paired sample t-test, which was used to assess hypotheses 1 and 2a, 2b, and 2c. All four hypotheses predict that the intensity of internal collaboration system attributes differ in NSD versus NPD, but in different ways. Hypothesis 1 proposed that the intensity levels of all five collaboration system attributes within the firm (mutual communication, joint engagement, sharing responsibilities, relationship commitment, and mutual trust) are higher for NSD than for NPD. This proposition was based on the impact of simultaneity and the more volatile collaborative environment among units within the firm that exist in a typical service innovation. As summarized in Table 2, there are no significant differences in terms of the level of intensity in the collaborative relationships among units involved within the focal firm for a NSD versus NPD. Hypothesis 1 is therefore not supported. This finding has major implications in terms of the nature of a firm’s internal collaboration system across different types of innovations, which will be discussed later in this study.

Hypothesis 2a, 2b, and 2c were concerned about the intensity of collaboration attributes in the collaborative relationship between the focal and a key partnering firm. As predicted and summarized in Table 7.2, the intensity levels for mutual communication and joint engagement between the focal and partnering firms were significantly higher in NSD than NPD partnerships (mutual communication: \( t = -1.78, p<.10 \); joint engagement: \( t = -2.02, p<.05 \)). Also, as anticipated, the intensity levels of sharing responsibilities for NSD were higher than NPD; however, this difference was not significant (\( t = -0.83, \text{n.s.} \)). Hypothesis 2a, based on the assumption that NSD
partnerships involve higher intensity levels, is therefore supported for the intensity level of mutual communication and joint engagement, but not for sharing responsibilities.

Hypothesis 2b, which predicted that the intensity levels of relationship commitment are significantly higher for NPD than NSD, was based on the assumption that investments in NPD are likely be higher and less easy to reverse than investments in NSD. This hypothesis is also supported (t = 1.69, p<.10). In Hypothesis 2c, it was proposed that mutual trust would be greater in NSD partnerships than NPD partnerships, because of the absence of physical resource commitments. The intensity level of mutual trust, though in the predicted direction, did not reveal a significantly different mean for NSD versus NPD, which leads not to support Hypothesis 2c.

Table 7.1 Descriptive Statistics and Pearson Correlation Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Internal mutual communication</td>
<td>3.58</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. External mutual communication</td>
<td>3.41</td>
<td>.68</td>
<td>.40**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Internal sharing responsibilities</td>
<td>3.35</td>
<td>.71</td>
<td>.49**</td>
<td>.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. External sharing responsibilities</td>
<td>3.35</td>
<td>.82</td>
<td>.10</td>
<td>.54**</td>
<td>.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Internal joint engagement</td>
<td>3.48</td>
<td>.71</td>
<td>.62**</td>
<td>.32**</td>
<td>.69**</td>
<td>.23**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. External joint engagement</td>
<td>3.48</td>
<td>.69</td>
<td>.15</td>
<td>.50**</td>
<td>.27**</td>
<td>.67**</td>
<td>.33**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Internal relationship commitment</td>
<td>3.62</td>
<td>.73</td>
<td>.39**</td>
<td>.13</td>
<td>.63**</td>
<td>.08**</td>
<td>.51**</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. External relationship commitment</td>
<td>3.86</td>
<td>.77</td>
<td>.10</td>
<td>.36**</td>
<td>.20</td>
<td>.56**</td>
<td>.27**</td>
<td>.57**</td>
<td>.30**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Internal mutual trust</td>
<td>3.83</td>
<td>.70</td>
<td>.28**</td>
<td>.16</td>
<td>.48**</td>
<td>.25**</td>
<td>.51**</td>
<td>.30**</td>
<td>.69**</td>
<td>.47**</td>
<td></td>
</tr>
<tr>
<td>10. External mutual trust</td>
<td>3.75</td>
<td>.74</td>
<td>.12</td>
<td>.40**</td>
<td>.25**</td>
<td>.59**</td>
<td>.25**</td>
<td>.62**</td>
<td>.24**</td>
<td>.78**</td>
<td>.47**</td>
</tr>
</tbody>
</table>

* n = 134; two-tailed
** p < .01, *p < .05

225
Table 7.2 T-Test Statistics\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.d.</th>
<th>t- value</th>
<th>Sig. (2-tailed)</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal mutual communication</td>
<td>Product: 3.56</td>
<td>Service: 3.63</td>
<td>Product: 0.71</td>
<td>Service: 0.69</td>
<td>-.49</td>
</tr>
<tr>
<td></td>
<td>Internal joint engagement</td>
<td>Product: 3.44</td>
<td>Service: 3.59</td>
<td>Product: 0.72</td>
<td>Service: 0.67</td>
</tr>
<tr>
<td></td>
<td>Internal sharing responsibilities</td>
<td>Product: 3.32</td>
<td>Service: 3.44</td>
<td>Product: 0.71</td>
<td>Service: 0.72</td>
</tr>
<tr>
<td></td>
<td>Internal relationship commitment</td>
<td>Product: 3.64</td>
<td>Service: 3.58</td>
<td>Product: 0.72</td>
<td>Service: 0.78</td>
</tr>
<tr>
<td></td>
<td>Internal mutual trust</td>
<td>Product: 3.79</td>
<td>Service: 3.95</td>
<td>Product: 0.72</td>
<td>Service: 0.65</td>
</tr>
<tr>
<td></td>
<td>External mutual communication</td>
<td>Product: 3.39</td>
<td>Service: 3.58</td>
<td>Product: 0.71</td>
<td>Service: 0.72</td>
</tr>
<tr>
<td></td>
<td>External joint engagement</td>
<td>Product: 3.43</td>
<td>Service: 3.65</td>
<td>Product: 0.73</td>
<td>Service: 0.70</td>
</tr>
<tr>
<td></td>
<td>External sharing responsibilities</td>
<td>Product: 3.31</td>
<td>Service: 3.43</td>
<td>Product: 0.83</td>
<td>Service: 0.80</td>
</tr>
<tr>
<td></td>
<td>External relationship commitment</td>
<td>Product: 3.91</td>
<td>Service: 3.70</td>
<td>Product: 0.84</td>
<td>Service: 0.82</td>
</tr>
<tr>
<td></td>
<td>External mutual trust</td>
<td>Product: 3.77</td>
<td>Service: 3.83</td>
<td>Product: 0.73</td>
<td>Service: 0.80</td>
</tr>
</tbody>
</table>

\(^a\)n = 134; two-tailed

While Hypotheses 1 and 2a-c addressed differences between NSD and NPD in the intensity of the collaborative attributes, Hypotheses 3a-e and 4a-e investigated how the success of a new service versus a new product is differentially impacted by the intensity of the internal and external collaboration system attributes. To test the independent contribution of each collaborative attribute toward the development success of NSD versus NPD, a hierarchical regression was performed. Product versus service development was included as a dummy variable in an additive and a multiplicative form (Gujarati, 1970; Terawatanavong, Whitwell, & Widing, 2007). By including the variable for NSD versus NPD (service = 0; product = 1), it was possible to test whether the difference between NSD and NPD lies in the intercept, the slope, or both. Table 7.3 presents the results of this regression.
Table 7.3 Results of Hierarchical Regression

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focal firm size</td>
<td>-1.4</td>
<td>-2.1</td>
<td>-1.9*</td>
</tr>
<tr>
<td>Partner firm size</td>
<td>.11</td>
<td>.18*</td>
<td>.18*</td>
</tr>
<tr>
<td>Accumulated experience with partner</td>
<td>.06</td>
<td>-.04</td>
<td>.01</td>
</tr>
<tr>
<td>Number of firms involved</td>
<td>-.09</td>
<td>-.15*</td>
<td>-.14*</td>
</tr>
<tr>
<td>Form of alliance</td>
<td>.1</td>
<td>.14*</td>
<td>.11</td>
</tr>
<tr>
<td><strong>Dummy variable product versus service development</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product or service development</td>
<td></td>
<td>.03</td>
<td>-.04</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internal collaboration system attributes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal mutual communication</td>
<td>.26*</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Internal joint engagement</td>
<td>-.07</td>
<td>-.31</td>
<td></td>
</tr>
<tr>
<td>Internal sharing responsibilities</td>
<td>.23*</td>
<td>.71*</td>
<td></td>
</tr>
<tr>
<td>Internal relationship commitment</td>
<td>-.33*</td>
<td>-.72**</td>
<td></td>
</tr>
<tr>
<td>Internal mutual trust</td>
<td>.26*</td>
<td>.71*</td>
<td></td>
</tr>
<tr>
<td><strong>External collaboration system attributes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External mutual communication</td>
<td>.02</td>
<td>-.16</td>
<td></td>
</tr>
<tr>
<td>External joint engagement</td>
<td>.22*</td>
<td>-.71**</td>
<td></td>
</tr>
<tr>
<td>External sharing responsibilities</td>
<td>-.18</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>External relationship commitment</td>
<td>.11</td>
<td>.55*</td>
<td></td>
</tr>
<tr>
<td>External mutual trust</td>
<td>.14</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td><strong>Interaction terms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product/service x internal mutual communication</td>
<td></td>
<td>.26</td>
<td></td>
</tr>
<tr>
<td>Product/service x internal joint engagement</td>
<td></td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>Product/service x internal shared responsibilities</td>
<td></td>
<td>-.46</td>
<td></td>
</tr>
<tr>
<td>Product/service x internal relationship commitment</td>
<td></td>
<td>.43*</td>
<td></td>
</tr>
<tr>
<td>Product/service x internal mutual trust</td>
<td></td>
<td>-.39</td>
<td></td>
</tr>
<tr>
<td>Product/service x external mutual communication</td>
<td></td>
<td>.20</td>
<td></td>
</tr>
<tr>
<td>Product/service x external joint engagement</td>
<td></td>
<td>1.00***</td>
<td></td>
</tr>
<tr>
<td>Product/service x external shared responsibilities</td>
<td></td>
<td>-.60*</td>
<td></td>
</tr>
<tr>
<td>Product/service x external relationship commitment</td>
<td></td>
<td>-.46*</td>
<td></td>
</tr>
<tr>
<td>Product/service x external mutual trust</td>
<td></td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.04</td>
<td>.32</td>
<td>.48</td>
</tr>
<tr>
<td>Change in R²</td>
<td>.037</td>
<td>.29***</td>
<td>.15**</td>
</tr>
<tr>
<td>Hierarchical F</td>
<td>.979</td>
<td>4.47***</td>
<td>3.13**</td>
</tr>
</tbody>
</table>

*a n = 134; Note. Dependent variable: Product development success. All coefficients presented are standardized coefficients. † p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001 (two-tailed)

‘Nuisance’ variables (the control variables) of lesser importance were entered first (model 1) and variables of more importance were entered last (Pedhauzer, 1997). Model 2 was used to verify the individual effect of each collaborative attribute. Estimated variance inflation factors for all predictor and control variables suggested an absence of multicollinearity among them (VIFs; 1.2-3.4). All independent variables were centered
to reduce nonessential multicollinearity among interaction terms and their individual components (Aiken & West, 1991). Model 3 includes all relevant two-way interactions between the product versus service variable and each of the five internal and five external collaboration system attributes. A comparison of model 2 with model 1 and of model 3 with model 2 suggested that the inclusion of the collaborative attributes, the predictor variables, and the interaction effect each significantly add to the model’s power to explain the variance of development success (model 2: hierarchical F = 4.47, p < .001; model 3: hierarchical F = 3.13, p < .01).

I start reporting the findings for Hypothesis 3a-e in terms of the value-adding nature of internal collaboration system attributes in NSD versus NPD innovation alliances. Hypothesis 3a and 3b proposed a stronger, positive relationship for NPD than NSD between the intensity level of mutual communication (Hypothesis 3a) and sharing responsibilities (Hypothesis 3b) among the units involved in the focal firms and performance. The intensity of mutual communication among the units within the focal firm revealed no significant relationship with performance and no interaction effect with the service/product variable. Whilst sharing responsibilities among the units within the focal firms revealed a significant positive main effect (β = .71, p < .05) and is thus directly and positively related to development performance, there was no difference in terms of whether a new service or a new product were developed. Hypotheses 3a and 3b are therefore not supported.

In Hypothesis 3c and 3d, I argued that the intensity levels of joint engagement (H3c) and relationship commitment (H3d) among units within the focal firms have a stronger, negative impact on development performance in NSD than NPD. I based these arguments on the framework of the Yerkes-Dudson law (1908). The intensity levels of joint engagement did not reveal any significant relationship with development performance and no interaction effect with the service/product variable. Hypothesis 3c
is therefore not supported. However, the intensity of relationship commitment revealed a significantly negative main effect ($\beta = -.72, p < .01$) and also a significant interaction pattern with the services/product variable ($\beta = .43, p < .10$).

To further test the relationship, a simple slope analysis was performed. It is illustrated in Figure 7.2 (Aiken & West, 1991). Findings reveal that where a new product was developed between the focal and partnering firms, the level of relationship commitment among units within the focal firms had a negative, but not significant pattern with NPD success ($\beta = -0.10, n.s.$). However, where the firms jointly developed a new service, the intensity level of relationship commitment among the units within the focal firms was significantly and negatively related to NSD success ($\beta = -0.61, p<.01$). Therefore, Hypothesis 3d is therefore supported in that the intensity level of relationship commitment among involved units within the focal firms has a stronger, negative relationship with performance for NSD than NPD.

**Figure 7.2 Interaction Effects of Internal Mutual Commitment in NSD versus NPD**

Hypothesis 3e proposed that the intensity of mutual trust among the units within the focal firms has a stronger, positive impact on performance in NSD than NPD. The significantly positive main effect of mutual trust ($\beta = .71, p < .05$) suggest a generally positive impact of mutual trust among the units within the focal firms and performance,
but there was no difference in this relationship for NSD versus NPD ($\beta = -.39$, n.s.). Hypothesis 3e is therefore not supported.

Next, I report the findings for hypotheses 4a-e, which were concerned with the value-adding nature of the focal firms’ external collaboration system attributes in NSD versus NPD. Hypothesis 4a proposed that the intensity levels of mutual communication have a stronger, positive impact on performance in NPD than NSD. The findings reveal no relationship between mutual communication between the focal and partnering firms and performance and no significant difference between NSD and NPD. Hypothesis 4a is therefore not supported.

In Hypothesis 4b, I proposed that the intensity of joint engagement between the focal and partnering firms has a stronger, positive impact on NPD than NSD. The regression results reveal a significant negative main effect between joint engagement and performance ($\beta = -.71$, $p < .01$). Moreover, the interaction between the level of joint engagement and the product versus service variable revealed a significant pattern ($\beta = 1.00$, $p < .001$). Findings of a simple slope analysis, as depicted in Figure 7.3, reveal that where a new service was developed between the focal and partnering firms, the level of joint engagement was significantly negatively related to development success ($\beta = -.35$, $p < .05$). However, where the firms jointly developed a new product, the level of joint engagement between the firms was significantly and positively related to development success ($\beta = .66$, $p < .001$). Hypothesis 4b is therefore supported.
Figure 7.3 Interaction Effects of External Joint Engagement in NSD versus NPD

Hypothesis 4c proposed that increases in the intensity of sharing responsibilities between the focal and the partnering firms have a stronger, negative impact on performance in NPD than NSD. The regression analysis reveals no relationship between the intensity of sharing responsibilities and performance. However, the interaction between the level of sharing responsibilities and the product versus service variable revealed a significant pattern (β = -0.60, p < 0.05). A simple slope analysis (Aiken & West, 1991) revealed and Figure 7.4 depicts that where a new service was developed between the focal and partnering firm, the level of sharing responsibilities was positively, but not significantly related to development success (β = 0.13, n.s.). However, where the firms jointly developed a new product, the intensity level of sharing responsibilities was significantly and negatively related to development success (β = -0.71, p<0.01). Hypothesis 4c is therefore supported.
Hypothesis 4d proposed that increases in the intensity levels of relationship commitment between the focal and the partnering firms have a stronger, positive impact on performance in NSD than NPD. The regression analysis revealed a significantly positive relationship between the intensity of relationship commitment and performance ($\beta = .55, p < .05$). Moreover, the interaction between the level of relationship commitment and the product versus service variable revealed a significant pattern ($\beta = -.46, p < .10$). To further test the relationship, I performed another simple slope analysis. Illustrated in Figure 7.5, the findings revealed that where a new service was developed between the focal and partnering firm, the level of relationship commitment was significantly and positively related to development success ($\beta = .38, p < .05$). However, where the firms jointly developed a new product, the intensity level of relationship commitment was not related to development success ($\beta = -.09$, n.s.). Hypothesis 4d is therefore supported.
Lastly, Hypothesis 4e proposed a stronger, positive relationship between the intensity levels of mutual trust between the focal and their partnering firms and performance in NSD than NPD. The regression analysis did not reveal a significant relationship between mutual trust between the firms and performance. Also, there was no significant interaction between mutual trust between the firms and the service/product variable. Therefore, Hypothesis 4e is not supported. Table 7.4 reports a summary of the results in terms of all hypotheses.

Also noteworthy in the regression are the significant values for the number of units involved within the focal firm, the opposing patterns for the size of the focal firm versus that of the partnering firm, and the negative relationship between the numbers of other firms involved in the partnership and performance. I will return to the major findings of the results in light of the discussion.
Table 7.4 Summary of Results against Hypotheses

<table>
<thead>
<tr>
<th>Hypothesized Relationships</th>
<th>Hyp.</th>
<th>Significant difference between NSD-NPD</th>
<th>Hypothesis accepted/rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collaboration intensity differences for NSD versus NPD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal system attributes more intensive NSD than NPD</td>
<td>1</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td>External communication, engagement and sharing responsibilities more intensive in NSD than NPD</td>
<td>2a</td>
<td>Yes for mutual communication and joint engagement; no differences for sharing responsibilities</td>
<td>Partly accepted</td>
</tr>
<tr>
<td>External commitment more intensive NPD than NSD</td>
<td>2b</td>
<td>Yes</td>
<td>Accepted</td>
</tr>
<tr>
<td>External trust more intensive NSD than NPD</td>
<td>2c</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td><strong>Relationships between internal collaboration and performance in NSD versus NPD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal communication intensity stronger, positive relationship with performance in NPD than NSD</td>
<td>3a</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td>Internal sharing responsibilities intensity stronger, positive relationship with performance in NPD than NSD</td>
<td>3b</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td>Internal joint engagement intensity stronger, negative relationship with performance in NPD than NSD</td>
<td>3c</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td>Internal commitment intensity stronger, negative relationship with performance in NSD than NPD</td>
<td>3d</td>
<td>Yes</td>
<td>Accepted</td>
</tr>
<tr>
<td>Internal mutual trust intensity stronger, positive impact on performance in NSD than NPD</td>
<td>3e</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td><strong>Relationships between external collaboration and performance in NSD versus NPD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External communication intensity stronger, positive relationship with performance in NPD than NSD</td>
<td>4a</td>
<td>No</td>
<td>Rejected</td>
</tr>
<tr>
<td>External joint engagement intensity stronger, positive relationship with performance in NPD than NSD</td>
<td>4b</td>
<td>Yes</td>
<td>Accepted</td>
</tr>
<tr>
<td>External sharing responsibilities intensity stronger, positive relationship with performance in NPD than NPD</td>
<td>4c</td>
<td>Yes</td>
<td>Accepted</td>
</tr>
<tr>
<td>External commitment intensity stronger, positive relationship with performance in NSD than NPD</td>
<td>4d</td>
<td>Yes</td>
<td>Accepted</td>
</tr>
<tr>
<td>External mutual trust intensity stronger, positive relationship with performance in NSD than NPD</td>
<td>4e</td>
<td>No</td>
<td>Rejected</td>
</tr>
</tbody>
</table>

7.5 Discussion

The objective of this study was to gain insights into how focal firms align their internal and external collaboration systems for successful NSD versus NPD alliances. The results suggest that the combined alignment of internal and external collaboration systems is complex for both NSD and NPD and somewhat different to what I predicted.
Focal firms’ internal collaboration systems reveal little variation in their intensity levels and impact on performance for NSD versus NPD. However, the nature and impact of external collaboration systems are, as proposed, different for NSD versus NPD on a majority of the collaboration system attributes.

I will start discussing the results in terms of the findings about the nature and impact of the focal firms’ internal collaboration systems. There was no significant difference in the intensity of a majority of internal collaboration system attributes and in terms of their impact on performance for NSD versus NPD. The only exception was a significant difference between the relationship of commitment among units within the focal firm and performance for NSD and NPD. Although pointing into the same direction, in NPD, relationship commitment was significantly more negatively related to performance than in NSD.

Therefore, contrary to what was suggested in existing studies (Johne & Storey, 1998; Lievens & Moenaert, 2000; Tatikonda & Zeithaml, 2001) and to what I predicted, the results of this study imply that the intensity levels of internal collaboration systems are not significantly higher in NSD than NPD. Moreover, similar alignments of internal collaboration systems lead to development performance independently of the type of innovation. It is important to note, however, that the findings of this study do not indicate that differences do not exist, but rather that they are not as robust as previously assumed.

The findings also reveal that the intensity of sharing responsibilities and mutual trust among units involved within the focal firm have a significant positive relationship with development success. Sharing responsibilities for decisions and outcomes is believed to counteract negative effects caused by diversity, as different units are pressured to accept their differences and find commonalities (Schippers et al., 2003). They also promote solidarity (Mullen & Copper, 1994), result in better time, quality, and budget objectives.
(Hoegl et al., 2004), enhanced information transfer (Gupta & Govindarajan, 2000), and ultimately lead to development performance (Frishammar & Hoerte, 2005; Hoegl et al., 2004; Kahn, 1996; Simonin, 1997). However, an organizational culture that has inherent high levels of sharing responsibilities for decisions and outcomes among different units is believed to be difficult and a task that takes time to establish and evolve. In terms of mutual trust, scholars have found that functional units within a firm will not collaborate with one another, unless they perceive each other as credible and trustworthy (Gupta & Wilemon, 1988).

High levels of mutual trust among functional units within a firm have been frequently linked to increased levels of information exchange and shared responsibilities (De Dreu & Van Vianen, 2001; Jarvenpaa & Leidner, 1999; Jassawalla & Sashittal, 1998), and, ultimately, innovation performance (Ghoshal et al., 1994; Jassawalla & Sashittal, 1998; Klein & Mulvey, 1995; Liedtka, 1996; Zaheer, McEvily, & Perrone, 1998). Mutual trust, in general, also evolves with time and is a result of accumulated satisfactory experience of gradually increasing efforts and expectations of continuity (Das & Teng, 2004; Poppo et al., 2008).

Therefore, during any particular NSD or NPD, the intensity levels of sharing responsibilities and mutual trust are likely to have embedded past routines and behavioural patterns. It may therefore be possible, contrary to arguments made in existing studies (Atuahene-Gima, 1996; Nijssen et al., 2006) that in NSD alliances firms also create value by taking advantage of existing collaboration practices developed among units. Thus, in terms of the focal firms’ internal collaboration systems, the findings indicate that collaboration practices within firms represent fairly stable and perhaps even routinized practices independently of the innovation context.

The majority of previous studies, which have compared firm internal collaborative activity in NSD versus NPD, did so along different measures. This study shows that the
same measures were sensitive enough to at least pick up differences in the external collaboration systems. The findings reveal that the focal firms’ external collaboration systems are different in their nature and impact on innovation performance for NSD versus NPD. For instance, the intensity levels of joint engagement among collaborating firms in NPD, operating at significantly lower intensity than NSD (confirmed in Hypothesis 2a), are only positively related to performance in NPD alliances, but not in NSD alliances (confirmed in Hypothesis 4b). An explanation for this pattern is in line with prior suggestions of a curvilinear relationship between the intensity of joint engagement and performance (Gavetti and Warglien, 2007; Froehle et al., 2000).

Accordingly, at the lower end of intensity of joint engagement, which was found in NPD alliances, increases in intensity are associated with increases in performance. Increases in intensity that occur at higher levels, which were found more often in NSD, do not predict performance. That is, it is possible that up until a certain level of intensity, sharing critical information and assisting one another may allow firms to complete tasks effectively, which in turn leads to development success (Hart & Saunders, 1997). Once a certain threshold of intensity is exceeded, very high intensity levels of engagement may indicate that the collaborating parties experience “groupthink” (Froehle et al., 2000; Janis, 1972), and “over-identification” (McEvily et al., 2003). Especially in the comparably more volatile collaborative environment of new services (e.g. due to simultaneity), this may slow down the responsiveness to quickly adapt to modifications and thus may have a negative effect on the performance of a new service.

Contrary to the patterns of joint engagement, although operating at significantly lower intensity levels (confirmed in Hypothesis 2a), the intensity levels of relationship commitment between collaborating firms in NSD, had a stronger, positive impact on performance in NSD than NPD alliances (confirmed Hypothesis 4d). A reason for these
patterns could be related to the earlier raised argument of commitment escalation (Garland, 1990; Ross & Staw, 1986, 1993). Following from this argument, it is unlikely that one would find increases in performance in NPD alliances, where relationship commitments, which often go hand in hand with resource commitments, are at inflated levels. Relationship commitments in NPD are therefore often bound to earlier commitments made and are associated with higher closing costs rather than increases in performance (Ross & Staw, 1993). In NSD alliances, however, partners are not bound to resource commitments to the extent they are in a typical NPD alliance (Ross & Staw, 1986). Therefore, where relationship commitment can be adjusted to the changing needs of a service innovation, they are likely to lead to NSD performance.

The intensity levels of sharing responsibilities are similar in NSD and NPD alliances; however, their impact on performance is significantly different for NSD versus NPD. Whilst increases in sharing responsibilities between firms in NSD alliances reveal a generally positive –yet not significant- relationship pattern with performance, with increasing levels of sharing responsibilities for decisions and outcomes in NPD alliances, performance decreases significantly. An explanation for this pattern could be that, compared to NSD alliances, in NPD alliances, responsibilities are and possibly should not necessarily be spread evenly. Setting responsibilities in a NPD alliance may be more difficult and costly, as usually different functional units are involved in NPD and these units may require different sets of responsibilities. Thus, it will take coordination to set responsibilities for all involved units from partnering firms at the start of a collaborative partnership (Reuer & Arino, 2003) and will require even more coordination to formally adjusted these responsibilities throughout the life of the alliance (Reuer & Arino, 2002).

The intensity levels of mutual communication between the collaborating firms (albeit being significantly higher in NSD than NPD), and the intensity levels of mutual trust
between the firms revealed no impact on performance and no differences between NSD and NPD. Considering the importance of mutual trust found in core papers 2, 3, and 4, I suspect that mutual trust may act as a “hygiene factor” (Herzberg, 1987, 1968) in innovation alliances. That is, a certain amount of mutual trust is needed for any innovation alliance to operate. However, increases in mutual trust itself do not directly lead to higher performance outcomes. As the findings of core paper 3 suggest, mutual trust between the focal and partnering firm positively strengthens the relationship between mutual communication patterns and development performance. Further research is needed to tease out, if this explanation is suitable to explain these patterns found.

Lastly, a further appreciation of the complex ways in which properties of the firms’ collaboration systems impact on development performance can be gained from the significant relationships of selected control variables with new product development performance. For instance, the regression results revealed, similar to the previous core papers 2, 3, and 4 that the size of the focal firm was significantly negative ($\beta =-.19$, $p<0.05$) and the partnering firm’s size significantly positive ($\beta =.18$, $p<.10$) related with development performance. Previous research has found that focal firms, which collaborate with larger sized partners, perform better than otherwise comparable firms that lack such partners (Stuart, 2000). In accounting for this pattern, Stuart (2000: 806) has suggested that because large firms are recognized for their reliability and track record, the alliance with the smaller firm signals that the smaller firm has something unique, such as quality or innovativeness. Therefore, an alliance between a small focal and small partnering firm does little to promote an outstanding product compared to when a larger firm chooses to be in the alliance with a much smaller firm.

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15 An identical explanation was given for this pattern in core papers 2, 3, and 4.
The patterns also revealed a negative relationship between the number of firms involved in the alliance and new product development success\textsuperscript{16} ($\beta = -.14$, $p< .10$). This finding is contrary to some previous studies, which have argued from a resource-based perspective that a larger number of firms involved potentially leads to a larger pool of resources that can be shared among collaboration partners (Lane, Salk, & Lyles, 2001). However, other studies have found that with an increasing number of firms involved, potential partner redundancy (Baum et al., 2000), excess re-negotiations throughout the life of the collaboration (Reuer, Zollo, & Singh, 2002), increased coordination costs (Garcia-Canal, Valdes-Ilaneda, & Arino, 2003; Gong, Shenkar, Luo, & Nyaw, 2007; Park & Ungson, 2001), decreased opportunities for rigorous communication (Baum et al., 2000), decreased levels of relationship commitment (Gong et al., 2007) and increased rivalry among collaboration partners (Kogut, 1988) may occur. Future research might explore, whether firms, which have a larger number of collaborating partners are more constrained in their ability to pursue stable, value-adding internal collaboration practices and routines.

\textbf{7.6 Implications and Future Research Directions}

Compared to the similar nature and the consistent impact of internal collaboration systems on innovation performance, the ways in which external collaboration systems impact on performance appear to be largely different, depending on the innovative context collaboration is observed. Addressing these findings in light of those in core papers 2, 3, and 4, this study adds additional insights and has major implications on the alignment of firms’ internal and external collaboration systems for innovation success: In core paper 2, the findings revealed that the intensity of internal collaboration system attributes are influenced by changes in the intensity of the external collaboration

\textsuperscript{16} The patterns are similar to those revealed in core paper 2 and 4 and are therefore explained in a similar fashion.
systems. Moreover, in papers 2, 3, and 4, I also found that internal collaboration systems largely account for and influence the strength of the relationship external collaboration systems have with innovative performance.

Although the findings in this paper only suggest that internal collaboration systems of different firms are similar across NSD and NPD innovation contexts, it is possible that internal collaboration may also be similar for different innovation contexts within the same firm, that is, where the same firm engages in both NSD and NPD. An important question arises from this assumption: How can firms, which seem to be more consistent across different innovation contexts in terms of their internal collaboration systems, respond to changes in the much more dynamic nature of their external collaboration systems in order to reach innovation performance? This assumption leaves the possibility of a paradox of flexibility versus dynamism in terms of the nature of a firm’s internal collaboration systems. The individual and combined findings of core papers 2, 3, 4, and this study therefore call for further longitudinal research on testing whether such a paradox exists and if so, how a firm manages the dilemmas this paradox causes. I will develop this theme in chapter 8.

**7.7 Limitations and Conclusion**

The study provides a basis for further researching the role of firm collaboration across different types of innovation in general and for further synthesizing NPD and NSD research in particular. Despite its contributions, this paper is prone to several limitations that simultaneously can be viewed as pathways for future research. One methodological issue concerns the scope of the data collected. The data is based from the viewpoint of focal firms about themselves and about their partner. It does not include direct data from the partnering firm. Nor does it include information about collaboration practices with other firms or their respective positions and responsibilities in the value chain. Second,
although this study provided a test of a multi-dimensional definition of firm collaboration and a dualistic conceptualization of innovation, the baseline model only used the five most commonly employed dimensions and did not include other dimensions of firm collaboration that other researchers may identify. Furthermore, many other commonly known drivers of the propensity of NPD and NSD, such as different stages of the development and the organizational structure of the firms, could have been included. Other methods and further case studies could therefore provide more insight into these complex collaboration configurations for NSD versus NPD and extend this initial effort.

This study provides new insights into the role firm collaboration plays for innovation theoretically and empirically. The empirical results provide an important basis for the further development of an integrated model of firm collaboration in innovation. The findings reveal new insights into the unlike nature of a firm’s internal and external collaboration systems and their impact on development performance. Moreover, the results support the promise for an understanding of similarities and differences of firm collaboration in the product and service innovation context, bridging two fields by elucidating their joint underlying mechanisms. However, more research is needed to validate the underlying explanations of the patterns found and address the paradox created by the findings of this study in light of those gained in core papers 2, 3, and 4.
7.8 References


CHAPTER 8

Overall Conclusion and Future Research

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Aligning internal and external collaboration systems for new product development performance: Addressing the stability – flexibility paradox

Abstract

In this concluding chapter, I first integrate the findings of the five preceding core papers into a number of key implications in terms of aligning collaboration across different types of innovation, and aligning collaboration systems for alliance success. I then shift from the implications of an alignment of internal and external collaboration for a particular new product or service development to suggestions for further research. This section on future research addresses some of the limitations of the thesis and focuses on aligning collaboration systems over time. Considering the alignment of collaboration systems over time, I raise a ‘stability-flexibility paradox’ that can guide future research into managing collaboration systems. I use and expand upon current dynamic capability theory to address this paradox. Lastly, I identify specific planned research and provide concluding remarks.
8.1 Overall Implications of the Core Papers’ Findings on Collaboration Research

8.1.1 A Multi-Attribute Conceptualization of Collaboration

In core paper 1, I examined the ways researchers have conceptualized the term collaboration. This analysis of the literature resulted in a categorization of five attributes that captured most of the activities with which over 100 studies described collaboration both within and between firms. The five attributes are (1) mutual communication, (2) joint engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. The patterns of the empirical core papers 2 to 5 suggested that each of the five attributes (independently and in combination with one another) looks and impacts differently on new product and service development success. I conclude that collaboration is indeed multi-faceted and should therefore also be examined as such. Therefore, a shift in focus from a one-dimensional or composite measure of collaboration to a system comprised of multiple attributes is paramount to gain insight into the complex nature of collaboration and the ways it impacts on performance of any particular new product or service innovation.

8.1.2 Mediating and Moderating Linkages between Internal and External Collaboration Systems for Innovation Performance

In core papers 2 and 4, I investigated mediating and moderating organizational linkages between focal firms’ internal collaboration systems and their external collaboration systems. In core paper 2, I build upon the investigations of Stank et al. (2001). The findings of my inquiry broadly confirm that internal collaboration systems mediate otherwise positive relationships between their external collaboration systems and new product development performance. In core paper 4, I extended the inquiry to how focal firms’ internal collaboration systems may also moderate the relationship their external
collaboration systems have with innovation performance. The findings support a moderating mechanism along selected internal collaborative activities on the same activities in the external strategic partnerships. The findings lead to the suggestion that research needs to shift away from focusing on either internal or external collaboration alone. Instead, a focus on managing the relationship between internal and external collaborative activities is far more important for innovation outcomes than the impact of either alone.

8.1.3 Different Configurations of Internal versus External Collaboration Systems

An inquiry into the nature of internal versus external collaboration systems in core paper 3 revealed that both systems are differently configured and add different value to innovation performance. The findings of core paper 3 allowed me to advance some initial conclusions about the different degrees of modularity (the degree to which system components can be separated and recombined) of internal versus external collaboration systems. It is thus likely that internal collaboration systems are comprised of largely de-coupled activities, because internal activities were related to performance individually and independently of one other. In contrast, the findings revealed that activities in external collaboration systems are tightly coupled and synergistically create value. The findings provide a platform for future research. I suggest that future research might focus on the different degrees of modularity of firm internal versus external collaboration systems and how the degree of modularity affects the nexus of internal and external collaboration systems with innovative performance. That is, future research should provide a more in-depth focus on loosely- versus tightly coupled collaboration mechanisms and feedback systems.
8.1.4 Aligning Collaboration Systems across Different Forms of Innovation

As each of the empirical core papers was located in a product- or service innovation context, the findings about collaboration in the core papers have implications for the literature concerned with new product (NPD) and new service development (NSD). Specifically, the findings of core paper 5 provide novel implications about the differences in the nature and impact of aligning firm internal versus external collaboration systems for different forms of innovations.

First, the similar nature in terms of the ways units within the firm collaborate in NSD and NPD is different to what previous studies have found (Johne and Storey, 1998, Nijssen et al., 2006). The majority of previous studies, which have compared firm internal collaborative activity in NSD versus NPD, did so along different measures. Second, the findings in core paper 5 showed that the same measures were sensitive enough to at least pick up differences in the external collaboration system. That is, contrary to the firm’s internal collaboration system, the findings of core paper 5 also suggested that the nature and impact of a focal firm’s external collaboration system varies largely, depending on the service versus product innovative context.

A question arises from the findings of core paper 5, which carries important future research implications: To what degree do firms change or adjust their internal and external collaboration practices according to different types of innovations? Taking the patterns found into a more general context, we can assume that firms often engage in both services and product developments (Heim and Sinha, 2005). Firms that use the same internal collaboration configurations for different types of innovation may be likely to be more productive, that is, if they use different external collaboration systems for different types of innovation. It may, however, also be possible that firms have separate, but stable internal collaboration systems for different types of innovations. Independently of whether firms have the same or different internal collaboration
systems, it is likely that the ‘ideal’ degree of dynamism of a firm’s internal collaboration systems is comparably less than its external collaboration systems for different types of successful innovations. However, the research design employed in this thesis only captured patterns for a particular new product or service innovation alliance from the view of the focal firms. It is up to future research to test whether these patterns also exist for firms that are engaged in both new services and new product development partnerships at any point in time and over time.

8.1.5 Aligning Collaboration Systems for Strategic Alliances

Most studies on strategic alliances have their focus on the collaborative activities in the relationship between the focal and their partnering firm(s) and do not include investigations on collaboration among members involved within the collaborating firms. That limited focus may be appropriate for many routine and arm’s length inter-firm partnerships, including spin-offs, and entirely necessary for those partnerships where the collaborating firms only have a single functional unit involved. However, where inter-unit collaboration within the firm co-exists during an alliance, examining the nature of collaboration among functional units within the firm may be able to help uncovering why some strategic alliances lead to successful new product development performance while others do not. That is, if the nature of a firm’s internal collaboration systems largely impacts on the relationship between alliance activity and innovation performance, the influence of internal collaboration may have implications on every stage of an alliance, from partner choice to managing existing alliances. The findings in the empirical core papers thus represent a number of interesting future research avenues on whether the alliance partner choice, the management of alliances, and alliance success/failure rate are related to the nature of the alignment of collaboration within each of the partnering firms.
8.2 The Alignment of Internal and External Collaboration over Time

In the empirical core papers of this thesis, I have gained insights into the alignment of focal firms’ internal and external collaboration systems for innovation performance of a particular new product or service development. This thesis utilized cross-sectional data and not a longitudinal research design. Therefore, it remains uncertain how firms may change their alignments of internal and external collaboration systems for performance over time as relationships change among the players who engage in these systems. Extrapolating from the findings, on the one hand, each of the four empirical core papers lead me to suspect that internal collaboration practices are more independent (core paper 3) and more stable across different types of innovation (core paper 5) and throughout different stages of product developments and have a direct and positive impact on innovation performance (core papers 2, 3, 4, and 5). On the other hand, the findings of core paper 2 suggest that the intensity levels of external collaboration are influential in determining the intensity of firm internal collaboration systems. I presume that this influence manifests itself over time.

Furthermore, the findings in both core papers 2 and 4 suggest that value in an innovation alliance may be created through the deliberate alignment of firm internal collaboration system activities. An important question therefore arises: How can a focal firm, which may be more stable in its internal collaboration systems (at least across different types of innovation – core paper 5), respond to changes in the much more dynamic external collaboration environment in order to reach innovation performance? Considering the increasing demands for responsiveness to changing markets, it is unlikely that a firm stays stable in its internal and external collaboration systems over time. It is more realistic to assume that organizational systems and with them collaboration systems are constantly changing and adjusting (Pfeffer and Sutton, 1999).
Collaboration systems change over time because they lay in the relationships between people and changing demands of people and are therefore subject to fluctuation. The findings of core paper 5 revealed that differences in external collaboration systems are not related to the stage of a product or service development\textsuperscript{17}, but one associated with different alliance partners. Therefore, in a comparative sense, while both internal and external collaboration systems are dynamic, internal collaboration systems may be less dynamic than external collaboration systems. This may be because there may be more consistency in partners involved in internal collaboration systems compared to the external collaboration systems.

It may thus be possible that for best performance outcomes over time, a firm’s internal collaboration systems are relatively stable, but simultaneously flexible in order to be responsive to changes in the external collaboration environment. This interpretation views the nature of internal collaboration systems as a possible ‘stability-flexibility paradox’. That is, firms are faced with the dilemma of taking advantage of the value-adding nature of internal collaboration routines and, at the same time, they need to be responsive to changes in the external collaboration environment in order to reach satisfactory levels of innovation performance. Predicaments similar to the one created by the stability-flexibility paradox have also been explored in different streams of organizational literature. For instance, numerous studies investigated the notion of firm “ambidexterity” (Gibson and Birkenshaw, 2004, O’Reilly and Tushman, 2004). Studies about firm ambidexterity are concerned with how the firm can align its existing business units through stable organizational routines and, simultaneously, be able to adapt to emerging business opportunities. The paradox is also somewhat similar to the co-existence of change and structural inertia (Hannan et al., 2003). For instance, according to Schwarz and Shulman (2008), although organizations are constantly

\textsuperscript{17} The involvement of different functional units in new product development usually reflects different stages in the development (Song et al. 1998). As control variables, the types of functional units involved from the focal and partnering firms were not significant in any of the four core papers.
changing due to changes in the external environment and vertical integration, at the same time, their change is limited through routines and immobile structures.

The paradox may also be seen in light of the dynamic capability view. That is, firm internal and external collaboration have been frequently referred to as organizational capabilities (Eisenhardt and Martin, 2000, Helfat et al., 2007). This paradox of firm internal collaboration may therefore be observed as a special case of the more general paradox of dynamic organizational capabilities (Schreyoegg and Kliesch-Eberl, 2007). In what follows, I develop this theme by first contextualizing the paradox in terms of the more general paradox of dynamic organizational capabilities. I then utilize dynamic organizational capability theory to advance a better understanding of the internal collaboration system paradox and ways of managing around it.

8.2.1 The Paradox of Dynamic Organizational Capabilities

At the centre of the resource-based view (RBV), resources have been clearly defined as specific physical, human, and organizational assets that can be used to implement value-creating strategies (Wernerfelt, 1984, Barney, 1991). They include distinct abilities or ‘competencies’ that address markets and customers in unique ways and are therefore essential to competitive advantage of a firm (Prahalad and Hamel, 1990, Eisenhardt and Martin, 2000). In a general sense, organizational capabilities can be considered to be resources, as the firm draws upon them to accomplish its goals (Eisenhardt and Martin, 2000). Also, similarly to resources, capabilities are a key source for firms to generate and develop sustainable competitive advantages (Wernerfelt, 1984, Barney, 1991). However, this is where their similarities end. Whilst the conceptualization and use of the term ‘capability’ has varied largely in the existing literature (Schreyoegg and Kliesch-Eberl, 2007), researchers collectively agree that a capability is not an asset by itself, but rather represents purposeful, complex, formal and informal activities and
processes of allocating, re-configuring, integrating, and/or releasing resources (Eisenhardt and Martin, 2000, Helfat and Peteraf, 2003, Helfat et al., 2007).

As strategic research has advanced in the last 20 years, scholars argued jointly that neither the RBV nor the existence of organizational capabilities sufficiently explain how and why certain firms are performing well in dynamic markets (Teece et al., 1997). A response to this deficiency was the introduction of the term ‘dynamic capabilities’, which are capabilities that create value for firms located within high velocity markets (Teece et al., 1997). In its original definition, Teece et al. (1997: 516) defined a dynamic capability as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments”. Organizational competencies were thought of as managerial and organizational routines and processes (Teece et al., 1997) that dynamic capabilities can alter and transform into new strategic paths for the firm (Helfat, 1997).

Eisenhardt and Martin (2000, p. 1107) followed this definition and added that “dynamic capabilities are organizational and strategic routines by which firms achieve new resources configuration as markets emerge, collide, split, evolve, and die”. In recent years, Helfat et al. (2007) extended previous definitions of dynamic capability to ‘the capacity of a firm to purposefully create, modify and extend its resource base’. The intentionality differentiates the patterned aspects of dynamic capabilities from accident, luck, and rote organizational activities that lack purpose. That is, emergent streams of activity, which are incorporated in intent, have an at least partially, if not fully planned aim. The capable firm in dynamic markets has therefore become a new ideal of organizational research (Teece et al., 1997, Eisenhardt and Martin, 2000, Zollo et al., 2002).

More recent research has, however, questioned the dynamic nature of organizational capabilities in rapidly changing markets (Schreyoegg and Kliesch-Eberl, 2007). In their
definition of dynamic capabilities, studies referred to the term ‘routines’ (Eisenhardt and Martin, 2000, Zollo et al., 2002, Zollo and Winter, 2002). Routines, however, reflect habitualized action patterns (Nelson and Winter, 1982), which inherit a difficulty to change when confronted with new development (Schreyoegg and Kliesch-Eberl, 2007). Thus, the tendency to structural inertia (Hannan et al., 2003) and limited structural change forms the basis of the recent debate on whether capabilities are dynamic or stable routines. Eisenhardt and Martin (2000) unravelled this paradox in high-velocity markets by suggesting that problems are solved without relying on previously formed expertise. That is, competitive advantage in high-velocity markets can only be gained through rapid learning and flexible swiftness (Eisenhardt and Martin, 2000. p. 1116).

However, a major concern with this logic of total elasticity is whether it is viable even in the most flexible organizations (Winter, 2003). According to Schreyoegg and Kliesch (2007), the mode of total flexibility eliminates the very reasons for creating organizations instead of market coordination (Williamson, 1975). Thus, organizations could no longer observe and react upon environmental changes on the basis of proven patterns and rules (Schreyoegg and Kliesch, 2007, p.920). As a consequence, organizations are confronted with this paradox. On the one hand, they have to develop reliable, unique patterns of selecting, allocating, and re-configuring resources in order to attain sustainable competitive advantage and on the other hand, these capability routines inherit a considerable risk of becoming locked in certain capabilities that are somewhat helpless in the face of changing conditions.

8.2.2 The Nature of Collaboration Systems: Addressing the Stability-Flexibility Paradox

I recognize that only a longitudinal study or comparisons of multiple product developments within the same focal firm would have given more specific indications on
the dynamic nature of internal versus external collaboration systems. Nevertheless, as discussed above, the findings of core paper 5 have led to speculations about different degrees of dynamism for internal versus external collaboration systems. In the following sections, I build upon these speculations about the degree of dynamism of internal versus external collaboration studies and address the stability-flexibility paradox of firm internal collaboration systems. I first examine whether internal collaboration is a dynamic capability and then I focus on whether external collaboration is a dynamic capability. I then raise the possibility that in order to maximize both dynamic capabilities, firms need to develop a meta-system, a ‘dynamic feedback system’ that successfully links internal and external collaboration activity over time.

8.2.2.1 Firm Internal Collaboration Systems: A ‘Dynamic’ Capability?

Jay Galbraith (1983) proposed that firms learn different lessons associated with the stage of vertical chain in which they began operating. The lessons learned at this initial stage, the “center of gravity”, influence a firm’s successive values, business lessons, management systems, succession path, organization, and mindsets. In other words, firms create stable, unique firm internal patterns through vertically integrating (up- or downstream) in the industry supply chain they were originally located in. Ilinitch and Zeithaml (1995) have provided empirical evidence that firms that operate close to their historical centres of gravity are able to successfully apply the values and routines that contributed to their initial success. Therefore, following Galbraith (1977; 1983) and Ilinitch and Zeithaml (1995), firm internal patterns, which tend to be stable over time, are largely shaped by the firm’s external environment.

In recent studies, scholars (Gupta and Govindarajan, 2000, Marsh and Stock, 2003) have argued that collaborative patterns and routines within a firm also have inherited a content that stems from their historical centres of gravity. Firm internal collaboration
has embedded routines that evolve over time and are based upon and embedded in successful past organizational routines and practices of a firm (Gupta et al., 2007). The influence of a historic content as such has been called the “shadow of the past” (Poppo et al., 2008), and is believed to lead to “path dependency” (Schreyoegg and Kliesch-Eberl, 2007). The nature and intensity of internal collaboration systems in any particular new product development may therefore have imprinted excess baggage of past decisions and collaborative patterns that have largely shaped its current nature (Schreyoegg and Kliesch-Eberl, 2007). Along with collaborative routines, researchers have also stressed the importance of “structural inertia” (Hannan and Freeman, 1984: 153), the “capacity to produce collective outcomes of a certain quality repeatedly”.

Whilst acknowledging the power of path dependency and structural inertia, it would be misleading to perceive internal collaboration as a totally immobile capability due to the ways it is shaped by the external environment. Also, during times of uncertainty, introspective self-renewal, and change in collaborators, collaboration patterns may change (Schwarz and Shulman, 2008). Thus, in order to be responsive to the ever-changing external collaborative environment, internal collaboration must be dynamic – at least to some degree. Therefore, internal collaboration systems are relatively immobile, but are still subject to change (Helfat and Peteraf, 2003, Schwarz and Shulman, 2008). This need to be stable and simultaneously flexible thus represents a paradox for internal collaboration systems.

### 8.2.2.2 External Collaboration Systems: A Dynamic Capability?

Collaboration practices among focal and their partnering firm can also have a historic content, which shapes their current nature, in the form of collaborative routines firms have established prior to a current partnership (Zollo et al., 2002). For instance, researchers have found a positive relationship between experience accumulation of a
firm with another firm and the intensity with which they collaborate with one another (Simonin, 1997, Santoro, 2000, Zollo et al., 2002, Sampson, 2005). Returning to Galbraith’s centre of gravity, repeated alliances bring down transaction costs and may shift a firm’s centre of gravity.

However, while it is likely that functional units within a firm share collaborative relationships that have existed well before and extend indefinitely beyond those for any particular product development (Xie et al., 2003), most alliances a firm engages in do not involve the same partnering firms. Even where firms have collaborated with one another previously, a new alliance may look different and have different objectives than the previous one. This is due to the fact that partnering firms often have different expectations and place different values on each joint alliance (Sampson, 2005). Therefore, every alliance a firm may enter, is likely to have a different depth and scope of task assignments, and consequently look and impact differently on firm performance (Gerwin and Ferris, 2004).

Nevertheless, a firm acquires collaboration experience throughout its life that may allow the firm to build certain collaborative practices that it generally uses when engaging in partnerships with other firms (Zollo et al., 2002, Sampson, 2005). Compared to internal collaboration, however, the degree of dynamism in external collaboration may be comparably high, but not entirely flexible, as it may build upon existing routines and practices with previous partners.

8.2.3 Managing Internal and External Collaboration through a ‘Dynamic Mutual Feedback System’

Although not articulated as a paradigm that needs to be addressed, the idea of a collaboration system linking function as such is not new. Combining firm internal and external ideas, systems, and paths to market into one architectural business model has
been at the centre of numerous strategic frameworks and paradigms (Pfeffer and Sutton, 1999, Goodman, 2000, Chesbrough, 2003, Gibson and Birkenshaw, 2004, Schreyoegg and Kliesch-Eberl, 2007). Moreover, functional units dedicated to link firm internal and external collaboration practices have been successfully implemented by firms such as Xerox, Hewlett and Packard, Oracle, Intel, and IBM (Dyer et al., 2001, Chesbrough, 2003). As such, Hewlett and Packard and Oracle, for instance, created dedicated ‘strategic alliance functions’. The dedicated functions coordinate all alliance-related activity from previous and ongoing alliances within the organizations and articulate, document and routinely share all alliance-related know-how throughout the firm. At Eli Lilly & Co and Dow Chemical, dedicated alliance functions also have the responsibility of creating processes for promoting and identifying potential alliance partners based on previous alliance experience (Kale et al., 2002). Similarly, Intel introduced a venture capital program (now called ‘Intel Capital’) with which the firm actively linked its existing internal collaboration system with new external collaboration partners into projects that created successful future technologies in first and emerging markets (Ham, 1998).

However, although practiced successfully by innovative firms today, the properties of a linkage system between a firm’s internal and external collaboration environments have, to the best of my knowledge, so far not been articulated in terms of a dynamic capability framework. For firms, internal collaboration systems represent major systems, which have different properties to the firms’ external collaboration systems. They tick to different clocks, involve different activities and collaborating parties, yet, according to the findings in the empirical core papers of this thesis, both need to be coordinated with one another. Therefore, a firm requires a meta-system to manage both systems simultaneously. In what follows, I suggest that one such meta-system could be a dynamic mutual feedback system (DMFS). The basic idea of a DMFS is, on the one
hand, to exploit the power of firm internal collaboration patterns and, on the other, to counterbalance a possible patterned rigidity of internal collaboration routines. The guiding thought is to take advantage of the relationship a firm’s internal and external collaboration systems share with one another. I argue that a firm’s competitive advantage is therefore created and sustained by aligning internal and external collaboration systems through an inter-system linking DMFS.

8.2.4 Properties of a ‘Dynamic Mutual Feedback System’

The properties of a dynamic mutual feedback system (DMFS) may look and work differently depending on the nature of the firm’s collaborative activity, firm size, organizational structure and nature of the environment the firm is located in. For instance, in larger firms, DMFS may be articulated as a dedicated functional unit, which is similar to the ‘alliance function’, as used by Hewlett and Packard and Oracle (Kale and Singh, 2007). However, whilst an alliance function in the above firms mainly teaches and leverages alliance-management experience and know-how throughout the firm, the dynamic mutual feedback system should act much more as a two-way knowledge-transfer system rather than acting merely as a one-way communication mechanism. In small firms, however, the DMFS responsibilities may be part of each organizational member’s responsibilities. That is, DMFS responsibilities can either be formally assigned to a dedicated functional unit or to specific or all members of the firm, depending on the nature of its organizational structure and context. The predicament of whether a DMFS should be assigned to a dedicated unit or should be part of all organizational members’ responsibilities is similar to the recent discussion about whether firm ambidexterity should be structural or contextual (Gibson and Birkenshaw, 2004). The assignment and management of DMFS responsibilities thus represent another interesting future research avenue.
Establishing a dedicated function that acts as a DMFS is costly and requires skill. If DMFS are part of each firm member’s responsibilities, the firm must introduce and reinforce systems and processes that facilitate the successful implantation of these responsibilities. As opposed to the idea of routinization of the feedback process, DMFS should be, similar to Schreyoegg and Kliesch’s (2007) monitoring system, open and away from routines and rules. This is mainly because routines reflect familiar problem situations and their solutions, but do not include the handling of unknown events. This requirement also results from the fact that it is unknown where and in which context relevant information from the external collaboration systems enters the firm (Schreyoegg and Steinmann, 1987).

In the empirical core papers of this thesis, highlighting the same collaborative attributes for internal and external collaboration systems enabled direct comparisons of the individual and conjoint value-adding nature of firm internal and external collaborative activities on innovative performance. Therefore, measuring internal and external collaborative activity along their common attributes enables firms to better evaluate whether and if so, how changes in activity in one system do or do not affect changes in activity in other systems, and how that affects overall innovative performance. No doubt, much valuable knowledge may be gained in both internal and external collaboration systems. However, only by understanding their configurations and relationships will a firm be able to align both systems to improve innovation performance.

8.3 Planned Future Research

In this thesis, I have advanced insights into the alignment of focal firms’ internal and external collaboration systems for new product and service development performance. The findings of the empirical core papers have highlighted some important linkages
between firm internal and external collaboration systems. As a logical extension of the empirical studies and their methodological limitations, a number of future research opportunities arise.

Future researchers may re-test the questions asked and findings revealed in the empirical papers of this thesis using larger samples. Investigations into collaboration should use multi-attribute measures of collaboration systems. Especially the mediating and moderating relationships found between internal and external collaboration systems should be re-examined. In doing so, future research could examine whether a firm’s internal collaboration system acts as a mediating moderator or as a moderating mediator (Baron and Kenny, 1986) on the impact of external collaboration systems.

An important future research prospect would also be a longitudinal study that explores the changing alignments of internal and external collaboration systems in firms over time. As raised in relation to the DMFS, a question that needs to be addressed is concerned with the degree of dynamism of a firm’s internal collaboration systems over time. Researchers may want to examine how firms address the stability-flexibility paradox of internal collaboration routines and develop best practices in attending the paradox.

Another research opportunity that follows from this thesis would be case studies that examine the alignment of firm internal and external collaboration within the same firm for a number of different new product and/or service developments. As part of this research program, data should be obtained from several individuals located in different parts of the firm. This would also further reduce concerns about common method variance.

Yet another research program that I would like to initiate is to examine the nature of the accumulation of collaborative capability throughout the development of a new product. In this dissertation, I have treated collaboration as a firm’s property. Separating
collaboration from the firm and attaching it to a specific new product/service development, it becomes a rather different phenomenon to research. Synergy arises through the ability of the system of involved firms in a typical new product development to efficiently integrate the path dependent use of absorptive capacity by each lead innovator (Newey and Shulman, 2004). I would therefore like to examine the accumulation of collaboration throughout the full development of a new product as it goes through changing lead innovators. Taking this thought into the study of internal and external collaboration systems, with changing development stages and altered alliance partners, different demands are also put on collaborative relationships among functional units and subunits within the firm. It is therefore questionable, how the systemic and cumulative nature of collaboration will change from the first innovator to the final product. Thus, this research would enable first insights into whether and if so, how firm collaborative capability (within each firm and between the firms) is a function of its accumulated history across lead innovators. This research will also allow insights into the role and impact of collaboration across different product life cycle stages and allows new information about a collaborative capability life cycle (Helfat and Peteraf, 2003).

8.4 Concluding Remarks

The focal research question of this thesis was concerned with how internal and external collaboration systems align to improve innovation performance. Due to the limited number of studies that have examined the nature and combined impact of a focal firm’s internal and its external collaboration systems in innovation alliances, I identified an opportunity to address this research question. The analyses of the empirical core papers, aiming at answering the research question, have made a number of key contributions. Core paper 1 led to a multi-attribute conceptualization of a collaboration system and
thus builds the first major contribution of the thesis. Empirical survey data of 134 dual partner innovation alliances assisted an examination and confirmation of a mediating relationship path between internal collaboration, external collaboration, and product development performance (core paper 2). Third, the survey data revealed that firm internal and external collaboration systems are differently configured in terms of the value-adding relationships among the system attributes within each system (core paper 3). Fourth, utilizing the same survey data, I discovered that firms’ internal collaboration systems also largely moderate the relationship between external collaboration systems and new product development performance (core paper 4). The fifth contribution was reached through analysing the different nature and impact of internal and external collaboration systems across different types of innovation (core paper 5). Finally, examining the findings of all four empirical core papers led to a stability-flexibility paradox of internal collaboration routines. I addressed the paradox by introducing a dynamic mutual feedback system, which links a firm’s internal with its external collaboration system and represents the last major contribution of this thesis.

I have indicated an opportunity for a continuing and promising future research path based on the findings of this dissertation. The concepts and relationships proposed in each of the core papers are largely novel and have revealed unique patterns in an empirical setting. The implications of this research therefore carry value to both academics and practitioners. Academics will benefit from the empirical insights into the nature, linkages, and specific value-adding relationships of a firm’s internal and external collaborations systems that build on a broad range of existing collaboration research. The findings of the empirical core papers will foremost assist practitioners in understanding the importance of aligning firm internal collaboration systems for successful innovation alliances.
### APPENDICES

#### Appendix A

**Table A1. All studies**

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<tr>
<th>Journal</th>
<th>No.</th>
<th>Article</th>
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<tbody>
<tr>
<td>Academy of Management Executive</td>
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<td>Liedtka (2001)</td>
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<td>Academy of Management Journal</td>
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<td>Simonin (1997), Tsai (2001)</td>
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<td>Asia Pacific Journal of Management</td>
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<td>Bastos (2001)</td>
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<td>California Management Review</td>
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<td>Handfield et al. (1999)</td>
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<td>European Management Journal</td>
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<td>Hoegl &amp; Schulze (2005)</td>
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<td>International Business Review</td>
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<td>Cavusgil et al. (2003)</td>
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<td>Sanders &amp; Premus (2005), Stank et al. (2001)</td>
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<td>Maltz et al. (2001)</td>
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<td>Santoro (2000)</td>
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<td>Journal of Intellectual Capital</td>
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<td>Sveiby (2001)</td>
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<td>Journal of Organizational Behavior</td>
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<td>De Dreu &amp; Van Vianen (2001)</td>
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<td>Journal of Supply Chain Management</td>
<td>4</td>
<td>Barratt (2004), Horvath (2001); Petersen et al. (2005), Spekman et al. (1998)</td>
</tr>
<tr>
<td>Conference papers</td>
<td>4</td>
<td>Brady et al. (2002), Bresnen et al. (2002), Chini &amp; Ambos (2005), Minbaeva (2005)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>119</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix B

### Table B1. Collaborative Processes of Firm Collaboration

<table>
<thead>
<tr>
<th>Collaborative processes</th>
<th>Internal collaboration studies</th>
<th>External collaboration studies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mutual communication</strong> (i.e. participation in meetings, committees/task forces, phone conversations, exchange of mail and fax, exchange of internal reports, exchange of electronic mail)</td>
<td><strong>Tested linkage with performance</strong></td>
<td>Ahuja (2000a, b); Andersson et al. (2002); Barratt (2002; 2004); Cummings (2004); Deeds &amp; Hill (1996); De Luca &amp; Kwaku (2007); Frishammar &amp; Hoerte (2005); Goh (2002); Grant (1991); Haas (2006); Hansen &amp; Nohria (2004); Hoegl et al. (2004); Jensen &amp; Szulanski (2004); Kahn (2001); Kahn (1996); Kim et al. (2003); Sanders &amp; Premus (2005); Stank et al. (1999; 2001); Sherman et al. (2005); Spekman et al. (1998; 1999); Subramani (2003); Spring (2003); Sveiby (2001); Takeishi (2001); Truman (2000); Tsai (2001)</td>
</tr>
<tr>
<td><strong>Tested linkage with performance</strong></td>
<td><strong>No test of linkage with performance</strong></td>
<td>Ahuja (2000b); Appleyard (1996); Argote &amp; Ingram (2000); Barki &amp; Pinsonneault (2005; 2006); Barratt (2004; 2006); Bastos (2001; 2004); Darr &amp; Kreutzberg (2000); Dyer (1996); Dyer &amp; Singh (1998); Eschenbrenner (1999); Gerwin (2004); Gerwin &amp; Ferris (2004); Granovetter (1983); Hagedoorn (2002); Horvath (2001); Jaspers &amp; Van den Ende (2006); Park &amp; Ungson (2001); Powell et al. (1996); Reuer &amp; Arino (2002; 2005); Santoro (2000); Sanders &amp; Premus (2005); Stank et al. (1999); Takeishi (2001); Teece (1986); Teece et al. (1997)</td>
</tr>
<tr>
<td><strong>Joint engagement</strong> (i.e. advice &amp; counsel each other, joint planning, share sensitive information, help each other)</td>
<td><strong>Tested linkage with performance</strong></td>
<td>Bresnen et al. (2002); Cummings (2004); De Luca &amp; Kwaku (2007); Frishammar &amp; Hoerte (2005); Gupta et al. (1985); Haas (2006); Hansen &amp; Nohria (2004); Hoegl et al. (2004); Moenart et al. (2004); Olson et al. (1995); Sanders &amp; Premus (2005); Sherman et al. (2005); Stank et al. (1999); Takeishi (2001)</td>
</tr>
<tr>
<td><strong>No test of linkage</strong></td>
<td>Argote &amp; Ingram (2000); Argote et al. (2000).</td>
<td>Barki &amp; Pinsonneault (2005); Barratt (2002; 2004); Bastos (2001); Horvath (2001); Darr &amp; Kreutzberg (2000); Dyer (1996); Dyer &amp; Singh (1998); Gray (1991); Ghoshal &amp; Bartlett (1990); Hillebrand &amp; Biemans (2004); Spekman et al. (1998; 1999); Horvath (2001); Park &amp; Ungson (2001); Sanders &amp; Premus (2005); Stank et al. (1999)</td>
</tr>
</tbody>
</table>
Sharing responsibilities for decisions and outcomes (i.e. joint decision-making processes, equal contributions, complemented one another, shared responsibility for results)

| Tested linkage with performance | Andersson et al. (2002); Bresnen et al. (2002); Frishammar & Hoerte (2005); Haas (2006); Hoegl et al. (2004); Kahn (2001); Kahn (1996); Hoegl et al. (2004); Moenart et al. (1994); Simonin (1997); Thieme et al. (2003); Spring (2003) | Andersson et al. (2002); Ahuja (2000b); Stank et al. (2000); Sanders & Premus (2005); Santoro (2000); Vickery et al. (2003); Zollo et al. (2002) |
| No test of linkage | Argote & Ingram (2000); Argote et al. (2000); Barki & Pinsonneault (2005); Barratt (2004); Borgatti & Cross (2003); Ghoshal & Bartlett (1990); Griffin & Hauser (1992; 1996); Gupta & Wilemon (1985; 1988); Liedtka (1996); Maltz et al. (2001); Marsh & Stock (2003); Principe & Tell (2001); Sanders & Premus (2005); Stank et al. (2000); Song & Perry (1992); Tsai (2001; 2002); Tsui (2005) | Argote & Ingram (2000); Ahuja (2000b); Appleyard (1996); Barki & Pinsonneault (2005); Barratt (2002; 2004); Bastos (2001); Dyer & Singh (1998); Faems et al. (2005); Echeverri-Carroll (1999); Gulati (1998; 1999); Granovetter (1983); Gray (1991); Ghoshal & Bartlett (1990); Horvath (2001); Wagner (2003) |

Source: Developed for this research
## Table B2. Collaborative Ownership of Firm Collaboration

<table>
<thead>
<tr>
<th>Collaborative ownership</th>
<th>Internal collaboration studies</th>
<th>External collaboration studies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relationship commitment</strong> (i.e. commitment to relationship, importance of relationship, spend maximum efforts to maintain relationship, intend to maintain relationship indefinitely)</td>
<td>Frishammar &amp; Hoerte (2005); Hoegl et al. (2004); Kahn (1996); Hoegl et al. (2004); Moenart et al. (1994); Simonin (1997); Thiene et al. (2003)</td>
<td>Handfield et al. (1999); Mohr &amp; Spekman (1994); Petersen et al. (2003); Santoro (2000); Spekman et al. (1998); Stank et al. (2001); Takeishi (2001)</td>
</tr>
<tr>
<td><strong>Tested linkage with performance</strong></td>
<td>Frishammar &amp; Hoerte (2005); Hoegl et al. (2004); Kahn (1996); Hoegl et al. (2004); Ghoshal &amp; Bartlett (1990); Ghoshal et al. (1994); Grant (1996; 2002); Griffin &amp; Hauser (1992; 1996); Gupta &amp; Wilemon (1988); Hansen &amp; Nohria (2004); Kostova (1999); Liedtka (1996); Minbaeva (2003; 2005); Menon &amp; Pfeffer (2003); Moenart et al. (1994); Ruekert &amp; Walker (1987); Sveiby (2001); Spekman et al. (1998); Tsui (2005)</td>
<td>Barki &amp; Pinsonneault (2005); Barratt (2002); Ghoshal &amp; Bartlett (1990); Gerwin &amp; Ferris (2004); Hoyt &amp; Huq (2000); Gulati (1998; 1999); Menon &amp; Pfeffer (2003); Wagner (2003)</td>
</tr>
<tr>
<td><strong>No test of linkage</strong></td>
<td>Argote &amp; Ingram (2000); Argote et al. (2003); Bailetti &amp; Litva (1995); Barki &amp; Pinsonneault (2005); Bjoerkman et al. (2004); Borgatti &amp; Cross (2003); Ghoshal &amp; Bartlett (1990); Ghoshal et al. (1994); Grant (1996; 2002); Griffin &amp; Hauser (1992; 1996); Gupta &amp; Wilemon (1988); Hansen &amp; Nohria (2004); Kostova (1999); Liedtka (1996); Minbaeva (2003; 2005); Menon &amp; Pfeffer (2003); Moenart et al. (1994); Ruekert &amp; Walker (1987); Sveiby (2001); Spekman et al. (1998); Tsui (2005)</td>
<td>Barratt (2004); Bjoerkman et al. (2004); Brady et al. (2002); Dirks &amp; Ferrin (2001); Ghoshal et al. (1994); Goh (2002); Grant (1996); Gupta &amp; Wilemon (1988); Griffin &amp; Hauser (1992); Hansen &amp; Nohria (2004); Jassawalla &amp; Sashittal (1998); Liedtka (1996); Maltz et al. (2001); McEvily et al. (2003); Menon &amp; Pfeffer (2003); Minbaeva (2003; 2005); Stank et al. (1999); Spekman et al. (1998)</td>
</tr>
<tr>
<td><strong>Mutual trust</strong> (i.e. collaborators are honest and truthful with each other, have confidence in each other, can be counted on to do what is right, have high integrity)</td>
<td>Frishammar &amp; Horte (2005); Hoegl et al. (2004); Kostova (1999); Lane et al. (2001); Li (2005); Zaheer et al. (1998)</td>
<td>Cavusgil et al. (2001); Judge &amp; Dolley (2006); Li (2005); Mohr &amp; Spekman (1994); Petersen et al. (2005); Santoro (2000); Stank et al. (1999); Spekman et al. (1998); Vickery et al. (2003); Zaheer et al. (1998)</td>
</tr>
<tr>
<td><strong>Tested link with performance</strong></td>
<td>Frishammar &amp; Horte (2005); Hoegl et al. (2004); Kostova (1999); Lane et al. (2001); Li (2005); Zaheer et al. (1998)</td>
<td>Cavusgil et al. (2001); Judge &amp; Dolley (2006); Li (2005); Mohr &amp; Spekman (1994); Petersen et al. (2005); Santoro (2000); Stank et al. (1999); Spekman et al. (1998); Vickery et al. (2003); Zaheer et al. (1998)</td>
</tr>
<tr>
<td><strong>No test of linkage</strong></td>
<td>Barratt (2004); Bjoerkman et al. (2004); Brady et al. (2002); Dirks &amp; Ferrin (2001); Ghoshal et al. (1994); Goh (2002); Grant (1996); Gupta &amp; Wilemon (1988); Griffin &amp; Hauser (1992); Hansen &amp; Nohria (2004); Jassawalla &amp; Sashittal (1998); Liedtka (1996); Maltz et al. (2001); McEvily et al. (2003); Menon &amp; Pfeffer (2003); Minbaeva (2003; 2005); Stank et al. (1999); Spekman et al. (1998)</td>
<td>Barratt (2002; 2004); Dirks &amp; Ferrin (2001); Gerwin &amp; Ferris (2004); Horvath (2001); Inkpen &amp; Currall (2004); Menon &amp; Pfeffer (2003); Wagner (2003)</td>
</tr>
</tbody>
</table>

Source: Developed for this research
APPENDIX C

Graphical models comparing studies’ findings in terms of collaboration and performance

<table>
<thead>
<tr>
<th>Figure C1a</th>
<th>Figure C1b</th>
<th>Figure C1c</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Diagram" /></td>
<td><img src="#" alt="Diagram" /></td>
<td><img src="#" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Internal collaboration** = coordination, communication

**External collaboration** = communication, knowledge integration, integrated problem solving

**Performance** = component design quality: functional performance, innovativeness, costs, weight, durability, maintainability, manufacturing quality, meet target customer needs

**Internal collaboration** = level of integration of internal systems within and between subunits

**External collaboration** = electronic data interchange (EDI): EDI use intensity, EDI volume, EDI diversity

**Performance** = administrative labour efficiency and effectiveness: claim error rate, claim payment time;

**Internal collaboration** = Integrated database; information exchange, providing feedback, reward system that encourage

**External collaboration** = operational information sharing, integrate operations, shared rewards and risks, benchmark best practices and share results

**Performance** = logistical service performance: Ability to meet delivery dates and quantities consistently; respond to customers; meet delivery time, match customer expectations
Figure C1d

<table>
<thead>
<tr>
<th>Internal collaboration</th>
<th>ps</th>
</tr>
</thead>
<tbody>
<tr>
<td>External collaboration</td>
<td></td>
</tr>
</tbody>
</table>

Performance

**Internal collaboration** = joint planning, integrated database, information sharing

**External collaboration** = operations information sharing, cross-functional processes, joint planning, share cost information

**Performance** = firm performance: cost improvements, product quality improvements, new product introduction time, delivery speed improvements

Note.

- Proposed and confirmed impact of A on B
- Proposed and confirmed relationship between A and B
- Proposed but not confirmed impact of A on B

ps = positive, significant effect
ns = nonsignificant effect
p = positive effect, but no statistical data available

Figure C1e

<table>
<thead>
<tr>
<th>Internal collaboration</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>External collaboration</td>
<td></td>
</tr>
</tbody>
</table>

Performance

**Internal collaboration** = Knowledge transfer (1) between individuals, (2) within internal structure, (3) from internal structure to individual competence

**External collaboration** = Knowledge transfer (1) within external structure, (2) from individuals to external structure, (3) from external structure to individuals

**Performance** = technology efficiency, productivity, staff turnover
Appendix D

Questionnaire Items

<table>
<thead>
<tr>
<th>Variable</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product/service success</td>
<td>How successful was the development of product/service X in terms of: Product development costs; product quality; achieving customer satisfaction; providing value for customers; keeping current customers.</td>
</tr>
<tr>
<td>Mutual communication</td>
<td>To what degree did units within your firm interact with each other through: Participation in meetings; participation in committees/task forces; phone conversations; exchange of mail and fax; exchange of internal reports; exchange of electronic mail.</td>
</tr>
<tr>
<td>Internal mutual communication</td>
<td>To what degree did units within your firm interact with those in the partnering firm through: Participation in meetings; participation in committees/task forces; phone conversations; exchange of mail and fax; exchange of internal reports; exchange of electronic mail.</td>
</tr>
<tr>
<td>Joint engagement</td>
<td>What was the level of engagement between units within your firm in terms of: Advice and counsel was sought by each other; units helped each other in planning activities; suggestions were encouraged by one another; units shared unit-specific information; in this relationship it was expected that any information was provided, which might help the other party.</td>
</tr>
<tr>
<td>Internal joint engagement</td>
<td>What was the level of engagement between units of your firms with those of the partnering firm in terms of: Advice and counsel was sought by each other; both firms helped each other in planning activities; suggestions were encouraged by one another; both firms shared proprietary information; in this relationship it was expected that any information was provided, which might help the other party.</td>
</tr>
<tr>
<td>Sharing responsibility</td>
<td>How frequently did units within your firm share responsibilities with one another: Units were engaged equally in decision-making processes; contributed equally to the development; complemented one another as best as they could; shared collective responsibility for all results of the development.</td>
</tr>
<tr>
<td>External sharing responsibility</td>
<td>How frequently did units of both firms share responsibilities with one another: Units of both firms were engaged equally in decision-making processes; contributed equally to the development; complemented one another as best as they could; shared collective responsibility for all results of the development.</td>
</tr>
<tr>
<td>Relationship commitment</td>
<td>The relationship units within your firm had with one another: Was a relationship they were very committed to; was very important to them; deserved their maximum efforts to maintain; was a relationship they intended to maintain indefinitely.</td>
</tr>
<tr>
<td>External relationship commitment</td>
<td>The relationship units from both firms had with one another: Was a relationship they were very committed to; was very important to them; deserved their maximum efforts to maintain; was a relationship they intended to maintain indefinitely.</td>
</tr>
<tr>
<td>Mutual trust</td>
<td>In their relationship during the development, units within your firm: Were perfectly honest and truthful with each other; were able to have great confidence in each other; could be counted on to do what was right; had high integrity.</td>
</tr>
<tr>
<td>Internal mutual trust</td>
<td>In their relationship during the development, units of both firms: Were perfectly honest and truthful with each other; were able to have great confidence in each other; could be counted on to do what was right; had high integrity.</td>
</tr>
</tbody>
</table>
Aggregated Reference List


