New Product Development Performance Determinants: the role of Buyer-Supplier Collaboration Networks

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Abstract

This work analyses the effects of supplier involvement in new product development (NPD) performance. The primary focus was to identify the key determinants of NPD performance in buyer-supplier relationships. We collect data from 85 dyads, from both relationship sides. Our results show that early supplier participation enhance its ability in contributing to NPD project performance. Additionally, we find that trust plays a key role in the buyer-supplier relationship, and that supplier's excess of embeddedness in a particular buyer diminishes its ability to contribute to collaborative new products development projects.

Keywords: New Product Development; Supply Chain Collaboration; Supplier Performance.

Introduction

In recent years new product development (NPD) initiatives have played a crucial role in the survival and prosperity of global organizations (Barczak and Kahn, 2012; Petersen et al., 2005). Coooper and Edgett (2012) study show that practitioners are concerned to amplify their organizational NPD capabilities, expressed as one of their main corporate objectives, and as an important source of competitive advantage.

Despite being critical to value creation, the mechanisms to successfully coordinate these interconnections of how firms design, manufacture, and delivery products, and how the supplier base can collaborate during de NPD cycle are still mostly indeterminate (Petersen et al., 2005). The economic value created by a firm is the wedge between the willingness-to-pay of its customers and the opportunity cost of its suppliers (Brandenburger; Stuart Jr., 1996). Therefore, the value created by a firm and, thus, its competitive advantage, also is a result of its relationships build and maintenance capability.

There is a significant body of literature on how trust can enhance value creation in buyer-supplier relationships, promoting collaboration and knowledge exchange that

create benefits for both buyer and supplier (Granovetter, 1985; Lado, Dant, and Tekleab, 2008; Li, Poppo, and Zhou, 2010; Gil and Marion, 2013; Cheung, Myers, and Mentzer, 2010). Trust can also influence positively value capture by being an effective governance mechanism (Dyer and Singh, 1998; Poppo and Zenger, 2002), which can reduce transaction costs (Williamson, 1985) and increase transaction value (Zajac and Olsen, 1993).

This approach enables to analyse NPD, since it is a process that transcends organizational barriers through interconnections between processes and activities aiming to create network alliances hence adding value to the product (Lawson et al., 2014, Petersen et al., 2005). According to Barczak and Kahn (2012), there are some "best practices" for driving NPD process. More specifically, there are techniques, methods, process or activities that are more effective in delivering a superior result (Kahn et al., 2012). Specifically, we test the effect of supplier involvement – participation and qualification practices – on NPD project performance. Additionally, we test if competence-based and goodwill-based trust moderates this relation. By unpacking the effect of trust, it is expected to be clearer how they can affect the buyer-supplier relationship differently. A positive and linear effect of competition-based trust is expected. However, the dark side of trust appears when analysing goodwill in the face of the paradox of embeddedness effect.

The paper is organized as follows. The next section provides the theoretical background and the arguments used to build our hypotheses. Section 3 outlines the methodology that we used to conduct our study. We present and discuss the empirical findings at Section 4. Finally, section 5 provides our conclusions and the limitations of the study.

Theoretical Model and Hypotheses

Governance mechanisms have a central role in interfirm relationships, as they affect transaction costs and the willingness of both members to develop actions that contribute to value creation (Dyer and Singh, 1998). A firm can avoid making specific investments in the relationship that could generate relational rents, if it considers the threat of this kind of behaviour significant (Dyer and Singh, 1998). Thus, the perceived risk of partners' opportunistic behaviour may reduce the potential benefits of the relationship (Das and Teng, 1998, 2001). Either legal aspects - contracts that specify and detail the obligations of each party in the relationship -, or informal norms based on trust can support governance (Poppo and Zenger, 2002). Nevertheless, the development of formal contracts is costly and incomplete by nature, due to bounded rationality of individuals in the preparation of some specifications that must cover all possible contingencies associated with the risk of the relationship (Williamson, 1985).

Trust-based norms act as substitutes for complex contracts (Dyer and Singh, 1998; Granovetter, 1985; Gulati, 1995). Such norms could become more effective and less costly safeguards (Uzzi, 1997). Too many contracts or highly detailed contracts could affect the evolution of a collaborative relationship, since it can be interpreted as a demonstration of lack of trust (Das and Teng, 1998; Nooteboom, 2004). Tenbrunsel and Messick (1999) argue that excessive reliance on formal governance mechanisms changes the "decision frameworks" of the members of the relationship.

Firms seek to develop trust-based relationships to enhance the generation of relational rents. Individually or in an ordinary market transaction, these rents would not exist. Rather, they are a result of a long-term combination of resources between firms (Dyer and Singh, 1998; Lavie, 2006). This additional value created is idiosyncratic to the dyad

and it emerges when the interaction between buyer and supplier influences the buyer's willingness to pay and / or the supplier's opportunity cost.

Although previous works recognize trust as an important element on buyer-supplier relationships, many of them did not consider if different dimensions of trust could have distinct effects on a relationship. Authors used to operationalize scales capturing distinct trust dimensions, but putting each dimension as one or two questions, to analyse interorganizational trust as the only one main construct (e.g., Cai et al., 2010; Chen et al., 2011; Nyaga et al., 2010; Zaheer et al., 1998). As a consequence, it is possible to observe results in distinct directions.

With this kind of study design, researchers prove a positive trust effect on buyer-supplier relationships. Academics and practitioners are induced to think that more trust in relationships will be always be better. Our approach extends the dark-side trust discussion (e.g. Villena et al, 2011), arguing that both linear and curvilinear relationship between trust and performance could exist in buyer-supplier relationship. We design our hypotheses to test if different types of trust have distinct relations moderating the effect of supplier involvement and new product development project performance.

We operationalize trust on two dimensions: Competence-based and Goodwill-based (Das and Teng, 2001; Nooteboom, 1996). Competence-based trust regards on being confident to other party's ability to perform as expected. Goodwill-based trust entail in a perception that the other party will behave in a trustworthy (non-opportunist) manner (Nooteboom, 1996). We expect that competence-based trust has a linear relationship with performance (hypothesis 3) and, on the other hand, goodwill-trust has a curvilinear relationship inverted u-type in moderating NPD project performance (hypothesis 4).

The theory of comparative advantage explains the linear relationship between competence-based trust and value creation (Dickson, 1996; Hunt and Morgan, 1995, 1996), where the specialization and exchange allow system efficiency gains. As higher is this type of trust, higher will be the value created by the relationship, assuming that exchanges have equal market value. Leading firms in a variety of industries have made successful efforts to involve suppliers in the DNP process and to these engagement efforts can be attributed to the success of these firms (Ragatz et al., 2002). Buyer and supplier, as they deep their relationship, collect benefits such as knowledge transfer, joint learning and the sharing of risks and costs associated with the exploitation of opportunities (Nahapiet and Ghoshal, 1998).

On the other hand, we expect a curvilinear relationship (inverted-U) moderating the effect of supplier involvement and new product development project performance. In the absence of goodwill-based trust, the firm is subject to opportunism and cost of coordination, which diminishes with the increase of this trust, generating efficiency gains for the relationship. However, buyer-supplier relationships are likely to exchange value uncertainty (Yamagishi, Cook, and Watabe, 1998), especially in NPD project. Thus, in the future, the value of transacting with a particular actor will shift. Goodwill-based trust indicates being embedded on relationships with close social linkages what "at times facilitate and at times derail exchange," creating the "paradox of embeddedness" (Uzzi, 1997, p.35). Blau (1964) states that when the value of particular exchange partners shifts dramatically over time, these close and committed relationships constrain the firm from shifting to new, more valuable exchange partners. So, goodwill-based trust is likely to curtail the propensity to act opportunistically but, in high-levels, could lock-in firms in sub-valuable relationships.

Successful relationships, with plenty of trust, create some 'shadows of the future' (Heide and Miner, 1992; Poppo et al., 2008a) which represent the expectation for the continuity of the relationship. However, this shadow may lead the firm to fear of

interrupting high-trust relationships (Uzzi, 1997). This fear stems from the emotional bond created by the development of goodwill-based trust (Mayer et al., 1995) or by concerns about the possibility of damages in the firm's reputation in future relationships (Granovetter, 1985). Villena et al (2011) discussed the dark-side of buyer-supplier relationships, using Social Capital approach, including trust. The authors confirm that building social capital in a collaborative buyer-supplier relationship positively affects buyer performance. However, if taken to an extreme the relationship can reduce the ability of the buyer to be objective and make effective decisions. Additionally, it may increase the opportunistic behaviour from the supplier.

The research model (figure 1) premise was that the supplier involvement affects the performance of the NPD project (hypotheses 1 and 2). NPD processes are dynamic processes governed by creativity and flexibility (Cooper and Edgett, 2012) where informal norms prevail acting trust as a substitute for complex contracts or even for vertical integration. Thus, trust is an alternative, more effective and less costly, for the use of contracts (Uzzi, 1997). The involvement of the supplier during the NPD cycle, either through its qualification through the provision of technology and practices by the client (Lawson et al., 2014), or by its participation in the product development cycle (Petersen et al., 2005) affect their performance when inserted in an NPD project.

The supplier qualification process is a focal firm practice to remedy technical and/or managerial shortcomings of a supplier through the capabilities development. Since there are costs involved for both sides, those qualification efforts reflect the intent of both firms in building a long-term relationship (Wagner and Coley, 2011).

The studies of Petersen et al. (2005) and Lai and Chen (2012) demonstrate that supplier participation in early stages in the NPD project cycle stems from the oportunity of exchange of expertise, with intense information sharing and high levels of cooperation between the members of the dyad. Moreover, the dynamic nature of an NPD cycle makes it difficult to implement control mechanisms (Cooper and Edget, 2012), so trust can play an import role in supplier qualification and participation efforts.

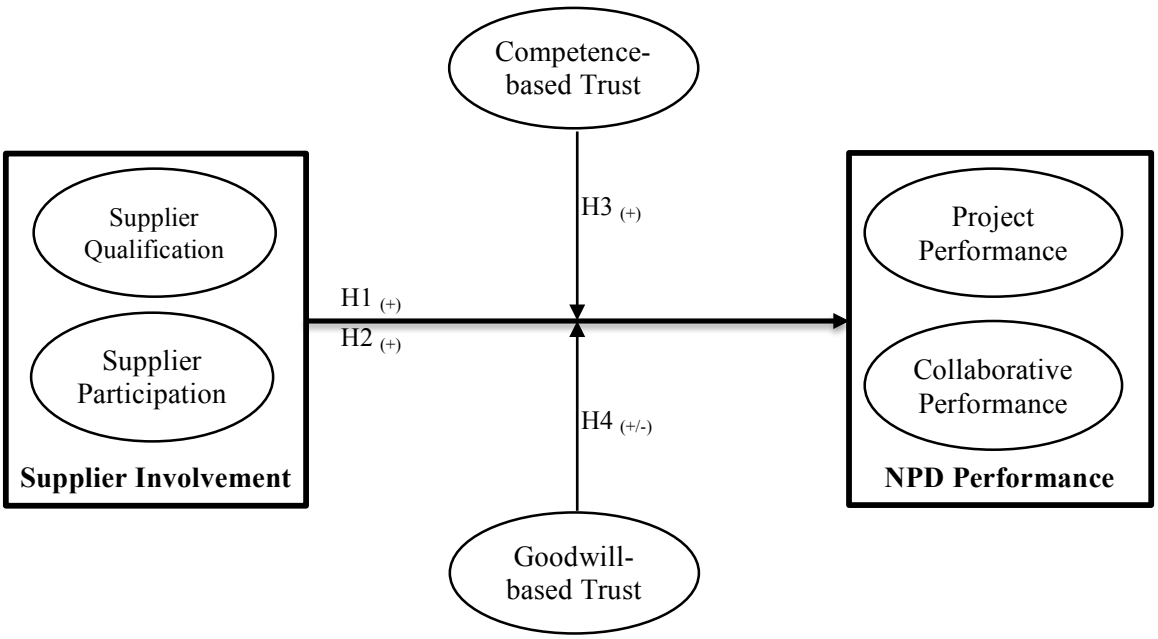

Figure 1 – Research model and hypotheses

Specifically, our hypotheses were structured as figure 2.

Figure 2 – Hypotheses statement

Main hypothesis	**Specific hypothesis**
H1: Supplier qualification positively affects new product development performance.	H1a: Supplier qualification positively affects project performance. H1b: Supplier qualification positively affects collaborative performance.
H2: Supplier Participation positively affects new product development performance.	H2a: Supplier participation positively affects project performance. H2b: Supplier participation positively affects collaborative performance.
H3: Competence-based trust positively moderates the effect of supplier involvement in new product development performance.	H3a: Competence-based trust positively moderates the effect of supplier qualification positively in project performance. H3b: Competence-based trust positively moderates the effect of supplier qualification positively affects collaborative performance. H3c: Competence-based trust positively moderates the effect of supplier participation positively in project performance. H3d: Competence-based trust positively moderates the effect of supplier participation positively in collaborative performance.
H4: Goodwill-based trust moderates the effect of supplier involvement in new product development performance with a U-shaped inverted curvilinear relation.	H4a: Goodwill-based trust moderates the effect of supplier qualification positively in project performance with a U-shaped inverted curvilinear relation. H4b: Goodwill-based trust moderates the effect of supplier qualification positively affects collaborative performance with a U-shaped inverted curvilinear relation. H4c: Goodwill-based trust moderates the effect of supplier participation positively in project performance with a U-shaped inverted curvilinear relation. H4d: Goodwill-based trust moderates the effect of supplier participation positively in collaborative performance with a U-shaped inverted curvilinear relation.

Methodology Approach

We tested the theoretical model and hypotheses using 85 dyads, collecting data from both sides. So, supplier answered questions about a specific buyer and this buyer answered questions about this specific supplier. We use one buyer as focal firm: a Brazilian branch of innovation-driven multinational corporation focused on the design,

manufacture, and distribution of agricultural equipment to more than 140 countries. Innovation is the main strategic vector; the firm hold more than 30% of participation in the Brazilian market.

Agribusiness plays a key role in Brazilian economy; the country is a major exporter of a large variety of processed foods including, soya, grains, meat products, fruit juices, sugar, and producer of biofuels. It also has strong agricultural machinery, input, hybrid seeds, and biotechnology sectors. Agribusiness sector accounts for about 40% of the value of exports and about 33% of Gross Domestic Product (Lora, 2012).

We invited 100 suppliers to our survey, and received 85 valid questionnaires. The high response rate is because this survey is part of a project to restructure the collaborative mechanisms between the focal firm and its suppliers. In data collection, we use operational definition of constructs and scales already tested in previous studies:

- Dependent variables: (1) *Project Performance* measures the supplier's ability to deliver new parts / components (including prototypes) following technical and quality requirements within the agreed timeframe (Lawson et al., 2014). (2) *Collaborative Performance* measures the supplier's ability to contribute to the final product by providing solutions that positively affect the end product in terms of competitiveness, functionality and profitability as well as an end product with superior design in terms of ease of manufacturing and costs (Lawson et al., 2014 and Petersen et al., 2005). These data were collected using buyer perspective.
- Dependent variables: two constructs were used to measure Supplier Involvement in NPD. *Supplier Qualification* is regarding to the extend focal firm invest in supplier development; *Supplier Participation* is the extend focal firm involved suppliers in early and key stages of NPD. The scales used here were obtained from studies by Petersen et al. (2005), Lawson et al. (2014), Ragatz et al. (1997) and Lai and Chen (2012). These data were collected using supplier perspective.
- Moderation variables: we measure two different types of trust – competence-based and goodwill-based (Das and Teng, 2001; Nooteboom, 1996). Competence-based trust regards on being confident to other party's ability to perform as expected; goodwill-based trust entails in a perception that the other party will behave in a trustworthy (non-opportunist) manner. Variables were adapted from Chen et al. (2011) and Zaheer, McEvily, and Perrone (1998) for goodwill-based trust and from Child (2001), Doney and Cannon (1997), Min and Mentzer (2004) and Chen et al. (2011) for competence-based trust. Trust level was measured on the supplier side.
- Control Variables: we control our analysis using sales concentration (focal firm participation in supplier revenues), relationship length (period of time in which supplier maintains a relationship with the focal firm), and the complexity of source (degree of complexity of the products produced by the supplier).

We developed a factorial confirmatory analysis to test the measurement model, eliminating items whose factorial load was less than 0.7. After testing the convergent validity of the constructs, we confirm the discriminant validity between them. We used Stepwise regression in place of entering all independent variables simultaneously, in order to compensate for the relatively small sample size.

Results and Discussion

Table 1, containing the results of the test of hypothesis, has two stepwise regression models, one for project performance and one for a collaborative performance. Results

indicate that involving suppliers in early and key stages of NPD – supplier participation – affects positively supplier's ability to deliver new parts / components (including prototypes) consistence with technical and quality requirements within the agreed timeframe. However, the model has a low explanatory power ($r^2 = 0.047$).

Regarding to collaborative performance, which measures the supplier's ability to contribute to the final product, we found two relevant effects. First, sales concentration hurts performance; so, focal firm's participation in supplier revenues decreases it contribution to new product development requirements. Second, goodwill-based trust enhances supplier participation effect on collaborative performance. Unlike expected, the effect of trust moderation is linear and curvilinear. The model has a good explanatory power ($r^2 = 0.448$).

Table 1 – Stepwise regression results

Dependent variable	**R2**	**F**	**Significant independent variables**	**Coefficient**	**t**
Project Performance	0.047	3.98	Constant	-0.294	0.108
			Supplier participation	0.216	0.109*
Collaborative Performance	0.448	21.38	Constant	-0.020	-0.23
			Sales concentration	-0.275	-3.15**
			Moderation: Goodwill-based trust in supplier participation	0.501	4.18***
			Moderation: Goodwill-based trust [square] in supplier participation	0.563	6.45***

*p < 0.05; **p < 0.01; ***p < 0.001.

With these results, we partially support hypotheses 2 and 4. Supplier involvement in NPD project affects performance (hypothesis 1 and 2), but we did not find supplier qualification effect on both performance measurements (hypothesis 1), even in the presence of a moderation factor. Buyers can take ownership of their suppliers' expertise by allowing them to participate actively and systematically in NPD project management by reducing the cycle time between idea design and product launch (Lai and Chen, 2012) and joint problem solving (Koufteros et al., 2010; Hoopes and Postrel, 1999).

We suppose a scale problem for non-H1 support. Supplier qualification construct does not measure the quality of investment efforts in qualifying or at what time these investments were made. Lawson et al. (2014) highlight this limitation as one of the possible causes of contradictory results on the effectiveness of investments in the qualification of suppliers under the NPD. They also point out that efforts are often carried out on the evidence of inferior performance, thus serving the qualification not to bring superior results but for a course correction. We also suppose a measurement problem with project performance; maybe the OTIF (on time, in full) approach does not reflect supplier involvement in NPD project.

It should be noted that the control variable for sales concentration effect, suggests that suppliers with greater degree of dependence of buyer focal firm have less ability to contribute to the competitiveness, functionality, and profitability of the final product. It suggests that suppliers with greater dependence on some buyers have less responsiveness given their limited exposure to different contexts and practices. Yao et al. (2012) show

that the effects of ownership and spillover effect by suppliers through different supply chains are positive and significant. This result can be related to the embeddedness paradox.

We expected that trust would play a key role in NPD project in buyer-supplier relationships context. Indeed, we found that goodwill-based trust moderates the effect of supplier involvement in new product development performance. However, we were expecting to find diminishing returns at high-levels of goodwill-based. But there are no decreasing returns for additional goodwill-based trust. A possible explanation for not finding the u-inverted effect is on the high average value of confidence; on a scale of 1 to 7, the mean confidence was 5.6. Thus, in seeking to evidence both the bright side and the dark side of goodwill-based trust, our results pointed to the existence of only the bright side. In this way, the embeddedness paradox seems more present, in our results, by the effect of the sales concentration and not exactly by the effect of the trust.

Researchers in Social Network Theory discuss the network structure of actor relations. A common argument in their study is that understanding an actor's social capital - that is, the surplus of his investment in social relations - requires a refined analysis of the specific structures of his network of relationships (Adler and Kwon, 2000). Burt (2001) argues that a dispersed network, with few redundant links, often provides greater benefits to social capital. For this author, the opportunity to mediate the flow of information between groups is a fundamental benefit to social capital, considering structural holes, which are links to groups that would otherwise not be connected. Therefore, embeddedness paradox in our study is presented by sales concentration, even in high-level trust-based relationships.

Finally, competence-based trust did not show itself relevant as a moderator factor (hypothesis 3). We assume that this result is related to the high correlation of this variable with the other constructs, indicating a possible multicollinearity problem.

Conclusion

Results show that the adoption of collaborative initiatives in the buyer-supplier relationship, notably the supplier's involvement during the project development cycle amplify the new product development performance. However, buyer-supplier relationship with excess embeddedness - i. e. relationships with high levels of goodwill-based trust - tend to bring decreasing benefits to the development of new products. One possible explanation is that the greater the participation of a supplier in other supply chains, the greater its capacity to respond to the demands of a NPD project given its greater exposure to different contexts and practices. In fact, when the supplier has a high concentration of sales in the buyer, its performance in new product development projects was worse. This indicates the need for the buyer to diversify the relationships for the development of new products, since relationships developed with other agents in other supply chains have proved to be beneficial.

Our findings hold theoretical and practical contributions. By collecting data from both sides of the dyad, this article extends the discussion of NPD in buyer-supplier relationships, in that it is possible to analyse the perception of both sides on the same point. Regarding the sector of application of the study, agribusiness is relatively little explored by scientific work related to management. Our findings may contribute to a better understanding of NDP practices in this sector, with good generalization capacity for other economic sectors.

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