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Abstract

Today, new product development (NPD) is viewed as one of the fundamental drivers of competitive advantage of firms. Despite the focus on customer orientation customers are often only called in to make an initial position sensing during new product development processes. Later on, they also effect a continuous validation of solutions generated by enterprises. However, the opportunity of regarding customers as partners of value creation during NPD as well as the chance of actively involving them into the process is often neglected. However, there is a lot of potential of customer integration during the whole process of NPD. Especially, the advent of internet technologies allows a variety of different forms of customer integration during NPD. In this paper we develop a typology of different online customer integration forms, i.e. Lead-Communities, Lead User-Portals, customer exchange forums, and personalized customer portals. A tentative mapping of different forms of online customer integration to different modes of knowledge generation is proposed. It is argued that knowledge about the potential and possible pitfalls of online customer integration gained during the implementation of such programmes can turn into a competitive advantage.

Key words: new product development, customer orientation, customer integration, Lead Communities, Lead User-Portals.

1.1. Customer orientation in product development

Today, new product development (NPD) is viewed as one of the fundamental drivers of competitive advantage of firms, i.e. as their "engine of renewal" (e.g. Bowen et al., 1994; Helfat and Raubitschek, 2000). Nowadays, as a consequence of the change from sellers' to buyers' markets, NPD as a business process is characterized predominantly by customer orientation. Despite the focus on customer orientation customers are often only called in to make an initial position sensing during new product development processes. Later on, they also effect a continuous validation of solutions generated by enterprises. However, the opportunity of regarding customers as partners of value creation during NPD as well as the chance of actively involving them into the process is often neglected (Joshi/Sharma, 2004). Customers have a rather passive role. Eric von Hippel, a pioneer in research on user innovation, criticizes the insufficient customer and user involvement in innovation processes as a "speaking only when spoken to" (von Hippel, 1978, p. 243). This is regrettable because knowledge about customer needs and market development can be identified as the key factor for success of new product development projects: such knowledge about customer needs and market development is even more fundamental than the degree of market innovativeness of products (Cooper, 1979). Thus, an in-depth comprehension of customer needs by involving customers in NPD may be viewed as a catalyst for the "engine of renewal" of firms.

1.1.1. New product sequencing as driver of competitive advantage

New product development projects involve high technical, temporal as well as financial risks for enterprises. The increase in flop rates of NPD projects which is nowadays higher than 90% clarifies that a lot of products launched do not correspond to customer needs. As a major reason for this high flop rate, ACNielsen identified the lack of 'real' innovation and an increasing number of "me-too-articles" (Foster, 2004).

The claim that there is a lack of implementation capabilities rather than idea and invention generating capabilities is often encountered in innovation management. The central issue is how 'real innovations can be generated efficiently and synergistically in consideration of customer needs and without neglecting new technological opportunities. Hereby, the difficulty of finding a 'balance' between market and

technology orientation in innovation management is indicated: new product development can be driven by a technological (technology push) or by a market perspective (market pull).

As far as 'technology push' is concerned, the decisive innovation impulse is affected by an application of internal and external technologies during problem solving. The question is: "What is technologically feasible?" It is implied that innovative product technologies cause a demand which did not exist before. Functionally, R&D departments deliver impulses for inventions and marketing departments implement innovations on markets. This view on innovation implies a one way street from research over production to marketing. Technological solutions are considered a "deus ex machine" (Dosi, 1982).

In case of 'market pull' (or 'demand pull'), elicited customer needs serve as the starting point. Now the question is: "What do customers or users want?" From a functional point of view, the marketing department generates impulses for inventions and solutions while the R&D and production enable the making of the innovation. This view on innovation implies that customers dispose of a complete overview on possible product decision alternatives and that they select rationally. Manufacturers are able to identify customer preferences by changes of relative prices and the quantified demand estimations. However, several famous examples raise doubts on the view of customer preferences elicitation. For example the Sony walkman story indicates that innovations are successful if they reach beyond actual customer preferences (Sanderson/Uzumeri, 1995). On the other hand, examples like the EMI computertomograph indicate that radical innovations can also be too innovative and little successful without complementary customer learning (Teece, 1986). Nevertheless, representatives of the competence-oriented approach in strategic management see a marketing that allows expeditions in the future, i.e. an "expeditionary marketing" as a major task in marketing and NPD (Hamel/Prahalad, 1991).

Von Hippel (1988) established the most influential framework beyond the bipolar 'market push' and 'demand pull' dichotomy. He observed dissatisfaction with traditional market research methods which are designed for already available products. In amplification he admits innovative potential to manufacturers as well as suppliers and users. As far as the users are concerned, he concentrates on "lead users". Lead users are also only experienced with existing products but they are familiar with application conditions which lie ahead the trend compared to other users. This has been called "leading edge status" (Morrison et al., 2004). Furthermore, lead users strongly benefit from an amelioration of existing products and therefore have an economic interest to cooperate with manufacturers in research.

As a conclusion it can be said that today NPD is seen as a cooperative or "open" model in many industries (Chesbrough, 2003). It rarely follows the two extreme versions of market pull or technology push.

1.1.2. Potential of customer integration strategies

Knowledge about customers' desires and preferences is crucial for manufacturers. Thus, a lot of enterprises have consumers articulate their desires. Mostly, this takes place in a space of alternatives given by the manufacturer. According to the results, manufacturers look for adequate solutions in order to satisfy articulated customer needs ("stated preferences"). This dichotomy of problem definition and problem solving is documented in numerous approaches concerning customer integration like e.g. 'Quality Function Deployment' (Hauser/Clausing, 1988): In the so called "House of Quality", subjective value judgements of customers and technological solution approaches are modelled as two orthogonal dimensions.

This approach models customer preferences as a "fix star". It is assumed that consumers have fixed and stable preferences concerning products on markets as well as potential products which they are able to articulate precisely. At the same time, consumers are implicitly viewed as technological laymen who are indifferent concerning technical solutions and who are only interested in functional results. An example to illustrate this is the car driver who is able to articulate precisely which benefits driving a car should have without knowing anything about technology deployed. This detachment seems to be overcasted since precision in articulating functional requirements should partly go along with technological background knowledge. Thus, one does not only expect precise ideas about driving performance from automobile enthusiasts but also concrete knowledge about applied technological solutions.

If one restraints customer enquiry on aspects of consumer benefits only, the task of transformation of m functional needs to n technological solution approaches is left to the manufacturer. This is not a trivial but a complex problem due to the $m:n$-relation: Different solutions support

and/or impede different functional needs. Furthermore, possible interactions among levels of needs and solutions lead to increasing complexity, i.e. the value contribution achieved from a design parameter depends on characteristics of another design parameter. Finally, a technological solution is not only a means to an end but can also be beneficial by itself. This is e.g. documented in the preference for dominant and already established technical solutions (Utterback, 1994). Through this, new technologies (e.g. Tiptronic-steerings in automobiles) might not be accepted.

Therefore, the conventional image of consumers is one of a split personality – on the one hand, the consumer is viewed as a "preference-professional" and on the other hand as a technical layman. One can also speak of a supposed "edge-profile" of consumer knowledge: It is assumed that apart from knowledge of own needs and external needs, there is no technological knowledge at all which might be exploited during NPD. This point of view can hardly be reconciled with findings of consumer behaviour. High involvement requires active information research, a strong topical dealing with the product and therefore also professional knowledge about its technical characteristics. With high consumer involvement one may expect clear preferences both for performance requirements as well as for technological means in achieving them.

The insights mentioned show that the potential of customer integration is by far not exploited. Customer involvement in problem definition and problem solving has not been practised to an extensive degree. Beyond knowledge about customer preferences, firms may obtain solution propositions which are developed by users themselves or in cooperation. Research in consumer psychology further indicates that consumers show a desire for own participation (cp. e.g. Holt, 1995). This willingness to participate in NPD accentuates existing, unused potentials of customer integration. Depending on product category, ten to forty per cent of users may get involved with development, modification or amelioration of existing products (Lüthje/Herstatt/von Hippel, 2003). As far as sport articles are concerned, up to 60% of products existing on the market can be traced to ideas of lead users (Lüthje, 2003). Also in high-tech sectors, lead user innovations have been analysed. In medical technology there exists a high number of product inventions (Lettl, 2005) that trace to "leading edge" users (Morrison et al., 2004).

1.2. Cooperative performance contributions in innovation processes

Success of NPD projects is hard to plan neither can it be guaranteed nor taken for granted. However, it can be better managed by considering the co-evolution of enterprise knowledge and learning systems and NPD sequences (Helfat/Raubitschek, 2000). From a management point of view, this co-evolution is realized by cooperative performance contributions between manufacturers and customers during NPD. Thereby emphasis of customers' and manufacturers' participation contributions can be placed differently during different stages of the NPD (Table 1).

Table 1

Modes of collaboration along the stages of new product development

Type of Innovation	Activities and Actors in the Value Chain					
User-dominated	User					Manufacturer
Cooperative	User	Manufacturer	User	Manufacturer	User	Manufacturer
Manufacturer-dominated	User			Manufacturer		
	Problem (Need) Identification	Idea Generation	Problem-Solving (R&D)	Solution Development (Invention)	Usage and pre-commercial	Diffusion commercial

Source: Brockhoff, 1999, p. 39.

In innovation research, stage-gate models of new product development are often presented as funnels. In early phases, problem solving processes are wide. It is crucial to manage market as well as technological insecurities simultaneously and to arrive at promising new product concepts. The amplitude of problem solving processes decreases with increasing duration of innovation processes. The result is a funnel which is presented in Figure 1 (Clark/Wheelwright, 1993; Iansiti/Clark, 1994; Iansiti, 1998).
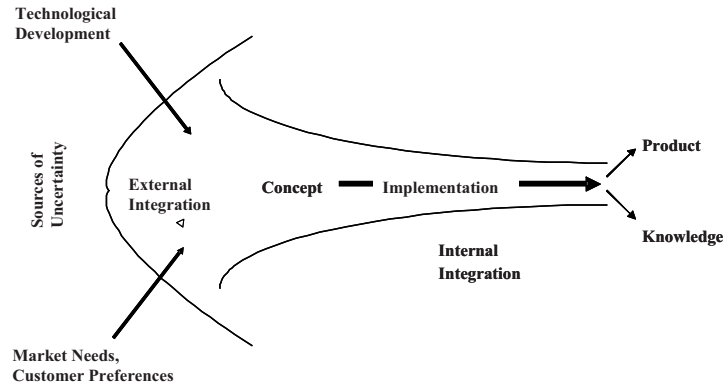

Fig.1. The innovation funnel

Source: Iansiti/Clark, 1994.

There is a multitude of frameworks portraying the sequence of stages of the so called "innovation funnel" on different levels of detail. They can be summarized as follows: idea generation, concept formulation, concept evaluation, tests and market launch. Each of these stages can be regarded as a window of opportunity for customer integration. Chances that can be deducted from customer value generation have to be opposed to costs of customer integration efforts in order to assess the potential of customer integration.

1.2.1. Customer integration in marketing processes of existing products

As far as marketing processes of existing products are concerned, customer integration is already highly developed: enterprises adapt their offerings closely to preferences of defined customer segments or even individual buyers by means of segmentation and direct marketing. Hereby, sellers rely on segment specific alignment of marketing practices or on adaptation and modular configuration of existing products to customer needs.

Traditionally, the average ideal point of customer preferences in a market is tried to be found by means of marketing research activities in order to offer products and solutions whose characteristics minimize the distance to the ideal point. A product differentiation strategy allows addressing several ideal points of several market segments. Today, firms try to meet the ideal point of each customer by "mass customizing" their products. The combination of order-specific manufacturing and mass production was enabled by technological advance in processes and was increasingly brought into action during last years. Manufacturer-customer exchange is a necessary condition for mass customization: the customer has to clarify his desires to the manufacturer and this needs to be put into words (i.e. explicit knowledge which can be captured in terms of texts, charts or notes)

To sum up, the customer is regarded nowadays as value adding partner (Piller, 2003). Customers are integrated at late stages of new product development by means of bilateral communication processes. Thus, this model of customer integration may be called a "co-diffusion". Beyond a mere "co-diffusion", customer integration in early phases of new product development is also feasible. However, it implies higher costs per produced unit since mass production saving potentials cannot be exploited. Furthermore, it differs from the practised concept of "mass customization" in several respects.

1.2.2. Customer integration in early phases of new product development

Customer integration in early phases of new product development processes is less developed than customer integration in marketing processes ("one-to-one-marketing") or customer inte-

gration for adaptation of existing products ("mass customization"). Customer integration in early phases of new product development often only covers the articulation of needs and market tests of new product concepts and early prototypes. Thus, regarding the complete innovation process, as e.g. illustrated in Table 1, the "state-of-the-art" of customer integration reduces to very early stages (problem detection) and the very late phases (commercial diffusion).

However, firms can try to integrate customer expertise at all stages of the innovation process. Lead users can exert different functions which go from idea generation over problem solving to creation of prototypes (von Hippel, 1988). As far as pre-commercial implementation of innovations is concerned (production and assembling), cases of "lead user" innovation are known that were rejected by established manufacturers and which were implemented by the inventing teams by founding new ventures (Christensen, 1997). Value added by lead users during commercialization is also an actual concern in the literature (Morrison et al., 2004).

If one acknowledges the potential of customer integration at stages of the NPD process the issue of how to effectively benefit from customer value contributions becomes a central concern for firms. The goal is to attract customer loyalty beyond the mere identification of customer needs and to enable an active customer participation in innovation processes (Prahalad/Ramaswamy, 2000, 2004). More specifically, interaction and communication possibilities over the internet represent a marketing potential which has not yet been exploited to its full extent (Wilkström, 1996). We refer to the latter as "online customer integration".

1.3. Online customer integration to integrate customer specific knowledge

Online customer integration by means of internet technologies is a comparably new phenomenon: It has been implemented for less than ten years. Knowledge about the success potential of different types of online customer integration for different purposes and conditions is only scarcely developed. Thus, as a first step and proposition for exploring the topic further, we focus on developing a typology of different forms of online customer integration.

Three questions are treated in order to develop the typology. First: which structural types of relationship networks can be established through online customer integration? Second: which types of knowledge may be generated by means of online customer integration? Third: at which stages can customer knowledge be activated by online customer integration in NPD? By elaborating on these dimensions, a typology of different forms of online customer integration will be developed.

1.3.1. Structural types of customer-manufacturer relationship networks

In the following, two structural types of customer-manufacturer networks will be distinguished: bilateral and multilateral. Bilateral online customer integration is e.g. effected by personalized customer portals; multilateral online customer integration is effected by so called customer forums.

Personalized customer portals can be used for information exchange with customers during the entire process of new product development. Hereby, in-depth knowledge about individual customer needs in new product development can be obtained. The traditional trade-off between depth of knowledge about customer needs and the number of considered customers can partly be dissolved (Evans/Wurster, 2000). In personalized customer portals, users do not interact mutually (multilateral) but bilateral with manufacturers (Figure 2). Through this, personalized product information and product adaptation can be implemented cost efficiently. Furthermore, opinions, ideas, and test results concerning new product functionalities can be obtained.
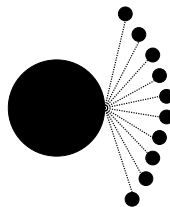

Fig. 2. Bilateral communication between manufacturer (major circle) and individual customers (small circles)

A customer forum represents a frequently used instrument for supporting multilateral communication between customers and manufacturers in the entire process of new product development. It is based on internet technologies. Customer forums are electronic discussion forums ("Bulletin-Board-Systems"). Users of bulletin boards can make their comments one after another in analogy to a bulletin board which is divided into topic fields. Hereby, the discussion "thread" is visible at any time. Users reading the contents of the bulletin board regularly are called subscribers because they subscribe to a particular discussion forum. After some time, the threads become established and "alive". Navigation between original issues and belonging answer chains is being done by clicking on hyperlinks i.e. links between hypermedia documents. On the internet, the discussion forums are called "USENET". At the present time, two-dimensional graphical user interfaces (GUIs) are dominating. In future, user interfaces will implement three-dimensional multimedia metaphors like e.g. navigation in an office skyscraper. These multimedia user interfaces are called "Multi-User-Dungeons" (MUI's and MUD's). Users are no longer represented by two-dimensional "icons" but by three-dimensional figures ("avatars").

In customer forums, 'one-to-many communication' of personalized customer portals can be completed by 'many-to-many-communication': Subscribers discuss mutually. Now, the relation density of the entire relationship network consisting of all relations between customers and manufacturers as well as among customers increases (Figure 3). By this and from a structural point of view, chances for more efficient communication flows are enhanced. A focal firm has either the possibility to participate actively in discussions among customers or to enable the exchange by providing a suitable infrastructure, i.e. to provide information technology infrastructure and align incentives for participation.
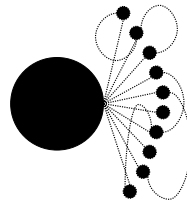

Fig. 3. Multilateral communication between manufacturer (major circle) and individual customers (small circles)

1.3.2. Generated and exchanged knowledge types

Today, knowledge generation and knowledge exchange in the context of NPD activities are regarded as the major driver of competitive advantages (cp. paragraph 1.1; Iansiti/Clark, 1994). Central concerns of the so called knowledge based view of the firm are the investigation of content and processes of knowledge generation and exchange (Spender, 1996; Grant, 1996). The distinctions between information and knowledge as well as between implicit and explicit knowledge are given central attention in this strand of literature. Concerning online customer integration the question is whether explicit as well as implicit knowledge is generated and exchanged in personalized customer portals and customer forums. This question does not address the already mentioned structural aspects of customer-manufacturer and customer-manufacturer-customer networks. Instead, in the following we look at the content of knowledge generated and exchanged in such networks.

The terms 'knowledge' and 'information' have often been used synonymously. However, knowledge is fundamentally different from information. Information is a necessary requirement in order to generate new knowledge (Machlup, 1983). Information is a flow of intentional messages and denotes 'Know-what' (Kogut/Zander, 1992) whereas knowledge does not develop simply by a mere accumulation of information. The essence of knowledge is that it only comes into being by interpreting new information against the backdrop of pre-existing knowledge, i.e. 'know-why' and the according linking of the derived new meaning within the mental structures. Therefore, in contrast to information knowledge cannot be bought or sold, i.e. traded. A certain type of knowledge, i.e. tacit knowledge comprises characteristics which foreclose its explication and communication (Polanyi, 1967). Therefore knowledge is often classified as implicit ('tacit') or explicit knowledge.

Explicit knowledge can be articulated and reproduced. It can be transmitted without difficulty by a formal, systematic 'language' like words and figures. Thus, explicit knowledge is held consciously by individuals. It represents specific or methodological knowledge because it can be literally understood and described in its application. Thus, in online customer forums customers can exchange explicit knowledge like instructions, error recovery procedure, product processing tips and tricks as well as other product related information. In personalized customer portals, enterprises can collect explicit opinions by vote or they may broadcast updated and individualized information to customers.

Tacit knowledge is hidden and unspecific knowledge which is characterized by inherent characteristics: "we know more than we can tell" (Polanyi, 1967). As collective knowledge it is rooted in a pattern of interlinked actions, commitments, and contributions in a specific context. These characteristics turn implicit knowledge into a 'sticky' form of knowledge (von Hippel, 1994; Szulanski, 1996). Stickiness describes the fact that knowledge attached to specific contexts is costly to transfer and therefore to imitate. Marginal costs serve as a measure for stickiness, i.e. as measure for a transferral of context specific knowledge in a suited form to a receiving entity in a different problem solution context. Core competences are based on implicit knowledge. Thus, stickiness of implicit knowledge explains the scarcity and difficult imitability of core competences. Implicit knowledge is reflected by a cognitive as well as a motoric-physical component.

As far as implicit knowledge is concerned, media richness theory indicates that online communication in forums or via e-mailing lists can carry only a limited amount of cues (Daft/Lengel, 1986). On the other hand, media richness is high in case of personal face-to-face interaction. Information richness of a customer forum is limited concerning gestures, mimics, and a gut-feeling of situations. Based on the information richness framework, one can argue that in a customer forum, development of implicit knowledge does not take place due to a lacking co-presence of actors.

However, information richness theory of communication media has not remained uncontested. Insights in the field of computer mediated communication (CMC) raise doubts on the appropriateness of the "information richness" construct. In their "social processing theory" Walther and co-authors indicate the following retentions:

- CMC-teams need more time to establish a social structure. After some time, a type of "E-Mail ethos" develops carrying with it the same social relations between group members as can be observed for 'face-to-face' interactions. Even though some of the most basic social cues are missing in text-based electronic communication media (e.g. attraction, place, or appearance) after some time interactions develop in which implicit social messages (relational aspects) are carried (Walther, 1995).
- In CMC it is tried to compensate missing gesture signals by writing conventions. Acronyms have a strong importance (e.g. ROFL stands for "rolling on the floor laughing") as well as expressions for actions and gestures between stars (*smile*, *be happy*, *thinking*), which would be effected in RL ("real life") and the so called "emoticons", i.e. icons for facial gesture expressing emotions).
- In CMC, time serves as a social cue. Discussion threads, in which one comment follows quickly after the other, can be interpreted differently depending on the content of the threads: slow answers on social news are interpreted as less emotionally involved whereas fast answers on task related news are perceived as a proxy for serious engagement (Walther/Tidwell, 1995).

As a conclusion, one can argue that implicit knowledge exchange is possible in customer forums as well as in personalized customer portals. However, a certain interaction frequency is necessary as well as a certain duration of customer integration. As far as personalized customer portals and customer forums are concerned, this means that interaction between manufacturers and customers on the one hand and among customers on the other hand has to be established on a long term basis. It can not be developed in a 'crash programme' in the context of one single innovation project or even during a project stage. Online customer integration implemented in this short-sighted way can be used merely for winning and exchanging explicit product knowledge. Figure 4 illustrates the discussion above:
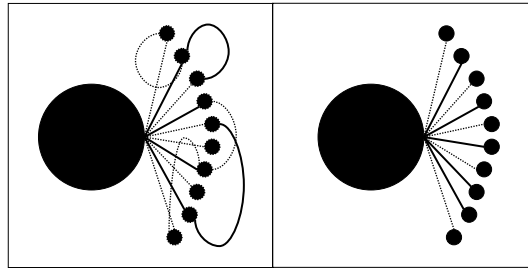
Fig. 4. Multilateral and bilateral exchange of explicit knowledge (dotted connections) and implicit knowledge (continuous connections)

1.3.3. Stages in new product development process

It has been argued above that pro-active online customer integration represents a chance for strategic knowledge development during NPD. Unlike the discussion about whether firms can generate explicit *and* implicit knowledge by online customer integration, there are no basic objections against whether firms can generate strategically relevant knowledge during all *stages* of NPD (Figure 5).
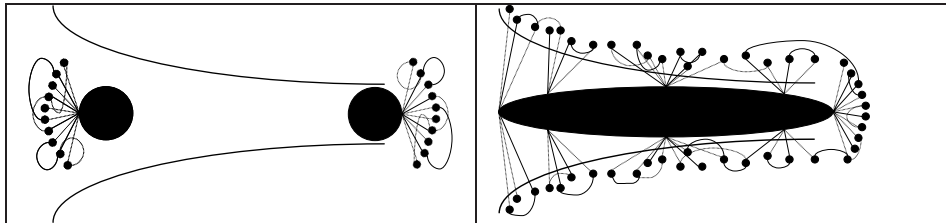

Fig. 5. Bilateral and multilateral communication in new product development processes limited to early and late phases of new product development process (left) or during the entire innovation process (right)

An example taken from a Smart-Club.de forum illustrates this point, i.e. that discussion contributions can be attributed to all stages of NPD:

Table 2

Examples from Smart-Club.de*

Generation of ideas: *"I went for a test drive in a Passion Cabriolet. It bothered me a lot that the interior trim of the white top had a lot of black line-like stains (probably by opening and closing it). Is the interior trim always white or does also a black one exist? Does the "Pure" have an interior trim?"*

Concept: *"The top is only attached to the anti-roll bar. Start cautiously in the front left and right (but be cautious because the material risks to rip, unfortunately, this happened to me the first time but one can rarely see it). Once the first part is gone, continue to annul the plastic bar in the top area in full length, it goes by itself, if one piece is off on the left or on the right. In the back area, at the engine box, it starts to become tricky but one can manage it. Then, put the piece in the bath tub, add water and washing powder and keep soaking. Afterwards, clean with a brush. Then drip off and install a little humid (of course only in summer). Otherwise, have it dried thoroughly."*

Concept evaluation: *"Good instruction. I did not know that one can take out the interior trim. I have two black lines because I followed a carboned truck when I drove open-top. I will clean them this weekend."*

Test: *"Thanks a lot, we note it as top tipp."*

Market launch: *"and one can also optionally stain with textile ink in the bath tub…"*

*) Source: http://www.smart-club.de, accessed on November 16th , 2004.

1.3.4. Resulting Typology

Table 3 presents the chosen approach for distinguishing different types of online customer integration along the structural (bilateral/multilateral) and content (implicit / explicit knowledge) dimension:

Table 3

Types of online customer integration

	Explicit Knowledge ("Know that") High costs of knowledge transfer (strong stickiness)	Implicit Knowledge ("Know how") Low costs of knowledge transfer (weak stickiness)
Multilateral (customers among each other)	Customer exchange forums "Co-Design" Exp.: Smart-Club.de	"Lead-Community" "Co-Development" Exp.: Jini Community
Bilateral (focal enterprise with each customer individually)	Personalized customer portals "Co-Design" Bsp.: Product configurators	"Lead User"-Portals "Co-Development" Exp.: private-personal & long-term portal solutions with individual customers

Customer exchange forums are determined by multilateral interaction. Customers exchange explicit knowledge among each other and with the manufacturing enterprise. From a technological point of view an exchange of implicit knowledge would also be possible if a long-term and target-oriented interaction between users was made possible. However, product related forums in which explicit knowledge between customers is exchanged are characterized by short-term discussion threads. Either way, a firm can gain valuable impulses for NPD. Customer exchange forums serve as an instrument of "Co-Design" during the entire NPD process. *Co-Design* considers customers' needs as explicitly formulated incitation, amelioration propositions, and functionality desires. Smart-Club Germany represents an example of a customer exchange forum (Henkel/Sander, 2003). Smart owners exchange views and experiences concerning different elements of the car as well as for solving problems. A content analysis of contributions indicates that only 0.2% of the contributions in Smart-club.de are innovation relevant for the manufacturer (cp. Henkel/Sander, 2003). This indicates an exchange of primary explicit knowledge in forums during short-term interaction.

Lead communities allow target-oriented, multilateral and mutual NPD. As an example, lead-communities can be identified in Software development where a focal enterprise tries to establish technological standards. The community consists of advanced (leading-edge) users and advocates of technology. They exchange experiences in solution development among each other and with manufacturers and they often implement these developed solutions. This can be called "co-development", which means *cooperative development* of new products by manufacturer and customer collectives. Jini Community (http://www.jini.org) represents an example of a lead community. The focal enterprise is Sun Microsystems. In Jini Community, technology adaptors collectively advance Jini network technology in cooperation with Sun Microsystems. In the community norms and rules concerning decision processes were established. Judged by duration of interaction and sophistication of organizational structure, we assume that explicit and implicit knowledge can be generated and exchanged in such communities.

Personalized customer portals: Online portals with different personalized functionalities serve to match customer needs as exactly as possible. Explicitly articulated preferences are stored in databases and custom-made product configurations are offered. In personalized customer portals, a co-design on a bilateral level is practised. Examples for personalized customer portals can be found in several sectors like e.g. in the cosmetic or in the clothing sector as well as at different stages of the innovation process, e.g. production and service. Information gained from the use of personalized customer portals can provide explicit impulses for the improvement of performance offering.

Lead-User-Portals serve as cooperative NPD between an individual lead user and a manufacturing enterprise. Electronic portals can help to overcome temporal and geographical dis-

tances. If personal meetings take place in addition there is a possibility of exchanging implicit knowledge given compatible interests. Lead-user-portals are similar to long-term private cooperation activities between a manufacturer and a customer in context of NPD. For example, SAP maintains cooperations with few customers in different sectors who are advanced in the use of offered applications. Implicit knowledge also has to be interpreted against customer context in order to implement propositions for new product generations.

The four different types of online customer integration can additionally be distinguished along the stages of the innovation process. In that case, a three-dimensional representation can be given (Figure 6).
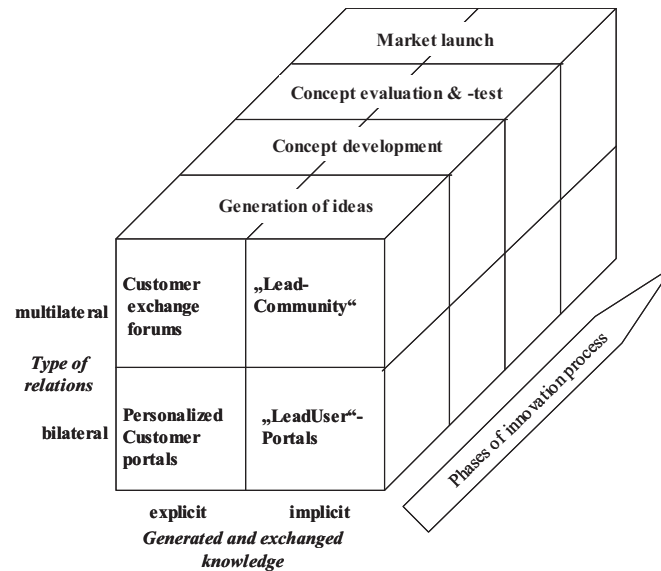

Fig. 6. Online customer integration types and NPD stages

The above developed typology is based on the idea that firms go through learning processes concerning performance potentials of different online customer integration forms for different uses in new product development. Firms which handle different types of online customer integration successfully at the same time are able to obtain an essential collective knowledge in the form of superior online customer integration routines. This knowledge experience represents a dynamic capability for the firm and helps to stand out against competitors concerning the use of online customer integration as well as to develop this knowledge further. It can therefore be verified by means of the typology developed below whether the implementation of online customer integration programs is well-balanced. An online customer integration policy will be labelled 'balanced' if the simultaneous application of (all) different forms of online customer integration in NPD allows for the learning opportunities just discussed.

1.4. Online customer integration as a self-reinforcing knowledge spiral

The model of a "knowledge spiral" (Nonaka/Takeuchi, 1995) clarifies how organizational knowledge is generated and exchanged. For this purpose, explicit and implicit knowledge as a source and result of knowledge conversion activities are combined to four different types of knowledge generation and transfer: Socialization, Externalization, Combination and Internalization (Figure 7). Each of these modes can be addressed by a type of online customer integration. In the following, the typology in Table 3 will be mapped in a one-to-one way to the four modes of knowledge conversion: one type of online customer integration is mapped to one form of knowledge conversion. However, it is important to note that the different types of online customer integration may add value to other modes of knowledge conversion than the attributed one as well.

Thus, the following mapping is only indicating the most plausible knowledge creation sustaining tendency for the different kinds of customer online integration.
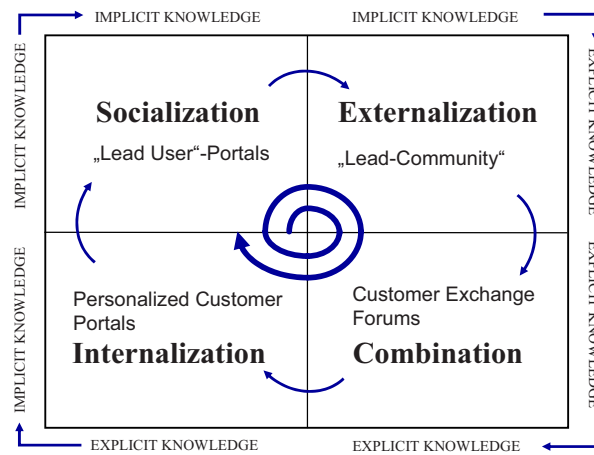

Fig. 7. Types of knowledge transfer

Source: Based on Nonaka/Takeuchi, 1995.

Socialization transfers knowledge from "implicit to implicit". This may happen to a large extent without language. "Learning by doing", i.e. observation, imitation and exercise is most important. Such learning requires both an in-depth as well as long-term communication flow between actors and can best be implemented in bilateral collaborations. In this regard, lead user portals may be seen as an especially suitable mode of producer-customer interaction which enable a two-sided exchange of know-why and know-how. Lead Users are deliberately chosen by firms and are attributed a highly profiled knowledge which is rooted in use-related experience. This use-related knowledge becomes the center of attention during the co-development of new product solutions with lead users. Thus, if any of the presented online customer integration types is suitable for the exchange of tacit knowledge then it should be the electronic support for lead user co-development processes. Lead-user portals as we defined them in Table 3 are designed to draw upon and make use of tacit knowledge held by lead users.

Externalization turns implicit into explicit knowledge. However, this conversion is only partially possible. Intensive and long-term communication is a requirement for explanation of implicit knowledge, e.g. in quality circles or interdisciplinary teams. Participants try to access to implicit knowledge by means of analogies and metaphors. Lead communities may support such an explication of knowledge because of three main reasons. Firstly, lead customers interact in forums which they are strategically interested in since the participation in lead communities is voluntary. Often, as has been described for the Jini development community, a focal firm acts as a host of different activities and events where representatives of the participating institutions meet. The supporting electronic lead community forum allows identifying potential collaboration partners under the umbrella of the community label by listing cutting-edge projects and the respective researchers or project leaders. Furthermore, semi-private communication and collaboration spaces, i.e. wikis, can be offered. Secondly, a lead community portal serves as a tool to attract new members who share the strategic interest in the project umbrella as a whole. For this, much of the tacit knowledge that has been accrued in the inner circle of the lead community has to be externalized in order to enable potential new entrants to decide about a membership and to build up their own knowledge about technologies and other foundations of the lead community. This description reminds of the concept of legitimized peripheral participation uttered in the context of communities of practice (Lave, 1991). In a sense, lead communities may be thought of as virtual communities of practice across organizational boundaries. Thirdly, members which have established knowledge about the

most important aspects and projects happening within a lead community possess the required amount of shared absorptive capacity, i.e. the capacity to absorb new knowledge, align it with prior knowledge and deploy the aligned knowledge productively, which allows a more efficient explication of tacit knowledge in lead communities.

Combination brings together different explicit knowledge. Combination of knowledge is especially apt to be supported by appropriate information technology. Here, mainly tipps and tricks are transferred between actors. Since this knowledge transfer does neither require in-depth interactions nor an advanced socialization of actors, it may well be achieved by customer exchange forums representing loosely coupled systems. Thus, with time these forums become archives of bits and pieces of more or less helpful knowledge. The contributions of members can be stored in databases and be converted and combined with other repositories of contributions leading to metacrawler engines of customer integration forums.

Internalization partially turns explicit knowledge into implicit knowledge but in an enriched, more complex form. This happens when individuals or groups are able to routinize action guidelines which were explicitly articulated. Personalized customer portals may serve as an instrument to enable the development of new implicit knowledge by the application of explicit knowledge on behalf of both, customers and producers. Customers may arrive at new implicit knowledge by applying formalized guidelines offered by producers on the respective customized portals, e.g. by using personalized help and repair systems. Producers may arrive at new implicit knowledge by means of internalization if they gain in-depth knowledge about usage patterns of products revealed by specific customer segments. This knowledge can then be used for adjusting either product or productions. With time, these new findings can become internalized from a producer's point of view.

The tentative connection of the knowledge spiral with types of online customer integration allows a deduction of concrete guidelines for a potentially successful management of online customer integration programmes:

Firstly, a continuous exchange between explicit and implicit knowledge is a requirement for the generation and transfer of organizational knowledge. Accordingly, firms aiming for a long-term competence in online customer integration should practise multiple types of online customer integration at the same time. For this, the developed typology in Table 3 can serve as heuristic or 'portfolio'. It can be deducted that an exclusive focus on e.g. "Lead-user-portals" neglects the aspect of multilateral cooperation as well as manifold spontaneous explicit contributions in customer forums.

S*econdly,* externalization processes between customers or between manufacturer and customers will only take place if there is enough experience in a common problem solving context. This requires a *long-term* and personal orientation of cooperative online customer integration. "Lead-user-portals" as well as "lead communities" are difficult and need a comparatively long time until they are established. Therefore, an entrepreneurial competence in online customer integration cannot be developed on a short-term basis. The success potential of customer integration programmes increases by the duration of their existence because the value of the cooperatively developed knowledge resources increases with additional investments in cooperative learning. Thus, firms can profit from investing early in online customer integration practices in order to avoid "time compression diseconomies".

In conclusion, one can say that a systematic and balanced management of different types of online customer integration is promising concerning development of competitive strength. It is crucial that the perspective of individual relationships between consumers and manufacturers can be completed by the aspect of multilateral cooperation. Individual relation between consumer and manufacturer is formative for one-to-one marketing, mass customization and lead users. Consumer groups meet in online customer forums in order to exchange product relevant experiences. Customers do not only interact bilaterally with the manufacturer but also exchange experience among each other. Lead communities promise the possibility to combine collective action with target-oriented procedure influenced by a focal manufacturing enterprise. It remains to be seen if the next years will bring a 'democratization of innovation' in sense of "taking the creative process of innovation out of the hands of a few and giving it into the hands of many" (von Hippel 2005, p. 12).

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