How Customer Interaction Improves Technology Driven New Product Development in Industrial Markets

Anne Vercauteren

Hasselt University

Agoralaan – Building D

3590 Diepenbeek

Belgium

anne.vercauteren@uhasselt.be

Abstract

This paper shows how customer interaction in industrial markets enables the creation of a value offer tailored to the target market's needs. The resource dependence theory helps understand how in technology driven environments early customer interaction provides direction to research and development efforts. The empirical part of the paper is a detailed description of a development project in a large chemicals company. Interactions with various types of firms in the target market for the product under development are discussed and analyzed. The driver for these interactions is a mutual dependence.

Keywords: device/product, customer interaction, resource dependence.

Introduction

New product development departments in technology driven firms run the risk of developing technological devices instead of products (Millier 1997, Davidow 1986). In their pursuit of technical performance for performance's sake they can loose sight of the selling proposition to be made. Technological devices "stand for 'the best' which is 'the enemy of the good'. They carry the myth of Technology-that-sells" (Millier 1997, p. 43). In contrast, basic marketing tells us that markets need products that fulfill customer needs. In the worst case, devices fail to meet a customer need. In case they do meet customer needs they offer unnecessarily high performance levels or they do not fit into the user's systems.

Work as early as that of Cooper (1975) already identifies the sources of failure for new industrial products. In industrial markets disappointing sales are typically caused by marketing flaws and not technical inadequacies. A lack of understanding of customers, competition and/or the marketplace leads to product failures. Cooper calls this lack of understanding a resource deficiency. The product developing firm simply did not have and did not acquire the resources needed for successful product development and launch.

Theoretical framework

This paper focuses on gaining a better understanding of prospective customers' needs and usage situation by interacting with them during the product development process. Relatively recent work shows that customer input in the new product development process becomes more important as technological newness and overall innovativeness of a product increase (Callahan and Lasry 2004; Salomo, Steinhoff and Trommsdorff 2003).

We argue that the resource dependence theory provides a useful framework for understanding how industrial firms solve resource deficiencies during product development. Our premise is that interacting with industrial firms, which are prospective customers for technology-based products under development, during new product development activities, facilitates the development process. The resource dependence theory states that for continued survival in the marketplace firms depend on the resources in their external environment. But firms are also seen as active managers of their own fate. Hence, firms develop strategies for coping with these dependencies through coordination with the resource owners (Pfeffer and Salancik 2003). For the development of new technology-based products in industrial markets the inventing firms depend on their prospective customers for resources. By interacting with customers the inventing firm gains access to external resources that are particularly relevant for directing development activities towards the creation of a market valued offer.

The Laser Case

The empirical part of this paper is a case study in which the interaction with prospective customers is pivotal in the development process of a technology-based industrial product. The Laser Case is situated in a large European chemicals company. We begin the section with an overview of methodological techniques used for building the case. Then, we provide some background for our case by describing its context. Third, we discuss the technological grounds of the product under development. We elaborate on the technology's application possibilities in the fourth paragraph. We conclude with discussions of the interactions with ear tag manufacturers and the interaction with a raw materials supplier respectively.

Methodology

The Laser Case is selected because of the technology-driven nature of its product development process and because it entails interaction with industrial customers. The project is housed within a large company. A study of how customer interaction contributes to the development process of industrial products necessitates a qualitative research strategy (Yin 2003). It is important to personally interview the managers involved to be able to probe for the how and why of interactions, decisions and processes. For appropriate interview techniques we studied Kvale (1996). All personal interviews are transcribed for analysis following Miles and Huberman's (1994) guidelines. Complementary to the interview data, intermediate business plans and corporate presentations are collected and analyzed. Respondents are also contacted by telephone for short follow-up conversations and for posing clarification questions that arise during analysis.

Case context

More specifically, the Laser Case's origin is situated within the laser center of the large chemicals company. This laser center is equipped with four lasers and three to four people with 10 years experience. These R&D people perform development activities for about 25 laser markable materials mainly for the engineering plastics group of the chemicals company but also for external customers. The center was originally also doing work for two other groups within the firm but when these are sold to other companies the center's customer base falls back considerably. On top of that, the government funding, that was instrumental for the center's start-up and continuation, reaches an end. In February 2002, a business development manager is appointed to identify a future direction for the laser group. She looks into possible alternative activities for the center such as doing job shop or consultancy. However, neither of these activities falls within the scope of the mother firm. She also considers integrating the center into a business unit as an internal service center. She finds herself necessitated to think about a slow phase out scenario for the center.

Technological invention

In May 2002 however, two R&D members of the laser center do a turnaround discovery. They found a universal solution for crystal clear and inerasable laser writing on virtually any type of plastic. Traditional methods of laser writing mean that plastic particles are carbonized under a laser beam. The technological invention does not entail carbonizing the plastic itself. Instead, newly developed laser active particles are brought into the plastic polymer. The plastic polymer is the matrix material. Adding the chemical additive to the matrix material results in a compound material. A laser beam carbonizes only the added laser active particles in the compound material. The result is plastic material that is more clearly and inerasably inscribed. Laser writing with the traditional method was erasable. The invention of the chemical additive enables high quality laser marking that is inerasable. Furthermore, the laser marking quality is independent of the characteristics of the polymers in which the additive is used. The basic technological principle is that adding the chemical additive to a matrix material enables matrix independent carbonization. Now, an almost endless list of plastics becomes laser writable, from silicon rubbers to polyolefins and engineering plastics. The additive is also apt for a broad range of production methods including extrusion and mould forming.

Application possibilities

The inventors team up with the business development manager to commercialize the new chemical. By the end of the year 2002, a patent application is filed and the first business plan is drawn up. In May 2003 team members present their new material at a seminar organized by a laser supplier. Potential customers from various market segments show interest. Several application possibilities are identified and pursued. The invention can be used for laser writing plastic corks for bottles and for silicon keypads for telephones and computers. In the security industry high quality and inerasable laser marking on identification passes results in better security guarantees. This paper concentrates on the application of the chemical additive for improved laser writing on ear tags for cattle.

Interaction with ear tag manufacturers

The presentation of the new chemical at the laser supplier's seminar triggers the attention of several ear tag manufacturers. They need to laser write registration numbers on the ear tags for cattle. Ear tags that were laser written following the traditional method tended to change colour and the writing would fade under the exposure to UV light and ammoniacal products. Chemically resistant ear tags can be produced with the newly developed chemical.

At their request, about a dozen ear tag manufacturers in different European countries are sent samples of the first grade of the new additive to do trials with it. Since neither the development team, nor the mother firm of the development team has any experience in this market, it is crucial to start up an interaction with parties such as ear tag manufacturers to learn about the specific requirements of their usage environment. Allowing these potential customers to do trials with the material in a real life usage situation provides the most relevant feedback on the material's performance. Hence, all the manufacturers that have received sample material are strongly requested to report back their experiences to the development team. About twelve ear tag manufacturers communicate problems, which they experience with the material, back to the development team. From this feedback the development team can identify three general problems that need attention. A first problem related to the laser writing speed, which was too slow. Second, the additive did not perform at all with some of the laser systems used. And third, several ear tag manufacturers uttered that they were afraid that the chemical additive wouldn't mix optimally with the polyurethane matrix material that was used for ear tag production. They feared that in the longer term the compound material would fail. They claimed that the fact that the chemical additive was based on a different carrier than their raw material posed a problem. This last 'problem' is a risk that researchers of the development team could immediately disregard based on their material knowledge. Nevertheless, the fear for suboptimal results on the longer term seemed to form an obstacle for some of the ear tag manufacturers.

The first two problems did really need the researchers' attention though. In the laboratory the researchers had worked with the latest laser writing systems. In practice however, ear tag manufacturers were working with older lasers. The chemical additive performed different or not at all with some of the older laser systems. For a moment, the team considers providing every ear tag manufacturer with a new laser together with the first grade chemical. Buying a new laser for each customer could actually turn out less expensive than incurring the costs of developing a new grade of the chemical additive. However, when researchers visit an ear tag manufacturer's production site and see that a production line can contain up to seventy lasers, the idea of giving away one laser per customer is quickly abandoned. Even when a potential customer uses only one laser, the laser is never used in a stand alone fashion. The simple fact that laser systems are integrated into the production line makes switching to another system quite complex. In many cases, it is even impossible to integrate a different laser system into an existing production line.

Customer site visits also enable researchers of the development team to correctly interpret some of the complaints ear tag manufacturers had. The ear tag manufacturers used to send some of the ear tags produced using the sample material back to the development team. This way, researchers within the development team could analyze the composition of and laser writing on the material to find out about the causes of any unforeseen results. In one case, adding the chemical to the raw material gave fluctuating results. However, in the lab the chemical's performance was already very robust. This meant that the optimal relative amount of additive to be added to a matrix material was known. This specific concentration level delivered good results in a reliable way. This specific ear tag manufacturer was using a die-casting machine to produce ear tags. While visiting the ear tag manufacturer's production site and studying his work flows and equipment the researchers observed that with this type of machine waste material is typically added to the original feedstock at the start of the production process. Continuously adding waste to the initial feedstock can cause fluctuations in the concentration of the chemical additive in the total compound material. The ear tag manufacturer who neglects taking concentration fluctuations caused by adding waste, into account in his production process, ends up with suboptimal results. But the manufacturer incorrectly attributes the failure to the quality of the chemical additive instead of to concentration fluctuations he unknowingly causes himself. By interacting closely with the ear tag manufacturer, analyzing his end products and workflows on his production site, the true causes of certain problems are identified. These are problem causes that the ear tag manufacturer incorrectly attributed to material properties.

Nevertheless, the researchers are necessitated to develop a new grade of the chemical additive to enable laser writing with less recent laser systems. They succeed in developing such a grade. The new grade is sent again to all twelve manufacturers for trials. However, the manufacturers are still not completely satisfied. Even though the additive's performance comes really close to the promised result, the manufacturers have a different kind of requests now. The ear tag manufacturers are trying to cut their costs. The laser writing speed on the first grade of the chemical additive was slower than the speed with which they were initially laser writing their polyurethane without the additive. The second grade of the chemical additive enables laser writing to take place at the same speed as they were initially using. However, having experienced the improvement in writing speed of the second grade the manufacturers are asking for an even better laser writing speed so they can speed up their production process. Furthermore, they want the researchers to develop a grade that delivers the same quality with less of the chemical to be added to their matrix material. On top of that, they are still demanding that the carrier of the chemical is changed to one that closer resembles their raw material.

In the background of these negotiations, the development team had also started interacting with a raw materials supplier.

Interaction with raw materials supplier

At the end of 2003 the development team is approached by a raw materials supplier who is interested in an additive that enables matrix independent laser writing. The supplier got in touch with one of the development team's researchers after reading about the new chemical on the Internet. One of the supplier's materials is polyurethane, the raw material used for ear tag production. Ear tag manufacturers are an important customer group for the supplier. Later on in the cooperation, the development team learns that some of its material also reached the raw materials supplier through one of the ear tag manufacturers. While cooperative activities are still ongoing with the ear tag manufacturers, the development team also starts cooperating with the raw materials supplier. The supplier turns out to be more familiar with research and testing activities. The firm also has better technical knowledge on material properties than ear tag manufacturers do. After appropriate testing, the supplier confirms that there are no objective grounds for the ear tag manufacturers' fear that the chemical additive's carrier could cause problems when used in polyurethane. The raw materials supplier confirms to the development team that he has no objectives to the currently used carrier. Ear tag manufacturers have also mentioned that they would prefer to receive a compound material that already includes the chemical additive over receiving the matrix material and the chemical additive separately and having to mix them themselves. The raw materials supplier would offer to mix the material for his customers. Now, the raw materials supplier wants to look into the possibilities of developing a grade that can be used in lower concentrations and he also wants to look into the possibilities of switching to another carrier. Only this time, the raw materials supplier does more than half of the work involved in testing different carriers. The development team's effort is more or less reduced to laser marking samples that the raw materials supplier delivers and delivering an analysis of the results. The supplier does not have laser equipment himself. The development team agrees to switch to the requested carrier, even though it does not alter chemical properties, because of the ear tag market size. In the mean time, development activities with the twelve ear tag manufacturers are put to a stop. They are informed about the relation with their raw materials supplier and that they can get the material from him after the chemical's properties are fine-tuned. At the moment, the development team counts on the current development activities leading to a third and final grade. The grade should use a different carrier and enable laser writing at an even higher speed.

Discussion

In the Laser Case, the inventing firm engages in an interactive process with twelve ear tag manufacturers and a raw materials supplier to gain the necessary knowledge to appropriately fine-tune its newly developed chemical. In what follows, we make a link between, on the one hand, the case context and the risk of developing devices as portrayed in the introduction and, on the other hand, between the case and the resource dependence theory as discussed in the theoretical framework section.

From technological device to product

The Laser Case shows how concentrating on technological performance can lead to an end result that is not in line with market practices. Standing at the source of technological progress, the research team had worked with the latest laser techniques. In a laboratory context this is the logical thing to do. However, when visiting production sites of potential customers, the researchers are confronted with practice. In less high tech production processes, that nevertheless apply laser techniques, older laser systems are used. The first grade of the chemical additive shows some characteristics of a 'technological device' in the sense that the grade was so well tuned to the latest laser techniques that it did not perform well or it did not perform at all with some of the older laser systems. The chemical did not fit into the target users' systems. The team initially outperformed the market. Not all applications need the latest laser systems. Many potential customers are still satisfied with the less recent systems. It would not even be economically feasible to expect these industrial customers to switch to the latest laser systems. This meant that the research team was sent back to the lab with the assignment to look for a solution for laser writing under the conditions as they were found in practice as opposed to the technologically most advanced conditions under which the first grade of the chemical was developed.

A resource dependence perspective on the Laser Case

The basic premise of our link between the Laser Case and the resource dependence theory is that knowledge is a strategically important resource in technology driven product development (Teece 1998). The interaction with prospective customers is aimed at overcoming a dependence on the external resources, being knowledge and production infrastructure, which these customers possess. In an early phase of the chemical additive's development the feedback from the twelve ear tag manufacturers is invaluable both for learning about what prospective customers like about the additive and for identifying problems with and hurdles for use of the new chemical. This is knowledge that was external to the chemicals company and that is accessed by interacting with the resource owners, being the ear tag manufacturers. By interacting with ear tag manufacturers the development team also gains access to these firms' production sites. The production sites are seen also as a resource. It would be uneconomical and even impossible for the development team to acquire or simulate such production environments in-house for the purpose of fine-tuning its product under development. Setting up a simulation of an ear tag production environment to enable trials on different grades of the chemical under development would be an uneconomical option since ear tag production is nowhere near the core business of the mother firm. It would be time and money ill spent to acquire such a site. Because the simulated ear tag production site would not serve any other purpose then trials and testing, it becomes highly unlikely that the investments made would be earned back. This scenario would also be impossible for the research team since the ear tag market is an unknown market for the team to begin with. As a consequence the team is too unfamiliar with ear tag production environments to attempt simulating such an environment in-house. Hence, as the resource dependence theory suggests, the development team in the Laser Case is highly dependent on gaining cooperation of different parties in the ear tag market to gain access to real life production environments for trials. The Laser Case shows how gaining access to production environments enables crucial lessons in the chemical's development process.

Application possibilities for the chemical additive under development are all within market segments where the chemicals company currently has no customers. Consequently, the development team experiences a lack of the relevant knowledge needed to fine-tune its offer to market needs. The fact that the inventing firm does not have any current customers in the aimed market strengthens its dependence on new prospective customers for the needed knowledge and access to customer sites for trials (Zander and Zander 2005). Starting up interactions with new prospective customers in unfamiliar markets involves a whole set of different challenges then interacting with current customers does. Interacting with unfamiliar markets resembles a trial and error process to the extent that as the development team progresses it learns about the different parties in the market and their strengths and weaknesses. Initially, the development team engages in interactive activity with a dozen ear tag manufacturers. Although this constellation may seem inefficient from a coordination cost perspective Zajac and Olson (1993) stress that in inter firm interactions as these, it is important to address issues of joint value maximization and the processes by which value is created and appropriated. In the Laser Case the manufacturers provide the team with useful information concerning the identification of problems that users in the target market experience with the chemical. The most striking lesson is that this market segment is using relatively outdated laser systems with which the first grade of the chemical additive does not perform as planned. The ear tag manufacturers also send back the ear tags produced with the sample material to allow the research team to properly analyze the results. The result is that the development team is able to align the chemical under development with market needs and usage situations. Thereby the value of the chemical additive for the target market increases. The development team increases its coordination costs by engaging in interactive activity with other firms. However, these interactions do allow the team to improve its value proposition by accessing relevant customer knowledge. Nevertheless, setting up and maintaining interactive activities with twelve ear tag manufacturers is a cumbersome process. As the development activities progress, the development team gets in touch with a raw materials supplier. This firm provides an excellent occasion to reduce coordination costs again. Especially, since this party has better materials expertise and is more apt to doing research, the choice is easily made to realign development efforts towards an interactive cooperation with one firm: the raw materials supplier. Coordination costs are reduced considerably by putting an end to the interactions with the twelve ear tag manufacturers. The ear tag manufacturers are also less desirable codevelopment partners because of their limited materials knowledge. The ear tag producing firms are clearly focused on 'manufacturing' rather than on 'critical thinking about materials and processes'. The switch to an interaction with one materials supplier instead of twelve manufacturers opens up possibilities to create an even better value proposition because of the skills of the raw materials supplier. On top of that, this joint value can be created with less coordination costs.

Finally, we add to the resource dependence theory that it is important to note that all interactions observed in the Laser Case were driven by a mutual dependence, whereas the resource dependence theory seems to depart from a dependence in one direction. The inventing firm depends on firms in the ear tag market for relevant information and access to production sites for performing trials. But every party in the ear tag market also depends on the inventing firm for access to the chemical additive under development that offers improved value to the ear tag market. Ear tag manufacturers as well as the raw materials supplier perceive increased value in the new chemical compared to their currently used materials. All parties want early access to the chemical and preferably with some exclusivity arrangement. The raw materials supplier wants to appropriate some of the extra value created by the development team by functioning as an intermediary between the chemicals company and the ear tag manufacturers. The raw materials supplier is willing to put in an extra research effort to tempt the development team away from direct negotiations with the ear tag manufacturers. In turn, the raw materials supplier becomes an approved supplier for the new chemical. This way, he appropriates some of the value created. With the new chemical additive in its product portfolio he can make a better value offer to ear tag manufacturers and maybe also to some of his other customers. The development team benefits from the results of the supplier's research effort and reaches a broader market by interacting with one instead of twelve firms. Furthermore, the core business of the chemicals company is the production of chemical granulates. The laser active chemical additive is itself a compound material and as such falls outside of the core business of the mother firm. Compound materials are produced by master batch firms. Master batch production does not fall within the scope of the mother firm. The raw materials supplier would be willing to manage master batch production of the new chemical. Mutual dependencies such as these keep the interactions going between the development team and firms in the ear tag market.

Conclusion

It is not surprising that, in laboratories, there is a tendency to develop technical devices instead of products. However, we should not forget that this technological genius constitutes the basis for new products. In that sense we do need technological inventions. This paper shows how early interaction with prospective customers enhances the creation of a market valued product that has its origin in a technological invention. Through interaction with prospective customer firms, external resources are accessed that redirect development activities towards the creation of a value proposition tailored to the target market. These external resources are a combination of knowledge and customers production sites. The knowledge consists of customer feedback about trials with different versions of the product under development. It is also crucial for development teams to gain access to production sites of prospective customers to study production work flows and the type of equipment used.

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