

Supplier and customer roles at different stages of co-innovation

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Abstract

This paper explores co-innovation, a phenomenon, in which supplier and customer actively work on a new solution. Previous studies have highlighted the benefits of co-innovation but less emphasis has been directed towards the shifting roles of the supplier and the customer in different stages of co-innovation. This paper focuses on revealing these roles, which are discussed through the goals and the involvement of the actors in different stages of the co-innovation process. The findings from a qualitative multiple-case study present six overlapping roles for the supplier and seven roles for the customer across the co-innovation process stages. Some of the customer roles are identified only in some of the three identified co-innovation process types. Match or mismatch between the supplier and customer roles can either contribute or harm the co-innovation regarding to e.g. the effects on the innovativeness of the outcome or the supplier-customer relationship. For example, the supplier-customer relationship might be harmed if the goals of the other actor are overlooked. For managers the often implicit role requirements of the actors are made more explicit and thus more manageable. This study contributes to the discussion on the roles of supplier and customer firms during co-innovation (Blazevik and Lievens, 2008; Öberg, 2010), and innovations in networks (e.g., Håkansson et al., 2009). Especially, this study provides insight into the different combinations of these roles at different types of co-innovation processes.

Keywords: Co-innovation, roles, supplier-customer relationship, industrial solutions, actors.

INTRODUCTION

Innovation often results from interactions between different organizations (Håkansson et al., 2009). In business-to-business markets customer involvement in product and service innovation has been identified to offer significant benefits (Anderson et al., 1994; Gruner and Homburg, 2000; von Hippel and Katz, 2002; Fang et al., 2008). Hence, companies are increasingly involving customers in their innovation processes to develop solutions that match complex customer needs (Hobday, 1998; Cova and Salle, 2008). On the other hand, the customers often need suppliers to solve their specific problems, as their solution development capability and resources have diminished while they are more and more focused on running their core operations efficiently. As customers are taking different roles from passive users to active creators in co-innovation, also the interest towards customer's roles in different stages of the co-innovation process has increased (Blazevik and Lievens, 2008; Öberg, 2010). This paper focuses both on the supplier and customer roles at different stages of the co-innovation process and highlights the varying and temporal dimension of the phenomenon.

Co-innovation refers to interaction where both parties actively work on the solution (Buur and Matthews, 2008; Öberg, 2010). Understanding of the interaction in buyer-seller relationships during the innovation process is needed for facilitating the management of co-innovation (Berthon et al., 1999; Roy et al., 2004; Desouza et al., 2008), which is noted to be difficult to control (Bruce, et al., 1995), requiring careful management to achieve the rewards (Wilson et al., 1995). Still, the existing studies about actor's roles in co-innovation process mostly focus on the single actor's viewpoint and the interplay between the actors' roles has been neglected. This gap is addressed through the following research question: *What kind of roles the supplier and the customer firms have at the different stages of the co-innovation process?* To examine the roles, the goals of the actors and their involvement in the co-innovation process stages are investigated.

This study aims to contribute to the holistic understanding of the supplier and customer roles in co-innovation through conducting a qualitative explorative case study. The focus is on the supplier and the customer because their relationship is often long-term with high financial and strategic importance compared to supplier's relationships with other possible co-innovation actors (Biemans, 1991; Hobday, 2000; Saez et al., 2002). Understanding the interplay and the possible match or mismatch of the roles is important for managing the co-innovation process. The co-innovation of industrial solutions, often described as complex products and systems, is the specific context for the study, because they are by nature often tailored through customer involvement, requiring several types of knowledge inputs and cooperation (Davies and Brady, 2000; Hobday, 1998; Hobday, 2000), and bilateral product development relationship approach (Athaide and Stump, 1999).

The rest of the paper is organized as follows. Firstly, we introduce the co-innovation process stages that provide the analysis frame for the roles. Secondly, the roles of the actors based on the previous literature are reviewed. Thirdly, the research method and the preliminary results are presented, followed by the conclusions and managerial implications.

CO-INNOVATION PROCESS STAGES

In this study innovation is referred as an iterative process which includes the perception of a new market and/or new service opportunity for a technology-based invention, the development, production, market introduction and possible reintroductions of the invention, aiming at commercial success of the invention (Garcia and Calantone, 2002). In this process, the supplier and the customer can cooperate at each stage. Formalization of the co-innovation process with customers is implied to enhance the relationship-specific investments in the innovation process from both parties, which in turn contributes to new product value creation

(Fang et al., 2008). However, the theory of customer integration in general still lacks an agreed concept and processes (Enkel et al., 2005b; Kristensson et al., 2008). Co-innovation with customers and phenomena close to it are studied in several research streams originating and utilizing a variety of concepts (customer integration, customer participation, customer involvement, co-development, collaborative innovation, (lead) user innovation etc.). For a process framework, majority of the studies adopt the new product development (NPD) process (e.g. Gruner and Homburg, 2000; Alam, 2005; Enkel et al., 2005b; Lagrosen, 2005; Fang et al. 2008), presenting typically two to five stages that are often based on the studies by Cooper and Kleinschmidt (1986) or Crawford and Di Benedetto (2008). The NPD process has been defined in numerous ways, but in general they all encompass the five stages of opportunity identification and selection, concept generation, concept or project evaluation, development, and launch (Crawford and Di Benedetto, 2008, p. 24). Some co-innovation studies refer specifically to the innovation process (Ulwick, 2002; Öberg, 2010), whereas service-focused co-innovation studies use, naturally, the new service development process (Alam, 2002; Alam and Perry, 2002; Carbonell et al., 2009). Due to the complexity of industrial solutions, requiring high customer involvement, and the fact that they often include products and services (Hobday, 1998; Davies and Brady, 2000; Hobday, 2000), the co-innovation in that context resembles the service co-innovation process, which also is largely based on the NPD process models.

Hence, a synthesis of the common stages of the service co-innovation models (Alam, 2002; Alam, 2006; Alam and Perry, 2002; Carbonell et al., 2009), is assumed to provide a suitable basis for the co-innovation process model utilized in this study. Co-innovation then includes the stages of *idea generation*, *concept development*, *solution development*, *solution testing* (including technical and market testing), and *commercialization*. It is acknowledged, that for example Håkansson and Snehota (1995) and Ford and Håkansson (2005) suggest that the co-innovation process is not as straightforward as the NPD process models due to the interdependencies between the development activities and the interaction and mutual negotiations between the actors. However, the focus of this study is not on describing in detail the co-innovation process, and therefore the presented co-innovation process model is assumed to provide a useful basis for analyzing the roles of the co-innovating actors.

ROLES OF THE ACTORS IN THE CO-INNOVATION PROCESS

CONCEPTUALIZATION OF THE ROLE

An actor may be conceived at several levels; individuals, organizational units, firms or groups of firms. When actors interact, they perform different activities (Axelsson and Easton, 1992, 28-33; Håkansson and Snehota, 1995, 28-49). In this research we focus on the activities the *firm level actors* perform at different stages of the innovation process. The *role* is defined here to include description of the actor and the *activities* one performs (Axelsson and Easton, 1992, 28-33; Håkansson and Snehota, 1995, 28-49; Öberg, 2010), as well as the actor's *goals*, since they are assumed to influence the actors' roles. A single actor might have differing goals in its relationships at different points of time (Corsaro and Snehota, 2011). Consequently, the supplier and customer roles may be predefined and semi-permanent, activity-driven and temporary, temporarily abandoned or complemented (Chreim et al., 2007; Ford et al., 2010). Kumar et al. (2007) for example point out how a customer may play two different roles simultaneously: the predefined and expected buyer role and the unexpected role as a marketer. In order to capture the temporal nature of the actor's role in co-innovation the actor's involvement in the co-innovation activities and goals are examined at each stage of the co-innovation process. Also the roles a single actor takes in different co-innovation projects are of interest, because that might help to deepen the understanding of the role shifts

Thus, in this research *we define actor's role through actor's involvement and goals in co-innovation* (Figure 1). The involvement of an actor is examined through breadth and depth of the actor's participation in co-innovation. The breadth describes the scope of participation across the co-innovation process stages, and the depth captures the level of contribution in a co-innovation process stage, where an actor may be remarkably passive, act neutrally or be active (applying Fang et al., 2008). The roles catalyze the interaction at different stages of the innovation process.

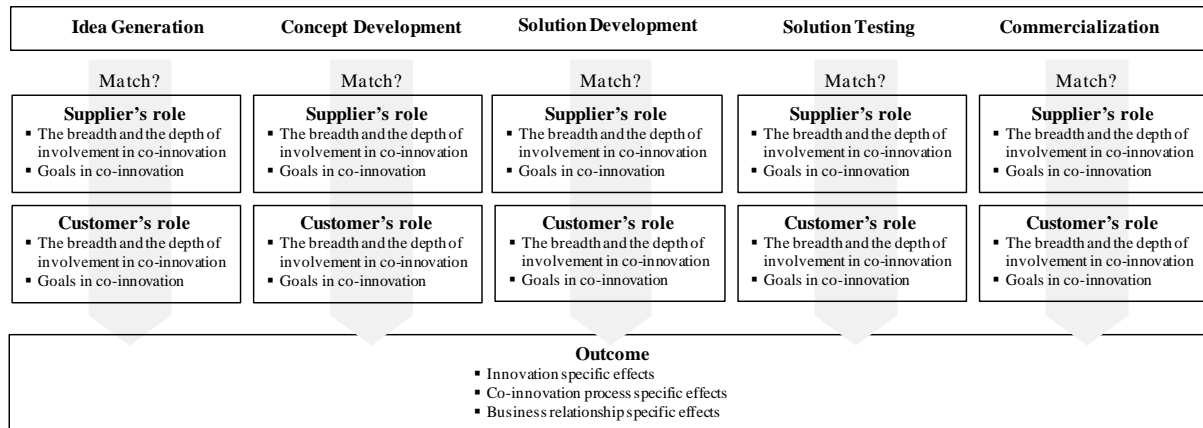


Figure 1. The roles of the supplier and the customer and their effects on the outcome of the co-innovation process.

The match or mismatch between the suppliers and customers roles results from the actor involvement and goals at different stages of the innovation process and that can have implications on the co-innovation outcome, more specifically on the co-innovation process itself, on the co-innovated solution, and on the business relationship. The match between the roles is always relative to the context of the interaction (cf. Gross, 1958; Williams, 1969; Laverie et al., 2002). Match implies that the roles (also the involvement and the goals) of the actors fit together. In other words, it is possible to achieve the goals of the both actors at least to some degree, so that the co-innovation is desirable. If the customer, for example, has valuable knowledge for idea generation and needs a solution to a specific operational problem, and the supplier respectively has knowledge for concept development in order to solve the problem and to develop a commercial solution based on it, they form a match. Their competences complete each other's regardless of the fact, that their involvement is not equal across the stages or that their goals differ. Mismatch of the roles implies that conflicts can be expected as the goals of each actor cannot be met. For example, both the supplier and the customer might want the full IPRs for the new solution.

However, the relationship between the match or mismatch of roles and the success of the co-innovation process is not straightforward. The success can be evaluated by the innovativeness or financial success, or by operational benefits of the new solution, by the effects on the supplier-customer relationship or on the proceeding of the co-innovation process, for instance. The misalignment or conflicts in goal setting is not necessary a limiting factor for innovation (Corsaro and Snehota, 2011). If the leadership in the co-innovation process is rotated, also the goals driving the process change, which has been found to contribute to the innovativeness of the solution (Davis and Eisenhardt, 2011). The technology learning benefits and the effects of co-innovation on the supplier-customer relationship should be evaluated on a long-term basis (van Echtelt et al., 2008). The new solution can be innovative and financially successful, but if the goals of the customer are overrun that might harm the supplier-customer relationship. Nevertheless, some sort of ability to combine and

find complementarities in the goals of multiple actors is needed to accomplish co-innovation and the influential actors initiating or acceding to changes are crucial for reaching a positive outcome (Munksgaard et al., 2012).

SUPPLIER AND CUSTOMER ROLES IN DIFFERENT STAGES OF CO-INNOVATION PROCESS

At first sight, the existing studies seem to have focused both on the customers' roles (e.g. Öberg, 2011; Blazevik and Lievens, 2008; Fang, 2008), and on the suppliers' roles in co-innovation processes (e.g., Wynstra, van Weele, and Weggemann, 2001; Petroni and Pancirolli, 2002; van Echtelt et al., 2008). But after a closer look it appears that in both streams the perspective has been of the focal firm who owns the major R&D and manufacturing resources and aims to develop and commercialize new solutions. Thus, the co-innovation partners are looked after both from the upstream and the downstream of the supply chain, but the roles of the focal firm in the middle and looking, here referred as the supplier, have been neglected. The academic interest in suppliers' and customers' roles in co-innovation processes have focused on the customer's involvement (e.g. Öberg, 2011; Blazevik and Lievens, 2008; Fang, 2008) because the supplier's participation in each co-innovation activity is taken as a presumption. As innovation process consist of social interaction (e.g., Sorensen, Mattsson and Sundbo, 2010), it is important to study the supplier's and customer's roles simultaneously. Both supplier and customer perspectives are also needed for understanding the dual roles in which actors are both a user and a provider of resources (Cantù, Corsaro and Snehota, 2011).

According to Alam (2002), activities that supplier performs during co-innovation are similar to its activities in internal innovation processes. The literature on supplier involvement in innovation process identifies several different roles for suppliers. Supplier can operate as a *source of information* or *co-developer* (Lau, Tang and Yam, 2010). Especially in the early stages of the co-innovation, the supplier's role as *informer* is important for the success of the innovation (Petersen, Handfield and Ragatz, 2005). In the later stages of co-innovation process, supplier acts as a *tester* and a *marketer* who plans marketing and promotional campaigns (Alam and Perry, 2002). As the public funding of R&D is not that critical in industries which have professional networks (Breznitz and Zehavi, 2010), often the supplier plays the role of *financier*. That role is continuous through the entire innovation process if other financiers are not available.

From the viewpoint of the entire innovation process without dividing the co-innovation process into different stages, customers have been found to act as *passive users* who are tracked but do not participate in innovating, *active informers* who provide information or *bidirectional creators* who make suggestions and produce new knowledge (Blazevik and Lievens, 2008). Another division suggests that customer acts either as an *information resource* or a *co-developer* (Fang, 2008). However, customers have been found to have different roles during different stages of the innovation process (Enkel et al., 2005b; Öberg, 2010), and there are differences in the intensity of customer's input in each stage (Alam, 2002). In the early stages of the co-innovation process, customer's role is to be an *informer*, and to state needs through suggestions and complaints (Alam, 2002; Enkel et al., 2005a; Enkel et al, 2005b). When customer's roles are defined through the activities it performs (Alam and Perry, 2002; Alam 2005; Enkel et al. 2005a; Enkel et al. 2005b) a huge number of different kinds of roles can be found, such as a *reviewer* who gives feedback and a *tester* who runs trials. In the commercialization stage customers can act as *reference customers* and *first buyers* (Enkel et al., 2005b; Jalkala and Salminen, 2010). Hence, customers can be *active initiators* in the early phases, *co-developers* and *developers* before innovation is fully functional, and they play traditional *buyer*, *user* and *marketer* roles when the innovation is commercialized (Öberg, 2010).

Figure 2 summarizes the supplier and customer roles in the co-innovation process stages that were found from the literature. Similar roles are combined under a common role name. In reality, the division of stages and roles is not that simplistic as actors can play several roles simultaneously and one role can be valid through several phases (Öberg, 2010). Also the stages in the co-innovation process may be parallel which may lead to overlapping roles (Alam and Perry, 2002). However, this framework is used as a basis for the empirical analysis for supplier and customer roles.

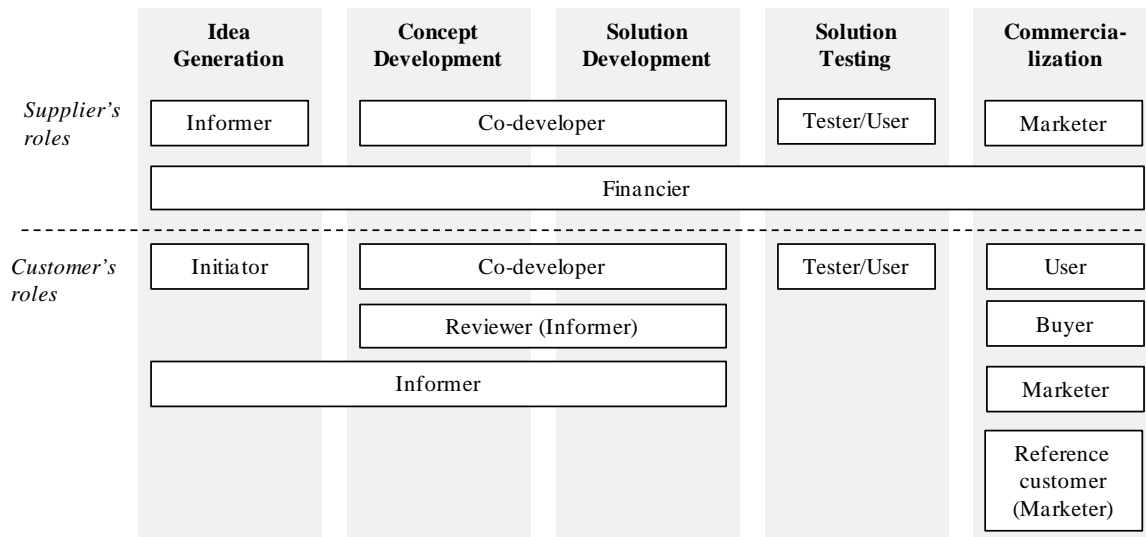


Figure 2. Supplier and customer roles at different stages of the co-innovation process.

RESEARCH METHOD

A qualitative explorative case study is conducted (Denzin and Lincoln, 2000; Yin, 1989), to contribute to holistic understanding (e.g. Eriksson and Kovalainen, 2008, p.5) of a complex and context-based phenomenon (e.g. Bonoma, 1985). Each of the seven cases concerns a co-innovation project between the same innovative supplier of complex process technology systems and its different customer firm (Appendix 1, case descriptions). The firm was selected due to its long experience in co-innovation with customers offering an expert view on the phenomenon and a broad selection of co-innovation projects. The cases are selected to offer a rich perspective on the phenomenon, representing different combinations of actors (e.g. also other suppliers and research institutions), different types of co-innovation outcomes (e.g. innovativeness, commercial readiness of the solution), and both shorter and longer co-innovation projects. As each of the seven cases concerns different customers but a single supplier, the diversity of a single actor's roles and goals can be analyzed across projects.

The main data (Table 1) consists of the interviews of key informants (Kumar et al., 1993) involved in the co-innovation processes from the supplier and in one case also from a customer firm. The informants were recruited through snowball method (Biernacki and Waldorf, 1981) and complementary archival data was analyzed for data triangulation (Denzin, 1988). Interviews were recorded and transcribed in text format resulting altogether 143 pages of A4 texts. Seven managers from the supplier firm were interviewed. Each manager was encouraged to discuss one co-innovation project with a customer they could remember well and they were asked open ended questions about how the process started, what happened then until the end of the project, the activities included, the actors involved and their goals, and the success of the project. The data collection was ended as the co-innovation process types started to reappear and satisfactory data saturation was agreed to exist for the purposes of this study.

Table 1. List of the interviews.

Data source	Interviewees	Date	Duration	Other data
Supplier Data for all of the 7 cases	Product Manager	11.11.2011	1 h 36 min	Company's internet pages, data sheets, project memos, conference article, process description
	Sales Manager	14.11.2011	1 h 22 min	
	Development Manager	17.11.2011	1 h 47 min	
	Sales Director	17.11.2011	1 h 58 min	
	Director	22.11.2011	59 min	
	Manager	23.11.2011	1 h 45 min	
	Technology Director	20.12.2011	1 h 36 min	
Customer Data for one of the 7 cases	Operating Engineer	01.03.2012	1 h 16 min	
	Production Foreman	01.03.2012	1 h 01 min	
	Research Director	01.03.2012	55 min	

Analysis followed the abductive logic (Dubois and Gadde, 2002), as the study started by building a preliminary theoretical understanding on the phenomenon before designing data collection and since then, the theoretical and empirical understanding have evolved side-by-side through systematic combining. Additions to the theoretical basis have been done based on the empirical findings and additional questions have been presented to the interviewees afterwards due to gained theoretical insight. Data analysis included the stages of data reduction, data display and conclusion drawing (Miles and Huberman, 1994). The data was categorized according to co-innovation activities performed by the actors, descriptions of the actors, and the goals of the actors on a case level. To support the understanding of these, also the coordination activities, the benefits for each actor, and the challenges were analyzed on a case level. After that the categorized data was tabulated and a cross-case analysis was conducted. Three co-innovation project types were indentified. Then, for each co-innovation project type, the roles of the supplier and the customer(s) were analyzed in terms of their goals and their breadth and depth of involvement in each stage of the process.

PRELIMINARY RESEARCH FINDINGS

Early in the analysis process it became clear that some of the roles are not identified across the cases because the seven cases represent three kinds of co-innovation processes (Appendix 2), which differ especially in respect to in which stages the customer was mostly involved, and the goals of the supplier and the customer. Therefore, the roles were analyzed in these three different co-innovation process types, which were named here as full-scale co-innovation, front-weighted co-innovation, and back-weighted co-innovation, describing the stages where both the supplier and the customer were active.

The supplier's involvement is broad and deep throughout each of the co-innovation process type, with one exception. In the front-weighted co-innovation the supplier's involvement in commercialization is not deep, as the outcome is not a ready commercial solution. Active marketer role of the supplier is therefore missing and the whole commercialization stage is not crucial in the front-weighted co-innovation. Instead, further co-innovation projects are planned based on the now developed outcome. *The customer's involvement* varies remarkably across the co-innovation process types. In the full scale co-innovation the customer takes part in all of the stages and can be quite deeply involved in idea generation, concept development and testing. In the front weighted co-innovation, the customer is deeply involved only in idea generation and concept development, but can be involved also in other stages. In the back-weighted co-innovation the customer is involved quite deeply only in the testing stage, but occasionally it can be superficially involved also in concept development, solution development and commercialization.

The most important *goal of the supplier* in co-innovation is to develop and commercialize new commercial solutions or when that is not yet possible, to develop new technologies to be applied later in new solutions (goals in Appendix 3). During the co-innovation the supplier

benefits from continuous feedback and information from the customer and testing on a real operating environment, which accelerates the innovation process and improves the quality of the solution. The most important *goal of the customer* in co-innovation is to improve their operations. Secondary goal to co-innovate with the supplier is to get the solution with a discount. That goal is strongly present in the back-weighted co-innovation, where the customer acts mainly as a testing site. In the full scale co-innovation the testing customers are interested in the development itself (actively offering feedback and improvement ideas and acting even as developers), and in the continuance of the good development relationship with the supplier, in addition to the operational goals. In this way, the goals and the roles are entwined. The customer's goal can also be to build their image and to be on the leading edge of technology development. *For both the supplier and the customer*, maintaining the good development relationship is an important goal. Co-innovating consecutively with the same partners does not only ease the selection of the partners and thus the beginning of the process, it also brings other benefits, such as fluent and fruitful cooperation as the parties know and trust each other. The full scale co-innovation processes are perceived as more extensive and relationship critical than, for example, back-weighted co-innovation. Based on this examination of actors' involvement and goals, the roles were then analyzed (Figure 3).

	Idea Generation	Concept Development	Solution Development	Solution Testing	Commercialization
<i>Supplier roles</i>	<u>Sponsor</u>				
	<u>Coordinator</u> Another party may coordinate front-weighted innovation		<u>Coordinator</u>		
	<u>Active developer</u>				<u>Marketer</u>
	<i>Seller</i> If the customer aims to buy from the start, or eventually buys, the commercial version of the solution				
	<u>Initiator</u>				
<i>Customer roles</i>	<i>Developer</i> Not in back-weighted co-innovation	<i>Co-developer</i> In full-scale co-innovation			<u>Passive marketer</u>
	<i>Initiator</i>	<i>User</i> In front-weighted co-innovation		<u>User</u>	
	<i>Informer</i> Not in back-weighted co-innovation	<u>Informer</u>			<i>Informer</i> Not in front-weighted co-innovation
	<i>Buyer</i> If the customer aims to buy from the start, or eventually buys, the commercial version of the solution				

(Shades of grey - how strongly the role was represented in the empirical study)

Figure 3. The identified roles of the supplier and the customer during the co-innovation process.

The supplier acts the role of the financier and coordinator through the co-innovation process in all of the types, with one exception. In the front-weighted co-innovation a university can coordinate the first, more explorative stages, and the supplier often starts to coordinate when the development of the commercial solution is at hand. The business interest of the supplier to develop and commercialize new solutions is the main factor behind the

dominant role of the supplier in co-innovation. The supplier is also an active developer and a marketer, and a seller in cases where the customer is buying the commercial version of the solution. Usually the supplier was also the initiator for co-innovation. *The roles of the customer* which are most strongly present across the process types are informer, then user, and then passive marketer. But even these roles appear differently in the stages of the different types of co-innovation processes. For example, typically customer acts as a user in solution testing and commercialization, but in the front-weighted co-innovation the customer acts as a user already during concept and solution development. In addition, in the full scale co-innovation the customer acts as a co-developer in concept and solution development. Thus, some of the roles are overlapping and exclusive – if the customer is a co-developer, it is also a user, but the role of the co-developer overruns the appearance of the user role. The customer can also act the developer or traditional buyer roles.

Major mismatches between the roles were not identified, which can be due to several reasons. Firstly, projects where major mismatches are foreseen are terminated early on. Secondly, all cases were considered successful through different measures lacking serious conflicts, and the success was often based on the long term cooperation between the actors in co-innovation. Thirdly and perhaps most importantly, with a long term co-innovation partner the cooperation itself is easier and it appears not to be problematic on a general level then to make the goals of the actors match, and accordingly, the roles fit together, as well. Typically the supplier wants to develop a new commercial solution and the customer wants to improve its operations. As long as both actors achieve their goals at least partially, major conflicts can be avoided. From the customer's perspective the role of the supplier in general is to provide technical expertise for solving customer problems, since the customers increasingly often lack the knowledge and resources to develop solutions on their own. From the supplier's perspective the role of the customer in general is to provide information on customer needs throughout the process and to act as a testing field and a reference.

Some minor mismatches were identified, though. When the supplier is too focused on developing the commercial solution, the customer can be forgotten along with a malfunctioning prototype. In addition, the co-innovated solution can end up being too customized to a particular customer in order to fit broader market needs. Occasionally the customer wants to be an active developer but it lacks the resources, slowing down the process, when the supplier's can save the project by taking over the development.

CONCLUSIONS

This study identified six overlapping roles for the supplier and seven roles for the customer across the co-innovation process stages. Importantly, the study comprised the entire co-innovation process in order to highlight the temporal dimension of the roles. Especially, the goals and involvement and, accordingly, the possible roles of the customer in each stage vary depending on the co-innovation process type. A major goal in co-innovation and other possible linked goals were identified for both actors. The goals of the actors are related to their shifting involvement and roles. In addition, three co-innovation process types were identified which differed especially according to the occurrence of customer roles.

The study contributes to the discussion on innovations in networks e.g. (Håkansson et al., 2009), the roles of supplier and customer firms during co-innovation (Blazevik and Lievens, 2008; Johnsen et al., 2006), and the types of co-innovation processes. Especially, this study provides insight into the changing roles of the supplier and customer firms at each stage of co-innovation by examining also the linkages between the actors' roles and the goals. The goals and the role of the supplier were surprisingly similar across the co-innovation process types, perhaps because the supplier had similar dominant position in all of them. If the supplier dominates the co-innovation process, that limits the possible roles of the customer.

Dominating leadership processes are associated with less innovation, and long term co-innovation relationships tend to move toward inertia, whereas deep and broad technological search contributing to the innovativeness of the new solution is more likely when the leader, and accordingly the driving objectives, changes during the co-innovation (Davis and Eisenhardt, 2011). That suggests that even though long term co-innovation partnerships can be beneficial, attention must be paid to the ways to keep the innovation potential alive. The most interesting findings concerned the varying customer roles. As assumed, the customer firm's depth and breadth of involvement and so also the role varies regarding to the co-innovation stage (e.g. Enkel et al., 2005b; Roy et al., 2004). However, this study was able to link the occurrence of the roles to certain co-innovation process types.

The same innovation can be developed with several customers in consecutive projects, following the iterative idea of co-innovation that involves cycles of learning (e.g. Steen, Hanson, and Liesch, 1998). As co-innovation often appears to happen within long-term supplier-customer relationships or other development relationships, the longitudinal perspective on the effects of the co-innovation projects on the relationship deserves attention (see also van Echtelt et al., 2008; Davis and Eisenhardt, 2011). The findings are in line with that solution suppliers need to see the customer deliveries as part of a relational process; the same way the customers see them (Alam, 2002; Tuli et al., 2007). According to Nambisan and Baron (2010), customers are more likely to be innovation partners if they feel that they are treated as partners. Similarly, the co-innovating customer should not be abandoned after the testing stage but the implementation and the updates for the solution need to be supported at the customer's site. Thus, perhaps a role of a supporter needs to be added to possible supplier roles in this context. For managers this study makes the often implicit roles in co-innovation perhaps more explicit and gives insight into managing different types of co-innovation projects. For example, in the back-weighted co-innovation the possibility to get the new solution with a discount was more important goal than in other types of co-innovation processes, which implies that when acquiring testing customers, this side of the co-innovation benefits might be emphasized.

Because the role of an actor becomes embedded and dependent on the level of the involvement, stage of the co-innovation process, and the industrial context, the generalizations should be made with caution. As this is work in progress, single supplier and customer data only from a single customer set limitations for the study. The findings supported the importance of the third parties in co-innovation (Biemans, 1991), especially the research institutes were remarkable actors at the exploration stage, suggesting that their roles and goals as actors of co-innovation could be studied further. The fit between the cases and the co-innovation process stages was somewhat compromised, and the examination of the actual proceeding of the co-innovation process is left for future investigations. Also the effect of the actors' resources on co-innovation roles could be investigated more deeply than in this study, because it appeared to be a critical antecedent for the roles, and resources are often claimed to be important for understanding innovation between different actors (e.g. Håkansson and Waluszewski, 2002). Here the resources were considered to affect roles indirectly through the involvement and the goals of the actors. The co-innovation processes have multifaceted pre-phases and also post-phases, meaning that usually the co-innovation processes are consecutive among familiar partners. Also Gressetvold and Torvatn (2006) argue that different innovation processes should not be examined as isolated events. This nature of co-innovation could be further examined to deepen the understanding of the long-term co-innovation relationships.

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Appendix 1. Case descriptions.

Co-innovation type	Case outcome and its actors	Description of the nature of the co-innovation
Full scale co-innovation	<p><i>Wireless process control system</i> Commercially viable innovative solution.</p> <p>Actors: The supplier and its customer abroad, two other customers, (a supplier network).</p>	<p>This is a true co-innovation project, especially during idea generation and concept development. The solution was ideated with the customer and the solution combined technology both from the supplier and the customer, but later the supplier took over the development because it was interested in developing a commercial product and had the resources to do that. Two other customers were involved in testing, and a supplier network was established later during the development to carry out the development and commercialization.</p>
Full scale co-innovation	<p><i>Online analyzer</i> Commercially viable product. A new research project was based on this project.</p> <p>Actors: The supplier, another equipment supplier, a customer, a research centre</p>	<p>This is a true co-innovation project where different actors are active at different stages, but the main actor throughout the project is the supplier. Another equipment supplier participated in concept development and solution development and brought in its technology. IPRs were agreed on a formal contract with the equipment supplier. One long term customer participated the concept development, solution development and testing. Parallel to this, a research centre was contacted for the further development of the analyzer for other contexts. After that the development continued with another research institute and two other customers in addition to the original co-innovation customer.</p>
Full scale (light) co-innovation	<p><i>Software for process control</i> New insights into developing a process control software. Not a commercially viable product.</p> <p>Actors: The supplier, a customer</p>	<p>The long term customer (with which the supplier has had several previous co-innovation projects), acted mainly as a testing site. Pre-project for the wireless process control system case.</p>
Front weighted co-innovation	<p><i>Reporting tool</i> Tailored reporting tool for a single customer, can be developed to a customizable product.</p> <p>Actors: The supplier, a customer</p>	<p>This is not a traditional co-innovation project, but a supplier-led and concept development-focused co-innovation within a sales project. The supplier was the main actor in all stages. The customer was the most actively involved in the idea generation and concept development. Testing at the customer's site was not conducted.</p>
Front-weighted (light) co-innovation	<p><i>On stream analyser</i> The commercial viability of the outcome is a bit unclear.</p> <p>Actors: The supplier, a university, a customer.</p>	<p>The main coordinator is the university and it also reports the results. But the supplier was still the main actor in co-innovation. Part of the funding is from external sources. A university was involved in idea generation. Customer provided insight into the practical problem, and provided the facilities for testing. The supplier has a long history in co-innovating with this customer.</p>
Back-weighted co-innovation	<p><i>Simulation system for training</i> Insight into training simulation system, piloted with some customer trainings (not with success). New project planned based on this.</p> <p>Actors: The supplier, a university a customer.</p>	<p>This explorative co-innovation project was conducted in parallel to another explorative co-innovation project, which was based on external funding and university collaboration. New features were developed for existing simulation software based on identified customer needs. The long term customer was active mainly in testing and providing feedback, and will participate in the forthcoming project developing further this same software (targeted at operators). The university was active in developing the system further.</p>
Back-weighted co-innovation	<p><i>Mixer</i> Totally redesigned parts for a mixer, commercially viable product, considered successful.</p> <p>Actors: The supplier, two customers at first, later more customers</p>	<p>This is a co-innovation project where the supplier is the main actor. Customers were mainly acting as testing sites and providing feedback. Two customers were involved as a testing site at first, to the second round of tests, more customers took part. Another first-round testing partner customer was especially motivated to participate, since it had similar kind of development project going on.</p>

Appendix 2. The roles and involvement of the actors in different types of co-innovation processes.

The deeper shade represents deeper involvement of an actor in a stage. “Also” refers to roles that were not present in *all* of the cases of the specific co-innovation process type.

Type	Actors	Idea generation	Concept development	Solution development	Solution testing	Commercialization
Full scale co-innovation (3 cases)	Supplier	Financier, coordinator, active developer Also: initiator (neutral or active)	Financier, coordinator, active developer	Financier, coordinator, active developer Also: initiator (neutral or active)	Financier, coordinator, active developer Also: marketer	Financier, coordinator, active marketer
	Customer	Informer (passive, neutral or active) Also: initiator (neutral or active), active developer	Informer (passive or active) Also: co-developer (passive or active)	Co-developer (passive or neutral), informer (passive or neutral)	Informer (passive, neutral or active), user	Informer, user, passive marketer Also: no role
	Testing customers	No role	No role	Passive co-developer, passive informer Also: no role	User, informer (passive or neutral)	User, passive marketer Also: Informer, buyer
Front-weighted co-innovation (2 cases)	Supplier	Financier, active developer Also: coordinator	Financier, coordinator, active developer Also: coordinator	Financier, coordinator, active developer	Financier, coordinator, active developer	Financier, coordinator Also: seller, marketer
	Customer	Active informer Also: developer, buyer	Active informer Also: buyer, user	User, (passive or neutral) informer Also: buyer	Also: no role, user, informer	Passive user Also: passive marketer
Back-weighted co-innovation (2 cases)	Supplier	Financier, coordinator, active developer	Financier, coordinator, active developer	Financier, coordinator, active developer	Financier, coordinator, active developer	Financier, coordinator, marketer (neutral or active) Also: seller
	Testing customers	No role	Also: no role, informer	Also: no role, informer	user (neutral or active), informer (passive, neutral or active)	User (passive, neutral), informer (passive or neutral) Also: buyer, passive marketer

Appendix 3. Goals of the actors in different types of co-innovation processes.

“Also” refers to goals that were not present in *all* of the cases of a co-innovation process type.

Actor's goals	Full scale co-innovation (3 cases)	Front-weighted co-innovation (2 cases)	Back-weighted co-innovation (2 cases)
Supplier goals	<u>To develop a new commercial solution</u>	<u>To develop a new commercial solution</u> Also: to sell a solution delivery project	<u>To develop a new commercial solution</u> Also: to continue good development relationship
Customer goals	<u>To improve operations</u> Also: to contribute to firm image, to develop a new solution, to continue development relationships, to get access to the leading technology	<u>To improve operations</u> Also: to get the solution with a discount, to get access to the leading edge technology	<u>To improve operations</u> , to get the solution with a discount Also: to get support for their own development project