Value-adding contributions of firm internal and external collaboration in new product development

ABSTRACT
The existing literature has provided a detailed examination of the nature of inter-firm collaboration. With this, recent researchers have suggested that external collaborative relationships between firms influence the collaborative environment within the firm and vis-à-vis. However, most studies have, with a few exceptions, not gone further than calling for a similar alignment between firm internal and external collaboration. This study attempts to fill this gap by systematically examining the value-adding contributions of key internal collaborative activities and key external collaborative activities during a new product development among 168 dual partner strategic alliances. We explore firm collaboration as a configuration of five structural and relational attributes that capture differently intensive collaborative activities within and across firms. We find that engaging in similar internal and external collaborative activities and trying to maximise the intensity of each is not the best-performing combination. Instead, the nature of collaboration among functional units within a focal firm is different to that between the focal and partnering firm with each adding a non-overlapping value to product development performance. This study enriches alliance and innovation research, especially regarding theorizing and validating the value-adding nature of firm internal and external collaboration.

Keywords: Firm internal collaboration, firm external collaboration, new product development

Student paper: The senior author of this paper is a student
The term collaboration has captured a prominent position across different domains including innovation, production/operations management, strategy, organizational theory, and information systems literature (Glouberman, & Mintzberg, 2001; Lawrence, & Lorsch, 1969; Tushman, 2000; Venkatraman, & Zaheer, 1990). However, collaboration has been differently understood and conceptualized across disciplines. Each discipline and even within each discipline, researchers seem to have a different perspective on the subject matter (Barki, & Pinsonneault, 2005). Moreover, the perspectives taken and nature of collaboration observed have varied by the location collaboration takes place.

Within the firm, theorists and practitioners from different organizational research fields have focused their attention on determining structural and behavioral solutions to the dilemma of who should interact with whom, how often and through which processes, mechanisms, and structures (Glouberman, & Mintzberg, 2001; Griffin, & Hauser, 1992; Gupta, Raj, & Wilemon, 1985; Souder, 1988; Stank, Daugherty, & Ellinger, 1999). Especially collaboration across different functional units within the firm has been frequently linked to higher performance and this “evidence is strong, consistent, common across a variety of methodologies, and seemingly applicable in both service and products and in both consumer and industrial markets” (Griffin and Hauser, 1996: 193).

Collaboration 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 in order to succeed (Powell, Koput, & Smith-Doerr, 1996) and firms need to source resources and capabilities from ‘outsiders’ (Hillebrand, & Biemans, 2004; Prahalad, & Ramaswamy, 2004; Rathaermel, & Deeds, 2004; Sveiby, 2001; Takeishi, 2001). Decreasing development cycles (Chen, Ling, & Wei, 2003), globalisation of market economies (Sanchez, & Perez, 2003), ever-rising opportunities of ICT (Nootboom, 2003), and the increasing complexity of products and services (Hoegl, Weinkauf, & Gmuenden,
2004) have resulted in a race to a sustainable market advantage with new and improved products and services. Collaborative relationships with external entities have therefore become a critical means of adding on to existing corporate strengths and covering weaknesses (Dyer, & Singh, 1998; Lane, & Lubatkin, 1998; Simonin, 1997; Teece, Pisano, & Schuen, 1997).

Whilst most scholars have focused selectively on either firm internal collaboration or firm external collaboration, most product and service innovations today consist of collaboration among functional units and processes within the firm and simultaneously include collaboration with entities outside the firm (Meyer, & DeTore, 1999; Spekman, Kamauff, & Myhr, 1998; Takeishi, 2001). Accordingly, selective scholars have noted a possible association between firm internal and firm external collaboration (Barki, & Pinsonneault, 2005; Barratt, 2004; Hillebrand, & Biemans, 2004; Sanders, & Premus, 2005; Stank, Keller, & Daugherty, 2001; Tushman, 2000). Most of the existing work, however, has merely suggested a possible strategic connection between firm internal and external collaboration without empirically testing the nature and impact of this possible connection. Prior studies that have called for a link between firm internal and external collaboration have been mostly descriptive in nature or focus on other issues at the centre of their study. The small number of researchers, which did test the relationship between firm internal collaboration, firm external collaboration, and performance within the same study did so in different ways and reported different findings.

Therefore, the purpose of this paper is to further investigate this relationship. We firstly explore how collaboration among functional units within a focal firm and collaboration among the focal firm and a partnering firm each lead to performance during the same product development, whilst controlling for the other. Secondly, we examine, how similar firm
The concept of firm collaboration

Firm collaboration, whether within a firm or between different firms, has been studied in diverse and complex ways and has been defined and measured in a different -sometimes even contradictory- manner. Different disciplines focused on different firm activities or components. The perspectives taken and nature of collaboration observed have varied by the location collaboration takes place (either within a firm or between different firms) and the strength of the intensity the collaborative relationship takes among different parties. Despite the apparent differences, conceptualisations of collaboration revolve around a fundamental notion, which Barki and Pinsonneault (2005: 173) label as ‘organizational configuration’. An organizational configuration reflects the extent to which processes, people and technologies of an organization are integrated. They are structural and relational characteristics of a given firm or between firms that vary depending on the firms’ environment, strategy, structure, and processes (Miller, 1990).

Thus, summarising the combined effort of the 119 studies that was analyzed in a meta-analysis by Schleimer (2007), we define firm collaboration for this study as ‘a configuration
of structural and relational attributes that capture ongoing activities within and/or between firms and that vary in intensity’. The most common attributes, which researchers of the 119 studies have attributed—usually in configuration with one another—to firm internal and external collaboration are (1) mutual communication, (2) positive engagement, (3) sharing responsibilities, (4) relationship commitment, and (5) mutual trust. We will use these attributes to review the limited literature that has studied both internal and external collaborative activities and to measure our propositions. We refer to firm internal collaboration as collaborative activities among functional units (e.g. Marketing and R&D) within the same firm. Functional units reflect different, yet complementary components of the firm that behave as a unified whole, without being merged into a single entity (Barki and Pinsonneault, 2005: 166ff). We refer to firm external collaboration as those collaborative activities that take place between units of a focal firm with those of a partnering firm involved in the collaboration.

THEORETICAL BACKGROUND

Existing research on firm internal and external collaboration

Selected researchers have started to address the relationship between firm internal and external collaboration. Hillebrand and Biemans (2004), for example, argued that firm internal collaboration serves as a mechanism to coordinate firm external collaboration and external collaboration stimulates internal collaboration. They further suggested that a firm’s internal and external collaboration should be ‘supportive’ of one another (2004: 119). However, the scholars did not test the strength and importance of this internal-external collaborative linkage in terms of performance outcomes. Other researchers have also suggested a positive relationship between firm internal and external collaboration, however they usually did not
test the nature and impact of this relationship on performance (Barki, & Pinsonneault, 2005; Barratt, 2004; Subramani, 2004; Vickery, Jayaram, Droge, & Calantone, 2003).

We were only able to locate five studies, which empirically tested the relationship between firm internal and external collaboration with performance. These five studies differed in a number of ways, such as (1) what has been studied, (2) how firm internal and external collaboration were measured, (3) the nature of the relationship tested between firm internal and external collaboration and performance, (4) the methodology used, (5) the type of performance firm internal and external collaboration were linked to, and (6) findings of the study. The following section shortly summarises and Figures 1a-1e illustrate the nature, propositions and findings of each of the five studies.

In the first study, Takeishi (2001) examines the relationship of a number of collaborative processes between Japanese automobile manufacturers and suppliers with component design quality. Coordination among different functional departments within the manufacturer is tested according to its influence on integrated problem-solving with the supplier. Findings of the study confirm that while internal coordination among departments within the manufacturer have a positive impact on joint processes between the manufacturer and supplier, collaborative processes between the firms have a positive effects on component design quality (Figure 1a).

The second study by Truman (2000) establishes a link between firm external and internal electronic data exchange and firm performance. Specifically, he tests (1) the relationship between the external electronic data interchange environment of a firm—which he refers to as interface integration- and performance outcomes and (2) the relationship between interface integration and integration of firm internal systems within and between subunits of a firm—defined as internal integration. Truman finds that interface integration is positively related to performance and interface integration is positively related with internal integration. He argues
that high internal integration creates a propensity for implementing high interface integration, which leads to administrative labour efficiencies and effectiveness (Figure 1b).

The third study by Stank et al. (2001) investigates the relationship between (1) firm internal collaboration - among functional units- and logistical service performance, (2) firm external collaboration - among supply chain partners- and logistical service performance, and (3) among firm internal and external collaboration. Findings confirm a significant and positive relationship between internal collaboration and performance. However, the results fail to reveal a significant relationship between external collaboration and performance. The findings also suggest a significant positive relationship between firm internal and external collaboration. The authors therefore argue that internal collaboration mediates the relationship between external collaboration and performance (Figure 1c).

In the fourth study, Sanders and Premus (2005) examine the impact of (1) IT capabilities on firm internal collaboration, on external collaboration, and on product-to-market performance; (2) the impact internal collaboration has on product-to-market performance; and (3) the impact firm external collaboration has on internal collaboration. In terms of (2) and (3), findings confirm that firm internal collaboration has a significant and positive impact on performance and external collaboration impacts significantly and positively on internal collaboration (Figure 1d).

The fifth study by Sveiby (2001) divides an organization’s boundaries into three families of intangible assets of (1) external structure, (2) internal structure, and (3) individual competence. He further creates nine knowledge transfers that mirror linkages within and across the three structures. He measures, how these transfers create value for the organization via an illustrated case study comparing one firm that implements the nine knowledge transfer and one firm that does not. The firm, which implemented the nine knowledge transfers
achieves higher technology efficiency, lower staff turnover and higher productivity than the firm that did not (Figure 1e).

Insert Figures 1a-1e about here

In sum, all five studies find a positive relationship between firm internal and external collaboration. However, in terms of the relationship between firm collaboration and performance, the studies offer different propositions and findings. While the studies by Takeishi (2001) and Truman (2000) find a direct positive relationship leading from internal collaboration to external collaboration and from external collaboration to performance, findings of the studies by Stank et al. (2001) and Sanders and Premus (2005) suggest the opposite. Their results reveal a direct positive relationship from external collaboration to internal collaboration and from internal collaboration to performance. Sveiby’s (2001) case study represents the only research, which proposes and confirms that firm internal and external collaboration jointly rather than subsequently add value to performance.

The different approaches and findings of the small number of studies do not provide enough evidence as to how the combined nature of collaboration within the firm and collaboration between separate firms add value to performance. The lack of support for a direct relationship between external collaboration and service performance let Stank et al. (2001) to the argument that collaboration with customers and suppliers is “a necessary but not sufficient condition for performance improvement” and if “internal collaboration drives external relationships, the performance improvements may not be achieved” (Stank et al. 2001; p.40). Other studies, however, suggested that firm internal collaboration also influences firm
external collaboration (Hillebrand, & Biemans, 2004) and that external collaboration also has a direct, positive impact on firm performance (Baum, Calabrese, & Silverman, 2000; Cavusgil, Calantine, & Zhao, 2003; Deeds, & Hill, 1996; Faems, Van Looy, & Debackere, 2005; Koza, & Lewin, 1998; March, 1991; Rothaermel, & Deeds, 2004; Santoro, 2000).

Therefore, despite the findings of Stank et al. (2001), and in line with results by Sveiby (2001), we argue:

**Hypothesis 1:** In a new product development, where the focal firm simultaneously engages in collaboration among functional units within the focal firm and collaboration among the focal and partnering firm, firm internal collaboration has a direct, positive influence on new product development performance.

**Hypothesis 2:** In a new product development, where the focal firm simultaneously engages in collaboration among functional units within the focal firm and collaboration among the focal and partnering firm, external collaboration has a direct, positive influence on new product development performance.

Although findings in Sveiby’s (2001) study suggest a positive link between firm internal collaboration and performance and firm external collaboration and performance, it was not elaborated, how this combination of firm internal and external collaboration ought to look like. It is thus uncertain, whether higher development success is reached, the more similar firm internal and external collaboration are configured, or if they each represent a separate value-adding phenomenon. The following section will discuss the existing literature, which has, in general, suggested that firm internal and external collaboration ought to be configured in a similar manner for best performance outcomes to occur.
**Similarity between firm internal and external collaboration**

Often, researchers suggested that similar internal and external collaborative practices are associated with better performance, however they usually did not test for this relationship (Prahalad, & Ramaswamy, 2004; Sanders, & Premus, 2005; Stank et al., 2001; Von Hippel, 2001). Others, as Hillebrand and Biemans (2004) propose that internal collaboration serves as a mechanism to coordinate external collaboration. Their interpretations, although not tested, suggest that a firm’s internal collaborative norms ought to be similar to its external collaborative norms. Moreover, a number of researchers argued that learning from external partners requires internal collaboration, as it “serves to disseminate, to interpret, to utilise, and to evaluate new knowledge acquired from external partners” (Hillebrand and Biemans 2004, p.118). Taking this argument further, internal systems, structures and procedures have to be able to interpret and utilise externally acquired knowledge in order to transform it into readily accessible knowledge (March, & Simon, 1993; Roethaermel, & Deeds, 2004; Zahra, & George, 2002). Thus, a certain similarity in systems, structures and procedures may be needed for knowledge adaptation so that it can flow between a firm’s internal and external collaborative environment without distortion (Jensen, & Szulanski, 2004).

There are also empirical findings indicating a firm’s internal collaborative environment has to be structured somewhat similar to its external environment for enhanced performance to occur. One way of doing this is to insist and assist external partners into coordinating their internal coordination in similar ways. In the automobile industry, for example, firms have started to actively include their suppliers and dealers into the product development process (Takeishi, 2001). BMW, for instance, uses the same IT software for internal communication, as it uses to communicate with dealers (McKellar, 2002). By including dealers in the same collaborative software, knowledge can be transferred and interpreted immediately between the organization’s internal and external environment without knowledge distortion.
Moreover, including customers into value-creating processes of a firm, is becoming increasingly popular among firms, especially for those located in services sectors (Prahalad, & Ramaswamy, 2004; Smith, 2006; Von Hippel, 2001). Due to the simultaneity of production and consumption, collaboration among front office functions, back office functions and customers has to be closely aligned for sound communication to evolve and virtually melts into one another (Johne, & Storey, 1998; Meyer, & DeTore, 1999). Boeing, for example, actively includes customers into their design processes in order to create products that satisfy customer requirements (Von Stamm, 2004). Therefore, collaboration within the firm has to be somewhat similarly structured to the collaboration with customers (Szymczak, & Walter, 2003). This argument is also supported by Subramani (2004; in Sanders and Premus 2005; p 5), who suggested the collaboration suppliers develop with buyers is “in fact directly strained by the communication within the supplier firm…internal communication serves to mediate buyer-supplier collaboration”.

Thus, we conclude:

*Hypothesis 3: The more similar collaboration among units within the focal firm is configured to the collaboration between the focal and partnering firm during the same product development, the higher is the product development success.*

**METHODS**

**Sample and procedures**

We tested the research hypotheses utilizing survey data collected on a sample of 168 dyadic innovation alliances. The unit of analysis are firms, which have at least one major subunit (e.g. subsidiary and/or headquarters) situated in Australia and are involved in product and/or
service development in the value chain of a product and/or service. We used the interview results and pre-existing scales to develop the measures for the pilot survey, which was done in form of a person-administered survey on 30 managers in several industry sectors, who reflected a similar orientation to those, who complete the main questionnaire.

For the main data collection, we 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.

Of the 3000 surveys e-mailed, we received 359 responses, which is a response rate of 11.9%. 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. This left us with a final sample of 168 responded surveys, which included data on collaboration among functional units from the focal firm that were involved in the product development project and on the collaboration between the focal and partnering firm during the same product development. The respective 168 firms were members of 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 168 respondents, a majority was located in the Marketing department (45), R&D department (38), or sales department (29) in their respective firms. We checked the 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 (p > .10). Moreover, we 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).

**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, we 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 the Appendix of this paper.

**Dependent variables**

**Development success.** Researchers have highlighted the necessity of capturing the multi-dimensional nature of performance (Chakravathy, 1986; Narasimhan, & Das, 2001).
Moreover, 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 (Venkatraman, & Ramunajam, 1986). We chose ‘development success’ as our performance measure. The index is comprised of five items from measures of previous studies (Homburg, & Pflesser, 2000; Narasimhan, & Das, 2001; Sanders, & Premus, 2005; Scannell, Vickery, & Droge, 2000) and includes measures of product development costs, product quality, customer satisfaction, and providing value for customers. Each item had high loading coefficients of above .64, an Eigenvalue of over 53% variance explained by the first component and therefore validated the appropriateness of individual items constituting this construct.

**Independent variables**

In accordance to previous research findings (Schleimer, 2007), we measure 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 (Chronbach’s alpha = 0.80).

(2) **Joint engagement.** The level of joint engagement between collaboration partners refers to 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.

(3) **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-.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.

(4) **Relationship commitment.** We chose to take four items from the 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). We 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 on 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. We 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, we controlled for several variables known to correlate with firm internal and external collaboration. We controlled for effects of firm size using the number of full-time employees (Collins, & Smith, 2006). We also controlled for 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). Moreover, we controlled for the effects of the number of units involved from the focal and the partnering firm (Schulz and Hoegl, 2006), the number of firms involved (Garcia-Canal, Valdes-Ilaneza, & Arino, 2003), and the form of agreement (1 = contractual, 0 = non-contractual) between the focal and partnering firm. Lastly, we examined whether a product or service was developed (1 = product, 0 = service).
ANALYSIS AND RESULTS

In this study, hierarchical regression was used to test the three hypotheses. Table 1 reports the descriptive statistics and Pearson correlation between all related variables. Table 2 presents the results of the regression analysis. We 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 firstly 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 the predictor variables. Three-way interactions among the variables have also been included in the initial regression model as an additional model 4. However, these interactions did not suggest a significant F change in explained variance and were therefore not included in this study.

To facilitate testing of interaction effects, we centred all independent variables to reduce nonessential multicollinearity among interaction terms and their individual components (Aiken, & West, 1991; Neter, Wasserman, & Kutner, 1989). For those variables, where distributions were highly positively skewed (‘number of units involved from focal firm’ and ‘number of units involved from partnering firm’) we chose a Poisson transformation in order to equalise the variance and reduce skewness for a more normally skewed distribution (Cohen and Cohen, 1983, p.263).

Hypothesis 1 and 2 predict that firm internal collaboration (Hypothesis 1) and firm external collaboration (Hypothesis 2) each have a positive relationship with development.
success. For these hypotheses to be supported, model 3 required a statistical increase in variance explained from model 2 (hierarchical $F = 1.77$, $p < .05$) and the main effects and/or interaction effects among internal collaborative attributes (for Hypothesis 1) and among external collaborative attributes (for Hypothesis 2) to be revealing a positive pattern. Hypothesis 3 required a statistical significant increase in variance explained from model 1 to model 2 and a pattern of results consistent with those hypothesised. A comparison of model 2 with model 1 suggests that the inclusion of the ten collaborative attributes, our predictor variables, significantly adds to the model’s power to explain the variance of product development success (hierarchical $F = 4.61$, $p < .001$).

We report the findings starting with patterns found for firm internal collaborative attributes. In terms of internal collaboration, the intensity level of shared communication ($\beta = .205$, $p < .10$ in model 2 and $\beta = .28$, $p < .05$ in model 3) and the level of shared responsibilities among units within the focal firm are individually and positively related with development success ($\beta = .24$, $p < .10$ in model 3, $\beta = .20$, $p = n.s.$ in model 2). Intensity levels of joint engagement ($\beta = .28$, $p = n.s.$) and the level of mutual trust among the units within the focal firm ($\beta = .29$, $p = .03$) reveal no relationship with development success. The level of relationship commitment among the units within the focal firm is, to our surprise, significantly negatively related to development success ($\beta = -.31$, $p < .05$ in model 2, and $\beta = -.29$, $p < .05$ in model 3).

Insert Table 1 and 2 about here

Insert Table 1 and 2 about here

Interestingly, the interaction between relationship commitment and mutual trust (model 3) reveals a significant and positive relationship with development success ($\beta = .37$, $p < .05$). To
examine this interaction, we followed the widely used Aiken and West (1991) procedure of plotting the interaction. The simple slope analysis (Figure 2) suggests that relationship commitment among the units involved from the focal firm at low levels of mutual trust (one standard deviation below the mean) is significantly negatively related to development success ($\beta = -.52, p < .05$). At high levels of trust among the units of the focal firm (one standard deviation above the mean), however, relationship commitment is not significantly negatively related to development success anymore ($\beta = -.07, p = \text{n.s.}$). The relationship of commitment on development success among units within the focal firm is therefore conditional on the intensity level of mutual trust.

Hypothesis 1, which proposed a significant positive relationship between firm internal collaboration and performance, is therefore only partly supported. Whilst mutual communication and sharing responsibilities lead to development success, joint engagement has no relationship with development success, and the impact of relationship commitment is either negative or not significant, depending upon the intensity level of trust among the units within the focal firm.

Examining the results for the collaborative attributes evident in the alliance relationship between the two firms, the patterns revealed were different from those we found among functional units within the firm. None of the main effects for external collaborative attributes reveal a significant relationship, except for the intensity level of sharing responsibilities, which is significantly negatively related with development success ($\beta = .23, p < .10$). However, the results also reveal two positive, two-way interactions, one of which is between joint communication and mutual trust ($\beta = .61, p = .009$) among the focal and partnering firm. To further test the nature of this relationship, we performed a simple slope analysis (Aiken, & West, 1991). Findings (Figure 3) reveal that in relationships with low levels of trust between the focal and partnering firm, joint communication is not related to development success ($t = -$
However, in relationships, where there are high levels of trust among the firms, communication is significantly and positively related to development success ($\beta = .54$, $p = .009$). The relationship of the intensity of joint communication on development success between the firms is therefore conditional on the intensity level of mutual trust.

The two-way interaction between the level of joint engagement and relationship commitment also reveals a significantly positive relationship with development success ($\beta = .58$, $p < .10$). A simple slope test (Figure 4) discloses that the intensity level of commitment between both 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 positively related with development success ($\beta = .55$, $p < .05$). Thus, the relationship of commitment on development success is conditional on the intensity level of positive engagement among the focal and partnering firm.

Hypothesis 2 predicted that external collaboration is positively related to development success. The Hypothesis is therefore supported in terms of shared communication and relationship commitment, but only at high levels of mutual trust and joint engagement between the focal and partnering firm. In terms of sharing responsibilities between the firms, which is negatively related to development performance and reveals no significant interaction, Hypothesis 2 is not supported.

Comparing the observed patterns of collaboration among the functional units within the focal firm with those among the focal and partnering firm, the value-adding nature of firm
internal versus firm external collaborative activities is different for sharing responsibilities, joint engagement, and relationship commitment. Surprisingly, although their impact is different, the intensity levels of sharing responsibilities and joint engagement are similar for firm internal and external collaboration (see Table 1). The value-adding nature for mutual trust and shared communication is similar for collaboration within the focal firm and between the firms, although their intensity levels vary significantly (mutual trust: $t = 1.885, p < .10$, shared communication: $t = 3.63, p < .001$). Mutual trust acts as a positive moderator for other collaborative attributes both within the focal firm and between both firms. However, mutual trust influences different collaborative attributes depending on the location collaboration takes place. The intensity level of shared communication also has a positive impact on development success both within the focal firm and between both firms. Whilst shared communication among the units within the focal firm is independently and positively related to development success, shared communication in the collaborative environment between the focal and partnering firm is only positively related to development success at high levels of mutual trust.

On the basis of the findings of all five collaborative attributes, Hypothesis 3 is rejected. The rejection of Hypothesis 3 implies that with increasing similarity of collaboration among units from the focal firm with collaboration among the focal and partner firm, development success is not higher. Instead, firm internal collaboration adds different, non-overlapping rather than similar value to development success than firm external collaboration.

**DISCUSSION**

In this study we address recent calls for further understanding of the association and the joint influence of firm internal and firm external collaboration (Hillebrand, & Biemans, 2004; Sanders, & Premus, 2005). We did this by recognizing that most product innovations today...
require both collaboration among units within a focal firm and simultaneously collaboration among the focal and partnering firms. We suggested that conceptualisations of firm collaboration have evolved around configurations of similar structural and relational collaborative attributes that capture ongoing activities within and between different firms. We proposed and the results partly confirm that in the presence of the other, firm internal collaboration (Hypothesis 1) and firm external collaboration (Hypothesis 2) each have a positive relationship with development success. These findings are somewhat similar to Sveiby’s results (Figure 1e) but different to those in the other four studies we examined.

The value-adding nature of collaborative attributes that lead to development success is different and non-overlapping for internal collaboration compared to those in the external collaborative environment. This result leads us to reject Hypothesis 3. In order to better understand the unique nature of each the firm internal collaborative environment and external collaborative environment, we take a further look at our findings.

Relationship commitment among units involved from the focal firm revealed a negative relationship with development success - unless the level of mutual trust was high. Although surprising at first, findings of other research offer explanations for this result. It has been found that people sometimes ignore knowledgeable people within the same organization to avoid implications of social comparison (Taylor, 1983). Similarly, a study by Burt (1992) revealed that managers gained status by using external contact and knowledge over and above that gained within the firm. Relationship commitment, as measured, reflects the willingness to exert effort on behalf of the relationship (Moorman, Zaltman, & Desphande, 1992; Morgan, & Hunt, 1994; Porter, Steers, Mowday, & Boulian, 1974). This may indicate the willingness to spend increased resources without immediate compensation. Therefore, at low trust levels, efforts exerted on behalf of the relationship with other units, who, possibly, compete for status and promotions and with whom a unit may get directly compared to, may negatively
associated with development success. Another explanation for the pattern could be that, while knowledge from a partnering firm requires greater expenditure and effort to be obtained, it often retains its uniqueness and value over knowledge gained through collaboration within the firm, which comes to be seen as familiar and flawed (Menon, & Pfeffer, 2003).

Our results further reveal that mutual trust acts as a moderator for the impact relationship commitment has on development success. Scholars outlined that mutual trust is “the cornerstone of the strategic partnership” (Spekman, 1988) and that relationship characteristics of trust are so highly valued by parties that they desire to commit themselves to such relationships (Hrebiniak, 1974, in Morgan & Hunt, 1994). Therefore, mutual trust is a major determinant of relationship commitment (Moorman et al., 1992; Morgan, & Hunt, 1994). Previous researchers suggests that relationship commitment by itself entails vulnerability (Morgan, & Hunt, 1994). Thus, at low intensity levels of mutual trust, potential benefits of relationship commitment may be negated due to social comparison or status reasons. At high levels of trust, however, units may be more likely to endure the wish for exerting effort towards the collaborative relationship as they perceive the other unit as desirable to maintain a collaborative relationship with.

Next, we draw our attention to the patterns found for external collaboration. The positive interaction between the intensity level of shared communication and mutual trust among the focal and partnering firm deserves explanation. At low levels of mutual trust, shared communication was not related to development success. Researchers have suggested a pattern as such may indicate that the communication entails conflict (Ancona, & Caldwell, 1992). At high levels of trust, however, the intensity of communication may reflect the amount of valuable information transferred between the collaborating firms (Gruenfeld, Mannix, Williams, & Neale, 1996). Scholars have argued that trustful relationships among partnering firms result in more intensive information exchange (Huber, & Daft, 1987). Thus, 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). This study did not measure the content of the communication and in order to make more sophisticated assumption about this particular interaction, additional analyses would be required that also measure the reflexivity that is ‘the extent to which collaboration partners reflect upon and communicate joint objectives, strategies and process’ (Schippers et al., 2003: 781).

Subsequently, we examine the positive interaction between the intensity level of joint engagement and relationship commitment between both firms. Joint engagement, as measured, reflects joint efforts to jointly plan and achieve not only the focal firm’s goals, but also to assist the partnering firm in reaching its own objectives (Dwyer, & Oh, 1988). Joint engagement among collaborating firms therefore results in mutual expectations to be established and cooperative efforts to be specified (Dwyer, & Oh, 1988; Mohr, & Spekman, 1994). At low levels of engagement among the focal and partnering firm, a commitment to working on and maintaining the collaborative relationship may have little impact on development success, if mutual expectations and cooperative efforts are low. Indeed, Liedtka (1996) found that most relationship commitments are crystallized during planning processes, as they represent an opportunity to recognize and incorporate input from all involved parties. Thus, exerted effort from both firms will only have a positive impact on development success, when the collaborating firms exert efforts to mutually plan and jointly attain their individual and shared goals.

Sharing responsibilities is only related to development success among units within the focal firm. This finding is in line with previous studies, which also found a positive relationship between the intensity with which functional units within a firm share responsibilities and innovation success (Griffin, & Hauser, 1996; Gupta, & Wilemon, 1990; Moenaert, Souder,
De Meyer, & Deschoolmeester, 1994). The negative main effect of sharing responsibilities between the focal and partnering firm may be best explained with the significant relationships we found in terms of firm size and development success. The size of the focal firm was significantly negatively and the partnering firm’s size significantly positively related with development success in all three models (see Table 2). This pattern seems surprising and unusual at first. Previous research has, however, found that firms, which collaborate with larger sized partners, perform better than otherwise comparable firms that lack such partners (Stuart, 2000). As such, Stuart (2000: 806) found 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. Consequently, a much smaller, focal firm may have comparably less responsibility for decisions and outcomes than the much larger partner. We are aware that there may be influences, which impact on this pattern that we were not able to capture in this study and therefore future research could further investigate the relationship between firm size, partner choice, and product development outcomes.

Comparing the results for firm internal and external collaborative attributes as a whole, the individual and interactive nature of collaboration among units within the focal firm is different and adds different value to that between the focal and partnering firm. Also, the intensity levels of the collaborative attributes indicate little about their value-adding character. Each of the five collaborative attributes, individually or in interaction with another attribute, seems to have a unique, non-overlapping effect on development success. Therefore, none of the five models that illustrated the propositions and findings of the five previous studies (Figure 1a-1e) seems to sufficiently capture the complexity of patterns of the impact firm
internal and external collaboration have on development success. Sveiby’s results implied that
firm internal and external collaboration each lead to higher performance. However, Sveiby’s
findings do not advocate, whether these contributions are separate, unique contributions, as
our results suggest.

In this study, we have found that certain combinations of firm internal collaborative
attributes and firm external collaborative attributes add value to development success. We did
not address, whether collaborative attributes interact beyond their collaborative internal or
external environment with one another and how this affects development outcomes. Previous
researchers (Vickery et al., 2003: 526) pointed out, but did not test that successful supply
chain integration involves ‘balancing’ intra-firm and inter-firm collaboration and Barratt
(2004) recommended that firm internal integration must be aligned with drivers and
constrains of the rest of the supply chain. This gap has also been noted by previous
researchers (Hillebrand and Biemans, 2004: 119) who argued that “while possible links
between internal and external cooperation were investigated, the strength and importance of
these links were not”.

Our results do allow us to reject the similarity notion (H3), as well as allowing us to reject
the simple processes suggested by the five models that summarised previous investigations.
However, we believe that further investigation is warranted as to the value-adding impact firm
internal and external collaboration. The next logical step would therefore be to interact the
different firm internal and external collaborative attributes with one another in order to find
out, whether their combined, value-adding relationship reaches beyond that of their respective
collaborative environment.

CONCLUSION
Although this study led to a number of interesting results, it also entails some methodological and conceptual limitations. Our 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, we only examined the collaborative relationship between the focal firm and a single key partnering firm. There are also limitations in terms of variables selected for this study and how they were measured. In addition, due to sample size constraints, we were not able test the combined relationship of firm internal and external collaboration beyond their additive contributions.

Our study joins initial efforts that have started to explore the association and impact of firm internal and firm external collaboration (Barki, & Pinsonneault, 2005; Hillebrand, & Biemans, 2004; Stank et al., 2001; Sveiby, 2001; Takeishi, 2001). To our knowledge, this study is one of the first to empirically test a ‘best-performing’ combination of collaboration within and between a focal and partnering firm during the same product development. Unlike previous studies, we define firm internal and external collaborations along similar sets of collaborative attributes that vary in intensity levels and validate the constructs of these variables. Our findings suggest that researchers should pay attention to the context in which collaboration is studied. Presenting all firm internal and external collaborative attributes in an integrated approach enables a comprehensive assessment of their ‘real’ contributions towards performance. Running separate analyses for firm internal collaboration versus firm external collaboration would have revealed patterns different from those we observed. Therefore, studies that single out a firm’s internal or external collaborative environment – whilst the other co-exists- have only captured part of a phenomenon that needs to be understood as a whole. Our current effort is, however, preliminary and opens the door to many additional
questions and investigations to theorise and validate the nature and impact of the value-adding relationship between firm internal and firm external collaboration.
REFERENCES


Lawrence, P. R. & Lorsch, J. W. (1969), "Organization and Environment", Graduate School of Business Administration, Boston, Harvard University


TABLE 1
Descriptive Statistics and Pearson Correlation Matrixa

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a n = 168  
** p < .01  
* p < .05
TABLE 2
Results of Hierarchical Regression

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<td>4.61***</td>
<td>1.78*</td>
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</table>

Note. Dependent variable: Product success.
† All coefficients presented are standardized coefficients.
* p < 0.10; ** p < 0.05; *** p < .001
Graphical models comparing studies’ findings in terms of firm collaboration and performance

**Figure 1a**
Takeishi (2001)

- Internal collaboration
- External collaboration
- Performance

*Internal collaboration* = coordination, communication
*External collaboration* = communication, knowledge integration, integrated problem solving
*Performance* = component design quality

**Figure 1b**
Truman (2000)

- Internal collaboration
- External collaboration
- Performance

*Internal collaboration* = system integration within and between subunits
*External collaboration* = electronic data interchange
*Performance* = administrative labour efficiency and effectiveness

**Figure 1c**
Stank et al. (2001)

- Internal collaboration
- External collaboration
- Performance

*Internal collaboration* = Integrated database; information exchange, providing feedback
*External collaboration* = information sharing, shared rewards and risks, benchmark best practices and share results
*Performance* = logistical service performance
Figure 1d

Sanders and Premus (2005)

- Internal collaboration
- Performance
- External collaboration

**Internal collaboration** = joint planning, integrated database, information sharing  
**External collaboration** = information sharing, cross-functional processes, joint planning  
**Performance** = product-to-market performance

Figure 1e

Sveiby (2001)

- Internal collaboration
- Performance
- External collaboration

**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

Note.

- Proposed and confirmed impact of A on B  
  - ps = positive, significant effect

- Proposed and confirmed relationship between A and B  
  - ns = nonsignificant effect

- Proposed but not confirmed impact of A on B  
  - p = positive effect, but no statistical data available
Figure 2
Two-way interaction between relationship commitment and mutual trust among units of the focal firms

Figure 3
Two-way interaction between shared communication and mutual trust among the focal and partnering firm
Figure 4

Two-way interaction between relationship commitment and joint engagement among the focal and partnering firm
## APPENDIX

### Questionnaire Items

<table>
<thead>
<tr>
<th>Variable</th>
<th>Items*</th>
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<tr>
<td>Product 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>1. Mutual communication</td>
<td>To what degree did units of both firms 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>2. Joint engagement</td>
<td>What was the level of engagement between units of both firms 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>3. 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>4. 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>5. 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>

*Note. A similar set of questions was designed for the collaborative environment between the functional units involved from the focal firm.