
Knowledge-based New Product Development: fostering innovation through knowledge co-creation

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Abstract: This paper develops and presents the concept of knowledge-based New Product Development (NPD) in an effort to explain the role of knowledge in NPD and the process of its (co-)creation and management. It tries to advance the notion of knowledge (co-)creation in NPD, with a particular focus on the involvement of customers – i.e., the co-creation of knowledge, value and innovation with customers. The purpose is to provide both academics and practitioners with a framework for understanding and analysing knowledge-based processes in NPD and how these can be leveraged to foster innovation.

Keywords: knowledge-based approach; knowledge creation; knowledge management; marketing; multinational companies; NPD; new product development; product development; tacit knowledge.

Reference to this paper should be made as follows: Kohlbacher, F. (2008) 'Knowledge-based New Product Development fostering innovation through knowledge co-creation', *Int. J. Technology Intelligence and Planning*, Vol. 4, No. 3, pp.326–346.

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1 Introduction

Knowledge has frequently been identified as a crucial factor in innovation. This is also why there exists a strong body of literature that deals with product development and product introduction from the organisational learning, knowledge management or market orientation perspectives. However, product development is often difficult because

“the ‘need’ information (what the customer wants) resides with the customer and the ‘solution’ information (how to satisfy those needs) lies with the manufacturer.” (Thomke, 2003, p.244)

Traditionally, “the onus has been on manufacturers to collect the customer need information through various means, including market research and information gathered

from the field”, a process that “can be costly and time-consuming because customer needs are often complex, subtle, and fast-changing” (Thomke, 2003, p.244).

There are three key points necessary to understand knowledge in this context:

- In accordance with the knowledge-based view of the firm, which sees knowledge and competencies as decisive foundations for the performance and abilities of organisations, knowledge can be identified as the decisive success factor in NPD. Note that throughout this paper, product or product development always means products and services.
- Much of the required knowledge in NPD is tacit and resides in entities outside the firm, specifically in customers but also within other stakeholders such as competitors, suppliers and business partners.
- Contrary to the assumptions made by most of the literature, the required knowledge is not simply ‘out there’, ready to be collected and processed by the firm, but actually needs – at least partly – to be created. This then involves the co-creation of essential knowledge with other entities in the business ecosystem, such as customers for example.

Despite efforts to deal with the first two key points, research on the third point is still in its infancy, even though it has received increased attention recently. Finally, there is no coherent framework that integrates these three points into a comprehensive theory of knowledge-based NPD.

This paper aims to close the disconcerting gap identified above. In an effort to explain the role of knowledge in NPD and the process of its (co-)creation and management, the paper develops and presents the concept of knowledge-based NPD. It tries to advance the notion of knowledge (co-)creation in NPD, with a particular focus on the involvement of customers – i.e., the co-creation of knowledge, value and innovation with customers. The purpose is to provide both academics and practitioners with a framework for understanding and analysing knowledge-based processes in NPD and how these can be leveraged to foster innovation.

The paper opens with the theoretical background, namely the framework of knowledge-based marketing and the literature on the role of knowledge in NPD. Then, it develops a theoretical framework for knowledge-based NPD. This is done in several steps. First, the literature on knowledge co-creation is reviewed, followed by two illustrative cases of knowledge-based NPD. Based on this the conceptual model of the marketing knowledge co-creation process in NPD is explained and main conclusions are drawn. Figure 1 provides a roadmap to the structure of the paper and my argument.

2 Theoretical background

The theoretical foundation of this paper is Kohlbacher’s (2007) framework of knowledge-based marketing and knowledge co-creation in the business ecosystem. He identified four core marketing processes (SCM, market research, CRM, and PDM) in which knowledge (co-)creation plays an essential role. This paper will focus on NPD and co-creation with customers (cf. Figure 2). This section first briefly introduces the framework of knowledge-based marketing and then reviews the literature on the role of

knowledge in NPD. This literature review, together with the literature on knowledge co-creation (to be presented in the next section) and empirical evidence, led to Kohlbacher’s original research (Figure 2).

Figure 1 Roadmap of the paper (see online version for colours)

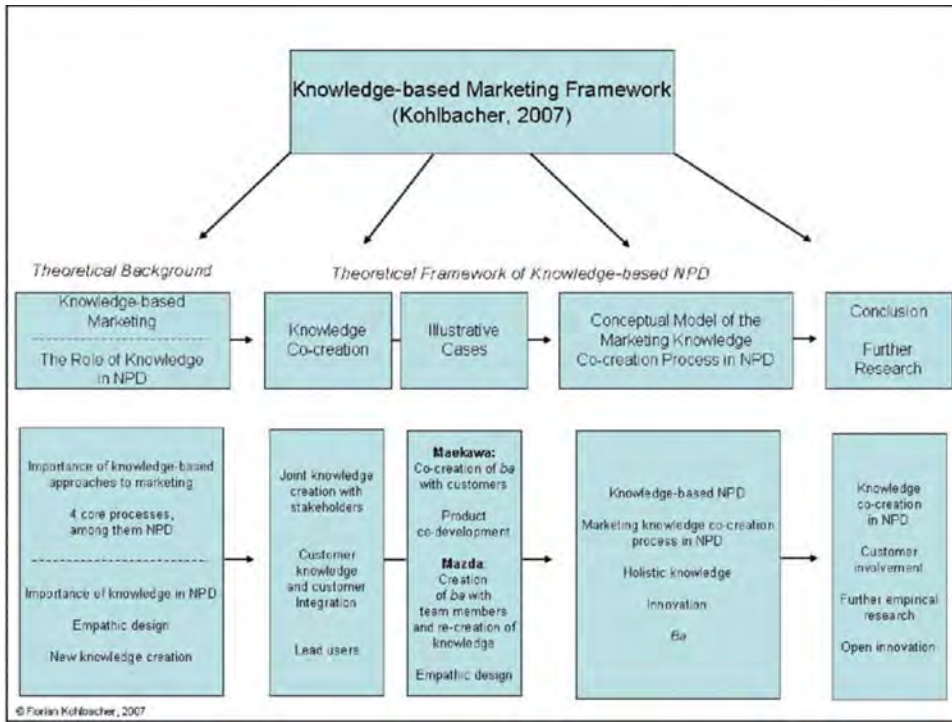
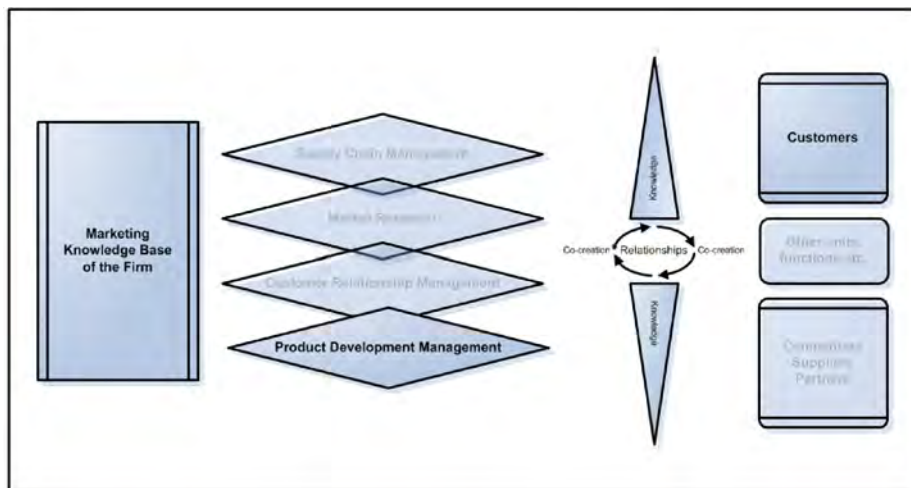


Figure 2 Knowledge-based marketing processes (see online version for colours)



Source: Adapted from Kohlbacher (2007, p.117)

2.1 Marketing knowledge and knowledge-based marketing

Despite the fact that the theory of organisational knowledge creation (Nonaka and Toyama, 2005) has been applied to numerous fields (cf. e.g., Nonaka et al., 2006b), this does not seem to be the case with marketing and marketing research. Indeed, even though “marketing functions lend themselves particularly well for an investigation of knowledge transfer within MNCs”, “there is a dearth of research on knowledge transfer in the field of marketing” (Schlegelmilch and Chini, 2003, pp.220, 221). Yet, in an increasingly global business environment, the creation and transfer of marketing knowledge and intra-firm collaboration through knowledge-based approaches to marketing will become ever more crucial a determinant in corporate competitive advantage and survival.

Kohlbacher (2007) has developed a conceptual framework of knowledge-based marketing and the essential processes of marketing knowledge co-creation among the main actors in the business ecosystem – or network – of which global firms are a part – customers, suppliers, competitors, and business partners (cf. Figure 2). While traditional marketing approaches have focused too much on explicit knowledge and neglected the important role of tacit knowledge, specifically in international (cross-cultural) settings, Kohlbacher’s approach aimed to adjust this imbalance in the extant literature and proposed a new knowledge-based marketing paradigm where knowledge and knowledge co-creation are the key to sustainable competitive advantage in the global network economy. Facing the current global business environment and fierce competition, knowledge-based marketing has already become crucial as a determinant for corporate competitive advantage and as such a *sine qua non* for leading MNCs. Needless to say, as much of marketing knowledge is tacit and hard to codify, face-to-face communication and the integration of local staff into marketing processes and decision-making is an important factor in global marketing knowledge sharing, one that that leads to successful marketing and sales (Kohlbacher, 2007).

Hanvanich et al. (2003, p.124) argue that while marketing scholars have been interested in the topic of marketing knowledge, “they have focused mainly on how firms acquire, disseminate, and store knowledge”, with related research areas being market orientation and organisational learning. Kohlbacher (2007, p.96) defines marketing knowledge as “all knowledge, both declarative as well as procedural, concerning marketing thinking and behavior in a corporation”. Taking a new approach to reconceptualising marketing knowledge and innovation, Hanvanich et al. (2003, p.130) claim that “marketing knowledge resides in three key marketing processes: Product Development Management (PDM), Customer Relationship Management (CRM), and Supply Chain Management (SCM)”. This notion is based on Srivastava et al.’s (1999) framework that redefines marketing as a phenomenon embedded in the three core marketing processes of PDM, SCM and CRM. Bjerre and Sharma seem to agree when they posit that the

“important thing is not one specific piece of knowledge, but an entire package that includes knowledge about clients, competitors, local institutions, suppliers etc.” (Bjerre and Sharma, 2003, p.140)

Given this, the three processes should, in the ideal case, be managed in an integrated way, rather than being treated separately and independently of each other. However, traditionally the three processes have been analysed and discussed as separate processes, which is also reflected in the extant literature. As far as the role of knowledge and

knowledge management in these marketing processes is concerned, PDM is by far the one that has received the most attention. One reason for this may be that new knowledge is particularly crucial for innovation and the generation of new products and services. This paper therefore focuses on the PDM or NPD process. However, it does not see the PDM process as isolated and recognises the importance of knowledge acquisition and co-creation with suppliers and customers, thus linking the PDM process with SCM and CRM.

2.2 *New Product Development*

According to Natter et al. (2001, p.1029), new product decisions “have significant strategic implications that determine the future of a business and involve several functional areas within an organisation”. Similarly, Leonard (1998, p.211) contends that “[o]ne of the most critical engines of renewal for companies is NPD”. Indeed, the capability to bring products to market that comply with quality, cost and development time goals is vital to the survival of firms in a competitive environment (Mild and Taudes, 2007). Some authors have shown that the resource-based view is well suited to explain a firm’s success in NPD (Dutta et al., 1999; Natter et al., 2001; Verona, 1999); the knowledge-based view is equally adequate. NPD requires knowledge creation and searching, and can be organised in different ways (Mild and Taudes, 2007). According to Bell et al. (2002, p.82), product development is “a particularly salient area for organisational learning inquiry for a number of reasons”: it is often a team-based pursuit, it requires a high degree of interfunctional coordination, and it is frequently project based. Indeed, there is a strong body of literature that deals with product development and product introduction from the organisational learning, knowledge management or market orientation perspectives (cf. e.g., Baker and Sinkula, 2005; Clark and Fujimoto, 1991; Dyck et al., 2005; Kusunoki et al., 1998; Li and Calantone, 1998; Madhavan and Grover, 1998; Moorman, 1995; Schulze and Hoegl, 2006, to name but a few).

Nonaka and associates (e.g., Imai et al., 1985; Takeuchi and Nonaka, 1986) already discussed the issues of creating and transferring knowledge in product development projects more than 20 years ago, and the theory of organisational knowledge creation is thoroughly grounded in and backed up by empirical research on such projects (e.g., Dyck et al., 2005; Nonaka et al., 1994; Nonaka and Takeuchi, 1995; Schulze and Hoegl, 2006). In fact, even though many vital processes of innovation, change, and renewal in organisations can be analysed through the lens of knowledge conversion (Nonaka et al., 2006b), knowledge creation and transfer in product development projects seem to be particularly important, as Western (cf. e.g., Leonard, 1998; von Hippel, 1994) and Japanese scholars (cf. e.g., Aoshima, 2002; Cusumano and Nobeoka, 1998; Kusunoki et al., 1998; Nobeoka and Cusumano, 1997) have shown. Indeed, “the ability to import knowledge from the market” is a principal component of the product development process (Leonard, 1998, p.179). Baba and Nobeoka (1998), in their study on the introduction of 3-D CAD systems, even speak of “knowledge-based product development”. Moreover, Nonaka et al. (2006b) suggest that members of a product development project share ideas and viewpoints on their product design in a *ba* (shared context) that allows common interpretation of technical data, evolving rules of thumb, an emerging sense of product quality, effective communication of hunches or concerns, and so on. The case material presented in this paper will add further empirical evidence to support this notion.

As we will also see below, developing, disseminating and implementing a unique concept is an essential step in product development. Natter et al. (2004, p.472) define a product concept as “a description of a product in accordance with attributes perceived by the target customers”. However, these concepts usually tend to be highly tacit and as such difficult to explain to others. Indeed, if conceptual marketing is used for concept development, “then a number of product ideas will be evaluated on the basis of tacit knowledge gained only through market involvement” (Natter et al., 2004, p.472). Therefore, especially in the concept development stage, it is critical to somehow convert this tacit knowledge into meaningful information (Nonaka, 1990).

Grasping customer needs and translating them into a product concept has been termed ‘empathic design’. Leonard (1998, p.194), emphasis removed), defines empathic design as “the creation of product or service concepts based on a deep (empathetic) understanding of unarticulated user needs”. It is “a set of techniques, a process of developing deep empathy for another’s point of view and using that perspective to stimulate novel design concepts” (Leonard and Swap, 2005, p.82). Empathic design differs from contextual inquiry precisely because it does not rely on inquiry; in the situations in which empathic design is most useful, inquiry is useless or ineffective (Leonard, 1998, p.288fn). The more deeply a researcher can get into the mindset of a prospective or actual user, the more valuable is the knowledge thus generated (Leonard, 2007).

Obviously, the knowledge gained and generated through market research, empathic design and product development etc. should not vanish after the project is finished. Indeed, it is essential to retain vital knowledge to share and transfer across functions, between projects and generations of projects and products (e.g., Cusumano and Nobeoka, 1998; Nobeoka and Cusumano, 1997). As Cusumano and Nobeoka put it:

“In addition to overlapping projects and using cross-functional teams, companies have various organisational and technological mechanisms to help them capture knowledge about designs or manufacturing processes and then transfer this knowledge across different projects or different generations of products.” (Cusumano and Nobeoka, 1998, p.175)

In fact, successful NPD depends at least partially on the ability to understand technical and market knowledge embodied in existing products, and the adaptation of this knowledge to support NPD (Aoshima, 2002; Iansiti, 1997; Iansiti and Clark, 1994).

Ikujiro Nonaka’s publications (e.g., Nonaka, 1994; Nonaka and Takeuchi, 1995) have drawn attention to Japanese firms as knowledge-creating companies. They argue the difference between Japanese and Western firms lies in the focus on tacit knowledge of the former and explicit knowledge of the latter (Hedlund and Nonaka, 1993; Takeuchi and Nonaka, 2000). The practices of the Japanese ‘knowledge-creating company’ are also interesting from a marketing perspective, “because they demonstrate how companies mobilise all employees to learn more about markets and how to captivate customers” (Johansson and Nonaka, 1996, p.164). The theory of organisational knowledge creation has always been closely related to the field of marketing due to its focus on NPD projects (Nonaka, 1991; Takeuchi and Nonaka, 1986). The same is also true for Leonard’s (1998) work on knowledge assets. These studies can be read as the initial step towards a knowledge-based NPD concept because they offer a significant amount of empirical evidence to illustrate the process of knowledge creation in NPD projects. This is why this paper builds on these works, especially Nonaka’s SECI model (see below). My work

expands upon these ideas by integrating their findings into a comprehensive conceptual framework of knowledge-based marketing, thus opening up boundaries in order to include knowledge co-creation with external stakeholders such as customers and other entities in the business ecosystem.

This section introduced the concept of knowledge-based marketing and reviewed and summarised the essential literature on the role of knowledge in NPD. The knowledge-based marketing concept serves as the encompassing, overall framework of knowledge-based marketing processes in firms. As explained and shown in Figure 2, this theory essentially incorporates four core marketing processes through which knowledge and value can be co-created within the firm or together with stakeholders in the business ecosystem of the firm. This paper deals with one of these four core processes, namely NPD. The review of the literature above therefore serves as the background for the further development of the concept of knowledge-based NPD as a part of knowledge-based marketing.

3 Toward a theoretical framework of knowledge-based New Product Development

As Kohlbacher (2007) has shown, applying knowledge management concepts and practices to the knowledge-intensive field of marketing and to marketing functions is particularly effective. Especially when introducing new products or when entering new markets, knowledge creation and transfer and intra- as well as inter-firm collaboration prove critical to project success. This section first reviews the literature on knowledge co-creation. Then it introduces two illustrative case studies of knowledge-based NPD activities in two Japanese companies. Based on this, a conceptual framework of knowledge-based NPD is presented.

3.1 Knowledge co-creation

Knowledge co-creation, and especially knowledge co-creation with customers, is at the heart of knowledge-based NPD. Sawhney (2002, p.96, original emphasis) notes that “[c]ollaboration has become an established way of doing business with suppliers, channel partners and complementors”, but, with a few exceptions, “working directly with *customers* to co-create value remains a radical notion”. But a “critical aspect of creating a successful market is the ability to integrate the customer into every key process” and collaborators “may play a major role in initiating knowledge creation in the marketplace” (Kotler et al., 2002, pp.36, 38). According to Achrol and Kotler (1999), the creation of marketing know-how is the most important function of marketing in the global knowledge-based economy. Indeed, “in marketing, a wide array of knowledge needs to be created” and “knowledge on customers and their preferences must be located or solutions for a particular kind of customer problem need to be identified” (Schlegelmilch and Penz, 2002, p.12). Most of the time knowledge creation or application is only conducted in a unilateral way. Firms generate, collect and analyse knowledge *about* customers, customers’ needs, competitors, suppliers etc. Customer knowledge *from* customers is possibly an exception, but here as well, the knowledge might be communicated unilaterally from the customers to the firm without any sort of interaction with marketing specialists. The real challenge and source of essential knowledge for

competitive advantage is to go beyond knowledge creation and application as a unilateral concept, and to focus on increasingly crucial interaction and knowledge co-creation.

It follows that knowledge and value co-creation with customers – but also with suppliers and other business partners – has received significant attention recently (cf. e.g., Doz et al., 2001; Lawer, 2005; Prahalad and Ramaswamy, 2004b; Sawhney, 2002; Sawhney and Prandelli, 2000; Thomke and von Hippel, 2002; Zack, 2003). The market has become “a forum in which consumers play an active role in creating and competing for value”, with the distinguishing feature of this new marketplace being “that consumers become a new source of competence for the corporation” (Prahalad and Ramaswamy, 2000, p.80). Indeed, “co-creation converts the market into a *forum* where dialogue among the consumer, the firm, consumer communities, and networks of firms can take place” (Prahalad and Ramaswamy, 2004b, p.122, original emphasis). According to Zack (2003, p.71), anyone who can help the business – customers, trading partners, suppliers, consumers, interest groups – should be involved to create the knowledge the company needs. Indeed, as discussed above, the “array of relationships in the set has been expanded from the dyad of seller and customer to include partners up and down the value chain (e.g., suppliers, the customers of customers, channel intermediaries)” (Day and Montgomery, 1999, p.4).

Gibbert et al. (2002, p.463) contend that since customer knowledge management is about innovation and growth, customer knowledge managers “seek opportunities for partnering with their customers as equal co-creators of organisational value”. According to Prahalad and Ramaswamy (2003), the value of products or services is in the co-creation experience that stems from the customer’s interaction with the product and/or the firm (cf., also Prahalad and Ramaswamy, 2004b). Gummesson (2002, p.8) further notes that “[e]specially in services and often in B-to-B, customers are co-producers”. Lovelock and Gummesson (2004, p.29) use the term ‘coproducer’ in the narrow sense of “a transfer of work from the provider to the customer” and contend that “[i]n its purest form, coproduction means that customers engage in self-service, using systems, facilities, or equipment supplied by the service provider”. However, research in this area is still rather scarce, and as Lawer (2005, p.11) has noted, “the organisational learning or marketing literature does not yet adequately define or empirically identify the nature or scope of the capability changes required for co-creation of knowledge with customers”. Indeed, “the challenge is to view customers as co-producers of knowledge” (Desouza and Awazu, 2005, p.143); in order “to be successful at co-producing knowledge, the organisation must seek customers who have open knowledge-sharing cultures, are willing to engage in learning and knowledge-creating activities, and are willing to take a certain degree of risk” (Desouza and Awazu, 2004, p.15). Finally, companies must

“redesign their businesses from a customer-driven starting point, so that they gather deep knowledge about customers and then have the capacity to offer customized products, services, programs, and messages.” (Kotler et al., 2002, p.164)

Customers’ ideas – specifically those of so-called ‘lead users’ – and the ideas of those who interact directly with customers, or those that develop products for customers, have become important (cf. e.g., Barabba and Zaltman, 1991; Leonard, 1998, 2007; Zaltman, 2003). “Lead users have foresight (knowledge) to help an organisation better plan for product innovations” and organisations have “begun to host user conferences for the specific purpose of getting to know how their customers utilise their products

and how they have customised or modified them to meet their needs” (Desouza and Awazu, 2004, p.14). In the 1970s, von Hippel (1977) found that most product innovations come not from within the company that produces the product but from end-users of the product. Note that lead users can be part of or even form networks where they share their ideas and knowledge (Furukawa, 1999). More recently, Thomke and von Hippel (2002) suggested ways in which customers can become co-innovators and co-developers of custom products (cf. also Gibbert et al., 2002; Thomke, 2003). Indeed, “[c]ontrary to the mythology of marketing, the supplier is not necessarily the active party” and in B-to-B, “customers initiate innovation and force suppliers to change their products or services” (Gummesson, 2002, p.15). As Prahalad and Ramaswamy (2004a, pp.10, 11, original emphasis) put it: “In the co-creation view, all points of interaction between the company and the consumer are opportunities *for both value creation and extraction*”.

In summary, the literature on knowledge co-creation has added an essential new dimension to the works on knowledge management and the theory of organisational knowledge creation. Before, the focus used to be only on knowledge creation within the firm as well as the transfer of knowledge within MNCs. In the network economy of the 21st century, companies can no longer be seen as isolated entities; collaboration and joint creation of knowledge and value with external stakeholders and other entities in the business ecosystem is becoming increasingly important. Indeed, according to Nonaka and Toyama (2005, p.430, original emphasis), the “ecosystem of knowledge consists of multi-layered *ba*, which exists across organisational boundaries and is continuously evolving”, with firms creating knowledge “by synthesising their own knowledge and the knowledge embedded in various outside players, such as customers, suppliers, competitors or universities”. However, the different research streams are quite heterogeneous, diverse and not well interconnected. Building on their key findings, my theory of knowledge-based marketing works to integrate them seamlessly with existing theories of organisational knowledge creation.

3.2 *Explanatory cases*

The insights presented in this paper are based on empirical research conducted by the author. A number of results have been published elsewhere (Ichijo and Kohlbacher, 2007; Kohlbacher, 2007; Kohlbacher and Krähe, 2007; Kohlbacher and Mukai, 2007) and this paper builds and expands on their theoretical work by using a qualitative research approach. However, my findings are employed primarily as conceptual work and the empirical evidence – case material from Japanese companies – is used as explanatory cases (Yin, 2003) to illustrate my argument. The research was conducted over a period of more than one year and involved triangulation among a variety of different sources of data, including the conducting of both formal and informal on- and off-site interviews with managers as well as scholars and other experts in the field; analysis of archival materials such internal company documents as well as articles in the business media; and an evaluation of existing case studies and other relevant literature (Yin, 2003). During 2005 and 2006 I conducted more than 100 qualitative interviews with top executives, middle managers and selected employees at more than 30 different MNCs – Japanese, European and USA – primarily in Japan. In the course of these qualitative interviews, interviewees were asked semi-structured questions in accordance with the theory of organisational knowledge creation and enabling, but they could nevertheless answer openly and usually led the direction of their interview. The interviews yielded important

insights into how marketing knowledge management is done in practice. Comparing these insights with the extant literature led to various research propositions and a refinement of the initial research questions. The informant companies and interviewees were identified through purposive sampling (purposeful sampling) (Gummesson, 2001). Through a review of the relevant literature, the media and expert interviews, especially information-rich, critical case were selected for this research project. These cases were analysed in-depth by triangulating interview, archival and other data. Each critical case led to the establishment of a different pattern of knowledge-based marketing which I then integrated into the overall framework. The two most relevant cases with regard to NPD were Maekawa and Mazda, the cases chosen for this paper. They are both represented here in the form of abbreviated vignettes. I recognise the common limits of generalising such field research (cf. e.g., Eisenhardt, 1989; Patton and Appelbaum, 2003), but some analytic, if not statistical, generalisation is possible (Numagami, 1998; Yin, 2003).

3.2.1 *Maekawa Manufacturing*

The case of Maekawa Manufacturing – a manufacturer of industrial freezers and related systems – illustrates how knowledge is co-created with customers through the co-creation of a joint *ba* – a shared context (cf. e.g., Nonaka et al., 2000) – between Maekawa and its customers. It also shows the importance of close interactions and long-term relationships with (key) customers and the sophisticated integration of product and service offerings (Kohlbacher, 2007).

Maekawa Manufacturing Ltd – famous for its decentralised structures and project-based management approach (e.g., Peltokorpi and Tsuyuki, 2006) – found that producing and selling industrial parts was no longer enough. Through co-creation of common contexts and knowledge with its customers it was able to combine its products with its process knowledge to offer more integrated parts service, including consulting. This means that Maekawa has transformed itself from a supplier of physical products and parts into a provider of comprehensive solutions. However, they do not simply offer pre-defined processes and manufacturing models, but actively co-create the solutions together with their customers (cf. also Maekawa, 2004; Tsuyuki, 2001), an achievement that helped them to escape the red oceans of cutthroat competition and create new market space (blue ocean), as yet ‘untainted by competition’ (Kim and Mauborgne, 2004, p.77).

Engineers at Maekawa, as one might suspect, are strongly encouraged to develop an ability to talk with customers; in fact, this is considered an indispensable aspect of their participation in that enabling context or *ba*. Engineers who can recognise the technical needs of customers by observing their production lines with them are more trusted than those who focus only on technical specifications (cf. also von Krogh et al., 2000, p.198). These direct interactions and the trust that results are absolutely necessary to co-creating and nurturing a shared context or *ba* between Maekawa and its customers. Moreover, as Maekawa aims to build and sustain relationships with its customers long-term rather than merely seeking short-term financial profit, these shared contexts with customers grow and are fostered over time. Establishing long-term relationships, mutual trust and joint *ba* enables effective cooperation and teamwork between Maekawa and its customers and at the same time fosters the co-creation and sharing of knowledge. Indeed, even though it is surely not a cause-and-effect relationship, the co-creation of *ba* – a shared context – requires and fosters the establishment of close, long-term relationships at the

same time. Here, the co-creation of *ba* means that *ba* is not only created and established within one organisation, but actively and jointly created together with and between organisations, specifically Maekawa and its customers. Many of these customers can be seen as lead users who challenge Maekawa with complicated and new specifications and applications that must often be co-developed from scratch.

This way of collaborating with customers to create superior service and innovation also leads to the co-creation of a vast amount of – often very tacit – product and service knowledge but also knowledge *from* and *about* customers. This knowledge is utilised and refined over years in long-term relationships with a customer, but it can also often be applied to projects with other customers as well. Collaborating with customers also means to think beyond them and about the customers' customers as well. As a result, the co-created customer knowledge also includes knowledge about, from and to support customers' customers. Indeed, Maekawa is not only concerned about the quality of its own products and services but also about that of its customers. This is a very special and important value proposition.

Maekawa directly involves customers in the new product and service development process; through personal interaction and knowledge co-creation, they co-innovate and co-develop solutions with them. They have realised that it is knowledge – especially tacit knowledge – that is at the heart of innovation and product development. In order to be able to serve their customers best they need to deeply understand their needs and wants, many of which are often latent: even the customers themselves are not yet aware of them. In the process of co-creating a joint *ba*, these latent needs and wants emerge as tacit knowledge that finally leads to the development of new products and services.

3.2.2 *Mazda motor corporation*

The development of the very successful Mazda roadster, the Miata MX-5, illustrates how an essential product concept and related tacit marketing knowledge were passed on and refined over three product generations. It also shows that co-creation between the product and the customers is crucial and that empathic design to tacitly understand customer needs is vital (Kohlbacher, 2007; Nonaka and Katsumi, 2006; Nonaka et al., 2006a).

Developing, disseminating and implementing a unique concept is an essential step in product development. However, these concepts usually tend to be highly tacit and as such difficult to transfer to others. Indeed, especially in the concept development stage, it is critical to articulate images rooted in tacit knowledge; meaningful information emerges only when this is done successfully (Nonaka, 1990). Explaining how tacit knowledge becomes explicit knowledge, Nonaka and Takeuchi (1995, pp.64, 65) maintain that a “frequently used method to create a concept is to combine deduction and induction”. They highlight the example of Mazda, which combined these two reasoning methods when it developed the new RX-7 concept. In fact, as Nonaka and Toyama (2003) argue, abduction or retroduction might be even more effective than induction or deduction to expose a hidden concept or mechanism. In the Roadster case, the use of symbolic language proved essential for the success of the car across product generations. Using the metaphorical concept of *Jinba Ittai* – (literally, “the rider and the horse as one”), Mazda sought to present the Miata as a vehicle where car and driver could become one in the sense that the driver would experience a perfect fit with the car and fully enjoy all aspects of driving the car.

Metaphors and concepts like *Jinba Ittai* can also be used for identifying and learning about customer needs. Using fishbone charts and discussing the concept on the basis of interpretations of it in the concept catalogue – a document that was jointly created by all engineers involved – were helpful measures for an externalisation of the tacit concept. As mentioned above, this way of capturing customer needs and translating them into a product concept has been termed ‘empathic design’. In order to better understand the special characteristics of the Roadster and to directly and physically experience the product and its concept, all 42 component team leaders of the third generation product development teams extensively test drove all kinds of light weight sports cars, including the first two generations of the Mazda Roadster and the best known sports cars on the global market (e.g., from Honda, Porsche, Fiat, BMW etc.). All of them would go on long drives during the day, and then share their lived experiences, feelings, sensations and thoughts over drinks together at night, often in heated and emotional discussions. These personal interactions and dialogues fostered not only a strong team spirit but also produced a joint/communal understanding of the concept of *Jinba Ittai* and the idea of ‘lots of fun’, i.e., the essence of an ideal sports car, its aesthetics, quality and motion. At long last, the product development team was able to understand customer needs and translate them into a successful product concept, primarily because of their capacity to grasp even tacit customer needs and knowledge, achieving a high level of experience co-creation between customers and product.

Transferring and refining – and thus *recreating* – the concept of *Jinba Ittai* over three generations was fundamental to the success of the Mazda Roadster over three product generations. In fact, as Herbig and Jacobs (1996, pp.66, 67) have pointed out, “Japanese innovation refers to the application, the refinement of an idea”, and “[i]deas from many people are gathered, assimilated, and squeezed into a new product or solution”. This is exactly what happened at Mazda. This is a very important point as it shows that time and experience play an important role. As Cusumano and Nobeoka put it:

“Engineers need to learn how to do this kind of design work through experience, and what they need to do may vary widely from project to project. It is difficult to write down or codify this type of knowledge.” (Cusumano and Nobeoka, 1998, p.176)

The development of the first generation Roadster can certainly be seen as a radical innovation. At that time, nobody saw a market or business opportunity for a lightweight sports car. But the Mazda Roadster turned out to be an outstanding success and created a whole new market for Mazda. To borrow a term from Kim and Mauborgne (1999), the Miata can be seen as a ‘value innovation’. Instead of trying to outperform competitors through better quality or new technological features etc., value innovation “makes the competition irrelevant by offering fundamentally new and superior buyer value in existing markets and by enabling a quantum leap in buyer value to create new markets (Kim and Mauborgne, 1999, p.43). With the development of the Roadster, Mazda managed to “break out of the competitive and imitative trap” (Kim and Mauborgne, 1999, p.43).

Leveraging empathic design proved crucial in the development process of the three Mazda Roadster generations. Understanding the latent needs and wants of consumers and creating a corresponding product concept – all highly tacit knowledge – were key factors. Indeed, knowledge is the decisive source and resource in product development. But simply managing existing knowledge or only individual knowledge is not enough. The essential step is the creation of new knowledge organisationally, as a team effort.

3.3 *Conceptual framework of knowledge-based product development*

Both the literature review as well as the cases described above show the importance of tacit knowledge for innovation and knowledge co-creation in new product development. The two cases described are particularly vivid examples of the crucial role of knowledge in NPD as well as the co-creation of knowledge with outside stakeholders – especially customers – as well as its co- and re-creation within the firm. Kohlbacher defined knowledge-based marketing as

“a knowledge management approach to marketing that focuses both on the exploitation (sharing and application) and exploration (creation) as well as the co-creation of marketing knowledge from contexts, relations and interactions in order to gain and sustain competitive advantage.” (Kohlbacher, 2007, p.103)

Similarly, knowledge-based NPD can be defined as

“a knowledge management approach to NPD that focuses both on the exploitation (sharing and application) and exploration (creation) as well as the co-creation of marketing knowledge from contexts, relations and interactions in order to develop innovative products, services and solutions.”

This is precisely the process that can be observed in the Maekawa and Mazda cases.

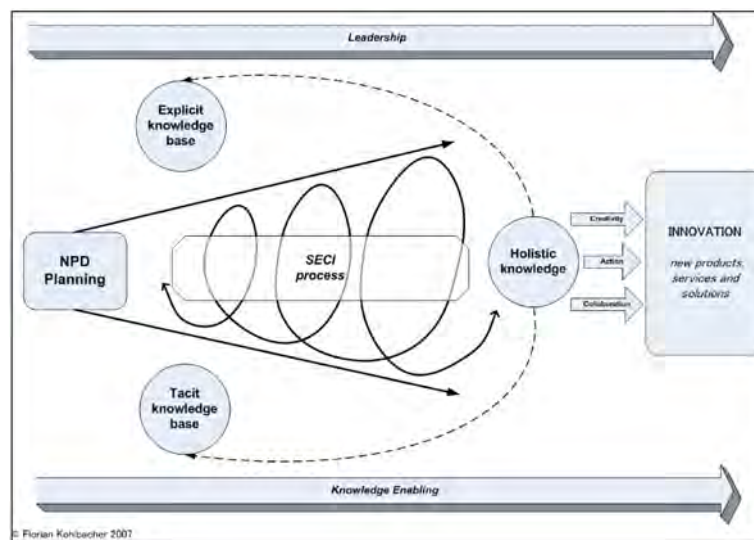
The main insights from the literature review in this paper are already incorporated in the framework of Figure 2. Figure 3 illustrates the interconnected processes of organisational knowledge creation and NPD, i.e., the marketing knowledge (co-)creation process. Through the SECI process – the process of organisational knowledge creation defined and explained by Nonaka (1994) and Nonaka and Takeuchi (1995) – new knowledge is constantly created and refined over time, lifting knowledge creation from the tacit and explicit organisational knowledge bases to a higher dimension. This more holistic form of knowledge bridges explicit and tacit knowledge, thus closing the gap “between the formula and its enactment”. Indeed, Taylor (1993, p.57) contends that the “person of real practical wisdom is marked out less by the ability to formulate rules than by knowing how to act in each particular situation”. Product development teams at both Maekawa and Mazda also work in this way, trying hard to synthesise both explicit and tacit knowledge. Some product specifications might be quite explicit, while others, such as the product concepts, are rather tacit. Nevertheless, both are crucial and need to be matched and combined.

Dixon (2000, p.13) defines knowledge “as the meaningful links people make in their minds between information and its application in action in a specific setting” and states that it “is always linked to action”, as it is “derived from action and ... carries the potential for others to use it to take action”. Similarly, tacit knowledge refers to a kind of highly personal knowledge that is hard to formalise and thus difficult to communicate to others, perhaps because it is deeply rooted in action (Nonaka and Takeuchi, 1995). In fact, in management, “knowledge about situations is of prime importance [...] not just knowledge about facts or people or technology, et cetera, but situational knowledge that combines all these factors” (Ghosn and Riès, 2005, p.175). Both at Maekawa and Mazda, knowledge is deeply rooted in action. At Maekawa, products are co-developed on the job with customers through direct interaction and frequent visits to the shop floor. At Mazda, the engineers extensively test drive a variety of cars and generate important knowledge through direct experience on the road. The test driving and the follow-up discussions on these experiences are at the heart of the empathic design process employed by Mazda’s

product development teams. Maekawa's way of integrating customers into the development process, too, can certainly be seen as a form of empathic design and development.

Note that the marketing knowledge co-creation process in Figure 3 is the same knowledge co-creation process that can be found in the model of knowledge-based marketing processes (cf. Figure 2). This model of the marketing knowledge co-creation process simply explains on the micro level and in greater detail what can be seen in the macro model of knowledge-based marketing processes in general.

Figure 3 The marketing knowledge co-creation process in NPD (see online version for colours)

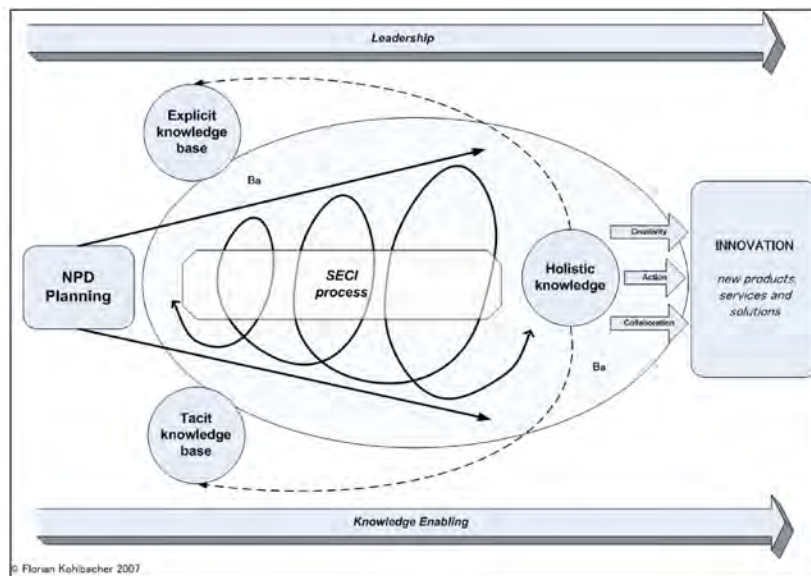


Source: Author's own illustration

The marketing knowledge creation process in NPD is an iterative process that starts with NPD planning and constantly loops back again. The final outcome is innovation in the form of new products, services and solutions. Kogut and Zander (1992) argue that innovations are products of a firm's 'combinative capabilities' to generate new applications from existing knowledge. The model of knowledge-based NPD incorporates these combinative capabilities but goes beyond merely combining already existing knowledge into new applications, instead emphasising the importance of constantly creating new knowledge to generate new products and services. Besides, it also adds the important aspect of jointly creating (co-creating) new knowledge together with other entities in the business ecosystem. Finally, the continuous process of creating and refining concepts, ideas and knowledge through direct communication and interaction fosters the emergence of innovation and competitive advantage. In the case of Maekawa, this communication and interaction not only takes place within the firms and internal teams, but also between the firm and its customers. In the Mazda Roadster case, crucial tacit knowledge is communicated and re-created over several product generations across different NPD teams. The knowledge creation process is supported and nurtured by leadership – usually by middle managers (Nonaka and Takeuchi, 1995) and knowledge activists (von Krogh et al., 2000) – as well as certain enablers or enabling conditions (von Krogh et al., 2000).

Finally, as shown by Nonaka and associates (Nonaka et al., 2000; von Krogh et al., 2000), organisational knowledge creation needs a shared context/*ba*, or is at least enhanced by it. Figure 4 takes this fact into consideration and incorporates *ba* into the model. Furukawa (1999) proposes the term ‘meeting *ba*’ (*deai no ba*) to describe the interaction and subsequent knowledge exchange and creation between firms and customers. This meeting *ba* needs to be designed to communicate actively with customers and consumers within the social network or ecosystem. For Maekawa, this *ba* or meeting *ba* is established between the Maekawa teams and the customers, while the Mazda Roadster case showed the importance of the right team atmosphere and the creation of the right *ba* among the product development team members. As mentioned above, Nonaka et al. (2006b) suggest that members of a product development project share ideas and viewpoints on their product design in a *ba* that allows common interpretation of technical data, evolving rules of thumb, an emerging sense of product quality, effective communication of hunches or concerns, and so on. The Mazda case, particularly, clearly illustrates this and thus supports and confirms Nonaka’s suggestion. Nonaka’s SECI model and concept of *ba* have indeed proven to be a valid and valuable theoretical foundation in building a knowledge-based marketing framework that allows extension and expansion of the theory of organisational knowledge creation.

Figure 4 The marketing knowledge co-creation process and *ba* in NPD (see online version for colours)



Source: Author’s own illustration

The models shown in Figures 3 and 4 build on the SECI process of organisational knowledge creation and integrate it into the overall framework of knowledge-based marketing in general and the concept of knowledge-based NPD in particular. They illustrate the importance of both tacit and explicit knowledge and their synthesis into holistic knowledge, and link the NPD planning process with the process of knowledge creation and finally, innovation. Understanding this essential mechanism is important for both theory and practice.

At the beginning of this paper, I put forward three key points:

- knowledge can be identified as the decisive success factor in NPD
- much of the required knowledge in NPD is tacit and resides with entities outside the boundary of the firm: mainly customers, but also other stakeholders such as competitors, suppliers and business partners
- the required knowledge is not simply 'out there', ready to be collected and processed by the firm, but actually needs to be created at least in part.

The conceptual models offered in this paper – Figures 2–4 – integrate and connect these key points. Figure 2, the macro model, illustrates all three points, while Figures 3 and 4 feature micro models focusing on points 1 and 3. The models thus bridge the gap apparent in the current literature in that they offer the first coherent framework that integrates the abovementioned three points into a comprehensive theory of knowledge-based NPD.

4 Conclusion, need for further research and managerial implications

This paper develops the concept of knowledge-based NPD in an effort to explain the role of knowledge in NPD and the process of its (co-)creation and management. It endeavours to advance the notion of knowledge (co-)creation in NPD with a particular focus on the involvement of customers – i.e., the co-creation of knowledge, value and innovation with customers. The purpose is to provide both academics and practitioners with a framework for understanding and analysing knowledge-based processes in NPD and how these can be leveraged to foster innovation. The ideas and concepts presented in this paper are grounded in empirical research conducted by Kohlbacher (2007), but a number of limitations apply, as already pointed out above. Thus, further conceptual refinement as well as empirical research will be necessary. One potential avenue for further development of the framework is found in the work on open innovation (e.g., Chesbrough, 2003). Chesbrough argues that in

“a world of widely distributed useful knowledge, one can only sustain innovation by actively licensing in external ideas and technologies alongside developing and deploying one’s own ideas.” (Chesbrough, 2006, p.15)

Open innovation is a paradigm that offers the prospect of lower costs of innovation, faster times to market and the chance to share risks with others (Chesbrough, 2003, 2006). The idea and the process of leveraging external knowledge as well as co-creating new knowledge with other entities in the business ecosystem is one of the key points of knowledge-based NPD as well.

The concepts of knowledge-based marketing and knowledge-based NPD also yield important managerial implications. However, it is important to note that there is no single correct approach. Indeed, depending on each company’s individual circumstances, the processes may look different and a particular knowledge-based approach to marketing and NPD will have to be developed and strategically managed. Nevertheless, the following four general conclusions can be drawn, which can be useful to both marketing managers and scholars (cf. also Kohlbacher, 2007, pp.193, 194):

- As knowledge has become a critical source for competitive advantage, marketing – and management in general – must become knowledge-based, as must all marketing processes such as NPD.
- Marketing scholars and practitioners have focused too much on explicit marketing knowledge in the past. Combining and synthesising both tacit and explicit knowledge and subsequently leveraging holistic marketing knowledge is a sine qua non for successful NPD.
- Marketing knowledge needs to be co-created, not only inside the firm or across different units of a corporation but also together with other stakeholders, most importantly customers, but also with suppliers, partners and competitors. This includes the opportunity to co-develop new products and services.
- Managers should perceive their firms as interconnected with the global network economy, and thus have to take seriously relationship marketing and the co-creation of knowledge and value with other entities in the business ecosystem. Indeed, knowledge-based marketing and NPD is a mind-set as much as it is a business process.

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