The Commercialization of User Innovations: The Development of the Rodeo Kayak Industry

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Abstract:

In this study, we analyze the commercialization process of user innovations in open communities. We have traced 16 cases of user innovators who have commercialized their own innovations or have been involved in the commercialization process to some extent. By developing and manufacturing new products, the user innovators in our sample created a fast-growing community. They used low-cost manufacturing techniques and were able to start a new industry before established manufacturers could enter the market. The transformation process from a user innovation community to a commercial and manufacturing community brought about a number of major changes. In this paper, we track those changes as: the motives for innovating, the community size and characteristics, the type of innovation, the type of assistance and the disclosure of information, the form of communication, and competition between innovating users.

1. Introduction

Every commercial success starts with an idea for a new product or service. Innovations have been said to be generated by companies that want to satisfy customer needs, but also by user innovators who generate new products or solutions for their very own needs (von Hippel, 1988, 2005). The integration of users as external sources for the innovation process has been considered an important factor in the development of *innovation generations* (Rothwell, 1986, 1994). Thus, user innovators are part of a larger innovation system (Lundvall, 1998; Lundvall et al., 2002). While user innovations might not be relevant in all industries (Pavitt, 1984), and companies can also be misled by listening too closely to general users (i.e., customers; Christensen and Bower, 1996; Christensen, 1997), other authors (Lilien et al., 2002; Morrison et al., 2004) have shown the importance of *leading-edge users* for new product development.

Still, the literature has not focused on the commercialization of user innovations due to the fact that the motives of user innovators to *start innovating* are not (primarily) economic[1]. Instead, user innovators have been assumed to act differently from the traditional market system (Raymond, 1994) and to neglect the typical product diffusion and selling process a manufacturer would aim for (von Hippel, 1988). Thus, the phenomenon itself has been analyzed (von Hippel, 1976, 1977, 2001), thus revealing the general conditions for user innovations and community interaction to occur without focusing on the process and outcomes of commercializing user innovations.

Therefore, we plan to contribute to the existing literature in two ways: (1) We will analyze the role of user innovators in the very early stages of industry development. Because of their distinct motivation, skills and cost advantages, user innovators can supply products for new market segments that established manufacturers would not serve. In this way, user innovators can act as an important institutional form in very early stages of product and industry life cycles. (2) We suppose that commercial activities have an effect on the open community system based on the free transfer of certain resources (e.g.: knowledge, experience; Morisson et al., 2000; Harhoff et al., 2003). It seems worth analyzing how communities react to such activities, and subsequently what transformation processes we can observe, especially in industries with analogous conditions and for companies that

wish to use the potential of open innovation.

For our field research, we deliberately chose an extreme sporting community, the rodeo kayak community. The rodeo kayak industry is a fast-changing consumer goods industry that emerged in the mid-1990s based on user innovations. Rodeo kayaking is part of the overall kayaking, canoeing and rafting industry. What is its market impact? According to the State of the Industry Report (Outdoor Industry Association, 2002), paddling activities (including kayaking, canoeing and rafting) are the second fastest growing outdoor sports (with a 37% yearly increase from 2000 to 2001) in the US after cross-country and nordic skiing. A 2004 report shows that 15% of the US population has enjoyed some kind of paddling activities at least once (Consumer Outreach Report, Outdoor Industry Foundation, 2004). Altogether, 35.9 million Americans paddle every year (Outdoor Recreation Participation and Spending Study, Outdoor Industry Foundation, 2002). The Outdoor Industry Association estimates the retail sales of products used in outdoor activities *at a conservative $18 billion*[2].

User innovators have a special impact on outdoor industries as they create new materials and equipment (Shah, 2000; Luethje et al., 2002; Franke and Shah, 2003). Together with 'job reasons', the 'lack of necessary gear/equipment' is the number one reason why general users stop outdoor activities indefinitely (22% of all respondents, Consumer Outreach Report, Outdoor Industry Foundation, 2004). Traditional companies apparently do not provide all the products needed. User innovators have the ability and interest to change existing products and to innovate new products (von Hippel, 2001). Additionally, they have rather low costs in developing and testing new products. In the rodeo kayak field, designs and characteristics (materials: mainly PVC, but also fiberglass) can be changed by users with the necessary technical skills. Individuals can make small changes to boats by cutting off and/or heating the material and by applying fittings. User innovators incur much lower costs and less time than manufacturers for developing new ideas. Another point that favors user innovations is the existence of a strong community: On the river, kayakers paddle together in groups for safety reasons. Via the Internet, kayakers exchange knowledge about new moves and materials. At championships, national teams and teams sponsored by kayak companies compete.

There are a variety of factors that form a strong overall community as well as smaller sub-communities that interchange and combine skills for innovation.

In this paper, we present an ex post analysis of 16 cases of user innovators who have commercialized their own innovations or taken part in the commercialization process. Some of them have become user manufacturers; others have simply sold their innovations to traditional companies or worked as lead users in innovation projects for a certain consideration. Using the comparative case study method (Jenson and Rodgers, 2001), we gain comprehensive data from the cases and illustrate the overall development process from user innovations to finished products. Our results show that the commercialization of user innovations in the industry chosen had effects on the conditions for open community innovation, like the free revealing of information, the interaction of user innovators, the assistance of community members and the motivation to innovate. Tracing the actions of user innovators, user manufacturers and traditional kayak companies, we identify and discuss factors that have an impact on the commercialization of user innovations and on the community.

2. Literature Review

The traditional model of new product development (NPD) illustrates a process that starts with the generation of ideas, undergoes a number of stages and finally leads to the commercial launch of new products (Cooper and Kleinschmidt, 1993; Cooper, 1996; Fox et al., 1998). While the traditional model of NPD focuses on different screening stages and involves only the partial integration of externals (customers) at early stages (Rice et al., 1998; Bidault et al., 1998), Rothwell (1986, 1994) and others (Rothwell and Zegveld, 1985; Perunovic and Christiansen, 2005; based on the work of Rothwell in the 1970s) have pointed out that the innovation process has changed over the years: Rothwell classified the innovation process into five major *innovation generations*. While early models of innovation were focused on firm internal capabilities and R&D, later generations (starting with the third innovation generation, the *coupling model*) feature a more complex process of

innovation, including internal as well as external sources of innovation alike, and emphasizing the importance of users in the innovation process (Holt, 1987; Foxall, 1987a, b).

In a related perspective, the user innovation approach (based on the work of von Hippel, 1976, 1977, 1988) focuses on end users as a source of innovation. Basically, user innovators generate new applications, products and problem solutions (in different development stages) themselves, often based on existing products from manufacturers, developing new uses and techniques or completely new products and solutions. User innovators have a direct personal need but usually no commercial interest. Thus, no manufacturer is involved in their innovative activities; users themselves test and retest their innovations (von Hippel, 1988). The impact of sticky local information hinders the transfer of problem-solving capabilities from one individual, the user, to another, the manufacturer (von Hippel, 1998; Mascitelli, 2000). For users, it is easier to cooperate and interact with other users in the community, where they share information for free (Luethje et al., 2002). Innovations from users do not have to pass traditional screening stages and follow company rules or standardized routines (Meeus and Oerlemans, 2000).

User innovations have been analyzed in various fields (von Hippel, 1988, 2002). The share of user innovations in new prototype and product development varies between different industries (a detailed overview is given in von Hippel, 2002). High percentages on average reveal that user innovations can be seen as a general and broad practice rather than an isolated phenomenon. User innovations have been analyzed mainly in open-source communities (von Hippel, 2001; Franke and von Hippel, 2002; Lakhani and von Hippel, 2003; Jeppson and Molin, 2003; O'Mahony, 2003; von Krogh, Spaeht and Lakhani, 2003), in high-technology equipment (Luethje, Herstatt and von Hippel, 2002; von Hippel, 1976; von Hippel, 1977), and in consumer goods industries (Franke and Shah, 2003; Luethje, 2002; Shah, 2000).

While not every user might be interested in future market trends, leading-edge users (lead users[3]) have been said to be able to anticipate trends, acting in advance of the actual NPD process, and to be starters or catalysts for new industries (Lilien et al., 2002; Morrison et al., 2004). Therefore, on the one hand NPD is carried out by companies striving to optimize their innovation output and to

commercialize ideas (with rather high failure rates of approximately 35 to 45%: Boulding et al., 1997). On the other hand, users who act in an informal and flexible manner innovate because of their needs and problem orientation, but without any particular intention for commercialization. Various studies have shown that user innovations are technologically sophisticated and have a high customer value and benefit (von Hippel, 1988; von Hippel, 1998; Shah, 2000; von Hippel, 2001; Lüthje et al., 2002; Franke and Shah, 2003).

Still, user innovators have to be seen as part of a greater innovation system (Lundvall, 1998; Lundvall et al., 2002). There might be strong stimuli for user innovations in certain industries and for certain products/solutions, while other industries will favor manufacturer-driven (i.e., high-capital) innovation (Pavitt, 1984; Freel, 2005).

Some authors have also argued that focusing too much on the ideas of general users might cause firms to fail (Christensen and Bower, 1996; Christensen, 1997; Christensen et al., 1998; Slater and Narver, 1998), especially when markets shift and when industries experience disruptions due to technological innovation. Christensen et al. (2001) put forward that leading companies are so *focused on sustaining innovations and addressing the more sophisticated and profitable customers* that they ignore disruptive technologies from the *low end*. They argue that the downturn of the booming Japanese economy from the 1960s to the mid-1980s was caused by such effects. Rothwell (1994) pointed out similar effects by describing the progression from a fourth-generation innovation process (Japanese companies) to a fifth-generation innovation process.

While that viewpoint seems relevant to manufacturer-customer interaction, it might not hold true for user innovators or especially lead users. They are at the leading edge of target and analogous markets. By developing new products, they *mainly serve their own needs* and act independently of the manufacturers' NPD process (von Hippel, 2005). Thus, analyzing and learning from lead users has to be distinguished from listening to the voice of the general customer (Danneels, 2004).

The current literature indicates the different roles of user innovators and manufacturers in the innovation and diffusion process (von Hippel, 2001, 2002; Franke and Shah, 2003). While the typical manufacturer expects to benefit from selling an innovation in the marketplace, the user

innovator benefits from in-house use or personal use. In addition, and in contrast to the innovation process of a manufacturer, the user innovation process is dominated by sharing and freely revealing information within a community (Morrison et al., 2000; Harhoff et al., 2003). The community, which is seen as the basis for user innovations, has been analyzed as a dynamic and changing system (Lynn et al., 1996; Deroïan, 2001; Tether, 2002). However, the impacts of community changes on the user innovation process have not been analyzed so far.

The user innovation can provide the starting point for new product development or even an entirely new industry (Franke and Shah, 2003; Kristenson et al., 2002; Luethje, 2000; Shah, 2000). User innovators are able to avoid fixed costs (e.g., upfront capital investment, personnel, etc.) incurred by the manufacturer and can therefore act very flexibly. Advantages in the user innovation process are found in the early stages of new product development, where ideas and prototypes have to be evaluated, tested and retested numerous times (Ozer, 1999). Much of the knowledge of user innovators in that stage is still tacit (Nightingale, 1998). With regard to models of new product development (Cooper and Kleinschmidt, 1993; Dahan and Hauser, 2002) and the innovation cycle (Teece, 1986), user innovations have mainly been analyzed in early stages, prior to industry standards and dominant designs (Suarez and Utterback, 1995; Funk, 2003). After that stage, manufacturers have been said to take over and produce and diffuse the new product or solution on a large scale, optimizing production and distribution.

Finally, how do user innovations, the commercialization of such innovations and community development fit into a broader picture of innovation systems (Lundvall et al., 2002)? It has been argued that within a complex system of innovation, different agents, institutions, companies, and individuals interact to form parts of the overall innovation and market process (Lundvall, 1998; Carlsson et al., 2002; Nelson and Nelson, 2002; Coriat and Weinstein, 2002; Francis and Bessant, 2005). Within that system, it might seem that user innovators and communities play a rather unimpressive role compared to large companies or research institutions. Additionally, their activities are hard to trace because they act within a very informal framework, and if they do not succeed in their activities their failure is not recorded. Still, they act at the very heart of the innovation process

because they have needs and likes which are not satisfied by the market. They find solutions to unsolved problems that established companies do not consider worth pursuing. Learning more about user innovations that have been commercialized and tracing the cases of lead users who started their own companies can reveal a substantial source of ideas, an active institutional form within an overall system of innovation. This makes the commercialization of user innovations an important phenomenon which is certainly worth studying.

Research Interest

The literature has just started to look at the commercialization process for user innovations (Shah, 2000), i.e., describing the actors and their motivations within a larger community system of open innovation. Therefore, the main research interest here is to take an exploratory look at the commercialization process of user innovations. Given that user innovators commercialize their innovations, what are the reasons and what are the effects? The research focus of this study is twofold:

1. The first aspect deals with the development of user innovations up to the point of commercialization. What roles do users play in the development of a new industry?

2. The second aspect deals with changes in the community caused by the development and commercialization of innovations. With the emergence and development of a new industry, certain factors influencing open community innovation and the commercialization of user innovations can be identified. Interesting aspects that might be subject to change are explored in the cases:

- Interaction between users/user innovators
- Assistance of community members
- Free revealing of information
- Community size and development
- Formation of sub-communities
- Type of innovation and innovation motives

- Role of traditional companies

Research Method and Data Collection

Case study analysis

In order to gain insight into a topic that has not yet been analyzed, we use the case study method. It has been used in innovative, new technology fields to question existing theory and develop further theory (O'Connor, 1998; Song and Montoya-Weiss, 1998; Perry, 1998; McDermott and O'Connor, 2001). For our research purpose, the case study method was extremely valuable because the development of user innovations and that of the overall rodeo kayak industry depended heavily on the actions of individual user innovators. Single user innovators played a major role in the industry over many years, and we were able to interview them in person. It was also possible to identify and trace radical and incremental user innovations. Due to the very dynamic industry and the number of changes it has seen, insights could not be gained by conducting a snapshot enquiry, but by analyzing the history of multiple cases of user manufacturers and user innovators ex post. In order to enable comparison across entities for generalization, multiple cases were handled; some cases were considered central, others complementary (Amaratunga and Baldry, 2001).

We used the case study method to detect the essential elements of a dynamic process (Eisenhardt, 1989): the innovative activities of users, the commercialization of innovations and the development of the community. By analyzing multiple cases, we were able to match patterns and develop a chronology of episodes, following the work of Yin (2003a, 2003b) and Miles and Huberman (1994).

Sample and data collection

The personal interviews were conducted on site at the Rodeo World Championships 2003 in Graz, Austria. The sample population consisted of 410 registered starters and staff members (team assistants and company officials). All major companies and professional kayakers came together for one week of competition and presentation. This proved to be the perfect opportunity to study the research phenomenon in its natural setting, combining users, user innovators, manufacturers, lead users and user manufacturers. We had the opportunity to watch and inspect different innovations in

use, were able to talk to different parties involved in the commercialization process, compare different cases, and question interview partners repeatedly. Additionally, the interview partners chosen came from different countries (United States, South Africa, Sweden, Zimbabwe, Germany, Austria, New Zealand, Australia and Canada).

What steps were taken to prepare for the case studies and the data collection process? First of all, a semi-structured set of interview guidelines was constructed. The guidelines focused on items from the existing literature to ensure consistency with the current state of research. We included topics that appear to be important conditions for user innovations in open communities and have already been analyzed, then we added a focus on commercialization (e.g., type of innovation (von Hippel, 1988), community characteristics (Franke and Shah, 2003), assistance and information revealing (Harhoff et al., 2003), innovation motives (Allen, 1983; Gans and Stern, 2003; Jeppson and Molin, 2003), competition, industry development (Teece, 1986; Shah, 2000; Van Den Ende et al. 2003)).

Second, the most appropriate cases for the overall design had to be identified. Random selection was neither necessary nor even preferable (Eisenhardt, 1989). Instead, cases had to be chosen according to the strength of the context description and the correspondence of individual cases to similar situations (Patton and Appelbaum, 2003). Therefore, pyramid networking, a novel approach that is used in lead user projects to identify individual lead users (Lilien et al., 2002), was used to select the cases relevant to our research purpose. Starting at any user-defined point, interview partners were asked to name the most appropriate interview partner for the overall case study design. As they were experts in their field, this method could be used as a substitute for complex screening processes that would not necessarily lead to all relevant cases in the field. By applying the pyramiding method, we were able to identify eleven user manufacturer cases and five lead user and user innovator cases. Some of the cases we found had been more active prior to the start of the industry, some of them had been heavily involved in the emergence of the industry, and still others only started in later stages of the industry. User manufacturers who had already commercialized one or more of their former innovations were identified as central cases, thus enabling ex post reflection on the development process. As additional and supporting cases (Amaratunga and Baldry, 2001),

user innovators and lead users who had also been integrated in the commercialization process were chosen. By comparing the cases and combining the data, we were able to construct an overall meta-case of the development of the community and industry. Questions and irregularities could be addressed in different cases, thereby providing deeper insight into the relevant data and causes.

In order to optimize our understanding of the cases, we used different teams in different stages of the study (with reference to construct validity in Eisenhardt, 1989). The semi-structured interview guidelines for the in-depth interviews were designed by the author with the assistance of two team members who also took part in the interviews. Visits to the case study sites were conducted by changing teams of two and three people. Interviews were videotaped in order to record all field notes and impressions. One person would conduct the interview, while the other one or two (depending on the team) would make additional notes and observe the topics of the questionnaire in order to avoid missing data. Additional data was gathered in telephone interviews, e-mail communication, analysis of relevant magazines, screening of company web pages and Internet discussion forums (see data verification).

Data reduction and presentation

Prior to the interviews, a starting list of codes was compiled on the basis of the study's conceptual framework and the more detailed research questions (classification of interviewees, classification of community assistance, commercialization activity, start-up activity, type of innovation and type of competition; we used dichotomous rating formats for all codes). Based on that list of codes, interviewers and assistants independently completed a short contact summary after each interview in order to provide information in addition to the data recorded.

Interviewers and assistants performed the coding by hand, and later on the author used spreadsheets to summarize coding results and SPSS to evaluate interrater reliability (Cohen's Kappa[4]). In the more general master codes (commercialization activity, start-up activity), there was complete consistency across the coders, and in the remaining sub-codes interrater reliabilities of above 0.75 were attained (classification of interviewees: user manufacturers: 1, user innovators, lead users: 1;

classification of community assistance 0.871; type of innovation: radical: 0.75, incremental: 0.75; type of competition: technical: 0.871, economic: 0.75).

One week after the interviews, the contact summaries and coding results were used to create an initial matrix of classifications in a first case analysis meeting attended by all interviewers. Based on that matrix and the recorded data, pattern codes were used to reduce the data further and to develop the final data matrix (Table 1). Due to the exploratory and narrative characteristics of the pattern codes used, a test of interrater reliability could not be performed at that stage of analysis. Instead, pattern matching of the cases was carried out in a second case analysis meeting. Information from the cases was used to map the pattern codes to the original code system developed. In this process, information was mapped not only regarding what the interviewees did themselves but also regarding what interviewees knew about others and general information concerning the development of the industry, respectively. A cross-case comparison was developed, resulting in a chronology of the development of the rodeo kayak industry. The most promising codes were written up in the form of memos and later used as a source for quoting in the text. In summary, the findings are displayed in a data matrix (Table 1; case numbers were added to the cells of the data matrix to show the source of information), in written text describing the stages (episodes) of development, and in quotes from individual cases used to point out particular aspects of the chronology.

Limitations

While the case study method has been used to provide comprehensive data and to reveal the dynamics of cases, it has also been criticized for providing little basis for scientific generalization (Chetty, 1996). Similarly, limitations on reliability and validity have been mentioned, especially when small numbers of cases are analyzed and the comparability of cases is not given (Perry, 1998). In addition to the more general criticism of the method, we expected limitations due to the selection of the sample, the selection of individual cases, and the interview situation. By analyzing one extreme sporting industry, we can not generalize the results of the case studies across various industries but only for industries that have similar general conditions (active and skillful users, possibility of developing innovations and prototypes with low capital, active and connected community, large-scale established manufacturers). Furthermore, we understand that the interview situation might cause interviewees to answer in a socially desirable way (i.e., answering in favor of user innovators and user manufacturers and/or evaluating user innovations more favorably than manufacturer-driven innovation).

Conclusion drawing and verification

In order to address the limitations mentioned above and to enable verification of the results, different methods were employed. First, data triangulation (Maxwell, 1996; Amaratunga and Baldry, 2001) was performed in order to validate the information derived from the interviews conducted (Yin, 2003a). The following types of data were used in addition to the personal interviews: (1) Telephone interviews were conducted with two industry experts, a member of the US Freestyle Kayak Association (USFKA), a member of the German Freestyle Kayak Association, and two designers and active users of rodeo kayaks. (2) An analysis of two kayak magazines (Kayak Session and Kanu Magazine) between 1997 and 2005 was performed in order to screen for user innovations and company histories. (3) Company web pages and Internet discussion forums were screened for user innovations, company histories, the commercialization of user innovations, and the development and structure of the community. (4) Market data was obtained from the Outdoor

Industry Foundation and IBIS world industry data.

Second, the results of the case studies were shared and discussed with two experts on the rodeo kayak industry. Furthermore, we shared final case results with four of the interviewees and checked for missing information and misinterpretations of the data. Finally, the results of the case studies were discussed at an international workshop held at the Vienna University of Economics and Business Administration with leading scientists in the field of user innovation.

Research Findings[1]:

In order to structure the research findings from our interview data, we first give an overview of the general development process of user innovations in the rodeo kayak industry. Then we provide information on four distinct stages in the commercialization process that could be identified: the user innovation stage, the community stage, the commercialization stage and the industry stage.

Commercialization of user innovations – general development process

> *"We were determined to start a riot within the industry. I'd say we succeeded!" (Corran Addison, CN16)*

The development of user innovations in the rodeo kayak industry can be seen in parallel to the development of the individual skills of users. The first kayak rodeo was held in Lofer, Austria, in 1990 (source: CN3). At that time, kayak rodeo meant balancing a traditional kayak (which was made for river running and about four meters long) on a wave or in a hole in the river. Actually, rodeos in those days were won by paddlers who were able to perform some kind of show on the river (e.g., Shawn Baker juggled three stones in the middle of a Class IV river without using his hands to paddle in 1990; in 1991, Jan Kellner pulled a banana out of his spray skirt and started eating the fruit on the rapids). Soon, kayakers as users began to feel that their traditional boats were much too long and immobile, and they wanted better equipment. They needed shorter kayaks with

less volume and sharper edges for better performance and greater maneuverability. A number of users who actively took part in competitions worked for kayak companies as designers and boat-builders. Users like Corran Addison, Shawn Baker, Jan Kellner and Arndt Schäftlein (CN3, CN16) had a lot of ideas on how to change existing products, but at that time traditional companies sold traditional products and would not change existing lines. Manufacturers did not want to produce differently, mainly because they doubted the possibility of a new, emerging market for different products.

Therefore, radical innovations in the rodeo kayak field came from the athletes, the users themselves. Professional athletes as lead users were ahead of the common needs of the market (similar to von Hippel, 1986; Morrison et al., 2004). They innovated, designed and shaped new products and materials according to their personal needs. First, they started to adapt existing products, mainly by shortening the kayaks. Some of our interview partners (CN1, CN3, CN5, CN10, CN16) were involved in the development of rodeo kayaks and equipment from the very beginning. Their designs became best sellers (like the Prijon Hurricane, designed by Corran Addison in 1993). But users wanted to go much further, to create radical designs every year. They wanted to redesign the body of kayaks completely, creating edges and concentrating the volume of the boat in the middle. That was too much change and risk for traditional companies that were used to selling a single design over many years.

Soon, users started their own businesses in order to be able to implement their innovations (e.g., Savage, CN16; Robson, CN5; Riot, CN3, CN16; Fluid, CN8; Sweet, CN9). With the first World Championships won with user-innovated kayaks, the message of totally new designs and therefore new possibilities in the sport was spread all over the market. Strangely enough, traditional companies still did not believe in the new products and refused to take over production. By acting passively, they enabled small companies led by user innovators to gain a new product segment in the market.

While in the early 1990s only a few hundred units were sold of each new kayak produced, during

[1] In the course of the paper, interview sources are given according to the case numbers (CNs) listed in the Appendix.

1996 and 1998 market demand rose to 2000 to 3000 units a year per design (data source: Riot 2004). A recent online poll on boatertalk (2003, with 2191 votes), the main kayak discussion forum in the US, revealed that 28.34% of all participants buy a new rodeo kayak every year, 26.24% every second year. As a consequence of market demand, companies like Pyranha, Dagger, Riot, Jacksonkayak, Wavesport, etc. offer at least one completely new design every year in different sizes and with different outfitting systems today. All those companies are owned or co-owned by users and in addition use the innovative potential of new users from the rodeo competition field (CN4, CN7, CN9, CN11, CN12, CN14).

Commercialization of user innovations – identifying stages

As a starting point in the case studies, we wanted to know whether user innovators went beyond the typical activities studied so far, namely innovating, using, testing and retesting, and sharing information within the community (Franke and Shah, 2003; Harhoff et al., 2003; von Hippel, 2002). In 15 of the 16 cases we analyzed, there was some kind of commercialization of user innovations involved in the development process. The user manufacturers we found had already built a company on existing user innovations, and the lead users we interviewed had already taken part in new product development processes. All the cases we analyzed show similarities concerning the commercialization of user innovations. They have similar time schemes and follow certain patterns. Therefore, we can illustrate the development of the rodeo kayak community and industry over time, started by user innovators and influenced by the commercialization of innovations. We use a classification of four periods and identify individual stages:

Stage	I User innovation stage	II Community stage	III Commercialization stage	IV Industry stage
Commercial aspect	Non-existent (1, 3, 10, 16)	Costs are covered (1, 3, 10, 5, 16)	Auxiliary income, user-led start-ups (1, 2, 3, 5, 10, 16)	Main source of income, user manufacturers, strong brands (1, 3, 5, 8, 9, 10, 16)
Type of innovation	Radical innovation (product) (1, 3, 5, 9, 10, 16)	Radical innovation (product and equipment) (1, 3, 5, 9, 10, 13, 16)	Incremental innovation - scale aspect (1, 3, 4, 5, 9, 10, 13, 16)	Incremental innovation - differentiation aspect (1, 3, 4, 5, 9, 10, 13, 16)
Community size and characteristics	Single users (small community) (1, 3, 11, 14, 15, 16)	Fast-growing community (1, 3, 11, 14, 15, 16)	Emergence of sub-communities (1, 2, 3, 4, 5, 9, 11, 12, 14, 15, 16)	Sub-communities and new forms of user communities (1, 2, 3, 4, 5, 9, 11, 12, 14, 15, 16)
Assistance and information revealing	Free assistance, free revealing of information (1, 2, 3, 4, 5, 12, 15, 16)	Free assistance and information to selected community members (1, 2, 3, 4, 9, 11, 12, 14, 15, 16)	Information revealing and assistance only in sub-communities (1, 2, 3, 4, 9, 10, 11, 12, 14, 15, 16)	Commercialized assistance (1, 2, 3, 4, 9, 10, 11, 12, 14, 15, 16)
Innovation motive	Individual needs, fun (1, 2, 3, 5, 10, 16)	Individual benefits, skill superiority (1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16)	Independence, individuality (1, 2, 4, 5, 6, 8, 9, 10, 16)	Economic motive (1, 2, 3, 4, 5, 6, 8, 9, 11, 14, 15, 16)
Competition (technical/economical)	No competition (1, 3, 5, 8, 10, 12, 16)	Technical competition (1, 3, 5, 6, 7, 9, 10, 11, 14, 16)	Technical and economical competition (1, 3, 4, 5, 8, 9, 11, 14, 16)	Technical and economical competition (1, 3, 4, 5, 8, 9, 11, 14, 16)
Industry life cycle	Pre-industry stage (1, 3, 5, 6, 10, 16)	Emergence of new industry (1, 3, 5, 6, 13, 16)	Growth (1, 3, 5, 6, 8, 9, 13)	Establishment (1, 3, 5, 6, 8, 9, 13, 16)

Table 1: Stages in the life cycle of the rodeo kayak industry

(Interview sources are given as numbers in brackets for each cell. These numbers correspond to the table of cases in Appendix 1; case numbers underlined: user innovators/lead users, all other case numbers: user manufacturers).

Stage I – Start of user innovations (before 1990)

> *"With no real equipment to choose from, and no finances to tap into, necessity became the mother of invention" (Corran Addison, CN16)*

Stage I marks the very beginning of user innovations in the rodeo kayak field. In the 1960s and 1970s, the sport was dominated by alpine kayaking and slalom, which was an Olympic discipline. General users had one or two boats for river running. Between 1960 and 1970 there was a change in the material for kayaks from fiberglass (which is still used for prototyping) to PVC. Basically the design of the kayaks was not changed, but the material became much more durable. As in every sport, some enthusiasts wanted to push the limits and started to run steep creeks and waterfalls. They experienced that in some spots in the river (holes or waves) it was fun to play, although the degree of difficulty was very high. While general users did not want to experience extreme situations, extreme users started testing their traditional kayaks in those spots. At that early stage, a rodeo kayaking community did not exist (CN3, CN5), nor were there any companies that would supply the products needed. It was rather the creative potential of outstanding individual users that was the key to ignition (CN1, CN10, CN16; similar to intrinsic creativity in Westwood and Sekine, 1988). Also, commercial motives did not exist at that stage.

> *"The sport was changing quickly and the industry was not." (Kevin Simpson, CN6)*

Individual users did not want to sell boats; they wanted to create something new for their own use. Corran Addison (CN16), for instance, started to design boats from an old 1973 slalom mold together with his father in the sports department of Grahamstown's Rhodes University. Using that mold, they built 40 kayaks for their own testing purposes. He stated that in that stage, "…we learned a lot just by trial and error". Eric Jackson (CN1) also used his knowledge from slalom kayaking to build new designs. He cooperated with an "external", a Navy technician (David Knight, Naval Surface Warfare Center, Bethesda, Maryland), who worked on fiberglass models and design. Olivier Feillette (CN10), a native South African, started to make fiberglass boats for his rides on the

Zambezi river; for him, there was no company at all that could have supplied any kayaks.

User innovators in our cases used fiberglass models and existing PVC products that were changed or redesigned. In a first step, they made the kayaks shorter. In doing so, they created prototypes that were still based on existing products (CN1, CN3, CN10, CN16) but had a very different look and use. They were not as fast and smooth for river running, but easier to move in play spots. It was not until Stage II that user innovators would start to create completely new designs. The number of people testing and reshaping materials was very small, and there was no competition between individual users. Users freely revealed information about their innovations as they wanted a good product for their use, not a commercial product. At that time, only a handful of enthusiasts had the skills to kayak at rather dangerous play spots and to design boats as well. As mentioned above, many of the users innovating at that stage worked in kayak production at traditional kayak companies besides being professional kayakers (CN3, CN4, CN5, CN16).

Stage II – Community building (early 1990s)

"We all had different skills – that made the whole thing possible." (Eric Martinsen, CN9)

Over the years, more paddlers got interested in the new technique and started innovating themselves. Some play spots were predestined for the sport (like on the Zambezi river or on the Ottawa river, etc.). Meeting at those play spots, user innovators knew each other personally and had no competition, just fun in mind. They innovated, assisted and freely revealed information to each other. As kayakers travel a lot and visit places on nearly any continent, they shared their knowledge with enthusiasts all around the world. Thus, regional users started innovating in the US, Europe, South Africa, New Zealand, Australia and South America (CN3, CN10, CN13, CN15).

"I had a team in Africa – 12 paddlers – we often sat down and talked about new products."

(Kennedy Linyado, CN15)

The emergence of an overall community and the building of regional communities mark the *second stage*. While in the first stage innovations were mainly pushed by individual user innovators who

shared knowledge with other individual users, in Stage II the community aspect became stronger. The sport got publicity and the first professional competitions were held (starting from 1990). People met on the river and made use of the skills of community members, interchanging with other user innovators. In many cases (CN1, CN2, CN3, CN4, CN5, CN7, CN8, CN9, CN11, CN12, CN14, CN15) user innovators were professional kayakers, team members who had a lot of innovative ideas. When a new design was completed, user innovators would let other kayakers try their prototypes and used the feedback for the next design. In that stage, the typical design of rodeo kayaks was developed because community members were able to participate in the innovation process. The design combined the input of many individuals, optimizing the product for the needs of a special, emerging market segment, the rodeo kayak users. There was a strong social structure among users. People knew each other very closely from their rides on the river. They also had information about individual skills and resources (CN1, CN3, CN5, CN9, CN16). The first radical product innovations that were successful in competitions came out in the early 1990s.

> *"We thought: boy, if we want to win, we need a boat that can cartwheel and do moves…" (Eric Jackson, CN1)*

With the success of individuals who used the prototypes, the overall community started to change dynamically. It became more and more important to belong to a team and to have a winning prototype for competitions. Rivalry conditions were low but emerging; in some cases free assistance was only given to selected community members on a quid pro quo basis. For assisting in the design process, users received prototypes for free and could use additional equipment (CN2, CN3, CN7, CN9). There was no market yet for final products or equipment. In some cases (CN2, CN7), user innovators even paid for the technical services provided by community externals. Sporadically, user innovators found interested users who purchased prototypes; the price was still a consideration, not a market value. For instance, users bought the prototypes of new paddle shafts (CN5) or new helmets (CN2). Technical solutions became more sophisticated as external services could be afforded. Over time, external technicians who had only cooperated part-time with user innovators

became part of a developing team (CN1, CN2, CN16). New standards in products and equipment emerged. For example, two important innovations that were developed during that stage and became technical standards were the flat planing hull for surfing and side cuts for vertical moves (CN16). The problem with radical prototypes was still that only some professional kayakers were able to handle them. Although the sport was very attractive to many amateur kayakers, the larger market segment – river running and leisure paddlers – did not yet have the skills to use the innovative products.

Finally, Stage II can be characterized by a number of radical innovations in products (kayaks) and equipment (paddles, helmets, etc.) that were the output of a common effort of user innovators and community members. The first world championships were won with user-innovated products, and role models emerged from the community. People like Jan Kellner, Corran Addison (CN16) or Erik Jackson (CN1) had a huge influence on the emergence of the industry, being lead users in the fast-growing community, winning competitions and designing new prototypes every year.

Stage III – Commercialization (1990-2000)

> *"The main reason why we started the company was that we were so fed up with all the products on the market that did not work and did not have the standard that we wanted." (Eric Martinsen, CN9)*

In the early 1990s, traditional kayak companies were still very cautious about new and differentiated products. Many companies (market leaders at that time) refused to produce radical kayak designs (CN1, CN16) because they did not expect any market demand. Eventually, user innovators started up companies and developed brands themselves (CN1, CN3, CN5, CN16). They had sold a number of prototypes to community members, had already invested their own capital for external services and were convinced that the market was ready for the new products. The transition from individual efforts (adapting existing products, testing and retesting prototypes) to commercialization and the start-up of user-led companies and brands mark the beginning of *Stage III*.

"I think the key is – and that is what I wanted to do – to bring the boats to the market as soon as possible" (Celliers Kruger, CN8)

While radical designs and products had already become a standard in the competition field, the first user-innovated products were sold to the market segment of advanced river-running or leisure paddlers (CN1, CN3, CN5, CN16). User-led companies started to produce and sell product ranges tailor-made for their own needs and for customers with similar needs. One example is Sweet (CN9), a company that started to produce protection gear and helmets because there was simply no other company on the market that sold any of the products needed for the sport. They developed a full range of protection gear for snowboarding and kayaking and were the first company in the rodeo kayak industry to focus on protection equipment. Another example is Robson, a company that was founded by Robert Sommer (CN5). He had been a slalom paddler and needed a light, durable paddle for his new passion, rodeo kayaking. As there were no paddles available in Europe, he changed the weight of the paddle shaft and designed new blades. His company started selling paddles and even started producing kayaks in 2001.

In Stage III, the overall community was still a basis of information and skills, but small teams became more and more important, especially for commercial start-ups (CN4, CN9). The motives of user innovators (some of them now user manufacturers) also changed. User innovators attached great importance to independence and individuality (CN1, CN8). Many of them had formerly been employed and then started their own businesses, enabling them to concentrate fully on their hobby and passion. On the one hand, the commercial activities (such as sales or marketing) of user innovators increased, but on the other hand their typical user activities (kayaking, testing, and developing) decreased because of the new entrepreneurial focus. As user companies grew bigger, they began to compete with existing, traditional kayak companies (CN2, CN4, CN8). Some of the user-led companies sold products that could be used by general paddlers (like helmets, paddles or life vests), while traditional kayak companies had started to develop new products and materials themselves. Although traditional companies still lagged behind and were not able to compensate for the experience of user innovators in terms of functionality and technology, they could build on their

distribution and sales networks (CN1). User-led companies, in turn, used the growing market to cut costs by producing on a larger scale (CN3, CN16).

"It was a financial incentive to innovate new products." (Kevin Simpson, CN6)

Some innovations were still too radical for existing companies. A good example of the impact of radical innovation was the company Savage (CN16), which was founded in 1994. After two years of radical innovations, the company encountered financial problems because of the high investment costs and the only slowly rising market for truly radical designs. The financier wanted the company to focus on traditional and larger market segments and to slow down the innovation cycle. As a result, Corran Addison (who had co-founded Savage and designed for the company) and Jeff Rivest (who was the Canadian distributor for Savage at that time) left Savage and founded Riot, one of the leading kayak companies today. Some of the innovations that were seen as too radical one year became a standard for the market in the following years. Two examples of radical new products were the Fury by Savage and the Rage by Riot (both designed by Corran Addison in 1996). More radical progress was made with the "Glide", a kayak that was actually disqualified from the World Championships in 1997. The team captains voted against it because they thought it would provide unfair advantages. Although boats in the following years would still be changed (mainly in length but also in volume), the products that were designed in the years 1996 to 1998 set a standard for the industry that is still used today.

According to our interview partners (CN2, CN3, CN4, CN11, CN13), the real breakthrough in the market in that stage was reached because the innovations and designs for the boats enhanced their usability for customers. In the first innovation stages, the kayaks had still been rather long and lazy. Only professional kayakers had the skills to maneuver them. As the boat designs became shorter and the ends thinner, people could suddenly do the same tricks as their professional role models. In addition, the boats became safer; they could be handled well on the river. People were no longer so afraid of performing in the same play spots as professional kayakers. Similar innovations for improving the performance of customers were also introduced in other sporting industries during

those years (also developed by user innovators). In the ski industry, for instance, the carving ski was developed (documented at: www.skiinghistory.org/skishistory.html). In the windsurfing industry, wide boards were introduced (documented at the starboard web page: www.star-board.com/company/about.asp). Concerning the kayak rodeo industry, customers now started to buy rodeo kayaks as beginners because the new designs accelerated the learning process. As a result, the market segment could be enlarged from a radical, small segment to the overall market of whitewater paddlers.

Stage IV – Industry stage (late 1990s and after 2000)

> *"I know that every other company is thinking: well, if we've got the best boat now – right – then other companies are trying to make a better boat than our boat – and if we don't make the better boat now, then next year, everybody will be like: well, you guys don't have a good boat – this other company has the best boat…*
>
> *…but today you can only make money if you've got the best product – period!" (Eric Jackson, CN1)*

Stage IV can be characterized by the highest degree of commercialization and the shift from radical user innovations to incremental user innovations. The main innovation motive was economic: Former user innovators, now user manufacturers, had to come up with new products every year to meet the demands of the market (CN1, CN3, CN16). Assistance in the NPD process was remunerated; information was only shared freely in the process for non-strategic, non-significant issues. The differences between traditional companies and user manufacturers leveled off more and more as traditional companies made use of user innovators as designers or lead users for NPD to increase the market's attractiveness and the usability of their products (CN11, CN13, CN14). Nico Langer (CN14), co-owner of Blue and White, a German kayak store, described the innovation process for the rodeo kayak "Switch" as a common effort of user innovators led by the kayak company Necky. Six professional German paddlers were given materials and funds for one year of

innovating and testing. They had to stick to a certain norm regarding boat size in order to ensure a good fit for a standard paddler. Within certain restrictions, they could try out changes and adaptations. During the year 2000, they designed 10 different prototypes. The users themselves made drawings and descriptions of the kayaks. The prototypes were then produced by a Czech manufacturer and sent back to Germany. Once the prototypes had been tested by all members of the small lead user team, they were sent to Montreal, Canada to be tested on big waves, after which they went into production.

User innovators continued to be active in that stage. The latest and most popular case of a user innovator starting a new company was Eric Jackson, World Champion in slalom and rodeo kayaking (CN1). He left Wavesport, a company he had influenced over a decade, and started Jacksonkayaks together with his long-time partner and technician David Knight. Again, a user innovator and designer wanted to act independently and to innovate freely. He stated that "…companies are still their own worst enemies, and that is [the case] with every company", and argued that companies still believed in selling successful products over years without focusing on innovation. User manufacturers in that stage became much more professional than they were at the beginning of the industry's life-cycle. In our interview, Eric Jackson told us that they used a new design program that enabled them to produce a prototype within two weeks without any iteration or testing on the river. By specializing in the functionality and the materials, they were able to defend a niche for the professional segment of the industry.

As the quality of products and equipment had already reached a very high level after 2000, radical user innovations became scarce. Since about 2002, different models might have been equipped with different fitting systems or slightly different shapes, but the size of the hull and the function of the design have basically not changed (CN3, CN14). User innovators mainly generated adaptations or product improvements. Examples of incremental innovations during the last year (2004) were a new feet fitting system from Liquid Logic (instafit), new kayak back bands from Immersion Research, or lifesaving vests from Prijon. Arndt Schäftlein (CN3) mentioned that innovations over the last few years were focused on individualizing standard products for the final customer. So, while in the

early days of rodeo kayaking, radical products were innovated for extreme paddlers, nowadays kayak manufacturers are improving comfort for amateur users, aiming at the larger market segment. With more buyers of rodeo kayaks from traditional market segments, the structure of the community changed, too. The proportion of extreme paddlers that develop their own material decreased, while the proportion of end users of the new products increased. Those users simply want to use the products and develop skills to perform tricks on the river (CN5, CN14). As a consequence of the new community characteristics, Internet platforms were set up where users can meet in cyberspace and discuss new products, locations and interests. Some examples of Internet discussion forums that were also used by the author for data collection are boatertalk (US), playak (UK) and soulboater (GER). Those platforms offer many services concerning buying decisions, general information about products, information about play spots, the newest tricks, etc., but they do not drive users to build their own equipment, nor do they enhance the innovation skills of users.

Discussion

The narrative findings of our explorative case studies illustrate a very special industry with a very special development of user innovations over time. We found evidence that user innovators commercialize their innovations under certain conditions, and we were able to trace the process of innovation and commercialization. Some of the new aspects we detected in the commercialization process for user innovations seem important to discuss. They might be used to extend existing theory by generating new research questions about the user innovation process and the development of new products out of user innovations. One discussion point is the commercialization of user-innovated products and the involvement of user innovators in the diffusion process as entrepreneurs or user manufacturers. With it, we were able to analyze different motives for the activities of user innovators in different stages. A second discussion point is the role of the community and changes in the structure of the community, which provides the skill and network basis for user innovations. An additional point here is assistance and free revealing of information throughout individual stages of

the development process.

The commercialization of user innovations

- Lead users try to commercialize their innovations under certain conditions

Up to now, studies have described the user innovation process under certain conditions (von Hippel, 1988; von Hippel, 2001; von Hippel, 2002). The user innovation process is influenced by individual needs, individual likes, or an altruistic motivation to create something valuable for a community, among other factors. While not every user innovator might be interested in commercializing his or her innovation, our case studies have shown that *lead users* go beyond the typical points of innovating for themselves and for community members. They were driven by a high need for innovations because of their competitive ambitions and could anticipate future trends in the industry. What is the difference to existing studies, and why did lead users start to commercialize their ideas in the present cases? In comparisons of manufacturers and user innovators, it has been stated (von Hippel, 2001) that user innovators would not become part of an economic landscape (1) because of their motivation for innovating and (2) because manufacturers would have significant advantages in economies of scale concerning the production and distribution of physical products. Moreover, it has been stated that user innovators would try to diffuse their innovations for free as long as they could compete with commercial production and distribution. In the industry studied as well as other extreme sporting industries or analogous industries that do not focus on a mass market in early stages, commercial competition from manufacturers is not given (initially). In our observation of stages, traditional companies would not join in the production until Stage III or IV because of small selling units and individualized products, avoiding the risk of substantial irreversible investments (Funk, 2003). Therefore, lead users did not face any competition in diffusing their innovations. To enable diffusion, to finance further innovation costs and to start distribution, they started selling prototypes and then finished products. *As lead users*, they spotted a strategic and economic opportunity to create a market. Motives like independence and individuality were often named as

fundamental reasons for starting up a business. The costs of testing and producing prototypes can be seen as compulsory reasons to commercialize an innovation. Also, reputation effects seem to matter. In contrast to the reputation effects from providing innovations for free (Lakhani and von Hippel, 2003; Hertel et al., 2003; Lerner and Tirole, 2002), lead users in our cases acted as role models (similar to Deroïan, 2001) by starting businesses and creating a new market segment of products. After all, lead users were the promoters of a whole new industry because traditional companies did not start to sell innovative breakthroughs themselves. Lead users who wanted to create a competitive, high-quality product had to start commercializing their inventions in some form.

- *From personal demand to market demand: the point of commercialization*

The development of user innovations and commercialization in the rodeo kayak industry, similar to other sporting industries, was a cyclical matching of different stimuli (Howells, 1997; Lynn et al., 1996). Some of these stimuli were more personal and technology oriented, others were created by a growing market. The importance and development of technology and market stimuli in the innovation process has already been shown by Carayannis et al. (2003).

Although personal demand and market stimuli are not the only influences on the overall innovation process (Achilladelis and Antonakis, 2001), they had a strong effect on the point of commercialization in the cases analyzed here. Basically, lead users started innovating because of a technological gap. They had needs that could not be met by existing products or materials. The users themselves found new ways to shape and process materials, generating new, technically advanced products. At that time, there was no market for their innovations at all, but they were able to anticipate the future trend very well. Traditional kayak companies did not cooperate or co-produce due to a lack of market demand. The innovative technique was superior to that used for other boats. In 1994, six out of eight World Cup rodeos were won by the “Scorpion”, a user-innovated kayak made by Savage. In 1997, a user-innovated kayak (the “Glide”) by Riot was even disqualified from the World Championships because its superiority was so significant. The company had a huge marketing effect. People were interested in the new designs but did not have the skills to paddle

them. Corran Addison (CN16) stated that when he made the "Gravity" (in 1994), people were scared to try it because they thought that no one could paddle it on the river. Still, the technology used proved superior in competitions so that anybody who wanted to compete at the professional level had to use the new technology. With further good results in competitions and world championships, the market was attracted. As people bought new products, lead users had the chance to further develop new products and materials using external cash flow. The switch from personal demand and technological superiority to market demand leveraged the commercialization of user innovations. Similarly, Roberts (1988) has mentioned that market pull stimuli are responsible for the final success of innovations, although different kinds of stimuli can be sources for initiating innovations, and Gans and Stern (2003) have shown that especially a *commercialization environment* is important to the economic success of an invention.

- *From radical innovations to incremental innovations: customer orientation*

At a very early stage in the cases analyzed, we have been able to identify typical aspects of user innovations as documented in von Hippel (1988), such as individual needs, sticky information and the locus of problem-solving. The innovation process was very much dominated by individual lead users. The type of innovation was radical. It was the first time in the history of the industry that the dominant design of the product was questioned and changed. The original kayak came from the Eskimos in the 18th and 19th centuries. The first commercially produced kayak was developed by a British lawyer (John MacGregor) in 1866 and set the design standard that still dominates the slalom sport today. With the increasing value of the community in later stages, we can find similarities to the papers of Franke and Shah (2003) and Lüthje et al. (2002) concerning the development process of innovations and interactions between users. It became more important to innovate openly and to create something jointly that could be used by a larger group of users. Thus for the first time in the user innovation process, costs could be covered by selling prototypes to community members. The degree of radical innovations became smaller. Still, there was no external market for the new products. By adapting the radical innovations with incremental innovations in equipment and

fittings, general customers could be attracted. The once so uncontrollable and rough prototypes had become customer-adapted. That point marked a true breakthrough for the commercial success of the rodeo kayak (CN3, CN16). From that time on, amateurs could learn to paddle in a rodeo kayak from the very beginning. They did not have to buy two or three kayaks at the same time for different uses. The new kayaks could even be used better for lessons in beginner's skills such as rolling or bracing (techniques in kayaking that are used for river running). By continuing the process with incremental innovations, user manufacturers can now sell slightly new designs and fittings to customers every year. In contrast, traditional boat designs have not been changed for years (a good example of a traditional kayak is the Eskimo Topolino that was first produced in 1980 and is still used for river running today; CN4). Therefore, in our cases of user innovation in the kayak rodeo industry, we found that radical innovations sparked the emergence of the industry, but incremental innovations were needed for the success of the commercialization process, the enlargement of the market.

What differences could be found concerning customer orientation between traditional kayak companies and user-led companies? User-led companies were very different to traditional companies in the early stages of the industry because they were not primarily oriented toward selling but toward satisfying user needs. Therefore, user orientation was the major advantage which they maintained over time. While traditional companies tried to satisfy a mass market (general distribution by manufacturers: von Hippel, 2001), user-led companies had a competitive edge in individualized products and services. The disadvantage was lower market penetration, a problem that many user-led companies overcame with a differentiated product range. They came up with innovative, lead user-oriented products every year (CN1, CN3). Those were products that a standard customer would not buy in the first year, but maybe in the second or third year after production. During that time, out of a handful of very innovative and top-level products, only a few proved suitable for a general customer. With those products (and a reduced price), larger market segments could be reached, thus providing the financial basis for further development in the top-level segment (CN16). With the rise of the new industry and the development of dominant designs (Teece, 1986; Funk, 2003), we noticed fewer radical innovations in the rodeo kayak industry. User manufacturers

developed incremental innovations, but there were no more major breakthroughs like those in the first stages of development. In recent years, traditional and user-led companies alike have started to use the innovative potential of new users and the community. While user-led companies have built on their own experience and the skills of selected community members, traditional companies have started to integrate lead users into the NPD process (CN5, CN8).

- *New challenges for established manufacturers*

In the period of commercialization (around 1990), lead users were able to start up their own businesses and outperform the established manufacturers with their innovations for about five years (CN1, CN3, CN16). This was mainly due to the very special skills of the lead users and their connectivity with the community. The new challenges for established manufacturers, which they recognized far too late, were the identification of lead users and the integration of open community innovation into the NPD process. From 1995 to 2000, established manufacturers began to look for paddlers who performed very well in competitions and also had a sense for upcoming market trends (CN1, CN3, CN 5, CN8, CN11, CN12, CN14, CN15, CN16). By doing so, they identified lead users and they also *reproduced* a form of sub-community around them to innovate for the company's purposes (company teams). In parallel, Internet communities emerged, and the manufacturers created electronic platforms for their customers to meet and discuss the new innovations. In this way, they integrated different actors within one innovation system and additionally used very direct feedback from the community.

How can manufacturers in other industries make use of the potential of open innovation? Similar to the approach above, we think that a combination of three modules seems promising: (1) identification of lead users; (2) building of sub-communities (innovation teams from the community); and (3) building of platforms for information and feedback from the overall community. While single modules have been discussed in literature (Morrison et al., 2000; Lilien et al., 2002; Harhoff et al., 2003; Morrision et al., 2004; Piller et al., 2004) and applied in practice separately, they should and will be applied as complete innovation systems interactively to take full

advantage of open innovation.

Changes in the community system

With the commercialization of user innovations in the cases analyzed, we noticed changes within the community system. These changes concern the number of people working together on innovations, the activities and responsibilities of community members, and the free transfer of information and assistance.

- *The building of sub-communities: an indicator of change in the overall community system*

In the literature, two main fields of community interaction have been analyzed. One type of community that has been analyzed repeatedly is the open-source community (Harhoff et al., 2003; von Krogh and von Hippel, 2003; von Hippel, 2001; Lakhani and von Hippel, 2003). In contrast to electronic communities, extreme sporting communities have been studied in the consumer goods field (Franke and Shah, 2003; Lüthje et al., 2002; Shah 2000). In both types of communities, the processes of formation and growth show similarities. Rather unstructured and large communities tend to become more and more structured and subdivided as definite tasks have to be fulfilled. It has been generally understood that communities are dynamic systems influenced by innovation and the commercialization of innovations (Allen, 1983; Deroïan, 2001; Lynn et al., 1996; Tether, 2002). The emergence of sub-communities is an indicator of the overall community's development. Lynn et al. (1996) differentiate superstructures and substructures and note that technological innovations often influence the nature and configuration of the innovation community. Deroïan (2001, with reference to Granovetter, 1973) points to weak ties and strong ties in communities. Similarly, we have identified the building of sub-communities in the commercialization stage and the industry stage. In the cases studied, the development of the community undergoes a radical restructuring process with the commercialization of user innovations. In our interviews, we detected that the final teams that prepare for a start-up consist only of two to eight people out of the former community, thus signifying a radical reduction (through concentration) of the original basis of people and skills

(similar to the independence of groups or teams in: Van Den Ende et al., 2003).

- *The free transfer of knowledge and assistance in communities: commercially/strategically sensitive content as a barrier*

Expanding on the existing literature (e.g., Hall et al., 2004), we have witnessed that information flow becomes concentrated in sub-communities once they develop. The free disclosure of information (with the overall community) is restricted to non-strategic and non-commercial issues. Furthermore, we have witnessed that assistance is remunerated in later stages of the innovation process. While the overall community can be seen as the original form of community, sub-communities consist of selected individuals who work together on commercial projects. The flow of communication between the two different levels of communities is still used for innovative activities, but while information from the overall community is transferred freely, there is no information outflow from sub-communities because of commercially sensitive content. The free disclosure of information (as described in Harhoff et al., 2003) no longer exists between those smaller sub-communities and the overall community. This is not only true of consumer goods in extreme sporting industries; it has, for instance, been shown by O'Mahony (2003) that software programming communities also try to safeguard knowledge that might be of strategic importance.

- *Activities and responsibilities change with the building of sub-communities*

Changes in the development process and new tasks require different structures, activities and responsibilities in communities to maintain the balance between order and chaos (Sawhney and Prandelli, 2000). In the early stages, users innovated with low resources and at low cost just for fun, friendship and personal motives and needs. There was no financial aspect; contributions within the community were small but important. In sub-communities, there is a much stronger relationship between community members. Contributions are fundamental, people show high levels of effort and bear personal (economic) risks if the projects fail (CN9). People work together for definite purposes and have different responsibilities in accordance with the functional tasks of the planned start-up or commercial activity. In that stage, sub-communities are very similar to start-up teams as the

innovation process is dense and interactive (Thether, 2002). The remuneration of individual team members signals the start of economic orientation within the overall community. Subsequently, strong and more formal interactions in sub-communities imply restrictions on the free transfer of information and assistance. The innovative and creative basis of the overall community is thereby reduced.

Limitations of the study

The limitations of this study are twofold: First, the methodology used has its limitations due to the qualitative nature of the design and the interview situation (described in more detail in the section on methodology above). By using additional data and discussing the findings with community externals, we have paid attention to validating the results by triangulation. Second, potential limitations can be identified in the transferability of the findings from this industry to other industries and other settings of early innovation processes. Can we expect other reasons for user innovators to advance their innovations and other development processes in the communities than the ones found here? In comparable sporting industries, similar patterns have been found (snowboarding, skateboarding, and windsurfing; in: Shah, 2000; sailplaning, canyoning, and cycling, in: Franke and Shah, 2003; mountain biking in: Luethje et al., 2002), thus identifying similar needs and motives among user innovators, the commercial potential of user innovations and the interplay of community members. In those studies, it has been recognized that user innovators develop their innovations under certain conditions that might not hold true for all industries and/or settings: low-cost production (high variable costs but no upfront capital costs), relatively low forms of technology used, high rates of interaction between community members, exchange of skills and know-how. In other industries, this might be characterized by high capital investment, high technology, or long and complicated innovation processes, and user innovators and communities might act differently. In such cases, the influence of available capital, opportunity costs, available production facilities and a different exchange of resources between community members might influence the overall outcome of open innovation, although the motivation for lead users to innovate

will be similar.

Conclusion and Further Research

As in previous studies on user innovators (Franke and Shah 2003, Luethje 2002, Shah 2000), we chose an extreme sporting industry to analyze the development and commercialization of innovations. This industry made for an interesting field of research, as we found a number of new aspects of open innovation processes and found that lead users had a strong impact on a considerably growing market. The two main findings that should be interesting for further research in other industries and other user innovation fields are the commercialization of user innovations and the transformation of the community into sub-communities.

The current state of the rodeo kayak industry shows that traditional companies and user-led companies alike can be part of the same industry and successfully develop and commercialize innovations. Lead users were not only active in the early stages of that industry. They made a significant contribution to the upturn and establishment of the industry by starting their own companies and by selling user-innovated products and equipment to a growing market. Nowadays, user-led companies and traditional kayak companies use the creative potential of users, similar to other sporting industries such as skiing, snowboarding or mountain biking. At the current stage of industry development we can not predict exactly what will happen to the user-led companies. Dominant designs have already been established, and many companies have incorporated the user innovation idea. The entrepreneurial aspect of innovation, the recognition of new opportunities and the exploitation of those opportunities (Shane, 2000; Shane 2001) might now affect the development of the industry.

The challenge for future research on the commercialization of user innovations and open community innovation is twofold: The first aspect deals with the economic setting of user manufacturing. In analyzing the cases, we have experienced that there seem to be certain transition points from small-scale manufacturing to large-scale manufacturing, from the use of generic capital

to large upfront capital investments. From the viewpoint of an established manufacturer, it will be essential to know when to enter a new market segment that is influenced by user innovations and how to design the R&D process to acquire the knowledge required to satisfy customer needs. The user manufacturer, in turn, has to know and be prepared for the best time to invest and design for large-scale manufacturing in order to stay in the market. While we have focused on a more qualitative description of this development, it will be worthwhile to learn more about the economic processes involved, i.e., to identify the different costs and returns of the different players, to analyze the potential market demand of new market segments, and to develop scenarios for the interplay of small and large companies.

The second aspect deals with the development of open communities. Over the last few years, many companies (e.g., Siemens, Microsoft, Nike, Lego, Ducati, etc.; see also Piller et al., 2004, on consumer integration and Baldwin and Clark, 2000, on modularity) have started to set up communities of users. In part, those communities have been used for marketing and information activities only, while some have also been used to gain knowledge about product innovation, product improvement and the trends that attract the attention of the customers. As we have seen in the development of the kayak rodeo industry, communities will change dynamically over time, influenced by the level of participation and the motivation of individual members. For companies that want to use communities for new product development, it will be essential to know (1) how communities will react to certain actions (like differentiating users by status, setting up sub-communities to focus on certain topics, providing remuneration for certain activities, etc.) and (2) how to best identify the lead users within communities. We strongly believe that open community innovation will be a vital source in the idea generation process and new product development for many companies in the future. Therefore, developing models and tools on how to integrate lead users and communities into the R&D process of companies will be a worthwhile task in future research.

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Appendix

Appendix 1: Table of Cases

Case Number (CN)	Function / Company	Classification[2]		Web Page
1	Founder of Jacksonkayak	UM	CC	http://www.jacksonkayak.com/
2	Founder of Butterside	UM	CC	
3	Partner and designer, Riot	UM	CC	http://www.riotkayaks.com/
4	Founder of "Young Pirates"	UM	CC	http://www.schorschi.com/
5	Founder of "Robson"	UM	CC	http://www.robsonpaddle.de/
6	Designer for Prijon	LU, UI	SC	http://www.prijon.com/
7	Designer for Butterside	LU, UI	SC	
8	Founder of Fluid Kayaks	UM	CC	http://www.fluidkayaks.com/
9	Co-Founder of Sweet	UM	CC	http://www.sweet.no/
10	Original user innovator, "Mr. Homegrown"	LU, UI	SC	
11	Team member, Dagger	LU, UI	SC	
12	Team member, Holland	LU, UI	SC	
13	Co-owner of Kaituna Kayaks	UM	SC	http://www.kaitunakayaks.com/
14	Co-owner of Blue and White	UM	SC	http://www.kajak.de/
15	Team member of RSA, developer of helmets	UM	SC	
16	Founder of Savage, founder and co-owner of Riot	UM	CC	http://www.riot.com

[2] UM…User Manufacturer, UI…User Innovator, LU…Lead User (e.g., test driver, design consultant) / CC… Central Case, SC… Supporting Case

Appendix 2: Internet Discussion Forums and Companies quoted:

Name	**Link**
Boatertalk	http://www.boatertalk.com/
Playak	http://playak.com/
American Whitewater	http://www.americanwhitewater.org/
Soulboater	http://www.soulboater.com
Fluid	http://www.fluidkayaks.com
Jacksonkayak	http://www.jacksonkayak.com
Riot	http://www.riotkayaks.com (also: http://2imagine.net)
Liquid Logic	http://www.liquidlogickayaks.com
Immersion Research	http://www.immersionresearch.com
Prijon	http://www.prijon.com

Endnotes:

[1] One exception is the study by Shah, 2000, who identified the existence of lifestyle firms in the windsurfing industry.
[2] Similarly, IBIS world industry data indicates the importance of the sporting goods sector for the US market: industry revenues of sporting and athletics goods manufacturing for 2002: $12.36 billion; industry revenues for sporting and recreational goods and supplies for 2002: $29.63 billion.
[3] von Hippel (1986) defines lead users as:
…users of a given product or service type that combine two characteristics: (1) They expect attractive innovation-related benefits from a solution to their needs and so are motivated to innovate, and (2) they experience needs for a given innovation earlier than the majority of the target market.
[4] There is a wealth of literature concerning the agreement of coders (Jones et al., 1983; Hughes and Garrett, 1990; Abedi, 1996; Lin et al., 2002; Hsu and Field, 2003; Krippendorff, 2003). Of all the interrater reliability measures discussed in the literature, we chose Cohen's Kappa because it is widely used to measure reliability for dichotomous data and two independent coders.