Toward triadic supply network relationships in collaborative new product development: An investigation on supplier-supplier relationship

Summary

Build on social network theory (SNT) and information processing theory (IPT), this paper investigates the coordination of inter-organizational relationships in supply networks during collaborative new product development (NPD) process. It studies the underlying coordination mechanism of supplier-supplier relationship in the buyer-supplier-supplier triad and explores the impact of product-related features on the coordination of supplier-supplier relationship. Empirical evidence from 16 cases supports the explanatory power of SNT and IPT in the realm of product co-development when multi-actors are involved. While this initial study considered limited variables, future research can enrich the framework with a wider set of theory constructs.

Keywords: supplier-supplier relationship, supply network relationship, triads, triadic relationship, new product development

Submission category: working paper

Introduction

Firms are becoming increasingly dependent on their suppliers due to the accelerated development of technology. This has led to the fact that a single company cannot master the entire range of knowledge required when developing new products (van Echtelt et al., 2008; Ragatz et al., 2002). The diffusion of competence and expertise into supply networks encourages the development of new product to be collaboratively performed between supply network members. Indeed, suppliers and customers are important source of knowledge and capabilities during new product development (NPD) process and has been considered to have significant impact on new product performance (Lau, 2011). While involvement of customer mostly deals with the understanding of market needs, supplier involvement in NPD is recognized as a good practice contributing to a wider range of performance, such as reduction of development time and cost, and improvement in new product quality and innovativeness (Ragatz et al., 2002; Zhao et al., 2014). Beside the involvement of external actors, the way of supply network interaction and relationships can also influence the NPD result (Choi et al., 2002). However, management complexity grows along with the extension of NPD actors, and different relationships enter into play as product development ends up being a joint activity performed by a network of players. The need of investigating collaborative NPD projects in the extended network of supply chain members has been further triggered by the increased product complexity and technology uncertainty (Hong and Hartley, 2011)

Earlier studies have raised awareness that a narrow focus on dyadic relationships is insufficient even when examining the purchasing process where strategic relationships are not necessarily required (Choi and Wu, 2009a; Wu and Choi, 2005). Contrastingly, in the supply network relationship studies, little is known from the network perspective and empirical evidence is even more limited. Despite the need of structured studies on collaborative NPD, few contributions have mentioned the NPD context as a lateral finding when examining supply network relationship in general (e.g. (Roseira et al., 2010; Wu and Choi, 2005)). However, the high levels of complexity and uncertainty of collaborative product development projects requires specific attention when studying the interactions and coordination among supply network actors (Ateş et al., 2015).

Therefore, build on social network theory (SNT) and information processing theory (IPT), the aim of this study is to understand the coordination mechanisms of supply network

relationship during collaborative NPD. This paper views *supply network relationship* from the network perspective, considering the smallest unit of study in a network as a *triad* (Ateş et al., 2015; Choi and Wu, 2009a; Wu and Choi, 2005). A *supply network triad* is composed by three *nodes* (i.e. actors in the supply network) and the three pairwise dyadic *ties* (i.e. relationships) that connect the actors within the triad by means of information or material flow, while is further embedded in a larger network that encloses the triad. In particular, our study is focused on the buyer-supplier-supplier triad (Choi and Wu, 2009a; Wu and Choi, 2005) from the buyer's *ego network* perspective (Borgatti and Li, 2009). As complement to the prevailing contributions in the well-established buyer-supplier relationship studies, we considered the *supplier-supplier relationship* as the missing puzzle towards the network perspective, aiming to unveil the interrelationships between supply network actors (Choi and Wu, 2009a; Wu and Choi, 2005). Therefore, this study investigates the supplier-supplier relationship in the buyer-supplier-supplier triad to study the characteristics of such relationship and the coordination mechanism during collaborative product development.

Literature review

Triadic supply network relationships from social network theory

Recent research has started to adopt the network perspective when investigating supply network relationships. Indeed, imported to the supply chain context, SNT has been proved appropriate to investigate the interdependencies in supply networks and the ties among supply network actors (Borgatti and Li, 2009). SNT views *nodes* (i.e. actors) and *ties* (i.e. relationships) within a network to be interdependent by means of interactions, relationships and flows, and cannot be completely isolated from its environment embedded (Borgatti and Li, 2009). SNT suggests to study and explain the behaviour of nodes considering its connection to other nodes through ties, that act as pipe or bonds for information flow and interactions.

The series of research from Choi and Wu has raised the discussion of supply network based on SNT and initiated to study the complex relationships in supply network by consideration the smallest unit of the network as a triad. This triadic perspective of supply network relationships has immediately gained attention, resulting in a body of literature that investigated supply network relationship from the network theory. Being one of the first works to investigate the supply network relationship with a triadic view, Choi et al. (2002) initiated the need to study supplier-supplier relationship within supply networks based on SNT proposed classification of supplier-supplier relationships into three categories. Wu and Choi (2005) have theorized the five types of supplier-supplier relationship based on an inductive grounded theory approach. Similar justification was given in their later work that *triad* should be the smallest unit to investigate within a network, so to be able to capture the context of an relationship and interdependencies (Choi and Wu, 2009b, 2009c). This stream of research grounded in SNT also provided empirical evidence to demonstrate the impact of supplier-supplier relationship on supplier's performance (Wu et al., 2010). Roseira et al. (2010) extended the triadic view into a complex network perspective and investigated the spill-over effect within the focal buyer's supply network with two embedded case studies.

Supplier-supplier relationship in the triadic supply network relationship

The focal of *triad* in supply network studies does not converge to a single form. Although the most commonly considered triad was the buyer-supplier-supplier triad emerged from the work series of Choi and Wu (e.g. (Wu et al., 2010)), other variants exist either by altering the type of supplier in the triad, or by stretching the focus to a multi-tier supply chain (Mena et al., 2013). Example of the first type includes the buyer-supplier-design agency triad (Ateş et al., 2015) and the buyer-supplier-logistics provider triad (e.g. (Yu et al., 2015)), while evidence of the second type covers triads such as buyer-supplier-2nd tier supplier (e.g. (Mena et al., 2013)) and buyer-supplier-customer (e.g. (Wynstra et al., 2015)) depending on the focal firm of investigation. However, supplier-supplier relationship has been the base of the other variants regardless of the

form of triad. Choi et al. (2002) has conceptualized supplier-supplier relationship into competitive, cooperative, co-optetitive distinguished upon product-market characteristics and the focus of relationship. Wu and Choi (2005) has categorized supplier-supplier relationship into conflicting, contracting, dog-fighting, networking and transacting based on the competitive and collaborative nature of relationship, considering the information flow and attitudes towards collaboration.

Despite the trend of adopting triadic perspective in supply network study, the current research is predominant by conceptual works and theory testing surveys. The researchers have primarily focused on the transactional activities between buyer and suppliers, such as multi-sourcing or triadic sourcing (Dubois and Fredriksson, 2008), while contributions are scant in investigating the triadic supply network relationship in the strategic collaboration context, such as product co-development and value co-creation. Inherently, collaborative NPD is different from the transactional activities for its significant impact on the firm's performance and knowledge accumulation. Indeed, the peculiarities of NPD projects deserve special attention and so as the need to be distinguished from the other context for careful scrutiny.

Information processing in inter-organization product co-development

In parallel with the development under SNT, some researchers studied triads from the perspective of coordination, providing evidence on the fact that not only the type of relationship is important but also the way actors are coordinated (Ateş et al., 2015; Hong and Hartley, 2011). They combined the triadic perspective with IPT to discuss how effective management could be achieved through coordination, method and content of information sharing, and the type of control.

IPT states that, the information processing capacity within an organization need to match its information processing need (Galbraith, 1974). When a process is characterized by certain degree of uncertainty, information processing is required to deal with the ambiguity of tasks and, therefore, reduce the uncertainty (Ateş et al., 2015; Peng et al., 2014). Product development activities are inherently characterized by a higher level of innovativeness compared to transactional business activities (Peng et al., 2014), thus, NPD process involves a higher level of technical uncertainty which calls for the need of information exchange to cope with such uncertainty (Ateş et al., 2015). IPT suggested that, in order to create match between information processing capacity and requirement, firms can increase their capacity of information processing (Galbraith, 1974). Practices addressing this point include establishing teams between the parties of co-development in seek of effective information exchange (Caridi et al., 2012; Hong and Hartley, 2011), adopting ICT tools and technologies to facilitate communication (Barczak et al., 2008; Peng et al., 2014), and motivating direct supplier-supplier connection during NPD projects (Hong and Hartley, 2011). Hong and Hartley (2011) proposed direct connection between suppliers and interactive team as the two ways to improve information processing capacity. As alternative to improve information processing capacity, organisations can also seek to reduce the need of information processing to match the current capacity (Galbraith, 1974). Practices of reducing information processing need include standardization of product or component by redesigning the product, or adoption of modular product design to facilitate well-defined interface between modules, and consecutively, reduce the need of information exchange (Hong and Hartley, 2011; Pero et al., 2010).

As a result, extant studies on supply network relationship fall short in separating the distinctive context of collaborative NPD with the transactional business processes, while studies in NPD collaboration seldom takes into consideration the network perspective.

Research framework

Collaboration between manufacturers with their suppliers during NPD has been referred in literature as supplier involvement. It has been recognized as one of the most effective approach to access to suppliers' resources and competence, establishment of strategic relationships for

future benefit and gain access to information on technological changes for product innovation for NPD performance improvement (van Echtelt et al., 2008; Petersen et al., 2005; Ragatz et al., 2002; Zhao et al., 2014). Involving suppliers in product development undertakes significant risk and uncertainty (Koufteros et al., 2007), thus, the NPD context gives a peculiar setting to study the triad. On the one hand, buyers should undertake a minimum level of collaborative attitude to the suppliers involved, delegating a certain level of responsibility to their suppliers in the NPD process (see *black-box, grey-box, white-box* integration in (Handfield et al., 1999; Petersen et al., 2003)). On the other hand, the supplier-supplier relationship could be developed unrestrictedly in seek of reaping the maximum suppliers' contribution in the NPD process.

As studies on buyer-supplier relationship are predominant in the supply network literature, we aimed to complete to the triadic perspective by primarily focusing on the supplier-supplier relationship. Therefore, this research is arranged to provide answer to the following research questions (RQ):

RQ1: How supplier-supplier relationships in the supply network triad can be coordinated during collaborative NPD?

RQ2: How product-related features can impact the coordination of supplier-supplier relationships in the supply network triad during collaborative NPD?

Definition of constructs

According to the transmission mechanism of SNT, *ties* in the social network can be viewed as the media to exchange and share information, resources and knowledge. The perspective of *ties* as coordination or bonding mechanism suggest that they can be viewed as bridges for inter-organizational coordination (Borgatti and Li, 2009). Therefore, dimensions of the *ties* in the social network encompasses elements of communication (i.e. information sharing), locus of control and the nature of coordination take place (formal or informal) (Hong et al., 2009).

Information sharing in the supply network is defined as the exchange of technological, marketing, production, and inventory information to the aim of supporting the material flow within supply chains, and eventually contributes to supply chain integration (Lau, 2010). It addresses the method, content and nature of information exchanged and its bidirectionality (Jin and Hong, 2007). If depicted on a continuous spectrum, information sharing between suppliers are generally more intensive for collaborative parties in seek of mutual objective, covering both technical knowledge and tacit information (Koufteros et al., 2007). Information sharing intensity is at the minimum extreme between co-existing parties where direct communication is absent. However, indirect communication might take place to compensate the necessity of information exchange with the mediation of other parties. SNT terms the absence of direct connection as the *structure hole* state (Choi and Wu, 2009a).

Locus of control is defined as the authority who holds responsibility of decision making and coordinate the co-development process among all the partners involved in NPD (Hong et al., 2009; Jin and Hong, 2007). Coordination can either be managed by a single actor, or as a shared activity among all the participants in collaborative product development (Ateş et al., 2015). Locus of control in NPD project is not only a descriptive characteristic in NPD but it might influence the product innovativeness outcome (Ateş et al., 2015).

Being the joint effort of multi-functions and multi-organization, collaborative NPD activities are inherent with high degree of complexity (Ateş et al., 2015; Peng et al., 2014). To cope with such complexity, firm may take various actions to increase their capability in managing the complexity or to control the level of complexity at the product design phase. *Product modularity* is cited in literature as a determinant of information sharing between NPD partners (Fine et al., 2005). Modular product design allows suppliers to work independently after clearly defined the interface at an early stage (Pero et al., 2010), and therefore, reduces the need of frequent and extensive communication between the module suppliers. Despite of the unconverging definition of product modularity, modular product refers to the product having most of its components under the coverage of building blocks, where the building blocks should

have a high level of independency, facilitating a clear division of the design tasks if they were to be performed in parallel (Gershenson et al., 2003, 2004).

Methodology

The investigation of relationships that are primarily explained and narrated based on qualitative expression relying on human words (Strauss and Corbin, 1998; Yin, 2014). Therefore, we adopted explorative case study aimed to gain an in-depth understanding of under-explored research fields (Eisenhardt, 1989; Yin, 2014). Multiple case design helped us to explore a rich variety of cases and reach saturation in in research findings (Yin, 2014). A structured research protocol helped to guide the research and align among researchers, which contains the detailed process of research, data collection and analysis approaches to ensure internal validity.

Case selection and data collection

The samples included in this study should meet the following criteria: i) manufacturing firms with relatively high ratio of R&D investment over income. This proxy is used to guarantee a high number of NPD project to assure the presence of eligible cases; ii) firms with global presence, so as to assure the organizational NPD process are standardized, mature and stable. iii) the firm should have an Italian branch to allow interview in the informants' original language for the aim of ensuring the richness of data collected and on-site visits. As a result of this process, firms from the electro-mechanical industry was considered to standardize the sample and variety of products.

Firms that met the criteria were contacted via email enclosing an invitation letter and an introduction of the research project. Semi-structured face-to-face interviews was the major source of primary data which covers five major areas following the research protocol: i) firm information and generic NPD process, ii) arriving consensus on a focal project for investigation, iii) information on the focal NPD project and actors involved, iv) coordination dynamics, information exchange and nature of relationship during NPD among the members in the triad, iv) NPD performance achieved. The eligible case to present in the study need to be NPD triads where more than one first-tier supplier is involved. In particular, we selected one triad per NPD project and focused the interview with reference to the pre-defined triad. We controlled the impact of *component interdependency* on supplier-supplier relationships (Hong and Hartley, 2011), and we included only suppliers for complementary (product that interact with each other) or independent components (i.e. no substitutable components). As a result, no competitive suppliers were included as the nature of interaction process tends to be unstable.

Informants for the interviews are managers who have led or participated on the NPD projects in which suppliers were involved with a certain level of seniority in their role, and their experience in the current position from 6.5 years to more than 10 years in the company. Interviewed managers hold the position range from R&D directors, project managers and technology managers to senior engineers. The data was collected in 2014/2015, and multiple sources of data were respected (transcript of interviews, company documents, secondary sources and site-visits) to triangulate gathered information and increase the validity. To assure reliability and validity of results, we used database and structured approach in the analysis process, and results were compared and discussed among authors.

Sample

The final sample contains 16 firms in the Italian electromechanical industry, who develop, manufacture and sell products combining electronic and mechanical technologies (Pero et al., 2018). The cross-industry sample allows to capture a higher variety of product types ranging from machineries to automotive and home appliances as in shown in Table 1.

Table 1 Case study sample

Case	Project analysed	# employee	Turnover [mln €]	Role of interviewee
Case 1	Mould requested by a customer	40	5	R&D director
Case 2	Distribution chain for car engine	19,100	7,437	R&D coordinator
Case 3	Breaking system	7,241	1,566	Designer
Case 4	Industrial switcher	3,000	4,250	Project Manager
Case 5	Coins validator for vending machines	200	30	R&D director
Case 6	Truck battery	10,300	2,100	Project Manager
Case 7	Car fastener	2,500	500	Designer
Case 8	Woodworking machine	2,800	327	R&D director
Case 9	High customized metallized polypropylene capacitors with high gradient	670	70	R&D director
Case 10	Electronic device for automotive based on thick film ceramic technologies	250	42	Technology manager
Case 11	Trigger mould for the plastic packaging of stick deodorant	10	1	Director
Case 12	Box for switchers and boards	163	25	R&D director
Case 13	Vacuum pump	1,011	149	R&D director
Case 14	Vacuum cleaner: maxi bag	230	35	Plant Director
Case 15	Motors for Machine tools	30	4	Designer
Case 16	New platform for electric oven	11,500	1,300	Industrial Engineering Manager

Result

Coordination of supplier-supplier relationship in collaborative NPD

Based on the research framework, we mapped the 16 cases in the supplier-supplier relationship coordination matrix (Figure 1) according to: i) information sharing intensity and ii) locus of control in the triad.

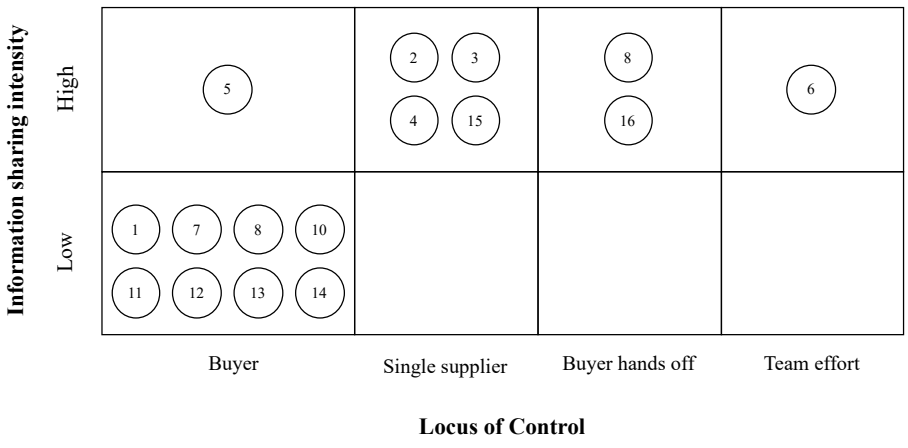

Figure 1 Supplier-supplier relationship coordination matrix

Information sharing is considered as low intensity when limited or no communication is observed between suppliers during the collaborative NPD process, while the intensity is high when the two suppliers frequently exchange technical or tacit information related to product development. The investigated cases present a homogenous distribution on the information

sharing intensity (see Figure 1). In half of the cases, suppliers do not directly interact with each other and the communication is arranged by the buyer, while in the other half of the cases, suppliers actively share information on technical specifications and knowledge through periodic meetings, video-conferencing, emails and phone calls. Regarding the other dimension in the coordination of supplier-supplier relationship, the resulted cases show either a single-actor locus of control (i.e. buyer or single-supplier) or a shared responsibility among multi-actors (i.e. buyer hands off or team effort). In cases where *buyer as mediator* (e.g. case 1, 5 and 7), the buyer act as the interface between suppliers to convey necessary communications. In the cases of *single-supplier as mediator* (case 2, 3, 4, and 15), the focal supplier arranges conversations via meetings and calls with the other supplier without direct involvement of the buyer. *Buyers hands off* is characterized by cases where suppliers actively coordinate with the other to provide the buyer with a complete assembled product or subsystem (e.g. case 8 and 16). Finally, the single case as *team effort* features a fully active interaction among all the actors (case 6), where suppliers continuously interact and exchange information, while the buyer facilitate this communication and giving approvals at the development gates.

Reading the empirical data from IPT, it shows that when information sharing between suppliers is of low intensity during NPD process, the buyer in the triad is assumed the role to coordinate suppliers and facilitate necessary information exchange to match the information processing need. On the contrary, when suppliers already share information extensively, the coordination locus of control can be of various types in seek of the best contextual fit.

Impact of product modularity on supplier-supplier relationship

With previously introduced taxonomy, we investigated the impact of product-related features on supplier-supplier information sharing in the collaborative NPD triad with specific focus on product modularity. By crossing the level of information sharing between suppliers with the use of modular product architecture, Figure 2 shows the results of the case distribution in a two-by-two matrix.

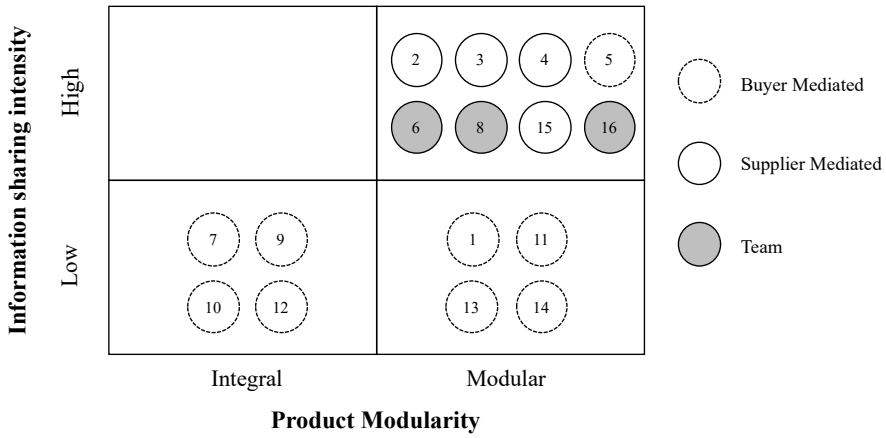

Figure 2 Product modularity vs. information sharing between suppliers

Data shows that information sharing between suppliers is not necessary in the development of integral product, since these suppliers of the integral product are supposed to develop its own part individually according to the specifications pre-define by the buyer (case 9 and 10). Whereas modular products may or may not require intensive information sharing between suppliers during its development phase. Leveraging on the modular product architecture, the buyer can clearly define the interfaces between modules to facilitate independent development between suppliers (case 14), while on the contrary, it can also happen that buyer and suppliers may coordinate to arrive to the initial definition of specification altogether through frequent face-to-face meetings and contact via email and calls (case 2, 3, 4, 5 and 6). Moreover, we did not find evidence of the effect of buyer size on such relationships and coordination.

Discussion and conclusions

This work investigates the coordination of supply network relationship during collaborative NPD projects adopting the theoretical lens of SNT and IPT. It provides theoretical and practical implications on the management of supplier-supplier relationship and provides empirical support to SNT and IPT in the realm of collaborative product development. This work empirically refines the classification of *locus of control* previously developed in literature (Ates et al. 2015) contributing with insight form product-related features.

Indeed, the empirical result of this work can be read using the theoretical lens. As far as SNT is concerned, results support that, in some circumstances, buyers are voluntarily creating *structural holes* (Borgatti and Li, 2009) to avoid direct information sharing between suppliers in the triad, while, in other circumstances, buyers are willing to invest time and money in closing the *structural holes* in the triad to allow information flow among all the actors. Indeed, the investigated triads are characterized by strong ties between the buyer and both of the suppliers, while the ties between the suppliers can be either weak or strong. In the first case, the buyer keeps control of the information sharing within the triad, while in the latter case, different alternatives for coordinating the information exchange have been found. It is observed that the structural hole is always kept open in case of integral product design. Literature commented the implications of product modularity on buyer-supplier collaboration claiming that, due to the high number of interconnections and low standardization of interfaces, low product modularity are generally associated with intense collaboration between parties (Caridi et al., 2012; Pero et al., 2010) and buyer's high level of control over product architecture (Fine et al., 2005). When looking at supplier-supplier relationships, the control of the buyer over the product architecture results in allowing low or no information exchange between suppliers, thus translated to the structural hole state. IPT theory explains such phenomenon suggesting that, the buyer may not perceive the need in facilitating suppliers' direct information exchange, being the buyer itself the owner of the information related to product architecture. In the case of integral product, the risk of mis-understanding and errors in information exchange overcomes the benefits of information sharing. In the case of modular products, the buyer might be interested in making the direct supplier-supplier connection, especially when the development activity is delegated to system integrators (Doran et al., 2007) and information exchange between suppliers is expected to improve the assembled product performance. In other case, the buyer keeps the structural hole open, since standardization of the module interfaces can significantly reduce the need of information proceeding between suppliers. However, it is not evident when the buyer will decide to reduce the need of information proceeding via interface standardization, or to pursue a higher capacity of information proceeding by creating direct supplier-supplier connections. This might be explained by other attributes in IPT such as product innovativeness (as in (Pero et al., 2010)) and complexity, or other supply network-related features, such as the trust of the buyer on its suppliers (Brun and Pero, 2011) might also justify buyers' willingness to leave suppliers working together and exchange information.

We reckon that not having collected information on these variables is one limitation of this work. Future research will be devoted in investigating the role of product related and supply chain related variables in shaping supplier-supplier relationships in the development of modular products. Moreover, while this initial study set up a new theoretical foundation, further research will be conducted to reinforce the broader application of this work in additional industries.

References

Ateş, M.A., Van den Ende, J. and Ianniello, G. (2015), "Inter-organizational coordination patterns in buyer-supplier-design agency triads in NPD projects", *International Journal of Operations & Production Management*, Vol. 35 No. 11, pp. 1512–1545.

Barczak, G., Hultink, E.J. and Sultan, F. (2008), "Antecedents and consequences of information Technology Usage in NPD: A comparison of dutch and U.S. companies", *Journal of*

Product Innovation Management, Vol. 25 No. 6, pp. 620–631.
Borgatti, S.P. and Li, X. (2009), "On social network analysis in a supply chain context", *Journal of Supply Chain Management*, Vol. 45 No. 2, pp. 5–22.
Brun, A. and Pero, M. (2011), "Assessing suppliers for strategic integration: a portfolio approach", *International Journal of Business Excellence*, Vol. 4 No. 3, p. 346.
Caridi, M., Pero, M. and Sianesi, A. (2012), "Linking product modularity and innovativeness to supply chain management in the Italian furniture industry", *International Journal of Production Economics*, Elsevier, Vol. 136 No. 1, pp. 207–217.
Choi, T.Y. and Wu, Z. (2009a), "Triads in supply networks: Theorizing buyer-supplier-supplier relationships", *Journal of Supply Chain Management*, Vol. 45 No. 1, pp. 8–25.
Choi, T.Y. and Wu, Z. (2009b), "Taking the leap from dyads to triads: Buyer-supplier relationships in supply networks", *Journal of Purchasing and Supply Management*, Elsevier, Vol. 15 No. 4, pp. 263–266.
Choi, T.Y. and Wu, Z. (2009c), "Go ahead, leap: Triads and their practical and theoretical import. In response to 'To leap or not to leap: Triads as arbitrary subsets of networks of connected dyads' by Anna Dubois", *Journal of Purchasing and Supply Management*, Elsevier, Vol. 15 No. 4, pp. 269–270.
Choi, T.Y., Wu, Z., Ellram, L. and Koka, B.R. (2002), "Supplier-supplier relationships and their implications for buyer-supplier relationships", *IEEE Transactions on Engineering Management*, Vol. 49 No. 2, pp. 119–130.
Doran, D., Hill, A., Hwang, K.S. and Jacob, G. (2007), "Supply chain modularisation: Cases from the French automobile industry", *International Journal of Production Economics*, Vol. 106 No. 1, pp. 2–11.
Dubois, A. and Fredriksson, P. (2008), "Cooperating and competing in supply networks: Making sense of a triadic sourcing strategy", *Journal of Purchasing and Supply Management*, Vol. 14 No. 3, pp. 170–179.
van Echtelt, F.E.A., Wynstra, F., van Weele, A.J. and Duysters, G. (2008), "Managing Supplier Involvement in New Product Development: A Multiple-Case Study", *Journal of Product Innovation Management*, Vol. 25 No. 2, pp. 180–201.
Eisenhardt, K.M. (1989), "Building Theories from Case Study Research", *Academy of Management Review*, Vol. 14 No. 4, pp. 532–550.
Fine, C.H., Golany, B. and Naseraldin, H. (2005), "Modeling tradeoffs in three-dimensional concurrent engineering: A goal programming approach", *Journal of Operations Management*, Vol. 23 No. 3–4, pp. 389–403.
Galbraith, J.R. (1974), "Organization design: An information processing view", *Interfaces*, Vol. 4 No. 6.
Gershenson, J.K., Prasad, G.J. and Zhang, Y. (2003), "Product modularity: Definitions and benefits", *Journal of Engineering Design*, Vol. 14 No. 3, pp. 295–313.
Gershenson, J.K., Prasad, G.J. and Zhang, Y. (2004), "Product modularity: Measures and Design methods", *Journal of Engineering Design*, Vol. 15 No. 1, pp. 33–51.
Handfield, R.B., Ragatz, G.L., Petersen, K.J. and Monczka, R.M. (1999), "Involving Suppliers in New Product Development", *California Management Review*, Vol. 42 No. 1, pp. 59–82.
Hong, Y. and Hartley, J.L. (2011), "Managing the supplier-supplier interface in product development: The moderating role of technological newness", *Journal of Supply Chain Management*, Vol. 47 No. 3, pp. 43–62.
Hong, Y., Pearson, H.N. and Carr, A.S. (2009), "A typology of coordination strategy in multi-organizational product development", *International Journal of Operations & Production Management*, Vol. 29 No. 10, pp. 1000–1024.
Jin, Y. and Hong, P. (2007), "Coordinating global inter-firm product development", *Journal of Enterprise Information Management*, Vol. 20 No. 5, pp. 544–561.
Koufteros, X.A., Cheng, T.C.E. and Lai, K.H. (2007), "'Black-box' and 'gray-box' supplier

integration in product development: Antecedents, consequences and the moderating role of firm size", *Journal of Operations Management*, Vol. 25 No. 4, pp. 847–870.
Lau, A.K.W. (2011), "Supplier and customer involvement on new product perfoarmance: Contextual factors and an empirical test from manufacturer perspective", *Industrial Management & Data Systems*, Vol. 111 No. 6, pp. 910–942.
Mena, C., Humphries, A. and Choi, T.Y. (2013), "Toward a theory of multi-tier supply chain management", *Journal of Supply Chain Management*, Vol. 49 No. 2, pp. 58–77.
Peng, D.X., Heim, G.R. and Mallick, D.N. (2014), "Collaborative Product Development : The Effect of Project Complexity on the Use of Information Technology Tools and New Product Development Practices", *Production and Operations Management*, Vol. 23 No. 8, pp. 1421–1438.
Pero, M., Abdelkafi, N., Sianesi, A. and Blecker, T. (2010), "A framework for the alignment of new product development and supply chains", *Supply Chain Management: An International Journal*, Vol. 15 No. 2, pp. 115–128.
Pero, M., Rossi, M. and Terzi, S. (2018), "Evolution of Global Product Development Networks: An Exploratory Study", *IEEE Transactions on Engineering Management*, Vol. 65 No. 1, pp. 34–45.
Petersen, K.J., Handfield, R.B. and Ragatz, G.L. (2003), "A model of supplier integration into new product development", *The Journal of Product Innovation Management*, Vol. 20 No. 4, p. 284 UR.
Petersen, K.J., Handfield, R.B. and Ragatz, G.L. (2005), "Supplier integration into new product development: Coordinating product, process and supply chain design", *Journal of Operations Management*, Vol. 23 No. 3–4, pp. 371–388.
Ragatz, G.L., Handfield, R.B. and Petersen, K.J. (2002), "Benefits associated with supplier integration into new product development under conditions of technology uncertainty", *Journal of Business Research*, Vol. 55 No. 5, pp. 389–400.
Roseira, C., Brito, C. and Henneberg, S.C. (2010), "Managing interdependencies in supplier networks", *Industrial Marketing Management*, Elsevier Inc., Vol. 39 No. 6, pp. 925–935.
Strauss, A. and Corbin, J. (1998), *Basics of Qualitative Research (2nd Edition): Techniques and Procedures for Developing Grounded Theory*, *Basics of Qualitative Research Techniques and Procedures for Developing Grounded Theory*, available at:https://doi.org/10.4135/9781452230153.
Wu, Z. and Choi, T.Y. (2005), "Supplier-supplier relationships in the buyer-supplier triad: Building theories from eight case studies", *Journal of Operations Management*, Vol. 24 No. 1, pp. 27–52.
Wu, Z., Choi, T.Y. and Rungtusanatham, M.J. (2010), "Supplier-supplier relationships in buyer-supplier-supplier triads: Implications for supplier performance", *Journal of Operations Management*, Vol. 28 No. 2, pp. 115–123.
Wynstra, F., Spring, M. and Schoenherr, T. (2015), "Service triads: A research agenda for buyer-supplier-customer triads in business services", *Journal of Operations Management*, Elsevier B.V., Vol. 35, pp. 1–20.
Yin, R.K. (2014), *Case Study Research: Design and Methods (5th Edition)*, *SAGE Publications*, 5th ed., Vol. 86, SAGE publications, London, available at:https://doi.org/10.1017/CBO9781107415324.004.
Yu, J., Subramanian, N., Ning, K. and Edwards, D. (2015), "Product delivery service provider selection and customer satisfaction in the era of internet of things: A Chinese e-retailers' perspective", *International Journal of Production Economics*, Elsevier, Vol. 159, pp. 104–116.
Zhao, Y., Cavusgil, E. and Cavusgil, S.T. (2014), "An investigation of the black-box supplier integration in new product development", *Journal of Business Research*, Vol. 67 No. 6, pp. 1058–1064.