The Dynamics of Openness and the Role of User Communities: A Case Study in the Ecosystem of Open Source Gaming Handhelds

Michael A. Zaggl, Tim G. Schweisfurth, and Cornelius Herstatt

Abstract—To remain competitive, it is critical for firms to integrate external sources of knowledge. However, finding the right degree of openness is challenging, especially in complex open innovation ecosystems. The interdependencies and dynamics related to the choice of openness are not well-understood. This paper investigates the role of openness as a competitive mechanism. Specifically, we research how openness affects firms’ interactions with user communities and how it changes the preference structure of customers. We build a longitudinal case study in the open source gaming handheld industry and trace the evolution and the dynamics of firms, user communities, and their interactions. We find that a suboptimal level of openness can pose a threat to a firm’s very existence. Further, we identify repeated patterns characterizing the dynamics in the ecosystem. Based on these patterns, we propose a framework of the dynamics of openness. Our paper contributes to the literature on open innovation. We illuminate the relevance and the dynamics of openness as a dimension for competition. This paper also contributes to the literature on user innovation by showing a shift from manufacturer-based to user-based innovation over the course of the product lifecycle.

Index Terms—Collaboration, crowdsourcing, dynamics, entrepreneurship, innovation management, open source software, organizational aspects, organizations, research and development management, technology management, user-generated content, virtual groups.

I. INTRODUCTION

OPENING the innovation process to extra-organizational actors, such as users, can be beneficial for firms. Users can contribute new product ideas [1]–[3], improve existing products [4], [5], and develop complementary products [6]. Thus, openness can lead to a competitive advantage for firms, they can gain knowledge, attract users, and differentiate themselves from competitors [7], [8]. However, being too open involves the risk of imitation [9] and value slippage [10]. Further, users can gain too much influence on corporate decisions [11]. Thus, firms need to carefully balance their degree of openness in order to benefit from extra-organizational actors’ contributions while limiting the potential for negative effects [5].

To better determine the optimal degree of openness, the managerial literature has suggested a dynamic perspective [7], [12]–[15], which has shown that openness can follow a self-reinforcing process [7] and escalate if firms are unable to restrict demands for openness from extra-organizational actors [13]. However, the literature does not capture what happens when the degree of openness provided by firms and the degree of openness demanded by users are misaligned, i.e., when there is a discrepancy in openness. This paper addresses such a discrepancy of openness in an open innovation ecosystem. Therefore, we ask the following research questions. First: how does discrepancy between the openness provided by firms and the openness demanded by a user community emerge? Second: what are the consequences for the ecosystem (especially the firms) when firms fail to address such a discrepancy?

To define openness, we build on the notion of design space, which is comprised of all the possibilities in which search and product improvement can take place [16]. We distinguish between open and closed areas in a design space. The open areas are accessible to extra-organizational actors (e.g., users) who can modify, improve, and change the product. The closed areas, in contrast, are not accessible. The ratio of open areas to closed areas represents a product’s degree of openness [8]. Although openness is a product-level concept, we argue in this paper for reasons of simplicity that firms are as open as their products.¹

We use a longitudinal case study approach [17]–[19] based on data from a netnography, qualitative interviews, and archival data to approach the research questions. As research context, we chose the ecosystem of open source (OS) gaming handheld. OS gaming handholds are similar to the better known Nintendo DS and Gameboy and Sony’s PlayStation Portable, but the OS gaming handholds became more open over time. The ecosystem consists of the firms that produce the handhelds and users who organize themselves in an online community.

Analyzing the emergence and consequences of discrepancies in openness at multiple occurrences over time in the OS gaming handheld ecosystem, we find a recurring pattern that we summarize in a framework: we find that the ecosystem is stable

¹This assumption appears uncritical since the firms in our empirical context offer only one product at a time.
as long as the openness provided by a firm is larger than the users’ demand for openness (i.e., there is an openness surplus). Yet, owing to further product development, the open areas of the design space shrink, and the ecosystem enters a state in which the openness demanded by users is larger than the openness provided by a firm (i.e., an openness deficit emerges). This openness deficit causes tensions and conflicts between the firm and the community of users. If a firm ignores this openness deficit, conflicts can escalate and create a business opportunity for a new entrant. By being more open, this entrant can attract users and their contributions, thereby improving the entrant’s product. In turn, this creates positive feedback, attracting further users. These dynamics can ultimately drive the incumbent\(^2\) out of business.

Our paper provides two major contributions to the existing literature. First, we extend research on the emergence and dynamics of openness [7], [12]–[14] by shedding light on how an openness discrepancy between firms and users emerges and what its consequences are for the firms. Specifically, we show how users—empowered through the possibility of organizing themselves in an online community—can influence a firm’s degree of openness. Conflicts arise if firms do not fulfill users’ demands for openness. Such conflicts can jeopardize a firm’s survival because new competitors have the opportunity of entering the ecosystem, or user-initiated projects can emerge as substitutes for the firm’s products. Thus, openness becomes a dimension of competition. The dynamics also demonstrate that firms cannot freely determine their degree of openness, as suggested by the literature [12], [20]. In addition to their own strategy, the degree of openness crucially depends on extra-organizational actors, such as users. Second, our paper contributes to the user innovation literature, which characterizes extra-organizational actors, such as users. In their own strategy, the degree of openness demanded by users is misaligned with the degree of openness provided by a firm. Conflicts arise if firms do not fulfill users’ demands for openness. Such conflicts can escalate and create a business opportunity for a new entrant. By being more open, this entrant can attract users and their contributions, thereby improving the entrant’s product. In turn, this creates positive feedback, attracting further users. These dynamics can ultimately drive the incumbent\(^2\) out of business.

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theory and take the research context into account. The method also allows us to longitudinally analyze the research object. This is critical in order to capture the dynamics of the events and the interactions among the multiple parties, e.g., important incidents, activities, choices, and outcomes [28].

A. Research Context: The OS Gaming Handheld Ecosystem

OS gaming handhelds are portable gaming consoles, similar to Nintendo's Gameboy and the DS and Sony's PlayStation Portable. However, compared to these better-known products, OS gaming handhelds hold a much smaller market share.

Two main criteria guided us in choosing OS gaming handhelds as our research context: the first is the changing degree of openness. The development of handhelds in general is very dynamic [29]. This especially applies to the OS gaming handheld ecosystem as our case study will show in detail. Firms with different degrees of openness have entered and exited it. This enabled us to identify patterns across these cases. Second, the opportunity to observe an entire ecosystem: the fact that OS gaming handhelds are a small niche representing an entire ecosystem helped us to capture the dynamics in their entirety.

B. Data Sources

We collected and combined three data sources using different data collection methods, which allow us to triangulate thus increasing credibility and validity of the case. Table I provides an overview of the data sources, the collection methods, descriptive numbers, and the main purpose.

<table>
<thead>
<tr>
<th>Source</th>
<th>Collection method</th>
<th>Descriptive</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP32x forum</td>
<td>Netnography</td>
<td>&gt; 17,000 active users, &gt; 700,000 posts, &gt; 5,000 posts selected</td>
<td>Captures all historical points in time, such as entrances and exits of firms</td>
</tr>
<tr>
<td>Company founders</td>
<td>Semistructured interviews</td>
<td>Three individual interviews with founders, Two individual interviews with users</td>
<td>Provides deeper insight on the founders' rationale, i.e., their decision-making and sense-making</td>
</tr>
<tr>
<td>Google news, Media releases, Magazine articles, Blogs, Firm web pages</td>
<td>Desk research</td>
<td>Provides contextual information to construct a comprehensive timeline and validates information from the netnography and the interviews</td>
<td></td>
</tr>
</tbody>
</table>

Since netnographic data documents the research object at the time of commenting in the online community, it is unaffected by hindsight bias [33]. We conducted an observational netnography without getting involved in the community [30]. The forum discussions reflected the relevant interactions among firms and users. The main forum (GP32x forum) exhibited high traffic (more than 700,000 posts from its inception in 2002 to May 2012) and a large number of individual message posters (more than 17,000). Although the early phase of OS gaming handhelds (from 1999 to mid-2002) is not covered, all relevant events—such as entrances and exits of firms—are well-documented. All firm founders were also active community members.

Following a theoretical sampling strategy, we focused on forum threads that provided relevant information. Thereby, we favored content depth over representativeness [34]. We used firm names and product names as search terms in the forum search engine and looked for threads with a high number of posts, assuming that intense discussions among community members contain the most important information. Community members often referred to past threads that discussed related issues. Such threads were added to the sample. For specific issues that came up later during theory building, we again used the forum search engine to identify discussions. In total, we included more than 5,000 posts.

Our second data source consisted of semistructured interviews with five users, including three company founders. The interviews centered around the firms, their strategizing especially their decisions regarding openness, the products, how openness evolved, and the drivers and consequences of openness. The interviews with the founders were specifically focused on the decisions made by them and their firms. The interviews with the users focused on their perception of the events, and especially their thoughts regarding the decisions made by the firms. In general, the interviews complemented our netnographic data by providing us with insights beyond the passive observation and interpretation of events. They allowed us to develop an understanding of the rationale used by decision makers as well as their goals. For example, we learned that openness was the
central motivation of the first founder. We use quotes from the relevant interview data later in the case description whenever the rationale of the decision makers is of interest.

Another main purpose of the interviews was to validate and extend the conclusions drawn from netnographic data. Therefore, we asked the entrepreneurs about the timeline of events, their product offerings, their strategizing around openness and collaboration with the community, the actual degree and focus of community involvement in product development, and economic success. The interviews lasted between 30 and 60 min and were conducted via telephone and chat. Each interview was recorded and transcribed.

The third data source consisted of archival data from web pages, blogs, news, and company press releases. Together with the netnographic data, the third data source allowed us to construct a timeline of the entire case (see Table II). We also used the

<table>
<thead>
<tr>
<th>Year</th>
<th>Gamepark (GP)</th>
<th>Project Ninja</th>
<th>Gamepark Holdings (GPH)</th>
<th>Open Pandora</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>GP founded in Korea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Launch of GP32 in Korea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>GP introduces GP32 FLU iteration in Korea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>GP introduces GP32 BLU iteration in Korea</td>
<td>Community member builds software development kit (SDK) for the GP32</td>
<td>GPH announces GP2X F-100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GP introduces GP32 BLU in Europe, entering the European market</td>
<td></td>
<td>GPH releases GP2X F-100 in November as open source, but withholds parts of the source code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community member builds software development kit (SDK) for the GP32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GP releases GP32 BLU+ iteration with new displays</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>GP splits into GP and GPH in July</td>
<td>User initiates Project Ninja in June</td>
<td>GPH announces GP2X F-100</td>
<td>4,000 units of Pandora are available for pre-ordering and are sold within a week in September</td>
</tr>
<tr>
<td></td>
<td>GP releases its own SDK (closed source)</td>
<td>Project specifications are set jointly with the community</td>
<td>GPH releases GP2X F-100 in November as open source, but withholds parts of the source code</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project founder unsuccessfully tries to source a system-on-a-chip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>GP announces novel GPX product line, but does not announce a launch time</td>
<td>Project founder announces termination of Ninja in January</td>
<td>GPH releases full source code in February 2006 after quarrels with community</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GPH sells 30,000 units by October</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>GP files for bankruptcy in March</td>
<td></td>
<td>Community developer group initiates Project Open Pandora in August</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Community is involved in idea generation and development</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
archival data for validating the statement from the interviewees, especially their recalling of the timing of events.

C. Data Analysis Procedure

Data analysis proceeded in several steps and was led by the goal of developing a case study as a means for inductive theory building [17]–[19]. The first step of the case study development was the investigation of the data from the netnography [30]. We analyzed the data in a bottom-up coding procedure [34]. Starting with our research question in mind, we looked for relevant statements and coded them. For example, when a user raised a question about the quality of a gaming handheld or mentioned that he or she wanted to contribute, we categorized that statement by developing specific codes. Statements on games that were unrelated to user contributions, openness, or the firms were not considered. The output of this step, which was carried out by two authors, was a structure of higher order themes and longitudinal descriptions of each major event. We, then, distilled the higher order themes into more aggregate dimensions by merging similar codes. The outcomes were higher order dimensions, concepts such as 
-demanded openness, actual openness, or user resentment.

The resulting preliminary coding structure already allowed us to develop a good understanding of the ecosystem of OS gaming handheds. However, we needed to add a perspective that is not shaped by the community. Therefore, we incorporated the archival data, which allowed us to get more clarity about the critical events. One outcome of this process was the timeline (see Table II) [35]. This timeline allowed us contextualize user statements from the forum and the interviews. In parallel, we also constructed an overview of the products offered by each company (see Table III).

After a first round of data analysis, we had a rough idea of how the case could look like. We went back to data collection and searched for additional information to fill the gaps in our understanding about the case and then repeated the data analysis. In doing so, we followed the grounded research approach of iteratively comparing emerging theory and data [34]. By collecting additional data, we extended our analysis and our theory. In each iteration, we looked at new data—also by conducting further interviews—that helped us specify our emerging theory. This often led us to new questions. This cycling continued until theoretical saturation set in [34]. In each step, we also sought
This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

TABLE III
OVERVIEW OF OS GAMING HANDHELDs

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>GP32</th>
<th>NINJA</th>
<th>GP2X</th>
<th>WIZ</th>
<th>CAANo</th>
<th>PANDORA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openess</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application writing</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Open source code</td>
<td>partly</td>
<td>yes</td>
<td>partly</td>
<td>yes</td>
<td>partly</td>
<td>yes</td>
</tr>
<tr>
<td>Hardware specifications and drawings</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>partly</td>
</tr>
<tr>
<td>Involvement in decision making</td>
<td>no</td>
<td>yes</td>
<td>partly</td>
<td>partly</td>
<td>partly</td>
<td>Yes</td>
</tr>
<tr>
<td>Technical specifications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>133 MHz</td>
<td>400 MHz</td>
<td>200 MHz</td>
<td>533 MHz</td>
<td>533 MHz</td>
<td>600 MHz</td>
</tr>
<tr>
<td>3-D Acceleration</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RAM</td>
<td>8 MB</td>
<td>64 MB</td>
<td>64 MB</td>
<td>64 MB</td>
<td>128 MB</td>
<td>256 MB</td>
</tr>
<tr>
<td>Display</td>
<td>3.5&quot;</td>
<td>3.5&quot; or 4&quot;</td>
<td>3.5&quot;</td>
<td>2.8&quot;</td>
<td>3.5&quot;</td>
<td>4.3&quot;</td>
</tr>
<tr>
<td>Touchscreen</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>External storage</td>
<td>SMC</td>
<td>SD</td>
<td>SD</td>
<td>SDHC</td>
<td>SD/SDHC</td>
<td>SDHC</td>
</tr>
<tr>
<td>Operating system</td>
<td>GPOS</td>
<td>No main OS</td>
<td>Linux-based</td>
<td>Linux-based</td>
<td>Open Linux</td>
<td>Angstrom Linux</td>
</tr>
</tbody>
</table>

to validate our theory. When we found evidence contradicting our current understanding, we refined the theory. For further validation, we also shared the findings with some interviewees and asked for their opinions [37].

IV. FINDINGS

We present the findings chronologically, structuring them according to the four major events in the history of OS gaming handhelds.

A. Gamepark (GP)

The first firm in the history of OS gaming handhelds was GP. It was founded in the Republic of Korea in 1999. Following an import ban by the Korean government on electronic devices from Japan and thereby blocking Nintendo’s and Sony’s gaming handhelds, GP introduced its first product, the GP32 console, in 2001. The company developed proprietary software and additionally ported Japanese games to its console in return for license fees. Later, in 2002, the import ban was lifted, and the Korean market was flooded with Japanese gaming handhelds (e.g., Gameboy, Nintendo DS), which offered a greater range of games.

Although the GP32 was officially sold only in Korea, it attracted many European users. They formed a community and, in 2002, founded the GP32x forum as their primary communication platform. User activities flourished after a community member programmed a software developer kit (SDK) for the GP32. This unauthorized SDK enabled users to develop their own software for the GP32 handheld.

In June 2004, GP began to sell its console in Europe. However, Korea remained the focus of the company and all public relations were carried out in Korean only. Overall, GP’s product had two facelifts. First, the GP32 BLU and later the GP32 BLU+. The firm sold more than 30,000 units in total.

In response to the unauthorized SDK—though with a considerable delay—GP released its own SDK in 2005. It allowed community members to develop and run their own software on the console. However, this authorized SDK did not open the console’s deeper layers. The firm kept control of the kernel, and the lower software layers, including the SDK itself. The authorized SDK’s low degree of openness did not meet the expectations of users. Resentment built up as community members were dissatisfied and felt that their needs were not accommodated even more so because they thought that GP’s success was in large part due to their contributions:

I agree that they will die if they keep up what they are doing, and that better support for the homebrew scene will be the only thing that keeps them alive, hell the homebrew scene is the only thing KEEPING them alive right now. (community posting, May 13, 2004).

B. Project Ninja

These tensions led to the first attack on GP as the incumbent and only firm producing OS gaming handhelds. Before GP could release a planned second-generation product, the community started developing its own console—Project Ninja.

GP kept the timing of its second-generation console secret. Among the user community, this created negative reactions to the drawn-out period of uncertainty:

No one even knows if there will ever be a GP32 2 or not. With GP you are always in the dark, who the hell knows what they are doing (community posting, June 19, 2005).
A community member initiated Project Ninja: “The first homebrew hardware, from users to users” (community posting, June 17, 2005). Many community members welcomed Project Ninja. Some even offered financial support:

I’ll put on a charity concert, sell my Baby for science, just please let not this fall!!! (community posting, June 15, 2005).

If you need money for the first prototype, parts, tools and so on, I would donate some. (community posting, June 16, 2005).

The founder of Project Ninja directly aimed at openness and involving the community in joint decision-making and the code-development of code. He continuously informed the community about the development activities, asked for ideas and advice, and discussed technical specifications. As a consequence, many users revealed their requirements and willingness to pay, which in turn enabled the project founder to tailor the product design to their needs:

My goal was to build an open console […] I thought, hey, they are all building great stuff, but it’s all closed (interview with the founder of Project Ninja).

This will come to two difficult questions. Are we building a Game/DivX/sound Machine only? (32MByte RAM, 2MByte flash, no touchpad) or an Qtopia/Windows Mobile Machine. (64MByte RAM, touchpad, 32MByte flash RAM)? (community posting, June 27, 2005).

Although the project received many positive and enthusiastic reactions, Project Ninja lost focus after its initial phase and was not continued, mainly because the project founder could not dedicate his full attention to the project.

C. GP Holdings (GPH)

After GP announced that it planned to launch a new console (its second-generation product, which the company named XGP), it soon leaked that this product was highly restricted in openness. This substantially increased frustration in the community:

XGP will NOT support homebrew. We have the specs of this handheld. GPH are creating their own handheld, this is the one that […] does support homebrew. (community posting, July 20, 2005).

Consequently, a group of GP employees left the company and found GPH as a competing firm. GPH promised users that the company would accommodate their ideas and contributions and support openness of the products. The company announced its console, the GP2X, which would be based on the Linux kernel. Many community members favored the greater transparency and accessibility promised by GPH, especially compared to their experiences with GP:

The GP2X is more for me than the XGP, I mean, what’s the point of XGP if it is not OS? […] This system will probably die pretty quickly (community posting, August 5, 2005).

GPH used the positive sentiment of the users to gain market share. However, GPH’s leadership was concerned about imitation and avoided complete openness of the GP2X. The transparency and accessibility of the source code and, even more so, the decision-making processes in the firm were much more restricted than the community members had expected:

It would be much better for everybody if GPH would realize that we can help them significantly, embrace us as contributors to their great product, and allow us to work with and submit patches to the official firmware source code. (community posting, January 7, 2006).

The community also accused GPH of violating the OS license conditions, which the company underlay by adopting Linux:

GPH are at least going to respect the GPL and their obligations. […] I have a huge moral issue with doing all this work for a company that basically pisses on the GPL, OS and all it entails (community posting, January 6, 2006).

Losing support from the user community, GPH started collaborating with select active users to incorporate homebrew software developers’ needs. However, after being invited to a series of meetings in order to present the community members’ needs to the management of the company, these users were disappointed to find that most of their suggested specifications were not implemented:

Then, we [leading developers] flew to Korea and met with them, to convey the users’ wishes and suggestions. […] Yet, little of the software solutions was implemented (interview with the founder of Open Pandora).

This issue further increased the tensions between GPH and the community. Some active developers accused GPH of exploiting them as free resources, without reciprocating their cooperation:

It’s the developers here that are making GPH their money, not GPH themselves […] [That] doesn’t seem right to me. (community posting, January 6, 2006).

Nonetheless, GPH could sell more than 60,000 GP2Xs, twice as many consoles as sold by GP. GP, which could not compete with GPH, filed for bankruptcy in March 2007. Their second-generation product XGP was never launched. Thus, despite ongoing disputes with the user community about product openness GPH as the firm with the relatively more open product, became the new and only provider of OS gaming handhelds.

D. Open Pandora

The conflict between GPH and users continued and provoked a new community initiative. Again, a group of users with financial support from their peers started to plan a new console. Among these “rebels” were some of the leading users previously involved in the meetings with the GPH management. Based on their inside knowledge about user opinions and needs, they felt that the GP2X did not adequately serve the needs of most of the users:

We had a lot of experience since we had been hanging around in the forums for some time. And we heard people saying “this is what we would like to have” and “this is what we would do differently.” (interview with founder of Open Pandora).

Realistically, I do not think GPH is going to do much to collaborate with the community, which is a pity, because they clearly do not
realize what kind of potential that would have. Their primary thought was only: “Hey, Linux! Free beer!” and not much else. The best thing to do would be to cut loose as soon as we can, ditch all the software that GPH provided before we get too dependent on it, and develop our own (better) alternatives (community posting, January 6, 2006).

Based on the community’s project, which the users called Open Pandora, a company was founded in 2008 (OpenPandora GmbH). The company’s console was positioned as a community project that offered a high degree of openness with its software and hardware architecture. The company also promised openness in their decision making and consideration of users’ opinions and preferences. Requested features were implemented by those users who were directly involved in Open Pandora. This enabled the community to incorporate elements that had been missed with GPH and GPH’s products. This increased user involvement and attracted new customers:

The fact that the Pandora was designed by the community, for the community, and knowing that it has that strong community to support it when it is released makes it better (community posting, April 9, 2009).

Last year I was a customer in need of a handheld computer and by now have become more of an enthusiast (community posting, April 10, 2009).

Unlike the Project Ninja console, which was originally planned to be completely open, Pandora did not aim for complete openness, at least not at the outset. The users active in the project perceived a tradeoff between openness and value capture. They foresaw that complete openness would create a substantial risk of imitation and thus of financial loss or even failure of the entire project. Thus, they kept secret a small number of select components and design configurations but planned to reveal the information after the market launch:

The CAD plans and circuit diagrams are not available as yet, due to the very high likelihood that some Chinese company starts putting out their own version (community posting, June 23, 2009).

If we publish all the hardware early on, there is a big danger that somebody comes along, takes our design, and produces a very similar device and brings it to market before we can. And then all our money would be gone (interview with founder of Open Pandora).

Pandora was announced in the spring of 2010. Meanwhile, in May 2009, GPH had started shipping their second-generation console, the Wiz, which exhibited similar openness to its predecessor. The Wiz had a better display and was cheaper than the Pandora, and a few felt the need to prevent a “rival” from supplanting their dream console. [...] Still, the Pandora and Wiz can hopefully co-exist. (community posting, April 7, 2009).

They [GPH] have no interest in the community or what you want from a device. They just want to make money however they can. They will never try to evolve the handheld industry in any way because evolution of the scene is of no interest to them (community posting, August 8, 2010).

Initially, the competition between the two devices was not strong. One main reason was that the production of the Pandora was delayed several times, and the firm did not start shipping before 2010. Some users grew tired of waiting and bought the Wiz instead, but they felt that the development of complementary games was progressing too slowly. Many of the community members, especially those who were actively involved in development, waited for the more open Pandora to be released:

Wiz development already appears to be pretty slow going, possibly because Pandora has already stolen interest (community posting, December 1, 2009).

The Pandora started distributing its console in May 2010 and sold 6000 units by 2013. The hardware design files and the circuit design were publicly available and limited for private use.

Shortly after the Wiz, GPH introduced another console, the Caanoo. The Caanoo and the Wiz were very similar concerning their technical specifications, but the Caanoo included an online store in which users could buy games (similar to Apple’s App Store). The Caanoo was not backwards-compatible to the Wiz, i.e., Wiz games did not run on the Caanoo. This again provoked discontent in the community:

This [lack of backwards-compatibility] is especially bad as a lot of [developers] would not get the new system, and as the Caanoo was not compatible with the Wiz, there wouldn’t be much development happening at the beginning [...] (community posting, September 13, 2011).

The Caanoo was unsuccessful and at the end of 2011, GPH was forced to exit the OS gaming handheld market. There was no official statement by the firm, but GPH’s European distributor explained that products sales were below expectations. The community was disappointed by GPH’s decision to exit, although it was foreseeable because GPH did not include the community in core design decisions:

It was foreseeable that GPH will fail sooner or later [...] The decisions were overall very strange and they hardly had listen to advice from people who had plenty of experience or scene knowledge (community posting, September 12, 2011).

They could have done it right if they just listened to the community a bit more. Some of you might know GPH invited me last year to show me their latest new handheld, the Caanoo. Once I have seen the Caanoo, I told them right away that selling it will be hard (community posting, September 13, 2011).

The Pandora, despite many obstacles due to production problems, became a success. Three versions have been launched, each with small changes over its predecessor. The most recent successor of the Pandora is the Pyra, which was launched in 2016.
Based on our case study, we developed a framework that shows how the openness provided by the firm and the openness demanded by users influence each other (see Fig. 1). The framework describes in an abstract way how discrepancies between openness provided by firms and openness demanded by user communities emerge, and what the consequences for the ecosystem and the firms are when firms fail to address these discrepancies.

The actors in the framework are the firms (incumbents and entrants) and users. An incumbent offers a product with a specific degree of openness. Users either passively consume the product (user nondevelopers) or actively participate in codevelopment (user-developers). For codevelopment activities, user-developers require openness. Openness, as defined in the introduction, is represented by the accessible areas in a design space [16]. As the product’s originator, the firm can select the design space’s degree of openness.

User-developers and user nondevelopers both favor openness, but for different reasons. User-developers directly benefit from a design space’s open areas. For instance, they want to codevelop by improving and creating games and other software which is only possible in a design space’s open areas. User nondevelopers only benefit indirectly from open areas: user-developers’ cocreation results in product improvements, more features, and complementary products, which—in turn—benefit user-nondevelopers.

In the case data, we observed that users who were only interested in buying a console often followed the advice of developing users. These user-developers quite accurately predicted the fate of the companies because they knew to which consoles they wanted to contribute and they also were aware of their contributions’ importance towards product success.

The dynamics in the framework are driven by the discrepancy between provided openness (openness as offered by the firm) and demanded openness (openness demanded by the user-developers to enable their codevelopment and motivate them to do so).

1) The starting point in our framework represents a situation in which the openness provided by the firm is higher than the openness demanded by the users, i.e., an openness surplus, which enables user-developers to innovate in the open area granted by the firm and corresponds to state in Fig. 1(a).

In our case, we found an openness surplus at the early beginnings of Project Ninja and Open Pandora. Even in the case of GPH, a high degree of openness was at least promised in the beginning.

2) This openness surplus becomes smaller over time, as user-developers’ codevelopment activities shrink a design space’s open area [see Fig. 1(b)]. As user-developers implement more and more new ideas, the likelihood of finding superior solutions in the open parts dwindles. Another reason for the shrinking of the design space’s open area is reduction by the firm. The firm may overestimate its ability to maintain openness or it has been forced to open by the users and later tries to reduce it. To continue codevelopment, user-developers demand more openness (demanded openness increases).

In the case data, we observed that openness attracted users’ attention and contributions. We also identified several attempts of reducing openness by firms (e.g., GPH violating OS norms...
and introducing the online game store, GP developing a more restricted SDK).

3) This development leads to a transitional state in which the openness demanded by user-developers exceeds the open area of the design space provided by the firm—an openness deficit emerges [see Fig. 1(c)]. In an openness deficit, user-developers are dissatisfied, they cannot or are unwilling to co-develop for the firm. This deficit likely leads to conflicts between the user community and the firm. By increasing openness, and thus extending the design space accessible for co-development, the firm could overcome the mismatch between the increasing demand for openness and actual openness.

We observed an openness deficit several times. One example is the phase before the development of the unauthorized SDK for the GP32 (GP’s console). Another example is the situation when GPH’s management ignored user contributions, even though they had invited several users to Korea for the very purpose of sharing ideas and suggestions.

4) However, if the firm chooses not to open further design space areas, the openness deficit and the tension between firm and users enables an opportunity for a new firm (entrant). This entrant provides more openness and a new openness surplus emerges. Thus, the user-developers redirect their codevelopment activities from the incumbent to the entrant [see Fig. 1(d)]. This redirection increases the quality of the entrant’s product relative to the incumbent’s product. When the entrant’s product has improved beyond the incumbent’s product, the user nondevelopers, who are motivated by product quality, also switch to the entrant. It then becomes very likely that the incumbent disappears from the market.

In our case, we observed that users dedicated their contributions to the more open console. Furthermore, the entrants Project Ninja, GPH, and Open Pandora were clearly driven by the idea of providing more openness than the incumbents offered. Shortly, thereafter, the incumbents with less open products exited the market or filed for bankruptcy (GP and later GPH).

The dynamics we observed are recurring. Although the entrant creates a new openness surplus and thus attracts more contributions from user-developers and later a larger customer base (i.e., the user nondevelopers), the openness surplus will shrink over time owing to the continued product codevelopment. The system will reenter a state of openness deficit and, at this point, the entrant finds itself in the same position as the incumbent firm earlier—it can either increase openness and accommodate user-developers’ preferences, or it can remain at its current degree of openness. In the latter case, the newly emerged openness deficit represents an opportunity for a new entrant with a more open product.

In the dynamics we observed, firms move toward more openness only to find themselves remaining in the same position relative to their ecosystem (the user community), because the demands for openness resurface each time openness increases. In the long run, the openness dynamics may become weaker owing to the limits of openness imposed by a minimum of value capture, which is required by the firm to remain sustainable.

V. CONCLUSION

A. Contribution to Theory

Our results contributed to the theory in two ways. First, we expanded on existing work that takes a dynamic view of openness [7], [13], which—more broadly—extends the literature on open strategy [14], [15], [38], especially in the context of technology-intensive and platform-driven industries [12], [39], [40]. Our case showed how discrepancies in openness between firms and users emerge and by showing the consequences of these discrepancies for the firms and the ecosystem. In this paper, we shed light on the dynamics that set in when users demand more openness than firms provide. Users—when they are important contributors and make usage of digital media—can leverage their influence in the ecosystem. They can make a “call to arms” and develop their own products. They can also raise funds to support such projects, and thus start their own firms which force incumbents to become more open. These escalations of openness can spill over from the software to the hardware level of the consoles.3

Our case substantiated the claimed relevance of openness as a dimension of competition [7] and showed the details and possible consequences of discrepancies in the openness provided by firms and demanded by users. The consequence of not fulfilling the demand for openness can lead to conflicts which can have serious outcomes as shown by GP and GPH’s inability to survive. This example shows that the dynamics toward more openness are not necessarily accompanied by a firm’s growing experience with openness as Henkel et al. [7] argue. Instead, the demand for openness can be a self-reinforcing mechanism without active involvement by the firm.

Our second contribution addressed the user innovation literature [41]–[43] by showing an alternative evolution over the course of the product lifecycle. The existing literature characterizes the dynamics between user and manufacturer innovations as a process, in which the innovations originate with users. As products mature, manufacturers take over and adapt them for mainstream customers [2], [16], [21]. In our case, we presented dynamics that evolved the opposite direction, i.e., from manufacturer-based innovation to user-based innovation.

This path might be conditional to the underlying product and technology. More precisely, a critical condition might be the size of the design space. The design space is much larger in gaming handhelds compared to most other products, especially classic hardware products [16], [44]. Gaming handhelds contain hardware and software components, they include several functions such as graphical outputs, multiple interfaces, and many other elements. All these elements increase the design space. A large size of the design space implies more possibilities for users to contribute [44], especially in later stages of the product lifecycle when they can build on existing solutions or recombine them.

B. Limitations

Our paper’s primary limitation is that it rests on cases from only one ecosystem, which is relatively narrow and specific.3

3In contrast, the firms in Henkel et al.’s [7] case were able to avoid openness of the hardware. This makes it much easier for a firm to maintain its position in an ecosystem.
While this is useful to identify grounded insights, subsequent research in other contexts is needed. Such research should seek to identify alternative consequences of unfulfilled demands for openness. Relatedly, our secondary dataset (the semistructured interviews) is rather small. Though we covered the most important individuals, other perspectives, such as the viewpoint of the user nondevelopers, might be meaningful extensions of the data. We admit that such perspectives have the potential to enrich the insights from the case but excluded them in order to retain our focus.

Our case is specific because openness is particularly important to users in the research context of OS gaming handhelds. Many of the user-developers in OS gaming handhelds had a background in the OS software development, in which openness is very common. Thus, generalization to any purely hardware-dominated context or to contexts in which user-developers play a minor role is limited. Also, the power balance between firms and users appears to be a special characteristic of our case. Users are powerful because they can provide significant contributions. They become even stronger when focusing their power by forming a strong cohesion in the online community. This might not necessarily possible in all contexts even though digitalization increases the chances.

Further, we treated openness as a one-dimensional notion, which simplifies the view that characterizes openness as a multifaceted construct [38], [45], [46]. Although it is reasonable to distinguish between different dimensions of openness, we also consider it is necessary to propose a general and simple framework as a basis for researching the dynamics of openness. Thus, in this paper, we traded simplicity for specificity. At the same time, however, we encourage researchers to identify the relationship between firms and extra-organizational actors concerning specifics of openness in terms of its dimensions (e.g., transparency, accessibility, and replicability [45], [46] or transparency and inclusion [38]).

C. Managerial Implications

Our case study provides several implications for firm managers. First, our findings suggest that openness decisions should be planned carefully because these decisions are difficult to reverse. Although the reduction of openness is a possibility [12], it is likely to alienate contributors and users who have become used to a certain degree of openness. Firms need to not only ensure value capture, which may represent a significant challenge in open innovation environments [15], [47], but they also should be aware that they change users’ expectations. Thus, firms must know their users’ preferences regarding product openness. Firms should also be aware that users may still be unsatisfied even if their current needs and expectation on openness are met because demand for openness can resurface.

Second, firms that change their open strategy should actively communicate with their users to identify their preferences for openness. Firms should also educate the users about the limits of openness. Two firms in our case study did not react appropriately to the demands for openness and users’ activities. They did not try to benefit from increasing openness, nor did they reach out to the community and attempt to negotiate openness. Active communication may have helped them to cope with the demand for openness.

ACKNOWLEDGMENT

The authors would like to thank C. Raasch and R. Reinhardt as well as the Department Editor and three anonymous reviewers for their valuable comments and suggestions.

REFERENCES


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