INTRODUCTION

It has become commonplace for a large part of the specific technological knowledge relating to a firm's product to be held outside the firm. The modern organization of work featuring outsourced subsystems and highly customized products has increased the need for multi-directional knowledge sharing within the value chain. The need for stretched knowledge sharing and integration occurs particularly in the field of product development. Much recent literature has examined product development collaboration between industrial companies (Dyer and Singh, 1998; Lai, Chen, Chiu and Pai, 2011). Collaboration between supplier and customer in product development can be divided into two main literature streams: supplier involvement and customer involvement. Supplier involvement concentrates on the role of suppliers in the customer firm's product development (Takeuchi and Nonaka, 1986; Johnsen, 2009), while customer involvement literature studies customer participation in a supplier's product development (Kaulio, 1998). Studies have empirically shown benefits deriving from both customer involvement (e.g. Gruner and Homburg, 2000) and supplier involvement (e.g. Ragatz, Handfield and Petersen, 2002).

Supplier involvement has an established position within supply chain management literature. Johnsen's (2009) recent review from the field of supplier involvement shows that the literature is extensive but not overly researched. In marketing literature, another type of product development collaboration – customer involvement – has been the target of interest in several studies (Kaulio, 1998; Lagrosen, 2005; Svendsen, Haugland, Grønhaug and Hammervoll, 2011). However, these literature streams have remained relatively unrelated. The concepts have been considered within the same research articles (e.g. Flynn, Schroeder, Sakakibara, 1994; Ittner and Larcker, 1997; Koufteros, Vonderembse and Jayaram, 2005; Lynch and O'Toole, 2006), but their similar and distinguishing characteristics have seldom been reviewed. To successfully apply or research customer and supplier involvement practices it would be advantageous to recognize the similarities, differences and the defining factors of these two product development collaboration tactics.

To fill this gap, this study aims to shed light on the differences in supplier and customer involvement and on the similarities between them. Whereas the earlier contributions that have considered both supplier and customer involvement have had a broad focus including the focal companies' collaborations with an end user and also with a supplier, this research focuses on the product development relationship between the focal company and supplying company. Furthermore, the study aims to develop basic rules that can be used to determine the form of product development collaboration. The data for this study are obtained from a literature review encompassing areas of supplier and customer involvement in product development. Furthermore, the present study draws its conclusions from a comparative case study. The case study is conducted within two relationships presenting customer involvement and supplier involvement in the Finnish metal industry.

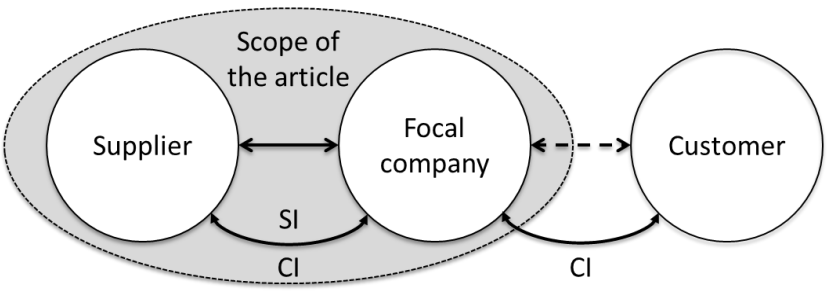

Figure 1. Positioning of the article.

The literature review and the analysis of the cases suggest that supplier involvement and customer involvement share many characteristics. For example, both collaboration types highlight the importance of efficient knowledge sharing and integration, complementarity of resources and trust in the relationship. The findings provide avenues for further research on product development collaboration by combining fragmented customer and supplier involvement literatures. The insights from the comparative case study also highlight the importance of the ownership of product rights being clear. Furthermore, the findings suggest that a distinction between customer involvement and supplier involvement can be made based on that ownership of the product rights.

The article is organized as follows: after the introduction the next section provides an overview of the recent developments in both supplier- and customer-involvement research. The section also discusses the main typologies used in both streams and creates a theoretical framework for the analysis of the case study. The methods section summarises the research design and methodology and is followed by the analysis of the cases. Then, the findings are discussed, and finally the paper presents its conclusions, implications and limitations.

SUPPLIER AND CUSTOMER INVOLVEMENT IN PRODUCT DEVELOPMENT

Searches within the SciVerse Scopus database show that both supplier involvement and customer involvement in product development has been the target of increasing interest in academic research in recent years. Journals have overlapped in their coverage of both streams. The current research finds that the three journals most commonly carrying pieces on supplier involvement literature are the International Journal of Operations and Production Management,(11 articles) Journal of Operations Management, (n=10) and Journal of Product Innovation Management, (n=9). For articles on customer involvement the International Journal of Technology Management, (n=8) Journal of Product Innovation Management, (n=8) and Journal of Operations Management, (n=5) top the rankings. Search strings that were used in this article produced a total of 211 hits for supplier involvement and 174 hits for customer involvement.

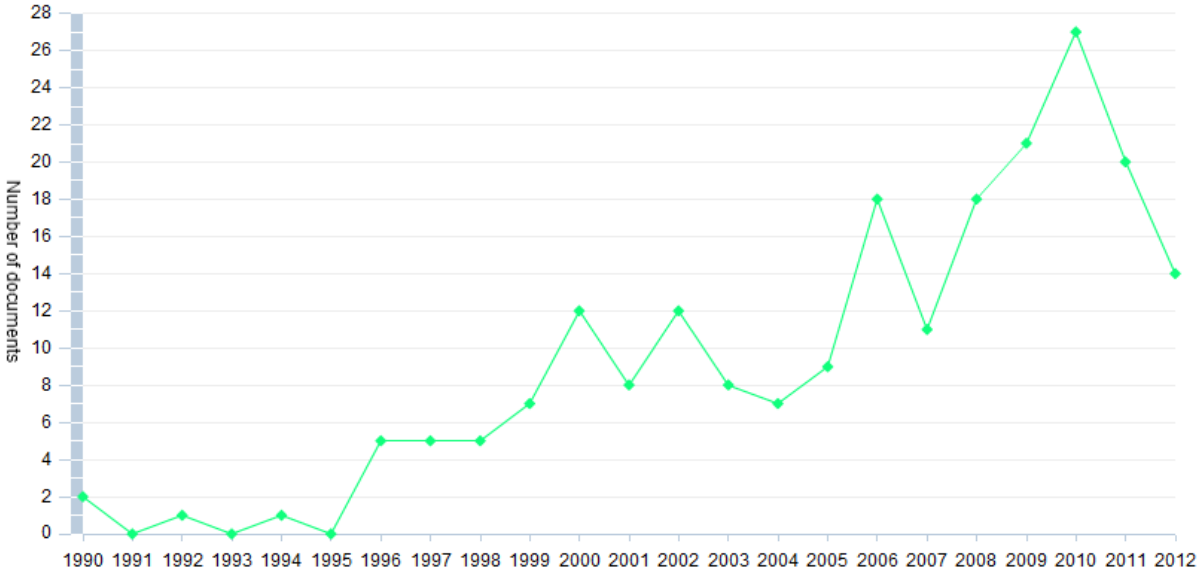

Chart 1. Articles published on supplier involvement 1990—2012.

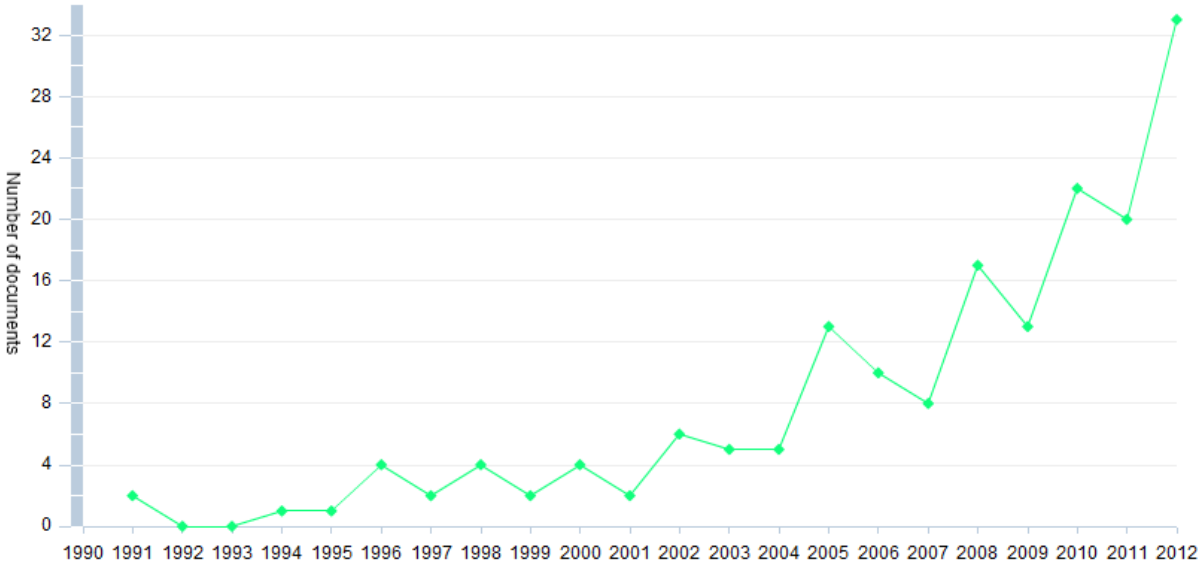

Chart 2. Articles published on customer involvement 1990—2012.

In addition to these searches, a combined search string was used to indicate articles discussing both types of collaboration. This combined search produced 18 hits, which shows that despite their similar nature, supplier involvement and customer involvement have seldom been compared or even discussed in the same study. The 18 exceptions found include articles where the research setting is broader such as the contribution of Flynn et al. (1994) to quality management, of which customer involvement and supplier involvement are parts. Results also include articles where the performance of supplier involvement and customer involvement compared. Sherman et al. (2003) compared the effects of the different forms of cross functional integration on product development cycle time. They found that customer involvement has a more positive influence on the reduction of product development cycle time than does supplier involvement. The research was conducted among US and Scandinavian technology companies. Flynn et al. (2010) found that among Chinese manufacturing companies too customer involvement is more strongly related to improving the focal company's operational and business performance than supplier involvement is. Lau (2011) studied supplier and customer involvement on new product performance using survey data from manufacturers in Hong Kong. He concludes that both customer and supplier involvement are particularly important when developing really innovative products. He continues that internal coordination is a prerequisite to customer and supplier involvement and that companies should improve internal coordination before adopting customer and supplier involvement strategies. Feng et al. (2010) also explored the effects of customer and supplier involvement on competitive advantage among Chinese manufacturing firms. They found that customer involvement had a positive effect on product quality, reliable delivery, process flexibility and customer service whereas supplier involvement only had a positive impact on cost. Sun et al. (2010) tested the simultaneous impact of supplier and customer involvement on new product performance using a sample of over 600 firms from 21 countries. They found that supplier involvement had a positive impact on quality and reliability, time to market and innovativeness dimensions of new product performance, that is, all the dimensions studied. However, customer involvement influenced only quality and reliability.

All of the abovementioned research investigates the focal company's perspective. From that point of view decisions concerning customer involvement and supplier involvement mean

decisions to integrate upstream or downstream in the value chain. However from the relationship point of view it is also the question of the product right ownership. Transfer of the ownership of the product rights from customer to supplier can immediately change the supplier-involvement relationship to a customer-involvement relationship. This being the case the effects of the collaboration will most probably soon diverge from those of supplier involvement to become those of customer involvement.

Typologies of customer and supplier involvement practices

Petersen, Handfield and Ragatz (2005) developed a typology for different types of supplier involvement. They divided possible collaboration types in supplier involvement in product development into four different categories. The type where the supplier's role is most comprehensive is in a black-box development. In that type, the supplier takes the main responsibility for providing a solution to the customer according to the limitations that the customer has set. In a black-box development, the supplier is responsible for developing the component or sub-assembly. A second type of supplier involvement is a grey-box development where co-operation plays the most important role. Design is undertaken together and collaborative companies quite often share their office to facilitate information exchange during the product development project. The third form of supplier involvement is the white-box development where design is customer driven and the supplier's role is limited to commenting on the customer's design. In a white-box development, the supplier's contribution typically relates to the input on whether the new component is processible. The fourth type in the typology of Petersen et al. is the situation where a supplier is not involved at all in product development.

In the field of customer involvement, a similar type of classification system has been provided by Kaulio (1998). He divided customer involvement in product development into three categories. First category is called *design for customer*. In that type, development is supplier driven and the customer's role is limited to input via interviews to passing on customer-specific data. The second type in Kaulio's typology – *design with customer* – features more collaboration, as the product concept and solutions are developed through collaboration between customer and supplier. The third type called *design by customer* is a customer-driven product development type where the customer actively designs the product.

The two abovementioned classification systems share many characteristics. Both focus on product development collaboration between supplier and customer. Both divide collaboration types into three categories and in both classification systems the defining factor is the extent of the contribution that the collaborators set up for the product development. In that sense, the supplier-involvement type grey-box integration is comparable to that of *design for customer* in the customer involvement typology. Black-box and white-box integrations are similar to *design for customer* and *design by customer* respectively.

Many of the characteristics of supplier involvement and customer involvement are similar an opposite way to each other (Flynn et al., 1994). These two collaboration strategies in product development could potentially be mixed depending on the viewpoint. This is the case especially if the unit of analysis is the relationship. In this article the distinguishing factor between customer and supplier involvement is the ownership of the product rights. For instance, if a customer owns the product rights, the collaboration type is that of supplier involvement and if the supplying company owns the product rights of the target of the development, the case is one of customer involvement. This determination clarifies the sometimes blurred distinction between supplier and customer involvement. An example that supports the determination above is the situation where the product rights are sold or

transferred from the customer to the supplier. In such a case the same collaboration switches from being supplier involvement to become customer involvement.

Similar characteristics of the supplier and customer involvement types			
Supplier involvement	Black-box	Grey-box	White-box
Customer involvement	Design for customer	Design with customer	Design by customer
Intensity of the collaboration	Low/medium	High	Low/medium
Supplier's contribution	High	Medium	Low
Customer's contribution	Low	Medium	High

Table 1. Characteristics of the supplier and customer involvement types.

Both supplier involvement and customer involvement can be seen as a collaboration types that should generate an inter-organizational competitive advantage described in Dyer's and Singh's (1998) research. They suggest that the sources of these relational rents are relation-specific assets, knowledge sharing routines, complementary resources and capabilities and effective governance. To explore differences between customer and supplier involvement and their similarities, this research uses Dyer's and Singh's framework for the sources of relational rents to analyse cases from both types of product development collaborations.

METHOD AND CASE STUDIES

Two cases from the Finnish metal industry provide the means to explore supplier involvement and customer involvement in practice. The first case documents the supplier involvement within a relationship between a multinational technology company from the shipbuilding industry and its national supplier. In this case the buying company's turnover was over a billion euros while the supplier's turnover was only 10 million euros. The second case is about the customer involvement within a relationship between an equipment manufacturer with a turnover of approximately 10 million euros and an infrastructure maintenance company, which turns over almost 500 million euros. The cases were studied based on three sources of information. First, the firms' products and services were mapped from publicly-available internet sources. Secondly, the main data were collected through eight interviews with key-informants from both sides of the collaborative alliances. In addition, financial information on each company was gathered from the Orbis database. Table 2. presents the findings from the cases.

In the supplier involvement case, the buying company wanted to extend its knowledge within a new line of business. It decided to search out a partner who could be involved in the development of the new product. Trust played an important role even in the supplier selection stage, states the product manager of the buying company:

> Plenty of suppliers of similar products were eager to start collaboration with us. However we choose this physically and culturally proximate supplier for this development project as we were sure that the supplier would not start to compete with us after two or three years of collaboration. Of course the price played important role as well.

Logistic challenges mean that the buyer will need to use other suppliers for the product in the future. However in the development stage the nearby location was an important factor particularly because of the extensive testing required. The most important factor requirement for successful collaboration from the supplier's perspective was open communication. As the supplier company CEO notes:

> The most important factor for the success of this project has been openness in collaboration. Both companies share the view of [it being in our] joint interest to develop a competitive product.

In the customer involvement case, the customer's motivation to collaborate comes from the belief that by doing so they can purchase products that suit them better.

> We have been willing to participate in their product development because we believe that through the collaboration we get better tools for our business. Sometimes we have doubt the benefits of the involvement if our competitors are able to purchase same products from our equipment supplier. In some cases we have agreed with supplier that we have temporary proprietary right to the developed product. (Divisional manager of the buying company)

The same informant also mentions their willingness to protect some of their ideas:

> We have patented some of the solutions what we have developed so that we would not be tied to this particular supplier with our own ideas. And more importantly we can prevent supplier to sell these products to our competitors.

The supplier in this case saw that collaboration benefits the company. As the sales manager of the supplying company puts it:

> Collaboration with customer in product development have given us full access to user experiences. They often have the best development ideas. Another thing what this collaboration gives us is the valuable testing environment.

It is evident that the relational rents in the two explored product development collaborations have similar sources; there is a dedicated asset through physical proximity, complementary resources concerning technological knowledge, knowledge sharing routines with a focus on face-to-face interaction on technological issues and efficient governance with trust present in both cases. The following table illustrates the manifestations of these sources of relational rents in the cases under study.

	Case 1: Supplier involvement	*Case 2: Customer involvement*
Collaboration	Supplier involvement	Customer involvement
Type of co-development integration	Grey-box	Design with customer
Dedicated assets	Investment in product development (Supplier), proximate supplier's site	Personal ties, proximate customer's site
Complementary resources	Supplier has offered technological and manufacturing knowledge and manufacturing resources for the new product. Customer has added to the collaboration in providing	Customer has offered real-use testing and engineering resources including product usage data. Supplier has contributed product development resources, product

	skilled development engineers with knowledge of the whole product entity, of which the developed sub-assembly is a part	certification skills and manufacturing resources
Knowledge sharing routines	Customer's engineers working at supplier's site, monthly meetings, primarily explicit know-how from the supplier's side	Continuous interviews of end users conducted by supplier's sales engineers, annual strategy meetings in terms of fostering product development, open communication concerning customer's new ideas on developing product further
Efficient governance	Formal contract according to the customer's policy, cultural trust	No formal contracts in development projects, in rare cases where the customer has claimed copyright on products made based on its ideas, the supplier has refused to develop the product further
Achieved benefits	Learning, new product line for the customer, increased sales for the supplier	Lower costs and higher profit margins for the customer, increased sales for the supplier

Table 2. Characteristics of the cases.

In addition to similarities in the formation of the inter-organizational competitive advantage, in both cases the ownership of the product rights was relevant. In the supplier involvement case, the customer indicated that it trusted the supplier to respect its intellectual property. That trust gave the selected supplier a competitive advantage over its more distant competitors. In the customer involvement case, the customer's willingness to protect some of its ideas has led it to apply for patents and write contracts that give it a temporary proprietary right over the developed product. These findings verify the relevance of product rights ownership in both supplier and customer involvement collaborations.

CONCLUSIONS AND IMPLICATIONS

Customer involvement and supplier involvement share many characteristics. This study proposes that each time a buying and selling firm collaborate in terms of product development, either supplier involvement or customer involvement occurs. The second proposition in this study is that the primary determinant of the collaboration type is ownership of the product rights. If that is not formally agreed, the type of collaboration can be defined according to the external sales resulting from the relationship. If the supplier is allowed to sell the product to a third party, the original collaboration type is a customer-involvement type. When there are no external sales, it is a supplier-involvement collaboration. The third proposition is that the same collaborative relationship can be transformed from one of supplier involvement to become one of customer involvement and vice versa by a collaborative strategic decision when firms are seeking a collaborative advantage. When supplier economies of scale are essential, a customer might be willing to permit a supplier to sell the product to customers other than itself. That being the case, supplier involvement becomes

customer involvement. On the other hand, a supplier might be willing to transfer product rights to the customer if the supplier's product offers a remarkable source of competitive advantage for the customer and, for instance, resource issues hinder the supplier selling the product to other customers. In the situations described above, each party's motivation to collaborate changes but the process and the collaboration might remain unchanged.

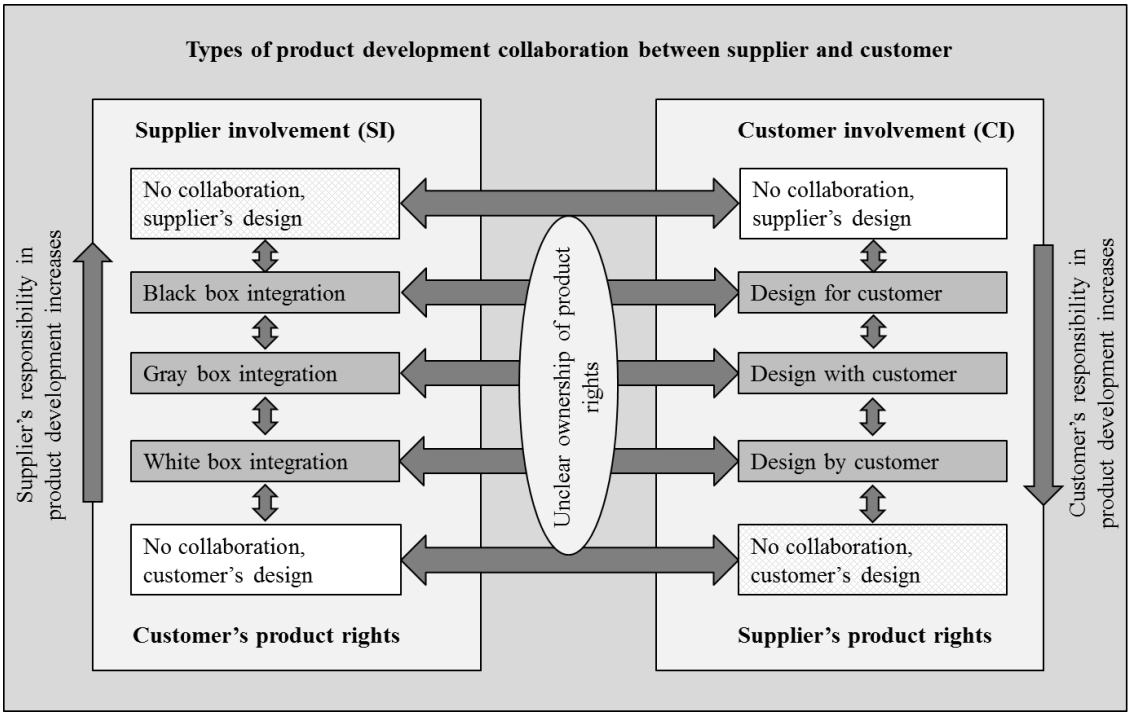

Figure 2. Framework for defining the type of product development relationship.

In an unclear situation, the customer may assume that there is a supplier involvement collaboration type, even while a supplier is assuming that its development efforts are focused on its own product. This kind of situation occurs in lengthy relationships where product development collaboration has developed over a long period of time and formal agreements have not been updated. The lack of a formal agreement may lead to complications in a collaboration in the face of personnel changes, if the strategies or targets of either company change or if another issue diminishes the level of trust between the companies.

The proposals made in this study raise further questions about the differences between these collaboration types, these include: When specifically does customer involvement create more relational benefits than supplier involvement? How are relational rents distributed in both types? How does the switch between these different types affect both parties to the collaboration? Are there other factors beside product rights that could be used as a proxy for the type of collaboration?

LIMITATIONS

Some limitations in the findings of this study must be considered. First concerning the case study, there is a trade-off between the insights gained from case studies of particular circumstances and the generalizability of the results. The cases were selected so that they offered relevant viewpoints for the comparison between supplier and customer involvement. Second, the chosen cases cover two of the six suggested main types of involvement. Therefore, it would be beneficial to broaden the scope of the cases to other types of supplier and customer involvement. Third, the suggested transfer from supplier involvement to

customer involvement or vice versa did not take place in either of the cases. To strengthen the model in the future it would be important to validate the suggested possibility for the transfer with empirical data. Fourth, the value network in which the cases took place was not the same for both of the cases studied. However, a range of issues united the cases and made them comparable. For example, they shared the same cultural environment, the target of the exchange was investment goods and the customer companies' size was many times bigger than that of the supplier in both cases. The literature part was constructed around the SciVerse Scopus service. Using another search engine or different kind of search string would presumably lead to different results. Despite these limitations, this study sheds light on our understanding of what determines what are sometimes only slight differences between supplier and customer involvement.

REFERENCES

Dyer, J.H., Singh, H., 1998. The relational view: cooperative strategy and sources of interorganizational competitive advantage. The Academy of Management Review 23 (4), 660–679.

Feng, T., Sun, L., 2010. Ying Zhang, The effects of customer and supplier involvement on competitive advantage: An empirical study in China. Industrial Marketing Management 39 (8), 1384–1394.

Flynn, B.B., Schroeder, R., Sakakibara, S., 1994. A framework for quality management research and an associated measurement instrument. Journal of Operations Management 11 (4), 339–366

Flynn, B.B., Huo, B., Zhao, X., 2010. The impact of supply chain integration on performance: A contingency and configuration approach. Journal of Operations Management. 28 (1), 58–71.

Gruner, K.E., Homburg C., 2000. Does customer interaction enhance new product success? Journal of Business Research 49 (1), 1-14.

Ittner, C.D., Larcker, D.F., 1997. Product development cycle time and organizational performance. Journal of Marketing Research 34 (1), 13–23.

Johnsen, T. E., 2009. Supplier involvement in new product development and innovation: Taking stock and looking to the future. Journal of Purchasing and Supply Management, 15 (3), 187-197.

Kaulio, M.A., 1998. Customer, consumer and user involvement in product development: A framework and a review of selected methods. Total Quality Management & Business Excellence 9 (1), 141-149.

Koufteros, X., Vonderembse, M., Jayaram, J., 2005. Internal and external integration for product development: the contingency effects of uncertainty, equivocality, and platform strategy. Decision Science 36 (1), 97–133.

Lagrosen, S., 2005. Customer involvement in new product development: A relationship marketing perspective. European Journal of Innovation Management 8 (4), 424 - 436

Lai, C-S., Chen, C-S., Chiu, C-J., Pai, D-C., 2011. The impact of trust on the relationship between inter-organisational collaboration and product innovation performance. Technology Analysis & Strategic Management 23 (1), 65–74

Lau, A.K.W. 2011. Supplier and customer involvement on new product performance: Contextual factors and an empirical test from manufacturer perspective. Industrial Management and Data Systems 111 (6), 910–942.

Lynch, P., O'Toole, T. 2006. Involving external users and third parties in the new product development process. Irish Marketing Review 18 (1), 29–37.

Takeuchi, H., Nonaka, I., 1986. The new product development game. Harvard Business Review, 137–146 (January/February).

Petersen, K.J., Handfield, R.B., Ragatz, G.L., 2005. Supplier integration into new product development: coordinating product, process and supply chain design. Journal of Operations Management 23 (3–4), 371–388.

Ragatz, G. L., Handfield, R. B., Petersen, K. J., 2002. Benefits associated with supplier integration into new product development under conditions of technology uncertainty. Journal of Business Research 55 (5), 389–400.

Sherman, J.D., Souder, W.E., Jenssen, S.A., 2000. Differential effects of the primary forms of cross functional integration on product development cycle time. Journal of Product Innovation Management 17(4), 257–267.

Sun, H., Yau, H.K., Suen, E.K.M., 2010. The simultaneous impact of supplier and customer involvement on new product performance. Journal of Technology Management and Innovation 5 (4), 70–82.

Svendsen, M. F., Sven A. Haugland, Kjell Grønhaug, Trond Hammervoll, 2011. Marketing strategy and customer involvement in product development. European Journal of Marketing 45 (4), 513 – 530.

Appendix 1. Search string CI.

(TITLE-ABS-KEY("customer involvement") OR TITLE-ABS-KEY("customer integration") AND (TITLE-ABS-KEY(develop*) OR TITLE-ABS-KEY(innovat*))) AND (LIMIT-TO(SRCTYPE, "j"))

Appendix 2. Search string SI.

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Appendix 3. Search string SI and CI.

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