

WHY AND HOW TO INVOLVE PURCHASING IN NEW PRODUCT DEVELOPMENT?

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In new product development (NPD) firms increasingly have to rely on external expertise from suppliers. However, results of early supplier integration have been found to be ambiguous. This research empirically tests the hypothesis that the participation of professional purchasing agents early on in the supplier integration process plays a decisive role to distinguish successful projects. Our sample gave evidence that early supply management integration positively moderated supplier involvement's effect on firm success. Hence, firms may benefit from avoiding supplier integration without professional purchasing management. Still, in many firms the procurement department is not yet integrated in NPD processes early on. Our research identifies four measures those firms applied, in which purchasing got fully embedded in the innovation process: top-management support, structural differentiation, explicit processes, and a collaborative corporate culture. This finding can serve as blue print for implementing purchasing integration and therewith improve the success of supplier integration in NPD.

Keywords: New product development; purchasing; procurement; supplier early involvement; purchasing integration in NPD.

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Introduction: Disbanding the Dilemma of Ambiguous Results in Early Supplier Inclusion in NPD by Testing Purchasing's Contribution

In 1989, Clark showed that Japanese automobile manufacturers benefitted from a shorter lead-time, as well as cost advantages, compared to their European or American counterparts. The reason? They collaborated closely with their suppliers and involved them early on in the new product development (NPD) process (Clark, 1989). Since then, early supplier involvement in NPD has become increasingly popular, almost reaching industry standard (Johnsen, 2009). However, empirical findings on the effect of early supplier involvement in NPD have not only shown positive, but as well negative outcomes. This paper tests if purchasing early inclusion in NPD can contribute to increasing the success likelihood of early supplier involvement and analyses how to make sure that the purchasing department is actually included early on in innovation processes.

The main positive outcomes reported from the early integration of suppliers in NPD processes evolve around product innovation (Koufteros et al., 2007), shorter time-to-market (Ragatz et al., 2002), product quality, NPD cost (Primo and Amundson, 2002), and process alignment as well as privileged relationship (Petersen et al., 2005). In sum, supplier integration enables the development of capabilities to integrate the knowledge gathered from innovative suppliers (Moya et al., 2019).

Nevertheless, research has also identified several challenges early supplier integration poses (Cooper, 2019). Some authors have emphasised the importance of selecting the right supplier for integration, as this has an effect on the NPD process and the benefits resulting from this relationship (Hong et al., 2009; Pulles et al., 2014). Other authors have even identified critical outcomes of early supplier inclusion in NPD, including: no significant effect (Eisenhardt and Tabrizi, 1995), no reduction in time-to-market (Hartley et al., 1997), less impact on manufacturability (Swink, 1999), loss of competence (Koufteros et al., 2007; Wagner and Hoegl, 2006), buyer lock-in on technology of a particular supplier (Handfield et al., 1999), negative effects on cost, time and efficiency (Littler et al., 1998) and supplier opportunism (Helm et al., 2020). There are reports of suppliers' incompetence and even project obstruction (Flynn et al., 2000; Petroni and Panciroli, 2002; Primo and Amundson, 2002; Zsidisin and Smith, 2005). From the supplier side, complaints about difficulties collaborating with customers are voiced (Flanckegård et al., 2019).

When looking at the important empirical question of how to establish successful collaboration between buying and supplying firms, research considers

professionals in a firm's purchasing department as playing key roles as supplier involvement agents within cross-functional NPD teams (Ellegaard and Koch, 2012; Gupta and Wilemon, 1990; Luzzini and Ronchi, 2011; Schiele, 2010; Van Echtelt *et al.*, 2008). Likewise, early purchasing involvement seems to correspond to savings generation in NPD projects (Van Poucke *et al.*, 2016). Purchasing knowledge has found to strongly influence supplier integration success and, as a next step, innovation (Luzzini *et al.*, 2015). Hence, early purchasing integration in NPD could be a missing link in early supplier integration research, providing a key to improve the success rate of collaborative NPD.

Regarding the ambiguous results of early supplier involvement in NPD and the option to include purchasing professionals in a cross-functional NPD team, we pose the following research question:

RQ1: What impact does purchasing integration have on performance improvement through supplier involvement in NPD? Should purchasing professionals be involved in NPD projects in early stages?

Assuming the answer to this question is positive, the next question would be how to involve purchasing. There are warnings, that sales personnel should avoid talking to purchasers at all costs in order to sell innovations (Kurpjuweit *et al.*, 2018). At the same time, empirical research has revealed that even today R&D often feels reluctant to include purchasers in NPD projects (Picard-Bello *et al.*, 2019). Many firms have a tradition of a strict functional orientation, meaning that the R&D department would develop products by themselves, possibly integrating suppliers on their own. After completion of the development project, R&D would then contact purchasing, asking to "negotiate a good price" with the supplier. The latter, in the worst-case scenario, may have already created a monopoly protected by a patent. In such a situation, negotiating is often no longer possible and the buying firm has to accept all conditions the supplier dictates. To change this situation, a cross-functional NPD process would have to be established, with the participation of purchasing professionals early on in the NPD project, ensuring professional supplier inclusion management. How can it be ensured, then, that purchasing professionals get involved in NPD projects on a regular basis?

There are very few studies trying to identify antecedents to early purchasing involvement in NPD. One explanation provided revolves around the status purchasing had in a firm, which has been found to have an indirect influence by improving purchasing's role in internal communication (Patrucco *et al.*, 2017). In this context, Schiele (2010) reviewed 25 quantitative empirical studies on the integration of purchasing professionals and suppliers in NPD. The analysis

revealed a paucity of research on purchasing integration. None of the studies had considered organisational factors such as the support of top management or the presence of formalised processes for supplier involvement.

Despite its relevance, research in understanding purchasing integration, let alone empirical work on the antecedents of purchasing integration in NPD, is very limited (Giunipero *et al.*, 2018; Mikkelsen and Johnsen, 2019; Servajean-Hilst and Calvi, 2018). In their recent case study, Mikkelsen and Johnsen address the issue and conclude that a prerequisite for early purchasing integration is a mature purchasing organisation. But how specifically should it look like? The second aim of our study, hence, is to focus on the following research question:

RQ2: What are organisational antecedents of purchasing integration in the NPD process? Which factors must be considered to ensure early purchasing integration in NPD?

Drawing on theory from the relational view, a conceptual model of the antecedents and supplier involvement outcomes of purchasing integration in NPD processes was built and tested. For this purpose, a survey among firms representing the German and Austrian discrete manufacturing industry was conducted. In its empirical content, this research revealed that in our sample the early inclusion of suppliers without professional purchasing had a slightly negative outcome, while the inclusion of purchasing enabled to reap the benefits of early supplier inclusion in NPD. Further, a model has been identified, which allows to draft a blueprint for accomplishing the integration of the purchasing function in NPD. Firms which successfully had integrated their purchasing department in NPD process had relied on top management support, changed the organisational structure of purchasing including a new group “advanced sourcing,” adjusted their process, for instance by assigning stage gates to purchasing, and benefited from a collaborative corporate culture.

The remainder of this paper proceeds as follows. We first analyse the theoretical background including the literature dealing with the involvement of purchasing professionals and suppliers to better understand the antecedents of integrating these parties into NPD processes. We then develop a research model to explain how the integration of purchasing professionals and suppliers into NPD teams can be facilitated by firms. After describing the applied method, we test the model on a sample of industrial firms, and present the identified antecedents of purchasing integration and supplier involvement. Finally, after the discussion and conclusion section, this paper concludes with limitations and future research opportunities.

Theoretical Background: Relational View of the Firm, Early Supplier Inclusion and Early Purchasing Inclusion

The relational view of the firm: explaining innovations as relational rents

The relational view is used to explain performance improvement in relationship-specific capabilities and processes in different settings, including relational contracting, cross-licensing agreements, logistics processes and value co-creation, i.e., innovation (Morgan and Hunt, 1994; Rai *et al.*, 2012). Dyer and Singh's theory (Duschek, 2004; Dyer and Singh, 1998) was developed out of the context of analysing buyer–supplier relationships, thus being ideally suited to analyse such relations in terms of their NPD performance (Schiele, 2019). According to this theory, firms may obtain relational rents by collaborating in the supply chain. Relational rents are returns on collaboration between independent partners who jointly are able to produce better results than alone. Relational rents are determined by the availability of relationship-specific assets, knowledge sharing routines, complementary resources and effective governance structures. In a collaborative NPD context, the knowledge of the collaborating firms are the complementary resources, NPD processes are knowledge sharing routines and the question for early purchasing inclusion defines the character of the governance structure enabling relational rents in form of innovations.

The relational view explicitly considers the relevance of relationships between buyers and suppliers as a potential source of relational rents and competitive advantage (Saxena *et al.*, 2013). Close buyer–supplier relationships allow buying firms to access various resources and/or capabilities in the form of knowledge embedded within suppliers and subsequently to increase their own innovativeness, for which aligned governance structures are needed (Akin Ateş *et al.*, 2018; Cao and Zhang, 2011; Craighead *et al.*, 2009; Wiengarten *et al.*, 2016).

Firms in innovation-driven high-tech industries — in their pursuit of gaining competitive advantage through innovation and NPD — find it more and more difficult to achieve advantages through command of superior internal resources, only. Instead, they increasingly have to rely on gaining privileged access to external resources (Servajean-Hilst and Calvi, 2018), i.e., they rely on the most precious suppliers to obtain an adequate relational rent (Hunt and Davis, 2012; Markman *et al.*, 2009; Pulles *et al.*, 2014). This research focuses on the particular case of NPD through interfirm collaborative NPD, which can be interpreted as a type of relational rent (Dai *et al.*, 2018; Eggers *et al.*, 2017; Lavie, 2006).

Involvement of suppliers in NPD and the stimulating role of purchasing

From a theoretical perspective, research on supplier involvement has become increasingly important because an operationalisation of the relational view of the

firm signifies the involvement of external resources like suppliers in the NPD process, forward-targeted sourcing and the active role of suppliers in the process of developing parts and products (Van Echtelt et al., 2008). Reflecting on the interorganisational character of NPD, the “open innovation” paradigm has been proposed (Chesbrough, 2003; Gassmann, 2006). To profit from external resources and expertise, firms must be open to innovations from suppliers and willing to structure optimal innovation networks within their supply bases (Beers and Zand, 2014; Chang, 2003; Gassmann et al., 2010).

There has been extensive research on the benefits of including suppliers in NPD (Clark, 1989; Johnsen, 2009; Langerak and Hultink, 2008; Van Echtelt et al., 2008). On the bottom line, supplier involvement can contribute to the sustainable competitiveness of firms (Jaakkola and Hakanen, 2013). However, supplier participation in NPD is not self-evident, but often may require active efforts by the buyer (Goldberg and Schiele, 2019; Makkonen et al., 2018; Pihlajamaa et al., 2019). The question is, then, how can supplier participation in NPD be enabled?

According to previous research, a prerequisite for enabling the involvement of suppliers is the integration of the purchasing department into NPD (Hillebrand and Biemans, 2004). As is generally argued, engineering personnel are reluctant about increasing supplier involvement, as they fear that additional tasks might be outsourced. Thus, supplier involvement should not be left to engineering personnel alone, as this might result in a paucity of suppliers on NPD teams (Geishecker, 2008).

In contrast, including purchasing professionals on the NPD team has the opposite effect. Purchasers have a natural incentive to include suppliers in a NPD project to proactively elicit the associated benefits of supplier involvement. The existence of suppliers is the purchaser’s reason for being. This could be an explanation for the finding that the probability of suppliers being involved in NPD increases when purchasers are part of the NPD team (Hillebrand and Biemans, 2004; Tracey, 2004). It becomes important, then, to understand when and how purchasing departments are integrated in NPD processes, at the first hand, so that they can fulfil their role in the NPD process.

Integration of purchasing professionals in NPD: Cost and innovation focus

Fast-changing technologies, general reliance on suppliers, and increasing organisational size and complexity are all factors that demand greater involvement of the purchasing department in NPD activities (Luzzini et al., 2015; Van Echtelt et al., 2008; Wynstra et al., 1999). Previous research showed that purchasing had limited influence in the technology selection process, but fulfilled an important role in the selection of the supplier and as a trouble-shooter throughout the collaborative

NPD projects (Melander and Lakemond, 2014). Purchasing involvement has been found to be earlier, the more strategic the supplier is according to the Kraljic matrix (Van Poucke *et al.*, 2016). At the same time, also warnings have been issued, arguing that suppliers wanting to push innovations with their customers should avoid involving the purchasers of their customers, i.e., to better do “backdoor selling” (Kurpjuweit *et al.*, 2018). The way purchasing is done, may strongly influence the outcome, i.e., if innovations generate in an exchange relationship, or not (D’Antone and Santos, 2016). From the buying firm’s perspective, several studies have demonstrated the positive effects of including purchasing professionals as part of an NPD team (Droege *et al.*, 2004; Luzzini *et al.*, 2015; McGinnis and Vallopra, 2001; Tracey, 2004). Yet, what exactly does the role of the purchasing department in NPD involve? The literature identifies a large set of activities that fall into two categories: those directed toward generating innovations and those that focus on optimising costs and company wide integration (Burt and Soukup, 1985; Clark, 1989; Di Benedetto *et al.*, 2003; Handfield *et al.*, 1999; Langerak and Hultink, 2008; Luzzini and Ronchi, 2011), i.e., purchasing fulfills a dual role (Ellram *et al.*, 2020; Schiele, 2010).

From the timing, purchasing has a role during the formation of the NPD project, as well as during its execution (Le Dain *et al.*, 2020). However — and this is a very crucial point — procurement professionals’ perspective and responsibilities extends beyond a particular NPD project. Purchasers are expected to develop a total-cost-of-ownership approach that considers the entire life cycle of products (Berenson, 1967; Birou *et al.*, 1997; Handfield and Pannesi, 1994; Rigby, 1996). The purchasing department’s responsibilities evolve over the course of the product life cycle, with the baseline of procuring parts and ensuring competitiveness pervading all stages; this contrasts with, for example, R&D, with its focus on only the first stage of the product life cycle (Doha *et al.*, 2013; Rink and Fox, 1999). This long-term orientation requires a broad perspective concerning, for instance, the need to choose a supplier capable of guaranteeing spare parts for many years (Handfield *et al.*, 1999). The difference in length of perspective between R&D and purchasing is a source of “natural” tension between these functions, which often leads to developer’s reluctance to involve purchasing. In this way, NPD might deprive itself from benefiting most from supplier integration.

Research Model and Hypotheses: Testing Purchasing Inclusion in NPD

The relational view claims that firms combine external and internal resources to develop competitive advantages, which improve the overall performance of the

company (Dyer and Singh, 1998). Consequently, integrating external resources, such as suppliers, into NPD can have a positive influence on the overall performance of a firm, which may be seen in sales growth, return on assets, market share gain and cost position. Thus, our research model (Fig. 1) relates supplier involvement in the NPD process to the overall performance of the buying firm. Purchasing professionals, when included in the NPD process, can potentially facilitate those determinants. Literature argues that purchasing's dual role puts purchasing professionals in the position of integration agents, safeguards communication and knowledge sharing, promotes suppliers to a complementary level, creates and manages supplier interfaces and supports corporate governance (Dowlatshahi, 1998; Ellegaard and Koch, 2012; Lakemond et al., 2001; Luzzini and Ronchi, 2011; Schiele, 2010).

To determine how best to deploy the purchasing department to act as an integration agent by including suppliers in the NPD process, Schiele (2010) suggests analysing the involvement of purchasing professionals alongside the factors that explain successful NPD. However, most NPD research models are limited by focusing on specific issues rather than employing a comprehensive approach that incorporates operative antecedents. An exception is the conceptual model presented by (Cooper and Kleinschmidt, 1995). It has found wide application in NPD research (Ernst, 2002) and introduces organisational antecedents — such as routines and processes as well as governance structures — corresponding to determinants of the operationalisation of the relational view (Dyer and Singh, 1998). Specifically, Cooper and Kleinschmidt (1995) describe the results of a multi-firm benchmarking study and develop five critical success factors that characterise the majority of successful firms in NPD. Schiele (2010) has highlighted the relevance and applicability of this framework to the purchasing perspective. Accordingly, we acknowledge that their five success factors top management support, structural differentiation (advanced sourcing function), process organisation, corporate culture, and strategic integration need to be considered as antecedents in examining the integration of purchasing professionals in NPD. Likewise, Van Echtelt et al. (2008) argue that both operative and strategic sets of activities are critical in achieving not only short-term objectives but also the long-term benefits of supplier involvement in NPD. Nevertheless, we exclude the strategic integration factor from our analysis in this study and instead focus on the often-disregarded organisational and cultural antecedents of purchasing integration. Our decision to focus on organisational antecedents is based on our chosen theoretical approach as well as our prior research. The relational view theory specifically highlights the organisational requirement to integrate external resources, which underlines the relevance of those often-neglected factors. Moreover, even though theory has significant relevance, organisational influencing factors on purchasing's

Table 1. Definitions of independent variables.

| Independent variable | Definition |
|---------------------------------|---|
| Top management support | Top management support stands for complete support, full appreciation and integral integration of purchasing by management in regard to innovation. |
| Advanced sourcing function | Structural differentiation refers to several specialised tasks of the purchasing department, such as serial procurement and advanced sourcing. This study is focused on advanced sourcing activities of purchasing within a differentiated structure (Burt and Soukup, 1985; Mendez and Pearson, 1994; Rendon, 2005; Trent and Monczka, 2005). Advanced purchasing activities can include, for example, supplier development, innovation identification, supplier quality assistance, etc. As opposed to the strategic sourcing function, advanced sourcing is exclusively dedicated to representing purchasing in the new product development process, whereas the classical strategic sourcing function is responsible for the entire commodity over the entire lifecycle of a component. |
| Process organisation | A process organisation represents the level of cross-functionally of agreed-upon processes for supplier selection, supplier development, NPD and supplier involvement in NPD. |
| Collaborative corporate culture | A collaborative corporate culture stands for the ease and chance of collaborating and communicating across hierarchical levels and functional boundaries. |

integration in NPD processes have not yet been researched (Lakemond *et al.*, 2006; Nijssen *et al.*, 2002). This significant gap in analysis has encouraged us to exclusively focus this study on organisational and cultural antecedents. A detailed definition of the four independent variables can be found in Table 1. Figure 1 illustrates our research model. H1 and H2 refer to the first research question (on the relevance of purchasing's inclusion in NPD). The upper portion of the research model (H3–H6) explores research question 2 (on how to integrate purchasing in NPD).

Hypotheses concerning research question 1: Relevance of purchasing's inclusion in NPD

Research on the resource-based view has highlighted that firms' configuration of internal resources drives organisational performance (Barney, 2001; Eisenhardt and Martin, 2000; Luzzini *et al.*, 2015). To foster competitive advantage and, in turn, performance (Porter, 2008), the resource-based view has “[...] evolved into a dynamic recipe explaining the process by which these ingredients

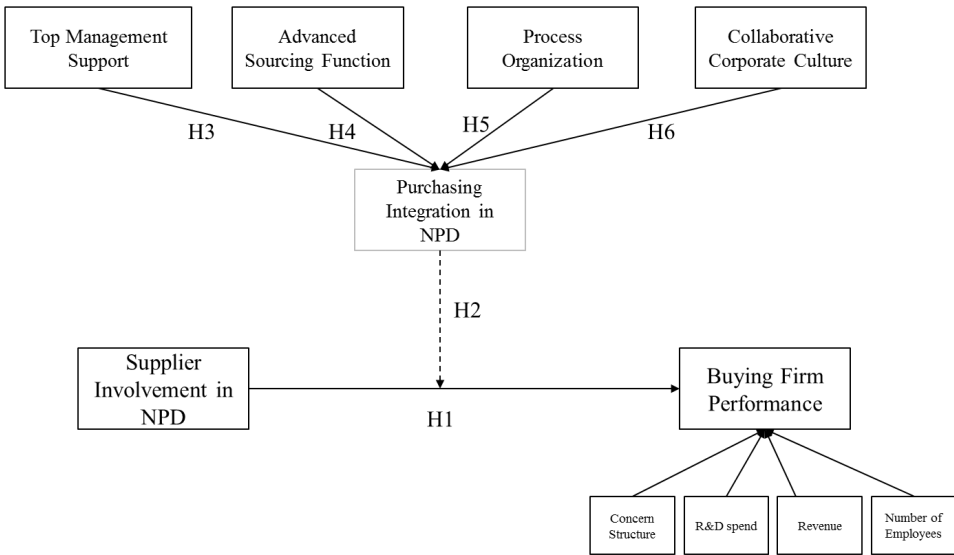


Fig. 1. Research model.

(a firm’s resources) must be utilized.” (Newbert, 2007, p. 124) Based on this argument, the relational view claims that organisations have to extend a firm’s own boundaries by considering external resources (Wang and Li-Ying, 2015), as vital resources are often found outside the firm “[. . .] embedded in inter-firm resources and routines.” (Dyer and Singh, 1998, p. 650) It is recognised that the type of linkage with partners outside the firm determines what type of shared external resource influences the relational rent and, as a consequence, a firm’s performance (Chiaroni et al., 2010; Tsai and Wang, 2007) by creating super-additive value (Tanriverdi, 2006). Accordingly, researchers have observed that supplier resources integrated in the NPD process show positive influence on the NPD performance, innovativeness and effectiveness of the buying firm (Song and Di Benedetto, 2008; Wagner and Bode, 2014). In detail, the involvement of a supplier’s resources contributes complementary expertise and ideas, thus fostering improved product manufacturability, lower costs, higher profits and increased innovation (Luzzini and Ronchi, 2011; Primo and Amundson, 2002; Tracey, 2004). Hence, we hypothesize the following:

H1: *More supplier involvement in NPD leads to better performance of the buying firm.*

With regard to NPD, research on the relational view (Dyer and Singh, 1998) shows that a firm’s performance is related to (a) the number of collaborations with

external partners and (b) the scope of collaboration partners (Wang and Li-Ying, 2015). A broad resource set of partners provides the firm with comprehensive knowledge that could increase its existing knowledge base (Foss *et al.*, 2013) and allows firms to benefit from the many opportunities of novel combinations of input factors, resources and capabilities (Fleming, 2001; Katila and Ahuja, 2002; Laursen and Salter, 2006; Li, 2010). As a result of organisational learning, firms may profit from complementary information and synergetic effects (Beers and Zand, 2014).

Purchasing professionals, integrated in NPD, directly contribute to NPD during the supplier selection procedure (McGinnis and Vallopra, 1999), for instance by supporting the evaluation of a particular supplier's innovation potential (Schiele, 2006). The purchasing department can advance supplier capabilities and adjust them based on the buying firm's needs, for instance through selectively stimulating activities such as the initiation of knowledge exchange between suppliers and sub-suppliers (Fagerstroem and Jackson, 2002). The significance of these supplier management activities has been illustrated by benchmark studies showing that the purchasing department's commitment to innovation increases the overall innovation level of a firm's supply base (Goffre *et al.*, 2005). Thus, the purchasing department can be seen as an integration agent that stimulates internal and external cross-functionalisation in NPD (McDermott and Handfield, 2000; McGinnis and Vallopra, 1999). Furthermore, it can be assumed that purchasing plays a leading role in coordinating internal collaboration within NPD by simultaneously including suppliers (Dowlatshahi, 1998; Hillebrand and Biemans, 2004).

Applying the relational view to the purchasing department's agent role, supplier management competencies and dual interests in generating innovation and managing costs facilitate the identification of complementary resources and organisational complementarities, allowing the firm to benefit from external resources. Thus, the involvement of purchasing professionals acts as a key enabling factor that stimulates the involvement of external firm-addressable supplier resources (Chen *et al.*, 2004; Clark, 1989; Ellram and Liu, 2002; Johnsen, 2009; Sanchez and Heene, 1997). Accordingly, previous research has found that the involvement of the purchasing department in NPD projects leads to cross-functional collaboration and, in particular, supplier involvement (Chen *et al.*, 2004; Droege *et al.*, 2004; Ellram and Liu, 2002; Hillebrand and Biemans, 2004; Johnsen, 2009; Servajean-Hilst and Calvi, 2018; Tracey, 2004; Van Echtelt *et al.*, 2008). However, purchasing's agent role might not only drive supplier involvement in general, it can also provide knowledge of how to identify, develop and integrate supplier resources effectively. We therefore hypothesise that purchasing integration not

only increases the level of supplier involvement but also stimulates the positive influence of supplier involvement on corporate performance:

H2: *The more intensive the integration of purchasing professionals in the NPD process, (a) the more supplier involvement and (b) the more positively supplier involvement affects corporate performance.*

Hypotheses concerning research question 2: Antecedents of purchasing inclusion in NPD

In the context of managing and obtaining suppliers' innovations, the purchasing department of a buying firm acts as a gatekeeper for suppliers by developing specifications and identifying innovative vendors (Schiele, 2010). Furthermore, it engages in value-added activities which generate relational rents (Dyer and Singh, 1998), such as the introduction of supplier development programs (Krause et al., 1998; Li et al., 2012; Trent and Monczka, 2005). Arguably, this re-definition of the role of purchasing departments requires support from top management (Cammish and Keough, 1991; Nijssen et al., 2002). The willingness of the top management to foster activities supporting collaboration within a firm depends on its long-term perspective. Only if top managers adopt this position can they value internal cooperation as an investment in a desirable lasting relationship. Relational rents may refer to superior knowledge about supplier preferences, complementary resources and the capabilities of suppliers (Harrison et al., 2010), or to lower supplier search costs or more effective governance approaches (Dyer and Singh, 1998; Sawhney and Zabin, 2002; Vos and Achterkamp, 2015).

The significant influence of senior staff support operates not only at the strategic or corporate level but also at the NPD project level (Cooper, 2019; Howell et al., 2005). Purchasing's dual role, and the related intuitive motive to act as an integration agent for internal and external resources (Dowlatshahi, 1998; Ellram et al., 2020; Lakemond et al., 2001; Schiele, 2010), can subsequently foster NPD contributions to corporate governance undertakings (Ellegaard and Koch, 2012; Luzzini and Ronchi, 2011; Schiele, 2010). Because of the need for efficiency, it can be assumed that top management will recognise the added value by having the purchasing department not merely involved, but actually acting as an integration agent within NPD. Top management leadership is also needed to overcome the often reported fundamental opposition of R&D against purchasing inclusion due to differences in priorities: "... as purchasing was pushing for a certain cost level while R&D was interested in the best technological solution for the product" (Eslami and Melander, 2019, p. 58).

Hence, we assume that top management support not only strengthens purchasing's position on a corporate level (Hughes *et al.*, 1998; Nijssen *et al.*, 2002) but also enables purchasing's integration into NPD by fostering the purchasing department's agent role at the NPD project level. Thus we hypothesise as follows:

H3: *Top management support enables the integration of purchasing professionals into the NPD process.*

Previous studies considering the impact of structural organisation on the integration of purchasing professionals in NPD have yielded mixed results (Johnson *et al.*, 2002, 1998; Wynstra *et al.*, 2001). Ideally, the organisational structure should allow for interactions between engineering as the technical stakeholder, the purchasing department as the integrator, and the supply base as the source of external expertise. The individual organisational design of the stakeholder groups, however, can present challenges concerning the identification of appropriate cross-functional interfaces. In particular, the NPD project team structure and the organisation of the purchasing department might be divergent and therefore pose difficulties for integration (Rozemeijer *et al.*, 2003; Wynstra *et al.*, 2001). Engineering departments are often structured along technologies or product lines, following NPD project logic (Lakemond *et al.*, 2001). Purchasing departments, on the other hand, tend to be focused on supply markets for sourcing and negotiation activities, i.e., they follow a commodity group structure, which is an organisational particularity of purchasing (Hesping and Schiele, 2015). If the purchasing department were to mirror the engineering structure and focus on technology fields, it would no longer have an adequate overview of the supply market nor be able to ensure benefits from supplier pooling. Yet, an exclusive focus on commodity groups derived from a supply market logic may result in multiple purchasers being present in each NPD project, which would also be impractical.

A solution to this dilemma lies in the structural differentiation that splits the traditional purchasing role into a strategic sourcing function and an advanced sourcing function (also called "procurement engineering") (Burt and Soukup, 1985; Mendez and Pearson, 1994; Rendon, 2005; Trent and Monczka, 2005). Recent research revealed an even stronger differentiation, including also a purchaser specially dedicated to the "fuzzy front end", i.e., the detection of innovation (Servajean-Hilst and Calvi, 2018). On the one hand, the strategic sourcing function addresses serial sourcing activities that are structured in coordination with commodity groups based on supply markets (Driedonks *et al.*, 2010). The advanced sourcing function, on the other hand, involves technically skilled purchasers building the interface between the NPD project team and diverse commodity managers from the strategic sourcing departments. The allocation of dedicated

advanced sourcing resources in alignment with the NPD project structure provides firms with the opportunity to actively integrate purchasing professionals. Such integration, combined with the dedication of resources, empowers purchasing managers and R&D specialists to jointly collaborate with important suppliers to discuss key topics and exchange knowledge (Wynstra et al., 1999). This group may comprise dedicated innovation champions, who not only integrate suppliers, but also identify them (Maier et al., 2017). Thus our hypothesis is the following:

H4: *A dedicated advanced sourcing function leads to better integration of purchasing professionals into the NPD process.*

Littler et al. (1995) have shown that more than 50% of collaborative efforts between suppliers and buyers are unsuccessful. Well-defined organisational processes such as the implementation of a risk management process (Hoffmann et al., 2013) and/or a cross-functional and cross-regional internal process could improve this figure and improve NPD success rates (McGinnis and Vallopra, 1999; Petersen et al., 2005; Rendon, 2005; Tessarolo, 2007; Van Echtelt et al., 2008). With a defined process, the comparability and consistency of attitudes, activities, or principles can be realised (David and Rothwell, 1996). When there is a clear and formalised NPD process description, purchasing integration would, for example, no longer depend on the benevolence of an individual project leader but rather follow an objective and standardised process, i.e., it would move from lucky chance to manageable predictability.

Due to the increasing insights of suppliers in NPD, supplier relationship management has become crucial and (Lambert and Schwieterman, 2012) and supplier selection as well as supplier development are considered to be two major activities within supplier relationship management (Rezaei et al., 2015). The purchasing department is regarded as the supplier relationship manager within organisations as it executes supplier relationship activities (Dowlatshahi, 1992). Thus, to manage supplier selection and supplier development activities, purchasing representatives need to be part of the NPD process. Relatedly, supplier management processes presumably foster the integration of purchasing representatives because purchasing capabilities are needed to execute supplier management activities. As a result, processes aiming for early supplier involvement presumably support the integration of purchasing resources in NPD. We therefore assume that the definition and standardised application of NPD and supplier management processes foster successful purchasing integration and, ultimately, supplier involvement. Accordingly, we hypothesise the following:

H5: *Well-defined NPD and supplier management processes are a prerequisite for the integration of purchasing professionals into the NPD process.*

A corporate culture openly committed to cross-functional collaboration — expressed through its support of cross-functional teams as well as the involvement of all stakeholders — has been found to be a major feature that distinguishes best-in-class firms from underperformers with regard to NPD (Adams *et al.*, 2006; Chang, 2003; Cooper and Kleinschmidt, 1995; De Brentani and Kleinschmidt, 2004; Goffre *et al.*, 2005). Within a framework of certain norms and attitudes, a firm's culture requires openness to knowledge exchange and collaboration across functions. The same applies to the integration of purchasing professionals within NPD projects (McGinnis and Vallopra, 2001; Petersen *et al.*, 2005; Wei and Morgan, 2004). The engineering representatives' amenability to purchasing's input should be particularly ensured, as the intention of purchasing professionals to incorporate external knowledge could seem threatening to the in-house engineers (Geishecker, 2008). Moreover, in light of the historically weak position of the purchasing department as purely a support entity (Ellram and Carr, 1994; Li, 2007), there may be limited acceptance of purchasing professionals within the team. If the purchasing professionals have to fight for their position, then cross-functional collaboration could turn into self-oriented empire building and functional isolation (Wynstra *et al.*, 2001). As a consequence, integration across stakeholder groups would decrease, which in turn would lead to a lower level of purchasing integration. Conversely, a firm where members from different departments have equivalent responsibilities and acceptance of each other's experience may find it easier to include additional departments in particular tasks, such as including purchasing professionals in an NPD project team (Rendon, 2005). We therefore hypothesise the following:

H6: *A collaborative corporate culture supports the integration of purchasing professionals into the NPD process.*

Methods: Quantitative Testing

Developing a survey instrument to test with a sample of high tech firms

A survey instrument was developed, pretested with seven expert professionals and five academic experts, and after small changes in wording it was distributed among members of German and Austrian purchasing associations as well as members of the mailing list of h&z, a consulting firm specialising in supply management. Out of a total of 101 usable responses, nine are from Austria. Four responses from other countries were deleted to avoid any cross-cultural influences. Potential respondents were invited, via direct emails and notices in association newsletters and magazines, to participate voluntarily in the survey on a web-based panel

(Callegaro and DiSogra, 2008; Couper, 2000). Employing the opt-in approach allowed us to capture our desired target population, given that firms visiting the purchasing association web sites are presumably conversant and actively involved in purchasing (Couper, 2000). Yet, due to the voluntary nature of participation in the survey, we are unable to define a denominator for the respondent pool (Callegaro and DiSogra, 2008; Fricker and Schonlau, 2002).

The collected data comprise information from 101 respondents representing firms across the German and Austrian industrial structure, with particular emphasis on engineering and electronics: 31% were from mechanical engineering and machine building firms, 27% from electronic and electrical engineering firms, 14% from the chemical industry, and 11% from vehicle building firms. The remaining 17% of respondents indicated that they worked in service industries. The profile of the sample is as follows: 45% of the respondents were purchasing managers; 39% purchasers; and 16% other, including senior management. The firms represented in our sample are of notable size and are considered high-tech, with an average turnover of € 840 million, 2,988 employees, and 7.9% of turnover invested in R&D. No significant industry differences could be found in the responses, either among services or production industries. We also set controls for firm size but no significant influence was detected.

Measures

To test the hypotheses in our conceptual model (Fig. 1), we used previously tested reflective scales.

The purchasing integration measurement is based on McGinnis and Vallopra (1999), as the construct evaluates purchasing's role in cross-functional NPD teams. Two items of the original construct were dropped because they refer to specific NPD projects, whereas this analysis looks at the general integration of purchasing in NPD. The measure of supplier involvement originates from Chen and Paulraj (2004); the construct was developed using a structured development approach by capturing the involvement of suppliers in crucial project and planning processes. Concerning top management support for purchasing, we followed Cousins *et al.* (2006) and Carr and Smeltzer (2000). They assessed purchasing's status by looking at its positioning with regard to the scope of top management support, its importance to strategy and its importance from the top managers' perspective. Furthermore, the innovation aspect was added to the strategy measure in order to reflect the NPD aspect. In a last step, features of the interdepartmental connectedness measure from Jaworski and Kohli (1993) were added to the purchasing integration measurement applied in this study. The measurement examines cross-functional interactions with a focus on individual employees from different

departments, which, from our point of view, describes a collaborative corporate culture. The performance measure of the buying firm is based on Tracey (2004) because the original construct considers the organisational performance of a firm. Following the resource-based view and the argument of Peteraf (1993), the cost position of a firm was added to the construct (using one item) to enhance the scope of performance measurement.

To improve the reliability and validity of constructs, we dropped ten items from purchasing integration, supplier involvement, collaborative corporate culture and buying firm performance. Nonetheless, the underlying theoretical domain of all constructs was not significantly affected.

In prior research, the measurement of structural differentiation has often been limited to issues of centralisation versus decentralisation with little consideration given to departmental structure. In their pioneering “Aston studies”, Pugh and Hickson (1976) tallied the number of different departments in particular firms to construct a variable for horizontal differentiation. In this study, we refine this measure by asking respondents to indicate the percentage of time spent on particular activities within the purchasing department. Thus, the measure becomes insensitive to firm size, as only large firms may set up a special department for a particular task. In practice, respondents were asked to indicate the percentage of time — out of a total of 100% — purchasing staff spends on advanced purchasing activities. In this way, the degree of horizontal structural differentiation of the purchasing department could be measured. As a result, an average of 12% of available time is spent on advanced sourcing activities, i.e., procurement engineering. Thus, the construct exclusively represents the percentage of advanced sourcing activities.

Furthermore, we assessed process organisation using a model proposed by Daugherty *et al.* (1994) that gathers information about the existence of documented processes. Based on Takeuchi and Nonaka (1986), we converted four key aspects of NPD into items by relating them to processes of NPD and supplier management. Our goal was to capture a comprehensive spectrum of collaborative NPD processes by including aspects of supplier management. The processes under scrutiny are not related to each other because each process can run independently. Thus, we opted for a formative design illustrating the independency of items.

Control variables

Based on Atinc *et al.* (2012), four control variables were introduced that potentially affect the research model, based on theoretical rationale and previous evidence. Following the resource-based view’s understanding that resources drive performance (Barney, 2001; Eisenhardt and Martin, 2000), we include group

structure, R&D spending, revenue, and number of employees as control variables in the conceptual model. All four variables refer to resource availability, which potentially influences buyer performance.

Data Analysis and Results

Construct validation using partial least squares

Descriptive statistics for our variables and their operationalisation are shown in Table 2. To evaluate our constructs, we followed Hair *et al.* (2011) who stated that formative measures, a complex structural model with prognostic target, and a medium sample size are indicative for the application of structural equation modeling (SEM) based on partial least squares (PLS). Although PLS is a regression-based SEM approach that tends to overestimate the measurement model and underestimate the relationships in the structural model (Hair *et al.*, 2014), in comparison to covariance-based SEM software it is able to estimate also non-mimic formative constructs (Esposito Vinzi *et al.*, 2010) and is favoured when predicting variables is the target, such as in our case (Hair *et al.*, 2011). Additionally, Monte Carlo simulations have shown that for samples smaller than 250, as in our case, PLS offers more accurate estimates (Reinartz *et al.*, 2009). We therefore used the SmartPLS software (Ringle *et al.*, 2015) to evaluate our measures and test our hypotheses. To further validate our findings, whenever possible, we also used ordinary least squares (OLS) regression analysis, which leads to similar results (Table 6).

We assessed the internal reliability of our variables by calculating the composite reliabilities (Cronbach, 1951; Tabachnick and Fidell, 2001). All reflective measures have a composite reliability of above 0.7, which indicates high reliability. Next, convergent validity was demonstrated with average variance extracted (AVE) values above 0.5 (Fornell and Larcker, 1981). These results are reported in Table 2. For the assessment of discriminant validity we evaluated the cross-loading values within a cross-correlation matrix. Table 3 shows that each indicator's loading on its own construct is larger than its cross-loading with other constructs, thus indicating high discriminant validity between constructs. Moreover, the square root of AVE of each construct is higher than the highest correlation with any other construct, which underscores the evidence of discriminant validity (Hair *et al.*, 2014). In our analysis, missing values were dealt with using mean replacement. The significance of the path coefficients was determined with a bootstrapping procedure (101 cases, 5,000 samples). We calculated a goodness of fit measure in SmartPLS 3.0 by running the PLS algorithm. The measure uses standardised root mean square residual (SRMR) to provide a result for the

Table 2. Variables and operationalisation.

| Variable | Items |
|---|---|
| <i>Top management support</i> (reflective) | <i>TMS1</i> The management completely supports our efforts to link purchasing more strongly to the innovation process. ^(a) |
| ⁽ⁱ⁾ CR = 0.94 | <i>TMS2</i> In our firm, purchasing is an integral part of our innovation strategy. ^(a) |
| ⁽ⁱⁱ⁾ AVE = 0.84 | <i>TMS3</i> The opinion of purchasing is highly appreciated by the management in regard to innovation. ^(a) |
| <i>Advanced sourcing function</i> | How much time do members of the staff spend on the functions listed below? |
| | <i>HDPI1</i> <i>Advanced Purchasing Activities</i> . |
| <i>Process organisation</i> (formative) | We have an explicitly documented and cross-functionally agreed-on process for: |
| | <i>PRO1</i> Supplier selection. ^(a) |
| | <i>PRO2</i> Supplier development. ^(a) |
| | <i>PRO3</i> New product development. ^(a) |
| | <i>PRO4</i> Early supplier involvement in new product development. ^(a) |
| <i>Collaborative corporate culture</i> (reflective) | <i>C1</i> In our organisation, it is easy to communicate with virtually anyone you need to, regardless of their rank or position. ^(a) |
| ⁽ⁱ⁾ CR = 0.86 | <i>C2</i> There is ample opportunity for informal 'corridor chats' among individuals from different departments in our organisation. ^(a) |
| ⁽ⁱⁱ⁾ AVE = 0.66 | <i>C3</i> In our organisation, employees from different departments feel comfortable contacting each other when the need arises. ^(a) |
| <i>Purchasing integration</i> (reflective) | <i>PI1</i> Purchasing plays an important role in new product development in cross-functional teams and continuous improvement efforts. ^(a) |
| ⁽ⁱ⁾ CR = 0.84 | <i>PI2</i> Purchasing takes a leadership role in new product development in cross-functional teams and continuous improvement efforts. ^(a) |
| ⁽ⁱⁱ⁾ AVE = 0.64 | <i>PI3</i> Purchasing plays an important role in identifying suppliers who offer technologies that give our business competitive advantages. ^(a) |
| <i>Supplier involvement</i> (reflective) | <i>S11</i> We involve key suppliers in the product design and development stage. ^(a) |
| ⁽ⁱ⁾ CR = 0.79 | <i>S12</i> We have key supplier membership/participation in our project teams. ^(a) |
| ⁽ⁱⁱ⁾ AVE = 0.55 | <i>S13</i> Our key suppliers have a major influence on the design of new products. ^(a) |

Table 2. (Continued)

| Variable | Items |
|--------------------------------|---|
| <i>Buying firm performance</i> | <i>P1</i> Our growth in sales is very good. ^(a) |
| ⁽ⁱ⁾ CR = 0.80 | <i>P2</i> Our return on assets is very good. ^(a) |
| ⁽ⁱⁱ⁾ AVE = 0.51 | <i>P3</i> In general we are satisfied with our competitive position. ^(a) |
| Control variables | <i>P4</i> Our cost position is very good. ^(a) |
| <i>Concern structure</i> | <i>G1</i> Our department belongs to a big multinational concern with many sub companies. ^(a) |
| <i>Revenue</i> | <i>G2</i> Revenue of company. |
| <i>Number of employees</i> | <i>G3</i> Number of employees. |
| <i>R&D spending</i> | <i>G4</i> R&D spending (percentage) in relation to the turnover of the company. ^(a) |

Notes: ^(a)Item measured on five-point scale: 1 = fully disagree, 5 = fully agree.

^(b)Item measured in percentage.

⁽ⁱ⁾Composite Reliability should be CR > 0.7*.

⁽ⁱⁱ⁾Average Variance Extracted should be AVE > 0.5*.

*Referring to Nunnally and Bernstein (1978), Fornell and Larcker (1981), Bagozzi and Yi (1988) and Henseler et al. (2009).

Table 3. Construct cross-correlation matrix.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Mean | SD |
|------------------------------------|-------|------|-------|-------|------|-------|------|------|-------|-------|----|---------|---------|
| 1. Top management support | 0.92 | | | | | | | | | | | 3.35 | 1.07 |
| 2. Process organisation | 0.36 | — | | | | | | | | | | 3.63 | 0.99 |
| 3. Advanced sourcing function | 0.25 | 0.27 | — | | | | | | | | | 12.66 | 4.67 |
| 4. Collaborative corporate culture | 0.37 | 0.30 | 0.1 | 0.82 | | | | | | | | 3.83 | 0.78 |
| 5. Purchasing integration | 0.59 | 0.41 | 0.42 | 0.41 | 0.80 | | | | | | | 3.15 | 0.86 |
| 6. Supplier involvement | 0.38 | 0.29 | 0.37 | 0.29 | 0.54 | 0.74 | | | | | | 3.16 | 0.90 |
| 7. Buying firm performance | 0.27 | 0.31 | 0.24 | 0.16 | 0.34 | 0.22 | 0.71 | | | | | 3.74 | 0.62 |
| 8. Concern structure | 0.11 | 0.18 | 0.2 | -0.19 | 0.17 | -0.01 | 0.08 | — | | | | 3.51 | 1.689 |
| 9. Revenue | 0.04 | 0.04 | 0.09 | -0.13 | 0.12 | 0.02 | 0.03 | 0.7 | — | | | 841.92 | 1383.10 |
| 10. Number of employees | 0.07 | 0.18 | 0.36 | -0.19 | 0.17 | -0.01 | 0.09 | 0.24 | 0.68 | — | | 2968.00 | 5702.01 |
| 11. R&D spending | -0.02 | 0.11 | -0.07 | 0.15 | 0.08 | 0.12 | 0.14 | 0.24 | -0.16 | -0.07 | — | 7.87 | 5.00 |

Note: Values on the diagonal are shared values within a construct (square root of AVE).

composite factor. A value between 0.05 and 0.08 indicates a fair fit, between 0.08 and 0.10 indicates a mediocre fit and above 0.10 indicates a poor fit (Hu and Bentler, 1998). The composite factor indicates a reasonable model fit (0.082). Thus, the results imply that PLS-SEM is a suitable technique to analyse our proposed model (Henseler et al., 2014).

Marcoulides and Saunders (2006) have strongly recommended that the power of PLS studies should be assessed. As a convention in behavioural research, values above the threshold level of 0.80 are considered sufficient (Baroudi and Orlikowski, 1989; Cohen, 1988; Cohen et al., 2013). In reference to Wetzels et al. (2009), we have used the PWR package (Champely et al., 2015) to conduct the power calculations in R, which is an open source software for statistical computing and analysis (Development Core Team, 2008). Our results imply that the power for all the parameters in our conceptual model exceeds the critical level, with all being above 0.90; only the relation between supplier integration and buying performance is slightly below the limit (0.78). This is also a non-significant relationship.

It is argued that survey data originating from a single informant and a self-assessment approach, as our data set does, may lead to common method bias effects (Podsakoff et al., 2003; Podsakoff and Organ, 1986; Richardson et al., 2009). We therefore followed Venkatesh et al. (2012) and applied two statistical analysis methods to test for a potential effect of common method bias. As suggested by Liang et al. (2007), we performed an unmeasured latent methods factor test (Podsakoff et al., 2003) by adding a common method variance factor that covers all principal constructs' indicators. Hence, we estimated the substantive variance that describes the loading between the main construct and the indicator construct as well as the average method-based variance, which stands for the loading of the common factor on the indicator construct. Table 4 show that the substantive variance was, on average, 0.66 and that the average method-based variance was 0.02. Because the substantive variance represents a value 30 times higher than the method variance and most of the method factor loadings are insignificant, results indicate that common method bias is unlikely to be a critical factor in this study. Moreover, we followed Richardson et al. (2009) and applied the confirmatory factor analysis marker technique that involves the addition of a theoretically less-relevant marker variable (Lindell and Whitney, 2001; Malhotra et al., 2006). As described by Malhotra et al. (2006), we opted for the second-smallest positive correlation between two manifest variables as a conservative estimate. After the deduction of this value from all correlations, we ran the model again. No significant difference between the original and adjusted correlation estimates was observed. Thus, the marker technique confirms the indication that common method bias is less problematic for this analysis.

Table 4. Common method bias test.

| | Construct Loading (CL) | CL ² | Method Factor Loading (MFL) | MFL ² |
|-----------------------------------|---------------------------|-----------------|--------------------------------|------------------|
| Top management support | | | | |
| TMS1 | 0.99 | 0.97 | 0.09 | 0.01 |
| TMS2 | 0.83 | 0.69 | 0.13 | 0.02 |
| TMS3 | 0.95 | 0.89 | 0.04 | 0.00 |
| Advanced sourcing function | | | | |
| HDP1 | 1.00 | 1.00 | 0.00 | 0.00 |
| Process organisation | | | | |
| PRO1 | 0.84 | 0.70 | 0.15 | 0.02 |
| PRO2 | 0.87 | 0.75 | 0.03 | 0.00 |
| PRO3 | 0.79 | 0.63 | 0.04 | 0.00 |
| PRO4 | 0.64 | 0.40 | 0.20 | 0.04 |
| Corporate culture | | | | |
| C1 | 0.82 | 0.68 | 0.10 | 0.01 |
| C2 | 0.85 | 0.72 | 0.02 | 0.00 |
| C3 | 0.79 | 0.62 | 0.10 | 0.01 |
| Purchasing integration | | | | |
| PI1 | 0.67 | 0.45 | 0.22 | 0.05 |
| PI2 | 0.91 | 0.82 | 0.19 | 0.03 |
| PI3 | 0.86 | 0.74 | 0.08 | 0.01 |
| Supplier involvement | | | | |
| SI1 | 0.71 | 0.50 | 0.15 | 0.02 |
| SI2 | 0.77 | 0.60 | 0.19 | 0.04 |
| SI3 | 0.83 | 0.69 | 0.00 | 0.00 |
| Buying firm performance | | | | |
| P1 | 0.73 | 0.53 | 0.10 | 0.01 |
| P2 | 0.84 | 0.70 | 0.11 | 0.01 |
| P3 | 0.78 | 0.61 | 0.01 | 0.00 |
| P4 | 0.53 | 0.28 | 0.22 | 0.05 |
| Average | 0.81 | 0.66 | 0.10 | 0.02 |

Hypothesis testing

We first validated our full model using PLS analysis. Figure 2 displays an overview of the path coefficients, highlighting the results per individual relationship. The model shows an R^2 of 19% for performance and 46% for purchasing integration, which underpins the theoretical and managerial relevance of our model (Combs, 2010). To evaluate the impact of the independent variables on the dependent variables, we calculated the effect size (Cohen's f^2) of each variable by

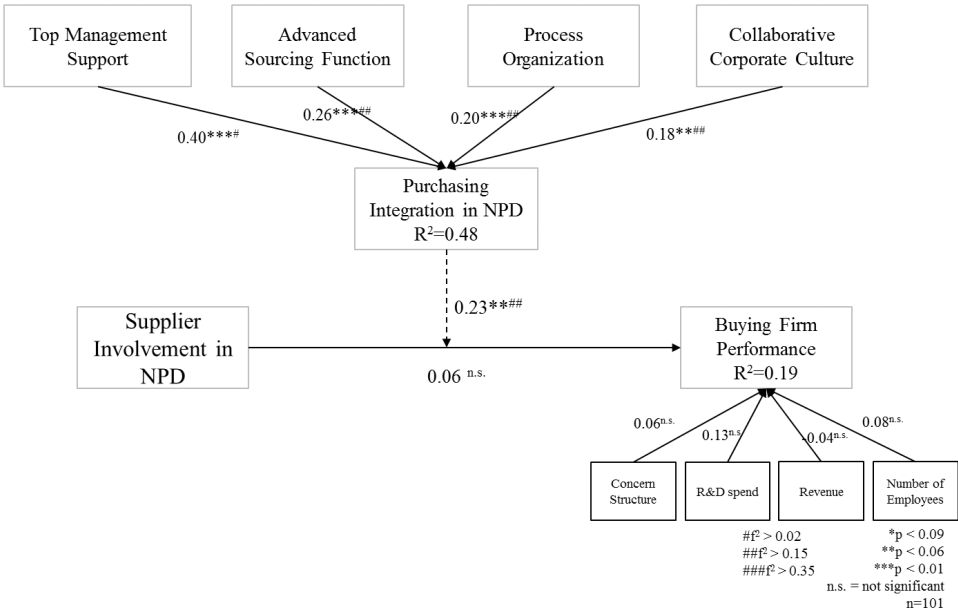


Fig. 2. Research model with results.

determining the change in R^2 . The f^2 indication level ranges from small (0.02) and medium (0.15) to large (0.35) (Chin, 2010; Cohen, 1988).

Table 5 reports results with confidence intervals (Jacob Cohen *et al.*, 2013). Top management support shows a moderate effect on purchasing integration, with an f^2 of 0.24, while advanced purchasing function ($f^2 = 0.05$), process organisation ($f^2 = 0.07$), and corporate culture ($f^2 = 0.04$) imply minor influence on the integration of purchasing professionals. This means that top management support has a strong relationship with purchasing integration compared to the other three antecedents. The sampling distribution calculation illustrates a bootstrap distribution for the coefficients, so that those can be used to evaluate the hypotheses (Hair *et al.*, 2014). The results obtained support the following hypotheses: H3 path coefficient = 0.40, ($p < 0.06$, $f^2 > 0.15$), H4 path coefficient = 0.26, ($p < 0.01$, $f^2 > 0.15$), H5 path coefficient = 0.20 ($p < 0.01$, $f^2 > 0.15$), and H6 path coefficient = 0.18 ($p < 0.06$, $f^2 > 0.15$).

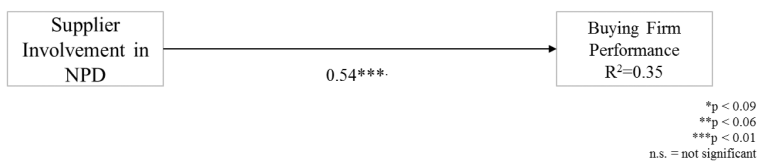
To verify hypotheses 1 and 2 we applied a PLS-based multi-group analysis using Henseler's (2012) non-parametric approach. A multi-group analysis compares the basic model under diverse conditions. We formed two comparison groups by splitting the initial sample at the median of the variable loadings of purchasing inclusion (Henseler and Fassott, 2010). The group with high loadings represented high purchasing inclusion ($n = 37$) and the group with low loadings represented low supplier involvement ($n = 64$). This allowed us to test for group-specific

Table 5. Cohen's f^2 -analysis.

| Independent variable | Dependent variable: Purchasing integration | |
|--|--|-----------------------------------|
| | f^2 | Confidence intervals |
| Top management support | 0.24 | 99%: $0.025 \leq f^2 \leq 0.601$ |
| | 95%: | $0.073 \leq f^2 \leq 0.498$ |
| | 90%: | $0.098 \leq f^2 \leq 0.451$ |
| Advanced sourcing function | 0.05 | 99%: $-0.051 \leq f^2 \leq 0.176$ |
| | 95%: | $-0.029 \leq f^2 \leq 0.142$ |
| | 90%: | $-0.017 \leq f^2 \leq 0.126$ |
| Process organisation | 0.07 | 99%: $-0.049 \leq f^2 \leq 0.223$ |
| | 95%: | $-0.023 \leq f^2 \leq 0.182$ |
| | 90%: | $-0.009 \leq f^2 \leq 0.162$ |
| Collaborative corporate culture | 0.04 | 99%: $-0.051 \leq f^2 \leq 0.151$ |
| | 95%: | $-0.030 \leq f^2 \leq 0.121$ |
| | 90%: | $-0.020 \leq f^2 \leq 0.107$ |
| Dependent variable: Performance | | |
| Supplier involvement | 0.003 | 99%: $-0.024 \leq f^2 \leq 0.031$ |
| | 95%: | $-0.017 \leq f^2 \leq 0.024$ |
| | 90%: | $-0.014 \leq f^2 \leq 0.020$ |
| Purchasing integration | 0.09 | 99%: $-0.047 \leq f^2 \leq 0.272$ |
| | 95%: | $-0.016 \leq f^2 \leq 0.222$ |
| | 90%: | $-0.000 \leq f^2 \leq 0.198$ |
| Interaction effect | 0.06 | 99%: $-0.052 \leq f^2 \leq 0.203$ |
| | 95%: | $-0.032 \leq f^2 \leq 0.164$ |
| | 90%: | $-0.014 \leq f^2 \leq 0.146$ |

Note: $f^2 > 0.02$ = small; $f^2 > 0.15$ = medium; $f^2 > 0.35$ = large.

High Purchasing Inclusion (n=37)



Low Purchasing Inclusion (n=64)

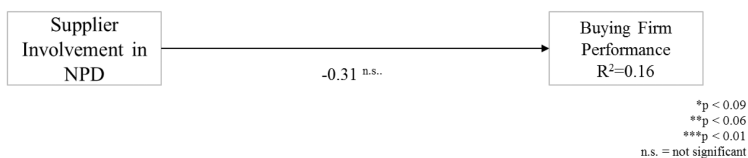


Fig. 3. Sub-group analysis.

Table 6. Result incl. comparison smartPLS vs. OLS ($n = 101$).

| Hypothesis | smartPLS | | | | OLS | | | |
|---|----------|----------------|--------------|---------|----------|----------------|--------------|---------|
| | Estimate | Standard Error | T-Statistics | p value | Estimate | Standard Error | T-Statistics | p value |
| Supplier involvement | 0.06 | 0.18 | 0.34 | 0.74 | 0.06 | 0.08 | 0.48 | 0.63 |
| Interaction effect: | | | | | | | | |
| Purchasing integration and supplier involvement in NPD | 0.23 | 0.10 | 2.13 | 0.03 | 0.12 | 0.06 | 1.90 | 0.06 |
| Purchasing integration in NPD | 0.33 | 0.17 | 1.96 | 0.05 | 0.22 | 0.85 | 1.87 | 0.06 |
| Top management support | 0.40 | 0.09 | 4.44 | 0.00 | 0.37 | 0.07 | 4.97 | 0.00 |
| Advanced sourcing function | 0.26 | 0.07 | 3.71 | 0.00 | 0.03 | 0.02 | 1.37 | 0.17 |
| Process organisation | 0.20 | 0.08 | 2.53 | 0.01 | 0.20 | 0.07 | 2.70 | 0.00 |
| Collaborative corporate culture | 0.18 | 0.08 | 2.18 | 0.03 | 0.13 | 0.09 | 1.35 | 0.18 |
| Concern structure | 0.06 | 0.13 | 0.44 | 0.66 | 0.03 | 0.04 | 0.73 | 0.46 |
| Revenue | -0.04 | 0.14 | 0.29 | 0.77 | 0.00 | 0.00 | -0.66 | 0.51 |
| Number of employees | 0.08 | 0.12 | 0.67 | 0.51 | 0.00 | 0.00 | 0.63 | 0.53 |
| R&D spending by supplier | 0.13 | 0.11 | 1.15 | 0.26 | 0.02 | 0.01 | 1.26 | 0.24 |

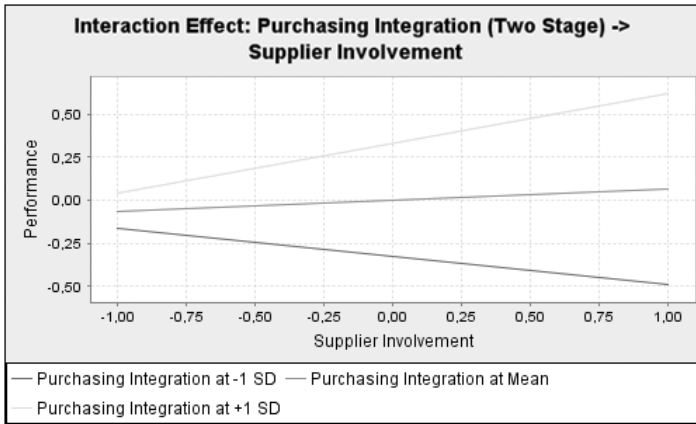


Fig. 4. Simple slope analysis: interaction effect.

characteristics fostering the positive effect of supplier involvement on performance in the basic model (Henseler, 2012). For the operationalisation we followed Henseler (2012) and ran our model separately for each group. The results of the sub-group analysis can be found in Fig. 3 for both the high- and low-loading groups. The comparison of the path coefficients for the two groups shows substantial differences, which underline the significant moderating effect of purchasing inclusion.

The results shown in Table 6 lead us to reject H1 and confirm H2. The results show a significant and positive interaction effect between the degree of purchasing integration in NPD and the degree of supplier involvement on buyer performance, this finding confirms H2 (path coefficient = 0.23 ($p < 0.06$, $f^2 > 0.15$)). To facilitate its interpretation, we plotted the interaction effect in Fig. 4. The lines show a positive effect of higher supplier involvement on buyer performance when purchasing professionals are integrated into the NPD process. However, in contrast to what H1 suggests, we find that when purchasing professionals are not integrated into the NPD process a higher supplier involvement has no effect on the buyer's performance; although this relationship is not significant, the slope of this line even appears to be negative. Clearly the effect of supplier involvement in NPD on buyer performance is conditional on the degree of purchasing integration in NPD.

As a robustness check and further validation of this result, the interaction effect and the antecedents were also tested with OLS regression analyses; the entire model cannot be tested in OLS. We used bootstrapping to increase the accuracy of the results. Looking at the results in Table 6, we can observe similar outcomes (except for two) between PLS and OLS because the directions of effects are the same. The problem with OLS regression is that it uses equal weights, which would be a lucky coincidence to hold true. PLS calculates weights based on all data

available in the model and thus individual weights. As a consequence, regressions typically underestimate the size of path coefficients, which is also true in our case. However, both methods give indications of the same direction, lending support to our findings independently of the particular analysis method used.

Discussion and Conclusion

Theoretical implications: successful supplier inclusion in NPD due to purchasing inclusion and importance of organisational antecedents for early purchasing inclusion

This study contributes to the literature on cross-functional collaboration in NPD with a focus on purchasing integration and supplier involvement. Our analysis advances previous conceptual research on cross-functional collaboration in NPD. The identification of organisational and cultural aspects generates new insights into the debate on how to establish the aforementioned cross-functional collaboration in NPD. By examining inter-organisational collaboration, this study provides evidence that firms seeking to establish external relationships need to first align internally (Horn *et al.*, 2014). Specifically, this study identifies purchasing integration as a key enabling factor in the implementation of supplier involvement with a positive influence on the performance of buying firms. Hence, this study also contributes to the understanding of purchasing's agent role by highlighting the significant enabling effect of purchasing professionals on supplier involvement (Chen *et al.*, 2004; Ellram and Liu, 2002; Johnsen, 2009).

Applying the relational view to these observations, purchasing professionals integrated into NPD aid in the identification of complementary resources, i.e., suppliers with the necessary competences, and facilitate organisational structures that enable relational rents in the form of innovations co-developed with suppliers. Consequently, firms that do not include their purchasing departments in NPD projects are more likely to fail at supplier involvement activities. For example, those firms might include too few suppliers or the 'wrong' suppliers and thus miss the benefits associated with supplier involvement in NPD. Supplier involvement without purchasing integration, as indicated by the negative regression coefficient in Fig. 3, has a potentially negative influence on the overall performance of the buying firm.

After identifying the relevance of purchasing integration to NPD for effective supplier involvement, this study is the first to test organisational antecedents for purchasing integration, which constitutes its second major contribution. To highlight how firms can integrate purchasing into NPD, we examined four factors that previous NPD research has revealed to be effective in NPD projects

(Cooper and Kleinschmidt, 1995; Ernst, 2002), namely, top management support, structural differentiation, process organisation, and cooperative corporate culture.

First, our results illustrate that top management support not only increases the strategic role of purchasing professionals within a firm (Carter and Narasimhan, 1996; Ellram and Carr, 1994; Li, 2007) it also leads to purchasing integration in NPD projects. Moreover, top management support for purchasing professionals also implies enabling effects for supplier involvement. By means of the group analysis, we observed that companies with a high supplier involvement level show high top management support, whereas firms with low supplier involvement have low top management support for purchasing. Accordingly, top management support seems to be the driving force for the successful implementation of purchasing's dual role, namely simultaneously ensuring innovation from suppliers and securing the best price (Chen *et al.*, 2004; Ellram and Liu, 2002; Ellram *et al.*, 2020; Johnsen, 2009; Schiele, 2010).

Second, we show that structural differentiation has a substantial positive effect on purchasing integration by demonstrating a possible approach to overcoming the cross-functional collaboration challenges that may exist among the engineering, purchasing, and supply departments involved in NPD (Wynstra *et al.*, 2001). Our results indicate that a differentiated purchasing structure with advanced sourcing activities (Burt and Soukup, 1985; Mendez and Pearson, 1994; Rendon, 2005; Trent and Monczka, 2005) can lead to the development of cross-functional touch points between engineering and purchasing. This means that the internal structure of the purchasing department has to be adjusted by adding to the operative procurement and strategic sourcing groups a third group called advanced sourcing, sometimes also referred to as "procurement engineering".

Third, our findings go beyond previous NPD studies by showing that a clear business process is more than just a highly relevant key factor for success in NPD projects (Page and Schirr, 2008; Petersen *et al.*, 2005; Tassarolo, 2007). Moreover, we demonstrate that a clear business process can also lead to the integration of purchasing professionals into NPD. Defining standardised processes, roles, and responsibilities enables the purchasing department to be actively integrated into NPD teams (Tassarolo, 2007; Wynstra *et al.*, 2001).

Fourth, our results support previous research findings that collaborative corporate culture is an antecedent to purchasing's integration in NPD (Rendon, 2005; Van Echtelt *et al.*, 2008). We show that the ability to communicate easily and across functions and hierarchies is vital for promoting cross-functionalisation and, consequently, the integration of the purchasing department. In this way, our results advance current knowledge by illustrating that a lack of collaborative corporate culture can be balanced by top management support in order to facilitate purchasing integration, and the other way around.

By relating our findings to the relational view, we can highlight further theoretical contributions as well as identify explanations for our results. Our findings extend the current understanding of the relational view by showing that integrating purchasing professionals into the NPD process is one possible way to operationalise relational rents with suppliers. The integration of purchasing in NPD, by incorporating the attitude of purchasing professionals, facilitates relational rents. Purchasing can establish organisational complementarities, which allows for the use of complementary resources between organisations. In other words, purchasing fosters knowledge sharing and manages supplier interfaces so that complementary resources are exchanged with the best possible outcome for the buying firm (Dowlatshahi, 1998; Ellegaard and Koch, 2012; Lakemond *et al.*, 2001; Luzzini and Ronchi, 2011; Schiele, 2010).

Overall, it must be noted that without internal collaboration, external relationships with suppliers can have a negative influence on the organisational performance of the buying firm (Fig. 4). Moreover, without top management support and adjustments to the structural, procedural, and cultural aspects of firms, cross-functional collaboration in NPD — such as purchasing integration — is less likely to occur. Given these striking findings with regard to organisational aspects, we expect that the future theoretical debate will be redirected to focus on the prominent role of organisational issues. Our results also suggest that research on NPD could be revitalised by more intensively examining sustainable organisational structures rather than predominantly concentrating on project management issues.

Managerial implications: A blueprint for planning purchasing inclusion in NPD

Our aim in this study was to provide firms with insight into the relevance of purchasing integration with regard to supplier involvement. Second, we intended to spotlight the organisational antecedents of purchasing integration to determine the decisive factors in achieving supplier involvement in the NPD process. Indeed, our results suggest answers to our research questions as well as practical guidance for managers.

RQ1: What role does purchasing integration play in performance improvement through supplier involvement in NPD? Should purchasing professionals be involved in NPD projects at all?

According to our results, the positive influence of supplier involvement on the corporate performance of the buying firm is a consequence of purchasing's integration into NPD. In fact, our data go even further, indicating that firms with weak

purchasing integration had only 4.1% innovative suppliers in their portfolio, compared to more than twice as many (9.1% of their A and B suppliers) for firms with successful purchasing integration — a finding that substantiates previous assertions (Hillebrand and Biemans, 2004; Johnsen, 2009; Tracey, 2004). Thus, this study is the first to present broad evidence that firms that facilitate purchasing integration on an operational level are likely to have higher and more efficient supplier involvement than those that, for instance, rely purely on engineering personnel for the integration of external expertise. The research question is clearly answered: yes, it is not only beneficial but clearly advised to involve purchasers early on in NPD in order to benefit from early supplier involvement. In the absence of professional purchasers, early supplier integration in NPD can even have detrimental effects.

RQ2: What are the organisational antecedents of purchasing integration in the NPD process? Which factors must be considered to ensure early purchasing integration in NPD?

In addition to the all-important factor of top management support, our study demonstrates that the often-neglected structural, procedural, and cultural aspects of a firm are highly relevant antecedents of the purchasing department's integration into NPD. Specifically, our results indicate that the structure of the purchasing department needs to be adapted to facilitate integration into the NPD process, for instance, by applying a structural differentiation approach using an advanced sourcing (sub-) department or, in the case of a smaller firm, at least one person executing (ideally) only that specific function. Moreover, a clearly defined NPD process framework facilitates purchasing integration into the NPD process. Therefore, a corporate-wide process description that finds constant application can be a useful tool for ensuring the establishment of a stable process environment for NPD. Additionally, a cooperative culture can act as an important influential factor for purchasing integration by encouraging the willingness and ability to cooperate and communicate internally. To sum up, to achieve the integration of purchasing professionals into the NPD process, our findings suggest first convincing the top management to provide appropriate support. The next step entails an explicit purchasing integration process with clearly defined steps in the NPD process, which would encourage its continuous and systematic execution. Then, the purchasing department may want to adapt its organisational structure by introducing a group of dedicated senior sourcing purchasers. Finally, a collaborative work ethic across functions would ensure effective integration of purchasing staff into the NPD project teams. If a firm lacks a cooperative corporate culture, top management support can prove effective in compensating for debilitating effects, which

gives managers an instrument to foster purchasing's integration into NPD projects in the short-run.

Limitations and Future Research: Shifting the Organisational Level into the Focus of Attention

As stated above, this research presents the first comprehensive and empirically tested blueprint for purchasing managers to successfully integrate their departments into the NPD process. However, there are some limitations that must be acknowledged and call for further investigation.

One limitation concerns the dependent variables — purchasing integration and supplier involvement — which were assessed using subjective items. Although such perceptual measures are considered satisfactory in operations management research (Ketokivi and Schroeder, 2004), collecting more objective and transparent data (for example, the number of projects with reasonable purchasing integration in comparison to the total number of projects) would add validity to the findings. Purchasing managers might tend to overestimate the effects of their actions. A second limitation of our study is that all respondents share the same cultural background, so cross-cultural differences could not be considered. However, innovation issues and willingness to cooperate could be subject to culturally influenced value systems (Hofstede, 1993), and thus analyzing the integration of purchasing in NPD from an international perspective may yield further insights. A third challenging aspect is the relatively small sample size, which signifies that this study was exploratory in nature (Forza, 2002; Nunnally and Bernstein, 1978). Fourth, most of our survey respondents are employed at large firms, thus, a study focusing on small and medium-sized firms may report different observations (Pressey et al., 2009).

We have several suggestions for extending our study through future research. Although we focused on the specific target spectrum of organisational antecedents of purchasing integration, future research should also consider the strategic aspects (Van Echtelt et al., 2008) of successful — agile — NPD projects. Analysis of strategic aspects, such as the influence of strategic purchasing integration, could yield interesting and highly relevant outcomes that would lead to a holistic understanding of the antecedents of purchasing integration. Third, due to the high complexity and failure potential of NPD (Littler et al., 1995), as well as the organisational identity-building potential of cross-organisational cooperation (Croom, 2001), a dyadic capabilities view, including the perspectives of suppliers, could increase the efficiency of organisational and process adaptations by the buying firm (Anderson et al., 1994; Ford et al., 1986). A dyadic analysis approach

that combines the buying and supplying perspectives could be beneficial for both academia and practitioners.

Recently, the inclusion of novel technologies such as blockchain in collaborative NPD was suggested (Marche *et al.*, 2019). The industry 4.0 technologies could open up a new way of collaborating in a chain, by increasing transparency and reducing principal-agent problems, while at the same time providing a platform for sharing information, increasing structural capital. Ensuring supplier willingness to invest into such industry 4.0 technologies becomes a new task for purchasing (Schiele and Torn, 2020). How to accomplish this, would be an important path for future research, further inseminating the R&D — purchasing collaboration.

Finally, the substantial explanatory power of the organisation-level variables used in this study indicates that research in NPD would benefit by shifting more from an overwhelming attention to the project level of analysis to the organisational level as lens of analysis. Considering processes, organisational structures, culture, rules and routines may pave the way forward to improving our understanding of effective NPD.

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