# Customer/supplier interaction for radical technological innovation: inhibitor or facilitator?

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**Abstract**

This paper builds an argumentation for the position that customer/supplier interaction facilitates radical technological innovation. The paper is basically conceptual in nature and organises arguments on three ever more specific levels. First, some theoretical misconceptions are addressed to create an unambiguous understanding of what falls within the scope of this paper and what does not. In spite of the limited amount of research into customer/supplier interaction for radical technological innovation, the scarce research findings do indicate that customer/supplier interaction facilitates radical technological innovation and that it is a subject worthy of further investigation. Second, arguments are drawn from extant literature to strengthen the statement that customer/supplier interaction facilitates radical technological innovation in all phases of the innovation process. Considerable attention is devoted to developing a motivation for engaging in customer/supplier interaction during the fuzzy front end of innovation. The paper takes into account that initiative for radical technological innovation can come from either party in the customer/supplier interaction. On a third level the fundamental mechanism by which customer/supplier interaction facilitates radical technological innovation is discussed. It is suggested that the learning opportunities in the customer/supplier interaction contribute to reducing uncertainty in the highly unpredictable radical technological innovation process.

**Keywords**: customer/supplier interaction, radical technological innovation, customer orientation, fuzzy front end of innovation, initiative, learning opportunities.

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## Introduction

It is generally assumed that incremental innovation is customer-driven and that radical innovation is technology-driven (O'Connor and Veryzer, 2001; Wijmans, 2001). Incremental innovation is driven by a customer's concrete desire for a new version of an existing product or service with enhanced performance along some specific feature(s). In contrast, radical innovation originates more often from technological invention. The irrelevance of customer input in radical technological innovation has been an implicit presupposition in innovation research. Hence, customer/supplier interaction for radical technological innovation as a full-fledged and worthy research topic remains under-investigated. In research of radical innovation customer/supplier interaction was mentioned only marginally and was often regarded as an exceptional phenomenon. Radical technological innovations are manifestations of the conviction that technology has the potential to change customer behaviour and create new markets. From this perspective, customer input into the technological innovation process is regarded to be only of secondary importance. Furthermore, it is questioned whether a customer with limited technological knowledge and resistance to novelty and change would not be more of an inhibitor rather than a facilitator of the radical technological innovation process (Hamel and Prahalad, 1994; Moriarty and Kosnik, 1989; O'Connor and Veryzer, 2001). This leads to the central question of this paper: "Can customer/supplier interaction facilitate radical technological innovation?". Emphasis lies on developing an argumentation for the stance that customer/supplier interaction can indeed facilitate radical technological innovation. This focus does not mean that it is assumed that customer/supplier interaction can never inhibit radical technological innovation. To the contrary, customer/supplier interaction is most likely to contain a mix of inhibiting and facilitating factors with respect to radical technological innovation. However, the innovation inhibiting factors within customer/supplier interaction fall beyond the scope of this paper. The fact that the benefit of customer/supplier interaction for radical technological innovation still is a rather contested issue contributes to the attractiveness of the topic. Arguments for the potential within customer/supplier interaction to facilitate radical technological innovation build on extant theory as well as on empirical results of previous research. This paper states that in all phases of the innovation process customer/supplier interaction can contribute to radical technological innovation. Before explaining how the arguments for this statement are organised, the next paragraph clarifies the basic concepts in the paper's focus. These basic concepts are radical technological innovation and customer/supplier interaction.

*Radical technological innovation* is a type of radical innovation that has an important technological component. Radical technological innovation is defined as having its origin in a technology that enables a new technological feature or a familiar technological feature at unprecedented performance levels (O'Connor and Veryzer, 2001). Though some authors view the newness of the technology involved as a criterion for radical innovation (e.g. Chandy and Tellis, 1998), the definition in this paper follows Mascitelli's (2000) reasoning and states that radical technological innovation can be based on new technology or on innovative combinations of existing technology. The technology that serves as a basis for radical technological innovation can be developed in-house, acquired externally or be the result of any intermediate form of technology acquisition between the two extremes of in-house development and external acquisition. Even though, in this paper, it is not important where the technology originates from, the paper focus does imply that technology is involved that is believed to have the potential to serve as a basis for radical product innovations. As such, the radically innovative technology is the onset and/or subject of the customer/supplier interaction.
*Customer/supplier interaction* refers to all forms of interaction between a downstream and an upstream firm in the innovation network. The term customer refers to industrial

customers. They can be current or potentially new customers. In the context of this paper, customers are always prospective customers of the technological innovation under development. This way a more narrow approach is applied than in lead user research where lead users can also contribute to the innovation process without necessarily being prospective customers for the innovation under development (e.g. von Hippel, Thomke and Sonnack, 1999). Customer/supplier interaction can have many different goals and characteristics. These can range from establishing business transactions to exchanging information and from cooperation to competition. This paper focuses on that part of customer/supplier interaction that relates to radical technological innovation. Customer/supplier interaction can be formal and informal, and, personal and impersonal. Though one single occurrence of a customer/supplier interaction that leads to radical technological innovation is possible in theory, viewed the complexity of the context, it is more likely to take multiple interactions over time between customer and supplier firm in an evolving relationship to realise radical technological innovation (Medlin, 2004; Ritter and Ford, 2004). Such dyadic interactions as the customer/supplier interactions discussed in this paper do not take place in isolation (Anderson, Håkansson and Johanson, 1994). They are embedded in and influenced by each firm's network of inter-firm interactions. However, the influence of the network on the customer/supplier interaction falls beyond the scope of this paper.

The argumentation for the statement that customer/supplier interaction can facilitate radical technological innovation is multileveled. Arguments are organised on three levels that address the potential for facilitating radical innovation at ever deeper levels. The argumentation begins with a discussion of some general theories. Then customer/supplier interaction is discussed in the context of the innovation process. Finally, the underlying uncertainty reducing mechanism which facilitates radical technological innovation is presented.

Argumentation at a first level begins by addressing some misinterpretations of extant theory. These misinterpretations can lead to the incorrect conclusion that customer/supplier interaction inhibits radical innovation. It is shown how, given that each theory's basic assumptions are met, extant theory is, in fact, reconcilable with the position taken in this paper. In order to correctly interpret research results pertaining to the relevance of customer/supplier interaction it is important to distinguish between two pairs of literature streams. First, it is explained that radical innovations differ from disruptive innovations. Theories of radical innovation and theories of disruptive innovation award different roles to customer firms in the innovation process. Hence, it is crucial not to mix these theories in order to draw correct conclusions on the benefits of customer/supplier interaction during the innovation process. Second, it is stressed that being customer-oriented and being customer-led also describe two different approaches. Again, the two approaches differ in terms of the role they attach to customer input in the innovation process. It is clarified which of the two approaches is most suitable in a context of radical technological innovation.

On a second level, the potential for customer/supplier interaction to facilitate radical technological innovation is discussed for the different phases in the innovation process. Until now, the benefit of customer/supplier interaction was especially contested with respect to the fuzzy front end of innovation. In a discussion of recent research results it is clarified what kind of customers can facilitate the early, fuzzy phases of radical technological innovation. An important finding is that either firm in the customer/supplier interaction can initiate the radical technological innovation process and start the customer/supplier interaction for the purpose of realising the radical technological innovation.

Argumentation on a third, even deeper, level explains how customer/supplier interaction facilitates radical technological innovation by reducing uncertainty. Uncertainty reduction is achieved in the learning opportunities within the customer/supplier interaction. Realising radical technological innovation is the joint aim of the firms in the interaction. In interaction

with one another the customer and supplier firm learn about ways to make progress in the radical technological innovation process.

The paper is organised as follows. The next three sections introduce the arguments for customer/supplier interaction for radical technological innovation. Each consecutive section addresses arguments at an ever deeper level, as described in the previous paragraph. The paper concludes with an overview of the presented discussion. In addition, directions for future research are suggested, implications of the paper's findings for theory and managerial practice are discussed and limitations of the present work are identified.

## Argumentation level 1: General theory

This section draws on general theoretical streams for two purposes. The main aim of this section is to identify theoretical misinterpretations that might lead to incorrect conclusions concerning the benefit of customer/supplier interaction for radical technological innovation. In addition, the paper topic is clarified by relating it to the appropriate theoretical approaches. When discussing the potential for radical innovation in customer/supplier interactions it is essential to distinguish between certain theoretical streams. It is important not to confuse radical with disruptive innovation and being customer-oriented with being customer-led. Because these theories have different basic assumptions concerning the consequences of customer involvement, inappropriate application of their concepts can lead to incorrect conclusions.

### Radical versus disruptive innovation

The authors that originally coined the term disruptive innovation stress that they regret that disruptive innovation is often equated with radical innovation. They explain that disruptive innovation denotes a very specific type of innovation and that it may not be appropriate to transfer the research findings related to disruptive innovation to other innovation contexts (Christensen and Raynor, 2003). They clarify what disruptive innovation entails by stating that "disruptive innovations … don't attempt to bring better products to established customers in existing markets. Rather, they disrupt and redefine that trajectory by introducing products and services that are not as good as currently available products. But disruptive technologies offer other benefits – typically, they are simpler, more convenient, and less expensive products that appeal to new or less-demanding customers" (Christensen and Raynor, 2003, p. 34). It is exactly by focusing on these kinds of niche segments with, initially, underperforming technologies that disruptive innovations find an environment in which they can develop and grow. Incumbent firms do not have an offer for these segments since their technology is over-performing relative to these customers' needs. Hence, the disruptive technology can improve and grow, free from the threat of incumbent firms in these segments of customers with relatively modest needs. Key to Christensen's theory of disruptive technology is that such technology can gain foothold in the market by resisting the appeal of mainstream customers' wishes and concentrating on emerging segments (Bower and Christensen, 1995; Christensen and Bower, 1996, Christensen, 1997).

However, when disruptive innovation is equated with radical innovation the false conclusion is drawn that radical innovation can not ever be targeted at customers of the currently available alternatives that address similar needs. Consecutively, this false conclusion might lead to the incorrect conviction that interacting with those customers would be a pointless exercise when aiming for radical technological innovation. To avoid such false reasoning it is of capital importance to be aware of the theoretical difference between disruptive and

radical innovation. Radical innovation is defined as innovation that delivers market valued new technological features or familiar features at significantly higher performance or lower cost levels (Leifer et al., 2000; O'Connor and Veryzer, 2001). Since this type of innovation is defined as more performant than current alternatives, it would not make sense to avoid mainstream customers as is recommended for disruptive, initially underperforming, technologies. Hence in this paper, radical is not considered a synonym of disruptive and findings of research on disruptive innovations are not included in the present discussion.

## Being customer-oriented versus being customer-led

Two other streams of literature that should not be confused with one another are the literature on being customer-oriented and the literature on being customer-led. The two approaches assign different roles to customer input in the innovation process. Researchers have previously stressed the importance of distinguishing between being customer-oriented and being customer-led (Slater and Narver, 1998; Slater and Mohr, 2006). The philosophy of being customer-led is characterised by a relatively short term and reactive focus. In a customer-led approach traditional research tools are applied to capture the explicit wants of existing customer groups in order to develop the requested incremental improvements. In contrast, being customer-oriented requires a long term commitment to understanding not only the expressed needs of current customers but also the latent needs of current and potentially new customers.

A customer-oriented approach to customer/supplier interaction for radical technological innovation requires awareness of at least two fundamental conditions. First, in order for firms to reap the potential radical gains in customer/supplier interaction they need to explore new marketing research techniques. Classical survey-based market research is an excellent tool for revealing incremental product improvements and for monitoring customer satisfaction. But survey research is notorious for its inability to reveal market opportunities for radical innovation. Leonard and Rayport (1997) suggest observing customers in their natural usage situation to identify needs that customers themselves may be unaware of. When a supplier emerges himself in his customer's environment he can explore customer products and processes with the unbiased eye of an outside observer and combine these observations with knowledge on technological possibilities. McQuarrie (1993) also stresses that customer visits are an interesting tool for uncovering information that can direct technological innovation efforts towards real customer needs. Useful sites and individuals for observation can be found within customer firms, customers of the customer or in firms closely linked to customers. A second condition is that firms that seek to commercialise new technologies need to invest in interactions with new customers that may be situated in unfamiliar markets. Such interactions can be especially cumbersome because of the very different knowledge bases of the two firms involved. However, if real potential to radically innovate is recognised in a technological application, by supplier or by customer, the interaction between the two firms provides many opportunities to fine-tune the innovation both in terms of identifying needed functionalities and technological specifications.

There is a growing body of research that confirms that customer orientation facilitates radical innovation. Multiple studies identify customer orientation as one of the antecedents of radical technological innovation (e.g. Herrmann, Gassmann and Eisert, 2007; Hult, Hurley and Knight, 2004; Lukas and Ferrell, 2000; Tajedinni, Trueman and Larsen, 2006). According to Herrmann et al. (2007) such customer orientation is characterised by "intense, dialogue-oriented customer interaction, and … the capability to take into account future market needs and implicit customer needs" (p. 103). Lukas and Ferrell (2000) find that customer orientation increases the introduction of radical innovations. Dutta et al. (1999) argue that especially technological innovation projects have a lot to gain from customer

orientation. The authors stress the importance of keeping customers informed of innovative technologies and of future research and development initiatives undertaken by the supplier firm. Callahan and Lasry (2004) find that the importance of customer input in the innovation process increases with technological newness of the product under development. These findings provide ample justification for a research focus on the benefits of customer/supplier interaction for radical technological innovation.

## Argumentation level 2: Innovation process

In this section, the benefit of customer/supplier interaction for radical innovation is discussed in terms of the different phases of the innovation process. Previous research addressed the role of the customer in all phases of the radical technological innovation process (Vercauteren and Vanhaverbeke, 2007). There is a general consensus that, regardless of the level of innovativeness, customer/supplier interaction is desirable at least from the prototyping phase onwards. Whether customer/supplier interaction can contribute to the fuzzy front end of radical innovation is a more contested issue. The fuzzy front end encompasses the stages of idea generation, idea screening and product concept development.

Lead user research is perhaps the most fully developed stream of research that confirms that ideas for radical technological product innovations can be generated and developed further in a customer-oriented approach (von Hippel, 1986; von Hippel, 1988; von Hippel, 2005). More recent research finds that also users that do not meet all of the lead user characteristics, can be well-placed to generate radically innovative product ideas (Lettl, Herstatt and Gemünden, 2006; Vercauteren and Vanhaverbeke, 2007). Lead users are defined as users that face needs years before the bulk of the market does (von Hippel, 1986). Recent research confirms that also users that face needs that are commonly faced by all users in a market, can contribute to radical technological innovation. These users actively seek outside of their own industry for technologies that can potentially meet their very demanding needs. They actively forge an innovation network by initiating interaction with one or multiple suppliers. In customer/supplier interaction the customers cooperate with the suppliers to develop a radical technological innovation that provides a solution for their needs. The fact that users or customers are able to initiate these kind of radical technological innovation processes provides justification for a shift away from a supplier oriented approach to the study of customer/supplier interaction for radical technological innovation in favour of a study of customer/supplier interaction for radical technological innovation that acknowledges the potential equality of the two parties or even the dominance of the customer firm in initiating the innovation process. Such actively innovating customers are characterised by openness to new technologies, intrinsic motivation and they are embedded in an environment that supports creative thinking and innovation (Lettl, Herstatt and Gemünden, 2006). A prerequisite for these potential customers to be able to establish a link between their needs and a new technology is that this technology is known in the market (Vercauteren and Vanhaverbeke, 2007). A supplier can accomplish this by a purposeful publication strategy on the in-house technological developments. This may prompt potential candidate customers to get in touch. It can also be a matter of having other applications, maybe even incrementally innovative ones, in the market. These applications allow market constituents to become familiar with the underlying technology and recognise any value that the technology might have in their own usage situation. A digital portal on the supplier’s website can provide an interface where potential customers can communicate their new product ideas.

Note that the failure rates in radical innovation are remarkably high and that this increases the cost of radical innovation (Choffray and Lilien, 1980; DiMasi et al., 2003). Intermediate 'failures' are known to be inevitable in the highly uncertain radical innovation process. Also many of the radical product ideas generated in customer/supplier interaction can be expected to be dead ends. However, customer/interaction in the fuzzy front end of radical innovation has the potential to separate genuine dead ends from product concepts worth pursuing further in an early phase. This way, customer/supplier interaction can contribute to faster and cheaper identification of such dead ends.

## Argumentation level 3: Fundamental processes

This section discusses the fundamental process by which customer/supplier interaction facilitates radical technological innovation. It is suggested that through the learning opportunities in the customer/supplier interaction progress is realised in the radical technological innovation process.

Customer/supplier interaction can be a cumbersome process. Especially in the context of radical innovation, customers and suppliers may start to interact with one another without having a previous record of buying from or selling to the other. The interaction may be complicated by differences in the cultural and organisational context of the parties involved. Negotiation for value and property rights may become part of the innovation process as soon as multiple parties start to contribute. The above considerations may urge management theorists and practitioners alike to advice against customer/supplier interaction during technological innovation. Nonetheless, Zajac and Olsen (1993) argue that investments in such seemingly uneconomic interactions can actually result in benefits that far outweigh the invested efforts.

Customer/supplier interaction during the innovation process has the potential to reduce both parties' experienced uncertainty (Gruner and Homburg, 2000; Salomo, Steinhoff and Trommsdorff, 2003). We refer to previous research (Vercauteren, 2007, p. 98-108) for a more detailed analysis of the specific areas in which customer and supplier experience uncertainty during radical technological innovation. Here, we focus on the way the uncertainty reduction comes about.

In an innovation process that entails interaction between customer and supplier firms uncertainty is reduced through the learning opportunities in the inter-firm interactions (Huber, 1991; Slater and Narver, 2000). Also the interactions between suppliers and their potential customers can incite learning in every phase of the innovation process. Customers can be active or passive sources of new product ideas. On the one hand, customers can actively approach manufacturers to urge them to develop or co-develop solutions for their specific needs. Such customers are actually looking for 'lead manufacturers' with specific technologies and competencies that make them particularly suitable to meet their needs (Lettl, Herstatt and Gemünden, 2006). On the other hand, suppliers can generate new product ideas from gaining access to customer environments and observing the customer in his natural usage situation. In that case, the aim is to learn about latent needs, of which the customer did not even know they could be addressed. In continued interaction between customer and supplier radically innovative solutions can be generated and developed further. In unfamiliar markets customer and supplier interact to learn about one another's technological possibilities on offer and usage context in need of a, preferably radically innovative, solution. The learning process enables both parties to define an innovation's relevant functionalities and technological specifications. When prototypes start to materialise access to prospective customers' infrastructure can enable learning by

experimentation in a real-world environment (Lynn, Morone and Paulson, 1996). As customer and supplier interact, they each deal with the high uncertainty they experience initially in the radical technological innovation process by learning in various ways and on multiple aspects of the radical technological innovation they aim to realise jointly.

## Conclusion

The aim of this paper was to alleviate doubts about the potential of customer/supplier interaction to facilitate radical technological innovation. This goal was accomplished by establishing a multi-levelled argumentation. First, some general theoretical misconceptions were addressed that can falsely lead to the conclusion that customer/supplier interaction inhibits radical innovation. This section implicitly urges researchers to clearly state the basic assumptions of their own theories and respect the assumptions of others' theories. On a second, more specific level the benefits of customer/supplier interaction are discussed in terms of the different phases in the innovation process. Scattered findings on the customer's role in radical innovation are integrated in previous research (Vercauteren and Vanhaverbeke, 2007). In this paper, recent research results are the basis of an argumentation that states that even in the fuzzy front end of innovation customer/supplier interaction can facilitate radical technological innovation. An opportunity for further research lies in the study of innovation processes that originate from a customer request. This seems to be a gap in extant literature. Furthermore, it could be an interesting avenue for further investigation to compare radical innovation processes that originate from a customer with those that originate from a supplier. The two processes can be compared in terms of the kind of customer/supplier interaction they result in and how the innovation networks are established. Third, the fundamental process by which customer/supplier interaction facilitates radical innovation is explained to be a learning mechanism. This learning mechanism contributes to reducing the high levels of uncertainty as experienced by both firms in the customer/supplier interaction for radical technological innovation. Besides interactions between customers and suppliers, the learning opportunities in interactions with competitors and suppliers of complementary products and services can be investigated in further research.

The main implication of the findings in this paper for theory is the need for future research that weakens the assumption of supplier dominance both in the radical technological innovation process and the customer/supplier interaction process. Recent empirical findings indicate that customer firms can be able to recognise the potential for radical innovation in suppliers' technologies. There is a need for a theoretical framework that incorporates such customer initiative for radical technological innovation and for customer/supplier interaction as a way to facilitate the realisation of the radical technological innovation.
For managers, it appears that there is real potential for radical technological innovation in customer/supplier interaction, even though interactions between suppliers and customers without a previous history of interacting may seem very cumbersome and uneconomical from a manager's perspective. This paper's findings indicate that it may be worth investing in such new interactions with a potentially very complex aim, i.e. radical technological innovation, since opportunities for radical technological innovation may be recognised by a manager outside your own firm. This manager may be working in a firm that can end up being a valuable supplier or customer.

This paper ends with the discussion of some limitations in the presented work. Due to the inherent complexity of radical innovation processes and the fact that radical innovation is relatively rare, research into radical innovation more often applies qualitative research methods than quantitative ones. As a result, it is impossible to make statements about the

statistical generalisability of the presented arguments. When instances of customer/supplier interaction during the radical innovation process are researched qualitatively it allows us to delve into the innovation and interaction process and its specific context. It does not allow us to assess how often such interaction occurs in general or how often it actually leads to radical technological innovation. There is reason to doubt that this kind of information can ever be generated since this would entail designing a research method that combines the high reliability, which is typically associated with quantitative methods, with the high validity of qualitative research.

Another limitation is the starting point of dyadic interaction by focusing on customer/supplier interaction. Previous research finds that the radical technological innovation process is located in a network of firms (Håkansson, 1987; Powell, Koput and Smith-Doerr, 1996). The network is made up of firms with varying competences and roles in the network. It is in interaction with one another that the firms in the innovation network influence and shape the innovation under development. Interactions between customer and supplier firms are also part of the radical technological innovation process that is situated in an innovation network. Hence the dyadic view in this paper is not contradictory to the network view. Nevertheless, a dyadic view is a relatively narrow approach to reality. The findings in this paper on the facilitating effect of customer/supplier interaction on radical technological innovation can be transferred to a context of inter-firm interactions in an innovation network. In such an innovation network multiple interactions take place in different customer-supplier dyads and also between firms in other roles than customer and/or supplier firm.

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