Why firm-established user communities work for innovation:

The personal attributes of innovative users in the case of computer-controlled music instruments

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Abstract: Studies of the sources of innovations have recognized that many innovations are developed by users. However, the fact that firms employ communities of users to strengthen their innovation process has not yet received much attention. In firm-established user communities users freely reveal innovations to a firm's product platform, which in turn puts the firm in a favorable position (a) because these new product features become available to all users by sharing on a user-to-user basis, or (b) because it allows the firm to pick up the innovations and integrate them in future products and then benefit by selling them to all users. We study the key personal attributes of the individuals responsible for innovations and the creation of value in this organizational context, namely the innovative users, to explain why firm-established user communities work. Analyzing data derived from a web-based questionnaire generating 442 answers we find that innovative users are likely to be (i) hobbyists, an attribute that can be assumed to affect innovators' willingness to share innovations (positively), and (ii) responsive to "firm-recognition" as a motivating factor for undertaking innovation, which explains their decision to join the firm's domain. In agreement with earlier studies we also find that innovative users are likely to be "lead users", an attribute that we assume to affect the quality of user innovation. Whether or not a firm-established user community can be turned into an asset for the firm is to a great extent conditioned by the issues studied in this paper.

Keywords: *Innovation, User community, User Characteristics*

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Introduction

There has been considerable interest in innovation resulting from user activities (Rothwell, et. al. 1974; Rosenberg 1976; von Hippel, 1976; von Hippel, 1988). The need to know more about the phenomenon of user innovation coincides with the rapid spread of the phenomenon itself, recently, and most importantly, as a consequence of the Internet and enhanced connectivity among agents involved in innovative activities. This paper is concerned with a new form of business organization for innovation that relies on users for innovation through a firm-established user community. Our specific interest lies with the key personal attributes of the main contributor to this type of organization: the innovative user.

Recent studies of community-based innovation models in which users join "peer-to-peer communities of common interest", suggest that innovative user communities may yield important values, for example, new product concepts or product features (Shah 2000; Lüthje 2000; von Hippel 2001; Franke and Shah 2003). While these findings are important, few studies have so far investigated the context in which a firm and a user community intersect and what firms can do to organize user innovation and capture the benefits of such innovations (Jeppesen and Molin 2003). Our main question is: Why do firm-established user communities work for innovation? By "work" we mean that in these communities users freely reveal innovations complementary to a firm's product platform, which in turn put the firm in a favorable position (a) because these new product features become available to all users by sharing on a user-to-user basis, or (b) because it allows the firm to pick up the innovations and integrate them in future products and then benefit by selling them to all users. We seek to answer the question by looking at the key attribute of the individuals who create and reveal value in this context, namely the innovative users. Hence, the relevance of this phenomenon to business economics is that under the right conditions firms may gain a competitive advantage from the effects of having a community of innovative users connected with it. Framed, for example, in the language of the resource-based view of the firm (Wernerfelt 1984; Barney 1991), a user community may turn into a strategic asset: an imperfectly imitable resource that can hardly be purchased but must evolve. By studying the personal attributes of innovative users this study thus points to some of the necessary conditions under which a user community turns into an asset for the firm in the first place. The attributes we focus on in this paper are innovative users' work related status, reputation mechanisms that may motivate users to innovate and participate in the community, and users' "leading edgeness" in the field of use.

To answer these questions we have conducted a study that draws on data collected from a variety of sources, such as interviews with users and in-house product developers and web-log information, but most importantly on data from a web-based questionnaire yielding 442 responses. We are aware that the question posed cannot be answered in full on the basis of the personal attributes of innovative users. Having the right users in the community is a necessary condition, but only a contributing factor in explaining why firm-established user communities work. Yet, user characteristics are a crucial factor in determining why firm-established user communities can yield innovations.

The remainder of this paper is structured as follows: As a backdrop for the current research, we briefly review the results of studies on user innovation. Then we outline the empirical context of our study, focusing on recent examples of innovation by users in computer-controlled music instruments. Subsequently, we establish hypotheses which are followed by a methodology section and a description of the data colleted. Finally, we present our results and a discussion followed by a conclusion.

User innovation – a brief review

For three decades scholars of user innovation have studied the patterns of innovation by users. While the majority of the contributions within the literature on user innovation have focused on innovation by users where users are firms, there has recently been a surge of interest in the phenomenon of user innovation in hobbyists' fields as well. Tables 1 and 2 below suggest a mixed picture, in which innovation by users covers the range from professionals to private hobbyists.

Table 1 shows the product area and the sources of innovation in cases where users are professionals in firms

Product Area	**Source of Innovation**			
	User	*Mfr.*	*Other*	*N*
Petroleum processing *Enos (1962)*	43%	14%	43%	7
Computer innovations 1944-1962 *Knight (1963)*	26%	74%		161
Chemical processes and process equipment *Freeman (1968)*	70%	30%		810
Scientific instruments *von Hippel (1976)*	76%	24%		111
Semiconductor and electronics subassembly manufacturing equipment *von Hippel (1977)*	67%	21%	12%	49
Wirestripping and connector attachment equipment *VanderWerf (1982)*	11%	33%	56%	20

Abstracted from Shah (2003)

Table 2: The product area of innovation in consumer goods and the share of user hobbyists who report having innovated within each area.

Consumer Products	*Share of innovators in the population*	*N*
Hiking equipment *Lüthje (2000)*	37%	153
Mountain biking equipment *Lüthje, Herstatt and von Hippel (2002)*	19%	291
Snowboarding, sailplaning, canyoneering, and handicapped cycling equipment *Franke and Shah (2003)*	38%	197

Abstracted from Shah (2003)

Tables 1 and 2 above establish the fact that user innovation is indeed taking place across a number of different product fields. Both industrial user firms and individual end-consumers/hobbyists innovate in their respective fields of interest. In Table 1, where professional are the users, we can observe that between 11 and 76 per cent of the innovation in a field was the result of user efforts. The studies of user innovation in consumer goods (Table 2) fields show that a large share (19 to 39 per cent) of a given population of users do in fact innovative.

Although the economic implications of user innovation have not received much attention (for an exception, see Henkel and von Hippel (2004)) one might assume that user innovation will have an important effect when introduced into the economic system through either sharing or commercialization. This assumption is supported by the facts that (a) user-created goods, such as open source software, has gained market shares from state-of-the-art commercial software manufacturers (Lerner and Tirole 2002; Lakhani and von Hippel 2003), (b) products developed by collaborating with lead users have been shown to perform several times better than in-house generated products (Lilien et. al. 2003).

Recent studies in this field show that some firms are now realizing that the sources of innovation related to a given product can be modified or shifted. Firms that wish to increase user innovation related to their products may offer free equipment, such as toolkits for user innovation, which open up a solution space to users (von Hippel 2001; Thomke and von Hippel 2002; von Hippel and Katz 2002). We are interested in cases in which firms seek to enhance product development by opening up their product via the user toolkit method and through the implementation of a user community.

An innovative user community in the field of computer-controlled music instruments

Our empirical context is a firm-established user community hosted by the firm Propellerhead Software - a manufacturer of so-called computer-controlled music instruments. Propellerhead released its first product in 1994 and has since become a leading force within its segment. Computer-controlled music instruments are tools for sound production, processing and

recording. Computer-controlled music instruments are software products providing the musician with a virtual rack that comprises a number of features such as sound producing modules (e.g. drum machines), sound effects, (e.g. distortions), and sound organizing elements (e.g. samplers) used in the creation of music content for, for example, CDs, games, movies, and advertising. The main difference between them and usual instruments is that they combine the making, processing and recording of music in one piece of software. They act as a substitute for a physical sound recording studio. As Propellerhead's products are quite affordable (prices range from 100-500 USD), easily accessible (via Internet), and compatible with a range of other digital audio visual production technologies they are attractive to users with diverse needs, resources, and abilities. The products are used by music creators ranging from highly skilled professional musicians and sound studio technicians to music creators with almost no prior knowledge of sound creation.

Following the 1999 release of Propellerhead's product Rebirth, a number of users joined in an Internet-based chat hub where they managed to 'hack' the Rebirth software. It was a collaborative process that went on for 6-8 months. Later, the hackers began to integrate their own sound samples and graphic designs into their hacked product version: 'It was a form of friendly competition among us,' a user recounted. When information about the hacking activity reached Propellerhead, the management found themselves 'overly surprised' by the fact that someone would spend so much time altering their product. 'We were really excited about this,' the CEO and founder of Propellerhead explains. This approach to hacking opened up Propellerhead's eyes to the benefits of having access to a community of innovative users. Keeping a welcoming attitude towards users' product modifications, the firm decided to support users' innovative efforts by opening up parts of the product code to users who wanted to make so-called "mods" (modifications of the original product) to their products. The development possibilities for users have since been refined and now include enabling technologies for user innovation referred to as "user toolkits for innovation" in the literature (von Hippel 2001). Toolkits allow users to undertake innovative work in a way that is structured by the firm.

Along with these events emerged a user-organized online community of people interested in bringing their innovative efforts further. As they became aware of this, Propellerhead decided to set up their own "official" online user community on the firm's website. Over time Propellerhead turned their community into the main hub for their products. Today the community comprises approximately 3850 members, generating approximately 150 – 200 interactions (question and answers) per day typically involving close to 100 users. In the community questions and answers are posted between users. However, users often directly address the firm through this channel to report bugs etc. Users also help test each other's developments as well as comment on designs created by users. When the firm releases a new product users are the first to find bugs and errors and report these to the firm. In addition, Propellerhead has started to use their website as a hub for diffusion and sharing of

user's innovations. The following quote from Propellerhead's website illustrates the firm's position on the issue:

> "Mods. A celebration of creativity. Here at Propellerhead we're crazy enough to let users take our precious ReBirth (a Propellerhead product) and redesign it any way they like. If you're skilled in graphic design and you have a bunch of cool drum samples you've always wanted to share - make a mod, mail it to us and maybe, just maybe, we will make sure it reaches every corner of the world" (www.Propellerheads.se).

That the strategy employed is not as "crazy" as Propellerhead indicate by the quote above becomes clear when observing the number of benefits that Propellerhead derives from the community. When users reveal their innovations made to Propellerhead's product the benefits from having additional fresh content or novel features available (produced free of charge by users) spills over on the firm. The process of constant development and content creation by users increases the value of the product to all users and may eventually result in a longer product life and greater sales of the basic product (Jeppesen and Molin 2003). We learned from our interviews with firm managers and product developers that user innovations are highly valued by the firm. One of the many illustrations of this is, for example, that a user has developed a radically different software interface that keeps Propellerhead's product work in sync with living pictures (movies and TV). In this way user innovation has dramatically expanded the scope of the product and possibly opened up new potentials for Propellerhead. Another example is the invention of the so-called mouse wheel control application, which substitutes the music keyboard as the main control unit for product. The mouse wheel application has been incorporated as a standard feature in Propellerhead's product (Reason) and is likely to be a central component also in future. The most typical user innovations appearing are the mods which are made using user toolkits supplied by Propellerhead. A mod is a combination of sound samples accompanied by a graphical layout that together creates a device for music creation. A similar development in-house took an experienced Propellerhead product developer between 100 and 150 hours to create[1]. The firm frequently picks up innovations in the community and integrates them in new versions of their products, which they then sell back to the users. However, more commonly, the firm hosts the innovations or refers to them on their website, thus making them available to all users. This latter practice adds additional value to the existing product. Approximately 100 mods similar to that described above have been created by users, a fact indicating that users are an important source of innovation for Propellerhead's product environment. Apart from direct sourcing of

[1] Assuming an average salary of software developers (Nordic countries) and the time consumed to create an equivalent mod the production cost amounts to €3000 – 4500. Average hourly salary for programmers in the Nordic countries is approximately €30 (source: Sam-Data (Danish labor union for IT employees), assessed November 19, 2003).

innovations from the community, feedback from users often plays a role in product development at Propellerhead: "many enhancements of our current products are a direct result of end-user feedback," Propellerhead asserts.

The community also works as a helpline that users utilize to interactively solve problems of product use in a manner similar to that described by Constant et. al (1996), and Lakhani and von Hippel (2003), in which users tend to help out other users baffled by a certain problem. Below is an example of how such help is provided:

Christofer: RV700 (19 May 2003, 19:14:35):

> How do you use this device as an EQ without having any Reverb effect. Obviously this a much better EQ device than the other one. I'm trying to EQ vocals but i don't want any reverb on them.

Ceffe: (19 May 2003, 19:46:36):

> I think what you want is not possible. According to the manual (p237) the EQ affects the wet reverb sound only. I guess,then, this EQ is for shaping the sound of the reverb. Try out the Vocoder as EQ instead!

Gnorpf: (19 May 2003, 23:59:49)

> It's actually possible to use the RV7000 as an EQ with a little bit of tweaking, and here's how:
>
> MAIN UNIT: EQ Enable: On, Gate Enable: Off, Decay: Min, HF Damp: Min, Hi EQ: Middle, Dry - Wet: Max Wet)
>
> REMOTE PROGRAMMER: Algorithm: Echo, Echo Time: 10ms (Min), Diffusion: 0, Tempo Sync: Off, LF Damp: 20 Hz, Spread: 0, Predelay: 0ms
>
> CABLING: Obviously, you need to make the RV7000 an insert effect (place it between your sound source and the mixer). The trick is basically to create a reverb that sounds like the original, because you can only apply the EQ to a processed reverb signal. Note that this solution introduces a 10 ms lag, and I've found no way around it. But for slow stuff like voices etc, you should barely hear the lag. And if you hate it, just introduce a DDL1 into all the other tracks to compensate for it. Cheers!

The process of user-to-user help reduces the amount of support that the firm would otherwise have to provide to their product users in a firm-established user community. Such user-to-user assistance in a related field (of computer games) has been found to outweigh several times the effort spent by a firm on supporting users (see Jeppesen, 2002). It should be considered an important feature of the firm-established user communities, which clearly depends upon knowledgeable users' willingness to diffuse their problem-solving knowledge.

In the particular case under investigation, the firm's welcoming attitude towards initial "hacking activity" (the firm did not take legal action towards hackers) and the provision of a place to meet, must be considered important in the establishment of a fruitful user innovation process. The firm's observation of "friendly hackers" and the establishment of fruitful interaction were wisely complemented by the implementation of a user toolkit which

encourages user innovation to occur in selected areas perceived relevant to the users such as in the mod-field described. This kind of experimentation may be refined into a real strategy in which the firm decides exactly which product areas it wants to "open up" to user innovation activities and in which areas it will take hackers to court. Such a strategy may also include a number of considerations about how best to structure product technology in order to obtain the most advantageous degree of openness – which invites consumers to undertake certain tasks and not others for the firm.

Hypotheses

In this section we put forward our hypotheses. We want to create an account of why firm-established user communities work for innovation by focusing on the presence of certain user attributes in such a community.

Hobbyist vs. professional user innovators

The rationale for hypothesizing about users' hobbyist vs. professional status relates to the likelihood of innovation appearing from these respective groups. The major share of innovation appearing in the firm-established user community context is the result of voluntary and uncompensated activities where some users innovate and (most often) freely reveal their innovations as non-rival goods. In such a context characterized by the absence of monetary rewards for innovative activity innovation relies in great measure on intrinsic motivations. As outlined below this feature leads us to expect that innovation will be more likely to come from hobbyists than from professional users.

Research in behavioral economics (Frey, 1997; Frey and Oberholzer-Gee 1997; Kreps 1997; Bénabou and Tirole 2003) and social physiology (Deci 1975; Deci and Ryan 1985) takes interest in the internal motivational forces propelling human efforts. According to these orientations, extrinsic rewards (monetary rewards) yield unsatisfactory results in a number of circumstances because they to "crowd out" intrinsic motivations, hence undermining the efforts forthcoming on a voluntary basis. Empirical research supports this argument and shows that there is often a "hidden cost of rewards" (Lepper and Greene 1978): in the words of Deci (1975) extrinsic rewards "corrupt" voluntary efforts. The hidden cost of rewards becomes a reality when monetary rewards have limited or no impact on current performance and reduces the agent's motivation to undertake similar tasks in the future (Bénabou and Tirole 2003). Results derived from a study of a now classic experiment (see Deci 1975) in which college students were either paid or not paid to work for a period on an interesting problem showed that unpaid students continued problem solving significantly longer in a non-rewarded leisure period than did those that had been paid and showed to be more engaged in

the task at hand[2]. We expect that only hobbyists will be able to preserve a sufficient level of intrinsic motivation to participate in these innovation activities. Professionals will be "corrupted" by extrinsic rewards and will therefore (other things being equal) not feel as attracted to participating voluntarily in community-based activities as do hobbyists. The above arguments lead us to our first hypothesis:

Hypothesis 1: Innovative users located in firm-established user communities are likely to be hobbyist users

The professional vs. hobbyist status of user innovators is central to our study because different types of users will have different motivations for revealing reveal their innovations. Firm-established user communities rest on the fact that users are willing to share their innovations with others.

There *are* obvious strong motivations that drive professional users to innovate. However, these motivations are not compatible with voluntary efforts and free revealing of innovation, which is the norm in a firm-established user community. Professional users in the business context can derive important economic benefits from using or licensing an innovation. Professionals are forced to defend competitive positions by secrecy or property rights and/or by in-house use of an innovation. In other words, the competitive nature of the professional environment will be less attuned to sharing innovations with others in the absence of monetary compensation[3]. On the other hand, there is reason to believe that innovation will tend to be freely revealed where innovators do not easily find ways to capture monetary benefits from using the innovation themselves and where there is no significant loss by free revealing it. Where competition is low or absent, users' losses due to free revealing are also low and explain why free revealing takes place. When taking the obstacles to commercializing innovations that user hobbyists face into account, there may be situations in which the arguments for secrecy are even outweighed by the benefits of free revealing (Harhoff et.al. 2003). Since hobbyists do not often have access to distribution, commercialization, and mass-production facilities, hobbyist innovation will tend to become more freely shared as non-rival goods than professional users' innovations.

Reputation mechanisms motivating users to innovate

The motivations leading to the private provision of goods has been discussed intensively in the literature that studies innovation by users (see, for example, recent open source software research (Lerner and Tirole 2002; Lakhani and Wolf 2003). An alternative set of "rewards" that

[2] For two excellent surveys on the topic of intrinsic motivation and the crowding-out hypothesis see Deci and Ryan (1985) and Frey and Jegen (2001).

[3] We are aware that free revealing sometimes occurs in professional fields (see Allen, 1983, von Hippel, 1987, Schrader, 1991, Morrison et. al., 2000). However, we believe that free revealing is a *less* likely feature than in a hobbyist field.

go "beyond the dollar" (Pheffer 1972) such as, for example, reputation gains through signaling (Glazer and Konrad 1999) may become relevant when the chances of direct monetary rewards or benefits from secrecy are low. One of the most influential studies interested in reputation as a driver of voluntary efforts in community settings is Lerner and Tirole's (2002) explanation of motivations of open source software programmers. In their view, the explanation for open source software programmers' innovative efforts and free revealing may be found in "peer recognition" – in this case, a reputation-based reward enhancing a provider's position in the job market. According to the authors, signaling of competence is the main driver of efforts in the community setting of this type of software production.

In this respect, the setting of firm-established user communities seems similar to that of the open source software movement. Users can easily signal their abilities to a large number of peers, and may easily gain reputation this way. On the grounds of these similarities we find reason to believe that peer recognition will be a motivator for participating in the community:

Hypothesis 2a: Innovative users located in firm-established user communities will be motivated by recognition from peers

Despite Lerner and Tirole's (2002) compelling argument about peer recognition (and related career advancements) as being the main motivator for innovation, recent survey evidence has not been able to verify the peer recognition hypothesis. Empirical studies from open source software programming (Hars and Ou 2002; Lakhani and Wolf 2003; von Krogh et. al. 2003), and simulator software (Henkel and Thies 2003) find a more mixed picture of motivations to be underlying innovative efforts, although they do not discard the explanatory importance of the peer recognition account. We do not find that the reputation-based rewards story has been properly investigated. Therefore, in our study we wanted to allow for an alternative, yet still reputation-based, explanation of users' innovative efforts which seemed plausible in the context of firm-established user communities. In this context, where a firm is intensely involved in community activity, we found it reasonable to examine an alternative hypothesis, namely that users may be responsive to so-called "firm-recognition".

Hypothesis 2b: Innovative users located in firm-established user communities will be motivated by recognition from the firm hosting the community.

Should this hypothesis be supported we will have identified a possible explanation for why innovative users choose to join and reveal innovations in the firm's domain.

The leading edge status of innovative users

The reason for hypothesizing about the presence of lead user attributes stem from the observation that lead users have been found to produce important results in the process of new product development and their presence may thus partly explains why firm-established

user communities work for innovation. The literature suggests that innovators are likely to have lead user attributes that differentiate them from the remaining users in a population. Lead users are defined as users of a given product or service type who combine two characteristics: (a) they expect innovation-related benefits from a solution and are thereby motivated to innovate and (b) they experience the need for a given innovation earlier than the majority of the target market (von Hippel 1986). Consistently with the argument that lead users are motivated and thus are highly likely to innovate, a range of empirical studies have found relationships between being an innovative user and lead user attributes. In their study of library software users Morrison et. al. (2000) found that innovating users had high scores on lead user characteristics relative to other users in the same community, with the impact of characteristics being moderated by the capability of users to harness their resources and those of the external environment. Also Franke and Shah (2003) found that innovators exhibit these characteristics more strongly than non-innovators. Similar results are derived by Franke and von Hippel (2003) finding that a high intensity of lead user characteristics displayed by a user has a positive impact on the likelihood that the respective user will innovate. We believe that these results apply to the context of our study of firm-established user communities.

Hypothesis 3: innovative users located in firm-established user communities will tend to exhibit lead user attributes.

The leading edge status of innovative users is important to our study in at least two respects: (i) it determines the value of the innovations produced and (ii) leading edge users are generally early adopters and willing to diffuse their "use-related knowledge".

It has been shown that lead user innovations represent a better commercial potential (Urban and von Hippel 1988; Herstatt and von Hippel 1994) and perform better in the market (Lilien et. al. 2003) than other types of innovations. Further, in a study of open source software programmers it was found that a single component of the lead user definition – being at the leading edge of a marketplace trend – predicts *not only* user innovation likelihood *but also* innovation attractiveness (Franke and von Hippel 2003). Another reason that the presence of lead users would seem to support the usefulness of firm-established user communities in which they are embedded is that these individuals act as opinion leaders (Morrison et. al. 2003). They are most often early adopters and willing diffusers of new products, knowledge and practices. Due to these characteristics lead users are critical in the contagion process (assisting others in the adoption process) and can pilot their organizations faster to the adoption of new product and practices. In sum, the benefits of having lead users in a firm-established user community is that they will positively affect the chances of successful outcomes in terms of valuable product concepts and they will also support the diffusion of state-of-the-art "innovative knowledge and practices".

Study sample and research methods

The choice of Propellerhead's community as the study object was made for two main reasons. First, the community was established by the product development firm, thus allowing users to study the intersection between a user community and a firm. Second, the Propellerhead community attracts users that employ the music tools for professional work-activities as well as users that utilize the tools for hobbyist activities. Only in such a setting, where both groups are present, could we test our hypotheses about innovative and work-related status (hobbyists vs. professionals).

There are clearly limitations to a case study based on one firm and its single community, such as research biases and other shortcomings. A case study of the kind that we undertake highlights only the nature of certain kinds of users, a particular branch of tools, and a limited set of innovation types. We chose our case for a specific reason, namely because it represented a setting in which we could test users with differing specific personal attributes of interest to us. Studying a community of, for example, only professional users would not have allowed us to distinguish between the propensity of user innovation by professionals and hobbyists. We were also willing to trade off the study of a larger number of cases for the opportunity to gain deeper insight into an as yet unexplored phenomenon.

Use of multiple methods and data sources

We chose a case study approach (see Eisenhardt 1989; Yin 1995; Glaser and Strauss 1967) to arrive at an encompassing view of the personal attributes of innovative users in a firm established user community. We employ multiple data sources, as it is the preferred method when one seeks to understand or explain a phenomenon (Wimmer and Dominick 1994). The use of overlapping research approaches is known as triangulation and defined as "the combination of methodologies in the study of the same phenomenon" (Denzin 1978). It may be used by the organizational researcher to enhance the precision of his conclusions by collecting different data related to the same phenomenon (Jick 1979). We make use of interviews, Internet questionnaires, and web-logs as sources of data.

1) Congruent with the exploratory nature of the research we initiated the study by using "netnographics" (Kozinets 1998). Netnography is described as the textual output of Internet-related fieldwork and is in essence an interpretive methodology. By observing and participating in the community we attempted to gain sufficient insight into the Propellerhead online community to avoid misunderstanding as we progressed. We were involved in the Propellerhead online communities approximately one hour per day during a three-month period (February through May 2003). This provided us with insights about the "local language" in the community, norms of communication, user interests, and "hot" topics, and helped us gain access to the users and to communicate appropriately with them. 2) A web-log was obtained which contained data about different quantitative aspects of the online communities such as: usernames, the activity of users, the interaction frequency between users, and which types of discussions users were involved in. As we had acquired the usernames of respondents

for the web-based questionnaire that we initiated later, we were able to cross-check their past appearances and interaction frequency through analysis of the web-log data. The web-log data was captured for the period starting 18 July 2002 through 10 March 2003. 3) Throughout the study period we conducted a number of interviews with CEOs, managers and administrators from Propellerhead and users involved in the community: four interviews were carried out with CEOs and product developers from Propellerhead, two interviews with the firm's online community management, and six interviews with leading edge users. The interviews were semi-structured and were undertaken in parallel with the launch of our web-based questionnaire in the spring 2003. We have later corresponded with the majority of our respondents a second time to get their reaction to the inferences we made from the study. The fact that we had already obtained an essential understanding of working of the community from our "netnographic" study and the examination of the web-log allowed us to do more targeted interviews and contrast respondents' information with observed behavior (in the community). 4) After gaining the necessary insights from interviews and our presence in the community we sent out a web-based questionnaire to the Propellerhead user community. The questionnaire was launched May 14 2003 and continued through to June 18 2003. The objective of the survey was to collect data on users' personal attributes particularly regarding innovative users.

The object studied, innovative users located in an online community, practically determined the choice of a web-based survey method since our population could hardly have been reached in other ways. The community goers were asked questions about: their background, community participation information, whether they had undertaken innovative work and about their motivation for community participation. The questionnaire appeared in a pop-up window, when a community participant logged in to the online community. When completed the respondent submitted the questionnaire directly to our database. Respondents could reply mainly with 1-7 (Likert scale) or yes/no answers.

We are aware that a web-based survey design holds a number of possible biases Roztocki (2001). We tested for the most important possible bias, namely response bias. This tests for the non-response problem that some users (e.g. due to their general interest in the field) may find it more interesting to participate in the survey than other users (Armstrong & Overton 1977). In our case, this implied testing that innovative users were not more likely to answer than non-innovative users. To test for this potential bias we compared the earliest 10 per cent of respondents with the last ten per cent of the sample and tested for higher frequency of innovative users answering in the early part. No bias was discovered.

The questionnaire had a response rate of 62.7 per cent (i.e. 62.7 per cent of those offered the questionnaire responded). The total number of responses was 442 of which 345 were found valid for our statistical analysis leaving out 97 responses due to missing values and lack of internal consistency. For some of our statistical exercises 395 answers were found useful. Eight per cent of our respondents (34) reported having innovated, while three per cent said that their creation was "new to the world" at the time of revealing it. We attribute the moderate share of innovative users to the strict definition of innovation that we had used. Our

proxy for innovation only considers existing and completed devices as innovations. Users that "only" contribute with ideas, advice and insights, and so on, are thus not counted as innovative users in our sample.

We conducted a follow-up investigation on the group of innovators. By carrying out a second questionnaire we gained detailed additional information on the individual innovators, allowing us to test and validate the findings from our first main questionnaire. In October 2003 we distributed the second questionnaires to the 28 user innovators for whom we were able to obtain contact information. This questionnaire yielded fourteen responses and provided us with detailed information on the user innovators.

Statistical method and variables

The focus here is on the relationship between various variables of our survey. Given that data are discrete and inherently ordered we opted for an ordered probit regression model as analytical tool in the estimation.

Our dependent variable is user innovation. The variable is discrete and is constructed as follows. To test whether users had innovated they were asked: have you developed modifications, add-ons or extras to Propellerhead's products? The following question was: "If yes, do you think that your modification, add-on or extra was "new to the world" at the time it was developed? By asking in this manner we were able to establish innovation as a discrete variable: If no innovation was reported, the value of the innovation variable was set to equal 0. If users had innovated, but innovation was not new to the world, the innovation variable was set to the value of 1. If a user reported having made an innovation that was "new to the world", the value of the innovation variable was set to equal 2.

Our first independent variable is professional status. The degree to which a user can be considered professional or hobbyist was measured by the user's income derived from the use of computer controlled music instruments. The question asked was: "How large a share of your income do you generate from activities of sound production and processing?" Answers were provided on a scale containing 4 possible answers: 1) none, 2) less than 25%, 3) less than 50%, or 4) I am a professional, this is my main job.

The second and third independent variables measure recognition and were constructed from two simple questions: 1) "Is recognition from other community goers a great reward? 2) "Is recognition from Propellerhead a great reward? Answers could again be provided on a seven-point Likert scale.

Our fourth independent variable is Lead User: it is built from the Lead User Construct (Morrison et al., 2000) and involved three questions that identify leading edge users: 1) "I usually find out about new products and solutions earlier than others", 2) "I have benefited significantly by early adoption and use of new products" and 3) "I have tested prototype versions of new products for manufacturers" Each of these questions could be answered using a seven-point Likert scale. The three items were then collapsed into one single variable by means of summation. As our independent variable - Lead user - was constructed from those

three variables we chose to perform a standardized Cronbach's Alpha test. Since the standardized Cronbach's Alpha is 0.67 the variable has an acceptable degree of internal validity.

Results and discussion

Table 3 below presents the results of the ordered probit analysis of the relation between user innovation and characteristics of users in the Propellerhead user community.

Table 3: Regression results explaining innovation at the level of the individual user (n=345).

Variables	**Model I**			**Model II**			**Model III**		
	Coefficient	Stand. Err.	P-value	Coefficient	Stand. Err.	P-value	Coefficient	Stand. Err	P-value
Constant	-3.120	0.774	0.001	-3.581	0.905	0.001	-3.660	0.917	0.001
Lead user	0.769	0.028	0.006	0.809	0.028	0.004	0.860	0.032	0.008
Professional	-0.247	0.129	0.056	-0.284	0.131	0.030	-0.308	0.131	0.019
Reciprocity expectations	0.090	0.087	0.304	0.061	0.091	0.501	0.069	0.092	0.458
Critical for my business	0.032	0.055	0.565	0.010	0.057	0.857	0.088	0.056	0.875
Enhance career opportunities	0.047	0.079	0.556	0.034	0.079	0.628	0.053	0.080	0.510
Peer recognition	0.082	0.064	0.899				0.067	0.077	0.381
Firm recognition				0.137	0.066	0.037	0.174	0.074	0.019
Log likelihood	-113.414			-106.705			-106.159		
Restricted log likelihood	-121.823			-118.805			-118.805		
P-value for log likelihood test	0.010			0.0005			0.0007		

Three models were estimated. In Model 1 the variable "Firm recognition" has been dropped and in Model 2 the variable "Peer recognition" is dropped. This is done to test whether these two arguably interrelated variables, independent of each other, maintain their sign and significance. In Model 3 the complete set of variables is analyzed. As the table shows, the sign and significance of the parameters for these variables are robust to the change in specification: The parameter for "Peer recognition" remains insignificant throughout the analysis while "Firm recognition" is positive and significant across the models. Further, the goodness of fit (measured by pseudo R-squares) is the highest in models 2 and 3 – a result of "Firm recognition" (which is significant) not being included in model 1.[4]

In Model 3, the coefficient for professional users' showing innovation activity is negative and significant (significant at the five per cent level), thus indicating that user innovators are not likely to be professional in the field of music creation, music production or music technology. Although one may argue that professional users would have significant economic gains from innovating, our results indicate that innovation is appearing from hobbyist users. Hypothesis 1 states that innovative users located in a firm-established user community are likely to be hobbyist users and it is thus supported by the findings. This result should, according to our argument, denote a high degree of willingness to freely reveal innovations created by the user innovators, a factor that is crucial for the function of firm-established user communities. Hobbyists are people with a strong product related interests but with no obvious need for, or channels to, derive rent from their innovations. No competition among users or no lost rents from free revealing explains why this practice is quite common in firm-established user communities. If users were professional they would not have the same propensity to reveal and share because secrecy would often be a pre-condition for reaping the benefits of a given innovation.

The coefficient of user innovation being related to peer-recognition is positive but not significant, hence not supporting the idea that innovative users are likely to be responsive to peer recognition. Thus, our findings cannot support earlier claims made in the literature that peer recognition is a driver of innovative efforts - at least, not in this context. Our findings could hence not support Hypothesis 2a, that innovative users located in firm-established user communities will be motivated by recognition from peers. However, the coefficient of user innovation related to firm-recognition is positive and significant (significant at the five per cent level), suggesting that innovative users are motivated by the desire to be recognized for innovative behavior by the firm. We thus find support for Hypothesis 2b, which stated that innovative users located in firm-established user communities will be motivated by recognition by the firm hosting the community. The main implication of this finding for our main question (why firm-established user communities work) is that it explains why innovative users join precisely the community hosted by the firm. Here their innovations and their knowledge are visible to the firm. Firm recognition explains why innovative users are drawn to the

[4] The pseudo R-squares of the respective models are: Model 1=0.07; Model 2=0.10; Model 3=0.11

community and why they openly show their innovation in precisely this domain. If innovative users did not respond to firm recognition they would have no particular incentive to reveal in the firm domain. We expect this finding to be of major importance for the function of firm-established user communities. We also think that it may be a sign of a more general pattern of user innovation diffusion in which users will tend to reveal innovations and knowledge in the domains where he expects most benefits. In this case, the place to reveal is the firm-established user community. The finding that innovators respond to recognition from the firm is also interesting in that it opens up a scope for management regarding how the firm may chose to "allocate" recognition to motivate users. The finding suggests that figuring out how the firm may more deliberately exploit this source of motivation will turn out to be useful to firms that deal with user communities.

The coefficient for lead users related to innovation by users is positive and significant, suggesting that users who reported having created innovations are likely to comprise the lead user characteristics (significant at the one per cent level). This finding clearly supports Hypothesis 3, that innovative users located in a firm-established user community will tend to exhibit lead user attributes. According to our argument this affects the quality of the innovations positively because lead users are found more capable of delivering important and high quality innovations due to the fact that they are ahead of the market in terms of discovering new product concepts and connections to other products. Our anecdotal evidence from interviews with firm employees indicates that the innovations produced are indeed highly valued and that several product features have been built from user innovations. Hence, we argue that one of the main reasons why Propellerhead has been able to integrate several innovations and generally rate user innovations as important is likely to be connected to the fact that "their" user innovators are primarily lead users. Apart from being innovators, lead users will have a low time of adoption of outside ideas and they will tend to bring such innovations to the community. Lead users have also been found to act as opinion leaders and should be willing to diffuse their innovative "use knowledge" to the remaining members in the community. This will happen in the form of concrete innovations and/or in the form of creative solutions to problems. The diffusion of user knowledge plays an important role in that lead users provide help and solutions to their fellow community members. Hence the way is paved for contagion processes in which average users (and other lead users) learn from leading edge users, leading to a diffusion of best practice problem solving and support. In this way the leading edge users take over a number of support functions that the firm would otherwise have to maintain.

The impact of control variables on the performance is largely as expected. We find no significant relation between being an innovative user and expecting reciprocity for participating or giving to the community. Neither do we find any significant relation between innovative users drawing on the community for business purposes. And we do not find a relation between the wish to enhance career opportunities and being an innovative user.

Beyond the results reported above, an additional analysis of the marginal effects of the model 3 (see Appendix 3) shows that being an innovative user increases the probability of generating incremental-type innovations the most (being an innovative user also increases the probability of producing new-to-the world innovations of the radically different type, but to a lesser extent). This result is not surprising, in that users in this setting most often build on and extend an existing firm product. Users can be said to be locked into innovating to this product and the outcome seems naturally often to be extensions to the product rather than breaking with the fundamental concepts of the product. This finding is consistent with Morrison et. al. (2000) showing that although user innovations are generally rated by manufacturers as being important they are usually low on novelty. The result indicates that the innovative users fill out small niches in the market, niches the firm has not paid attention to or had not found interesting enough to invest in. The innovations produced are highly complementary (not rivals) to the firm's product, which is of major importance to the firm's abilities to obtain fruitful outcomes from this type of organization.

Differences between innovators and non-innovators

In addition to the regression analysis, we performed a test of the differences in perception of community participation between the group of innovators and the group of non-innovators. The aim of the analysis was to single out the perceptions of innovative users versus those of non-innovative users in relation to a number of key questions. We focused on the differences in the "wish to innovate" by the two groups, and on the main reasons for users to participate and contribute to the community on a daily basis.

Table 4: Results of t-test measuring the relationships between the answers from respectively user innovators and non-innovative users (Innovators: n= 34; non-innovators: n=395)

Statements and questions	Mean for innovators	Mean for non-innovators	P values
Wish to innovate:			
I would like to make improvements to Propellerhead's products (yes/no)	0.76 (0.44)	0.55 (0.50)	0.02
I would use Propellerhead's products if they could not be modified or customized (yes/no)	0.59 (0.50)	0.78 (0.42)	0.02
Reasons for day-to-day participation in the community:			
Belonging to the community helped me find people contributing to my ideas (Likert 1-7)	5.21 (1.84)	4.29 (1.97)	0.01
Reason for participation; to answer posts (yes/no)	0.65 (0.49)	0.40 (0.49)	0.005
Reason for participation; for fun (yes/no)	0.82 (0.39)	0.66 (0.48)	0.05
Participating in the community gives me a feeling of accomplishment (Likert 1-7)	4.97 (2.00)	4.19 (1.88)	0.02
The experience gained in the community raises my skill level in programming (Likert 1-7)	4.19 (2.09)	3.19 (2.18)	0.013

Standard deviations are in parentheses.

As shown in Table 4 there is a significant difference (significant at the five per cent level) between the innovators and non-innovators in terms of their wish to undertake innovative work: innovators are more likely to want to undertake improvement activities (mean 0.76) of the product than non-innovators are. The result is important because it shows that those who want to innovate are generally also those who have done so. In other words, not all community goers have an equally strong desire to innovate. If they all were equally keen on innovating, actual innovation would be a matter of ability. Yet, this is not the case. Further, there is a significant difference (significant at the five per cent level) between the two groups concerning whether they would use Propellerhead's products if they could not be modified. This shows that innovative users are not as likely to become product users (and hence members of the community) when products cannot be modified. Together the two results suggest that innovators rate the value of having a modifiable product higher than non-innovators do, and possibly that firm-established user communities will gain a toehold when products offer some degree of "modabilty".

We find a significant difference in the innovative users' vs. non-innovative users' perception regarding whether their membership in the community helps them find people who contribute to their ideas: innovators rate belonging to the community more important for their sourcing of ideas than non-innovators. The innovative users assess to a higher degree (than non-innovative users) that their main activity in the community is to answer posts submitted by other users in the community. It follows that innovators willingly share their knowledge and tips to help others in the community – a factor that is important for the diffusion of best practice problem-solving knowledge. This finding also fits well with the expectation about diffusion from users exhibiting lead user characteristics. Innovative users also generally rate "fun" and "a feeling of accomplishment" more frequently as reasons to participate than do non-innovators hence indicating that intrinsic motivations play a role for these individuals decision to be active in the community. We find a significant difference between the groups (significant at the ten and five per cent level respectively). Furthermore, there is a stronger belief among innovators (than non-innovators) that experience and skills are enhanced through participation in the community (significant at the five per cent level). Earlier studies from Open Source Software (Lakhani and von Hippel 2003) show that leading edge programmers answer posts from average users because they learn from the process. A similar explanation may be suitable to our setting. In sum these findings indicate that innovators are more inclined to help others than the average user and place more value on the interaction with the community and its related activities than do their non-innovating counterparts. This means that apart from innovating, the innovative user can also be expected to play a more active role in sustaining the community's helpline functions and diffuse knowledge in the community.

Innovative users' specific attributes

From our in-depth questionnaire of the innovative users we derived detailed information on the personal attributes of innovative users in our population. The first observation is that all innovating users are young (mean=29 yrs. (min=17; max=40), well-educated males (one third hold a high school or college degree while almost half of them hold a bachelor/university degree) who are involved with the educational system or who have information technology jobs. As our multivariate regression analysis suggests, innovative users generally do not work professionally within areas such as music production or music tools development. However, an important segment does work in jobs concerning information technology – a factor that may explain innovative ability in this strongly IT-related field. This fits well with the observation that innovative users are hobbyists, but quite capable of creating valuable innovations. This ability is gained in closely related fields where users are experts and from where it is brought into the music software field. This pattern of users "importing" professional expert knowledge from the workplace to the hobby fields has also been identified by Lüthje et al. (2003) in a study of sports innovations. The authors find that only a minor share of user innovators in the mountain bike field needed to acquire new knowledge to develop their solutions while already existing professional knowledge was brought to use in hobby related fields. Such technical knowledge may be crucial in determining why some users stop at the idea concept stage while others go on to build a proto-type.

The innovative users typically do not innovate because the original products lack special features or because they can gain monetary rewards from doing so; only 2 individuals from the population have received monetary rewards in return for innovative efforts. Their ideas for innovations are generated on the basis of their own needs and the willingness to reveal comes from the recognition that stem from the firm. As indicated by the results of the Probit analysis, innovative users generally respond to recognition from the firm (6 out of 13 report it as being important), and they would be more than happy to see their innovations integrated in the firm's official commercial product. Innovative users from our sample indicate their willingness to innovate "on demand" to serve manufacturers: all but one innovative user identified would develop innovations for the firm if the firm asked them to do so. This shows a strong willingness on the part of innovators to serve the firm's interests. These observations point to the fact that innovative users (at least in this sample) are willing to develop and share their innovations with the firm. Innovative users' willingness to share with the community of users is also extensive: all but one of the innovative users has shared their innovation with others. This is consistent with Morrison et al. (2000) study of lead user's information sharing: only 5 out of 26 innovative users reported not having shared their information about their innovation and 56% of the modifications made to the software were shared in some way. In our case users share their innovation mainly with the Propellerhead community, a finding that is not surprising in light of the facts that Propellerhead product users are the most obvious users of user innovations and that the innovations are not necessarily compatible with other types of products. One important outcome of sharing is, of course, that other community

members can enjoy the products of innovative users. However, sharing in the community also allows interested innovators to build on and extend existing innovations without having to start from scratch: approximately one third of the innovating users report that they have built their innovation on earlier work by other user innovators. Sharing does not only serve to enhance users' utility; it may also be the basis of continuous innovation.

Conclusion

We have extended the study of innovative user communities to include a setting in which a firm is the host of a user community. We asked: Why do firm-established user communities work? By work we mean that in these communities users freely reveal innovations to a firm's product platform, which in turn place the firm in a favorable position (a) because these new product features become available to all users, or (b) because it allows the firm to pick up the innovations and benefit by selling them to all users. We studied innovative users' personal attributes in the context of a commercial manufacturer that hosts an online community for users, and hence is able easily to tap into the vast innovative efforts carried out in the context of its user environment. We analyzed a range of different data on a population of users and identified innovative users' personal attributes, which we believe explain a large part of why firm-established user communities work.

- The first key finding is that innovative users are likely to be hobbyists (not professionals) in the field in which they innovate. Hobbyists in this setting are not in competition with other users and do not have anything to lose by sharing innovations, a factor which explains why sharing and free revealing of innovation are common practices in the firm-established user community. Sharing of innovation is a key condition for firm-established user communities to succeed.
- The second major finding is that innovative users' motivation for participation and innovation in the community are related to a wish to be recognized by the firm hosting the user community. This finding explains why users are likely to choose to join and reveal in the firm's domain.
- The third of our main findings is that firm-established user communities work because the users that innovate in them are likely to be leading edge users. This attribute has a positive effect on the quality of the innovations produced and also on the rate at which new knowledge is diffused in the community.
- Being an innovative user (in this setting) increases the probability of generating incremental-type innovations the most. This result does not come as a surprise when the fact is kept in mind that users in the firm-established user community setting merely extend an already existing product.
- Users who innovate are more likely to want products that are open to modification than non-innovating users and may therefore tend (more than non-innovative users) to

join communities centered on products with an architecture that is more open for innovation.

- A large share of innovative users are likely to be competent in generic technologies related to (but not within) the field in which they innovate (many are IT people). This may explain why they can be hobbyists and still produce high quality innovations.

In the same way that firms may derive competitive advantage from their access to intangible and difficult-to-imitate assets such as connection to knowledge networks, university R&D and so on, the establishment of user communities may also come to represent an important source of innovations and hence possibly a means to achieve a competitive advantage. Whether or not a firm-established user community turns into an asset for the firm is conditioned in large part by the issue discussed in this paper. Firms embarking on a strategy of firm-established user communities for innovation should keep in mind that in order to attract leading edge users they may need to have a product that is somehow open to innovation by users. Apparently, this organizational form is most relevant in areas where a certain number of the users are hobbyists. This implies that the potential of this type of organization may be most effective in the area of consumer goods, or at least in areas in which hobbyists are likely to be present. Further, there is a scope for management when figuring out how best to allocate recognition to innovative users because this type of recognition is a source of motivation for innovative users in this context. A simple way to allocate firm-recognition in return for user innovation is to openly acknowledge their contributions in most the visible fashion. A useful way to do this may be to host examples of the best user innovations in the firm domain and to credit innovators openly in order to demonstrate that the firm appreciates their innovative efforts. These points are essentially related to the broader issue of firms' user community management, which the restrictions of space do not allow us to discuss in the present paper.

Limitations and implications for further research

We are restricted in our ability to make broad generalizations by only studying one case of user innovation. Further, the particularities of the products, modes of production and use of media (the Internet) may limit the generalizations that can be made. However, we believe that the fact that many products today comprise digital components opens possibilities for the type of organization described in this paper. Further research should address the differences between the Internet setting and physically-based communities – hence adding to Shah (2000), Franke and Shah's (2003), and Lüthje's (2000) research on user communities but going a step further by identifying the effects on the industry firms whose products are being innovated. We are aware that this question requires more answers to be properly explained: future research should examine more closely how firms structure technologies for innovation (toolkits) and govern their community, and the external factors such as broader change in technologies and social dynamics allowing for this new type of organizational form.

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Appendix 1

We can classify the innovations into three main groups: (i) "content innovations" such as song or sound and samples; (ii) "technological-element innovations" such as patch files and mods combining sound samples and design aspects; and (iii) "interface innovations" developed to solve problems related to hardware-interfaces and interconnected instruments.

A rough classification of content and style of innovations shows that the bulk of the user innovations are of a technical nature. The table includes the comments made by users indicating their perceptions of their own innovations (obtained from the questionnaire).

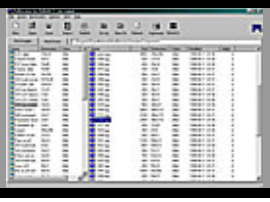
Community user name of innovators	**Innovation category**	**Statement on the character of the innovation**
Wwwobbler	2	Uh, jag började faktiskt att rita ett skin till en ny modul. Bara för att se om jag skulle kunna matcha den grafiska standarden som gäller idag. Raytracade animerade knobs, hittade på en logotyp å så.. ja, lekte mest iofs =)
Abraxis	3	Additional Useful "Rack Modules"
Niklas	2	Home made modifications that were for my pure entertainment only.
AndersPier	3	It is not really a mod. I use MidiOX, and have found a method to get my 13 knobs - mapped to 1664 (by using program changes). So now "I can use knobs all over" Reason, wv though I only have 13 physical knobs on my keyboard :-)
DJDM	1	Custom patches for the Malstrom (Reason Synth).
Divstah	2	Rebirth mod for Rebirth 2.1. Both graphic and sounds. Graphic: light and blurry. Sounds: many pads and stabs. Mainly for ambient.
nitro2k01	2	A midi arpeggiator that was never public
Flashmofo	3	creative use of hardware and midi implementation
Robotovat/jonyo	2	MIDI input remapping application for use with Reason
Johnpil	2	Small applet to temporarily set dual monitor setup to 800x600 or other preset res while in Reason, then restore on exit.
Vector	1	A lot of refills and sound banks.
Peff	2	I created the first official ReBirth Mod :-)
Ninjadog	2	Someone showed me a homehade Tape Ecco Effect. It was very complex and I still can't repplicate it from scratch, but I made a few cool fx by trying.
RykThekreator	2	All 3 of my inventions are currently residing under the care of Propellerhead Software. Once I know whether either will be used or not, shall I then be able to release them. 2 of them had been built into modular synthesizers by me, between 1996 and 1998.)
Janvc	2	Reason 1.0 javascript LFO-sync calculator (does that count or didn't i understand the question?)
Beatmincer	2	LFO setting -->> BPM calculator for reason 1.0
Lawbreaka	1	Various Refills with Song Templates and Sampler Implimentations
Einzelganger	2	ReBirth Mods
Supraphonic	1+3	Additional samples, rewiring Reason
DJVampeal	1	Ripped samples from my cousins synthesizers, and put them into ReFill format.
Jonas	2	Rebirth mods
Tunein	1	new samples/loops.
Suma	2	Rebirth mods
Aenforever	1	I've just made a few drum mods for rebirth, stansard loop chopping stuff.
Mschill	3	Pattern Master for Rebirth to edit ReBirth patterns in a piano roll view. http://www.mschill.com/patternmaster
zx81	2	rebirth mod with own sounds

Appendix 2

What are user-developed innovations in the case of Propellerhead's products?
The examples below illustrate the types of innovations that were made for Propellerhead's products.

QWERTY Note Input v1.1 by Robotovat This little program lets you play MIDI notes from your Mac's computer keyboard. You can use OMS's IAC to transmit notes to Reason. QWERTY Note input is Freeware.	

Digalog By Einzelgänger.		Long time board veteran Einzelgänger has made this very electronic sounding and synthetic looking mod. The interface is a very plastic blue and the sample set offers lots of bleeps and synthetic percussion sounds.
minimod By Peff.		The house producers toolbox! Peff's minimod has an excellent sample set that includes house organs, house basses, house pianos, stabs, bleeps and much more. The beautifully crafted GUI makes you think of a certain old synth brand...

Extra interface utilities - **Pattern Master 1.01** by Matthias Schill Are you confused by the 303 programming interface? Wish you could edit 303 patterns visually? Now you can! Pattern Master is a tool to program 303 patterns using a piano roll view. The program can save and open .rbs files so that you can edit songs made in ReBirth.		FTP-Sweden (267 kb)
ReNovator 2.0 by Florian and Rob1 ReNovator is a tool that assists you in creating mods by keeping track of all the files needed in your mod. It also has an image viewer and a very handy tool that lets you preview your mod without actually building it. A must if you build mods on a PC!		ReNovator homepage

ReVision 1.1 by Granted Software Makes soundtrack composition a bit more convenient by allowning a QuickTime movie to be played in sync with Reason. The latest version ov ReVision holds new features such as tempo and time signature changes at the marker locations. It's also got AIFF and Movie export and better timecode handling.		Get it from the Granted Software website

Appendix 3

Marginal effects of model I

Variable	INNO=0	INNO=1	INNO=2
Constant	0.4133	-0.2512	-0.1621
Lead user characteristics	-0.0102	0.0062	0.0040
Professional	0.0327	-0.0199	-0.0128
Reciprocity expectation	-0.0119	0.0072	0.0047
Critical for my business	-0.0042	0.0025	0.0016
Enhance career opportunities	-0.0062	0.0038	0.0024
Peer recognition	-0.0011	0.0007	0.0004
Firm recognition			

Marginal effects of model II

Variable	INNO=0	INNO=1	INNO=2
Constant	0.4158	-0.2600	-0.1558
Lead user characteristics	-0.0094	0.0059	0.0035
Professional	0.0329	-0.0206	-0.0123
Reciprocity expectation	-0.0071	0.0044	0.0027
Critical for my business	-0.0012	0.0008	0.0005
Enhance career opportunities	-0.0045	0.0028	0.0017
Peer recognition			
Firm recognition	-0,0159	0,0099	0,0059

Marginal effects of model III

Variable	INNO=0	INNO=1	INNO=2
Constant	0.4152	-0.2616	-0.1537
Lead user characteristics	-0.0098	0.0061	0.0036
Professional	0.0350	-0.0220	-0.0129
Reciprocity expectation	-0.0078	0.0049	0.0029
Critical for my business	-0.0010	0.0006	0.0004
Enhance career opportunities	-0.0060	0.0038	0.0022
Peer recognition	0.0076	-0.0048	-0.0028
Firm recognition	-0.0265	0.0168	0.0097