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Abstract

Over the last decade, free and open source software (FOSS) has gradually become recognized by different actors in society outside FOSS communities and increasingly integrated in corporate software development, challenging proprietary software practices and establishing new open source companies. Literature describing this transition is focusing a narrow view on the value of using FOSS, mainly understanding it as an efficient alternative to established models for software development. This is not sufficient to fully understand the uptake of FOSS into companies. In order to gain a deeper understanding of this, there is a need to articulate a wider range of different values associated with FOSS and how they interplay in the intersection of corporations and movements. To do this we propose the order of worth framework developed by French sociologist Luc Boltanski and colleagues, which focus on the arrangements of value logics as an analytical strategy to understand how values form strong or weak arrangements in processes of institutionalization. By applying the framework on key texts from the free and open source software movement as well as on an interview study with professional software developers employed by firms, we set out to identify how values associated with FOSS become justificatory arrangements that give legitimacy to FOSS and how these arrangements change over time, from the early free software movement to the emergent uptake of FOSS in contemporary professional software development. By understanding how justificatory logics come to play and interplay, corporations that want to adopt FOSS can better manage their engagement in FOSS activities.

Keywords: Free and Open Source Software, Orders of Worth, Justification logics, Value of Open Source.
1 Introduction

Over the last decade, free and open source software (FOSS) is increasingly incorporated in professional software development contexts (Bonaccorsi and Rossi, 2003; Demil and Lecocq, 2006; Lerner and Tirole, 2002; Spagnoletti and Federici, 2011; Ågerfalk and Fitzgerald, 2008). This development has been described as OSS 2.0, progressive open source, corporate code, and professional open source, indicating an adaptation of FOSS (Fitzgerald, 2006; Gurbani et al., 2006; Dinkelacker et al., 2002). A recent research stream also outlines FOSS and its mode of software co-production as an engine for innovation (Morgan and Finnegan, 2010; Murray and O’Mahony, 2007; Osterloh and Rota, 2007; von Hippel and von Krogh, 2003).

Most literature describing this transition tends to focus on FOSS as an efficient, high quality but less costly alternative to established models for software development. However, given the major differences between community and company goals and value rationalities this focus on efficiency and economic value cannot sufficiently explain why FOSS is actually chosen. Even if FOSS has challenged traditional software industry and contested its practices, there are differences between community and company goals that professional developers have to manage when adopting cultural, economical and social practices of FOSS.

There is a need to identify how the value of FOSS has become an asset in professional software development and how different forms of values associated with both company and FOSS movement interplay with FOSS entering companies. To gain this understanding we propose the order of worth framework developed by French sociologist Luc Boltanski and colleagues (Boltanski and Thévenot, 2006; Boltanski and Chiapello, 2005), which focus on the arrangements of value logics as an analytical strategy to understand how values form strong or weak arrangements in processes of institutionalization. The purpose is to identify how values associated with FOSS become justificatory arrangements that give legitimacy to FOSS and how these arrangements change over time, from the early free software movement to the emergent uptake of FOSS in contemporary professional software development. The research question is: how do professional software developers justify FOSS when introduced in their work practice? By understanding how justificatory logics come to play and interplay, corporations that want to adopt FOSS can better manage their engagement in FOSS activities.

The paper is structured as follows. First we present the order of worth framework. After that the method section describes the data used and methodological considerations. Following that the two empirical sections are presented. First justificatory arrangements during different historical periods of FOSS are analyzed to give accounts for the value base from which FOSS is today integrated into companies. The latter part of the analysis contains the interview study with professional developers and how they integrate FOSS into their business. Discussion and conclusion completes the paper.
2 Logics of Justification

In a series of texts Boltanski et al. have proposed a theoretical framework for analyzing logics of justification in societies (Thévenot, 2001; Boltanski and Chiappello, 2006; Boltanski and Thévenot, 2006), what they call “orders of worth”. The framework identifies six different logics or justificatory regimes by which societies justify different social orders. These are coherent and systematic principles of evaluation that strive for universality but are in reality more or less fragile compromises between different logics of justification. The more a value refers to “common good” the stronger it becomes as a justifying logic. A justificatory arrangement is a combination of logics of justification in a society during a certain time period. The more diverse and the less universal a justificatory arrangement is, the weaker legitimacy it can create. Justificatory logics are thus shared beliefs inscribed in institutions and bound up with actions in a certain time. Logics of justification are also used to legitimate changes. The logics of justification can therefore be seen as tools that may function to manage uncertainties or fragile organizational circumstances associated with the adaption to new phenomena, such as e.g. new technologies, business models, organizational behavior etc. The six logics of justification suggested by Boltanski and Thévenot (2006) are the following:

- An inspirational logic is founded on a principle of grace or artistry serving what is perceived as authentic qualities of life, e.g. manifested by creativity or authenticity. A “great person” would be akin to a saint or an inspired artist.
- A domestic logic is founded on an established hierarchy made out of personal interdependencies, with a patriarch on top. It is justified by referring to a stable social order or tradition. An example could be a conservative family organization. A noble person would here be the father or elder, to whom respect and loyalty is due, and who in return gives protection and support.
- In a popular logic justification is reached through importance of being renowned, by being granted credit and esteem in the opinion of others. The value is dependent on identification and fame.
- In a civic logic, justification relies on being representative and on acting in accordance with a collective will. Value is created through the capacity to mobilize collectives around common interests. In this process, moral claims, and definition of identity become important. A great person is the representative of the group, who expresses its collective will.
- In a market logic justification depends on individuals and their ability to possess and compete. The value is related to individuals’ selling and buying goods and services. This can be perceived as an egoistic practice. However, the right to possess and seize market opportunities is related to a claim that, if done fairly common good will emerge out of market transactions. The great one is the entrepreneur, the person who makes a fortune.
- An industrial logic justifies actions and initiatives by referring to efficiency and the scale of abilities. Contrary to the market logic, the industrial logic focuses on whether functionality and productivity is organized in a reliable way. The great one is the professional, the expert or director of a large industry.

The framework is applied as a way to identify justificatory arrangements and how they develop over time by describing the historical evolution of FOSS and identify changes in the arrangements as well as analyzing professional software developers’ experiences of working with FOSS in companies. The focus is not only on which logics are involved, but also how they are configured, e.g. if and how they support or contradict each other. Different actors struggle to justify the use of FOSS by referring to justificatory logics (Stark, 2009; Jagd, 2007). Weak or even competing orders of worth will create tensions and uncertainties about the consequences of adopting FOSS (Rolandsson et al., 2011). The justificatory arrangements guide developers in how uncertainties can be handled and FOSS appreciated. Through these arrangements, it is possible to identify how FOSS can become an integrative legitimizing force and which challenges are created by e.g. tensions between social order and moral claims. Furthermore, it enables tracing the role of previous and existing logics of justification on FOSS in contemporary professional software development as resources to agree and act upon (Boltanski and Thévenot, 2006).

3 Method

The result section is based on two sets of data. The first part identifies two justificatory arrangements in the historical development of the FOSS movement. The second part of the study consists of qualitative interview data describing the current uptake of FOSS in two types of companies. Methodological strategies chosen are described below.
Two justifying arrangements that historically have been used to define the value of FOSS, was traced by gathering and analyzing canonical texts i.e. discourses that are seen as the most influential, often referred to or considered to have a major impact on the perception of a phenomenon (Kilduff, 1993; Macintosh and Baker, 2002; Introna and Whittaker, 2004). Also additional work, such as journalistic accounts and previous research was used. When collecting and analyzing canonical texts we applied what Foucault named archaeology of knowledge (Foucault, 1969), which is an analytical method to compare series of sources over time in order to capture changes in dominant modes of thinking, acting and organizing, in this case the orders of worth. Certain events function as approximate starting points of the two time periods, each composing a distinct arrangement. The early movement justificatory arrangement appears already during the 1970s, but with the free software definition and the 1985 constitution of the Free Software Foundation (FSF) it becomes established, and hacker Richard Stallman emerges as a front figure. The second justificatory arrangement named pragmatic FOSS develops from activities in the 1990s leading to the formulation of the open source definition and constitution of the Open Source Initiative (OSI) in 1998. The empirical material is thus based on texts related to OSI and one of its front figures Eric Raymond.

<table>
<thead>
<tr>
<th>Hybrid companies</th>
<th>Pure-play companies</th>
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<tr>
<td>Hybrid 1</td>
<td>6 interviews</td>
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<tr>
<td>Hybrid 2</td>
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<td>Hybrid 3</td>
<td>3 interviews</td>
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<td>Hybrid 4</td>
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<td>Hybrid 5</td>
<td>2 interviews</td>
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<td>Pure-play 1</td>
<td>4 interviews</td>
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<td>Pure-play 2</td>
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<td>Pure-play 3</td>
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<td>Pure-play 4</td>
<td>4 interviews</td>
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<td>Pure-play 5</td>
<td>2 interviews</td>
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<tr>
<td>Pure-play 6</td>
<td>1 interview</td>
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</tbody>
</table>

Table 1. Type of companies and number of interviews performed in each company.

These historical accounts are used to contextualize professional open source developers’ application of FOSS in their companies, which is conceived as an emergent third justificatory arrangement. Qualitative interviews were conducted with 30 software developers recruited from pure-play and hybrid companies (Feller and Fitzgerald, 2002). Hybrid companies are based on proprietary business models that gradually incorporate open source software and methods. The majority of the hybrid companies are large corporations of which most act on a global market. However, in this category also smaller firms with a proprietary history were selected. 15 interviews were done among hybrid companies. Pure-play companies are formed around a FOSS business model. These are typically small and medium sized (SMEs) entrepreneurial service oriented consultancy firms, with a multitude of approaches for incorporating open source software development into their work practice. We have interviewed 15 programmers employed by such SMEs. Table 1 gives an overview of the types of companies and number of interviews included in the study.

Respondents were chosen to represent a broad sample of different approaches to FOSS and software development. The interviewees included designers, coders, system developers, software engineers, software architects and to some extent project leaders. They also differed in other aspects, such as age and length of employment. Programmers working for hybrid companies with a long proprietary history frequently were qualified engineers (with university degrees) whereas those working for pure-play SMEs had a wider variety of educational backgrounds.
4 The Historical Development of Justificatory Arrangements in FOSS

4.1 Justificatory Arrangements of The Early Movement

In the early computer history there were no market for software, since it was developed directly for specific hardware (Campbell-Kelly, 2004). Programmers were used to share solutions, knowledge and source code. When a market for software then emerged, these practices of sharing were abandoned, and the source code became private company property to be carefully protected. This provoked some developers to mobilize resistance in the shape of a politically driven movement, organized as an ideologically framed commune. A number of initiatives institutionalized this resistance to proprietary software, such as the GNU project (Stallman, 1986; 2002), the Free Software definition (GNU Bulletin, 1986), the Free Software Foundation, and the GNU General Public License (GPL) that was designed to ensure that the rights of the free software definition were preserved (i.e. an inscription of the free software definition in copyright law). The “viral” character of GPL, i.e. that other software that is bundled with a GPL-licensed software must also be released under GPL, created tensions with proprietary software.

An important justification was here the civic logic formed on principles and rules defining free software as a common good, i.e. source code must be made available for anyone to use, alter and redistribute to secure future development of the ideas that the code entails. The proprietary practices were seen as a threat against the programmers’ freedom: “fundamental act of friendship among programmers is the sharing of programs; marketing arrangements now typically used essentially forbid programmers to treat others as friends” (Stallman in Gay, 2002, p. 33).

Emanating from the roots of the hacker culture of the early sixties, we can also identify an inspirational logic. Programming was often seen as an art (c.f. Dijkstra, 1971). Donald Knuth described it: “The chief goal of my work as educator and author is to help people learn how to write beautiful programs” (Knuth, 1974, p. 6). This is also manifested by the culture of the MIT research groups’ early experimenting with new technologies, as described by Levy (1984):

“a new way of life, with a philosophy, an ethic and a dream.[…] hackers that by devoting their technical abilities to computing with a devotion rarely seen outside monasteries they were the vanguard of a daring symbiosis between man and machine.” (Levy, 1984: 39)

Hacking and playing with technology was justified as the authentic values of life. While the word hacking changed over time from “a spirit of harmless, creative fun” to “acquire a sharper, more rebellious edge” (Williams, 2002), it was still deeply linked to an inspirational logic of solving difficult problems for its own sake: “Playfully doing something difficult, whether useful or not, that is hacking.” (Stallman, 2002).

During the same period we also recognize a popular logic of justification. This is visible in the way skilled hackers are recognized by the community based on reputation. Being recognized as a hacker was something that earned by getting respect from the community. The most admired programmers were referred to as demigods: “a person who is defined as a hacker with years of experience, a world-wide reputation, and a major role in the development of at least one design, tool, or game used by or known to more than half of the hacker community.” (Jargon-file 4.3.1). Famous projects or persons could attract many contributors, creating a high value for certain FOSS initiatives.

Finally, a domestic logic could be traced in the early movement, resembling a tight community with closed clan like hierarchy of personal interdependence and patriarchal governance, what Raymond (1999a) later characterized as a cathedral-building style of development typical for both early free software and the proprietary software development.

The justificatory arrangement in this first time period was thus characterized by a strong civic logic built around the idea of creating a common god. This was expressed in several institutions such as the GPL and in hacker practices based on sharing and mutual respect. Communities where to a large extent oriented away from business and market due to a critical approach towards proprietary business models.
4.2 Justificatory Arrangements of Pragmatic FOSS

During the mid-nineties a new approach to justify FOSS occurred, rooted in some developers concern with what they defined as the early movement’s hostile attitude to commercial software:

“It seemed clear to us in retrospect that the term 'free software' had done our movement tremendous damage over the years. Part of this stemmed from the well-known 'freespeech/ free-beer' ambiguity. Most of it came from something worse – the strong association of the term 'free software' with hostility to intellectual property rights, communism, and other ideas hardly likely to endear themselves to an MIS manager.” (Raymond, 1999a)

In order to avoid these connotations, the term open source was coined, indicating that open source is viewed as a means to an end of producing software of high quality, not an end in itself. A number of initiatives institutionalized this more pragmatic attitude. The Open Source definition explicitly states that an open source license must not “contaminate” other software (as the GPL-license). More permissive licenses were used to make it easier for open source to coexist with proprietary software (Välimäki, 2003; 2005). The Open Source Initiative (OSI) was founded in 1998 to support the new focus on technology rather than ideology. This more pragmatic nature of the movement, downplayed the ideological focus, and contributed to a wider diffusion of free and open source software, including both large software companies and new small firms dedicated to open source. Civic logic companioned by a market logic, which created strong tensions between members of the communities, here illustrated by the dispute between FSF spokesperson Richard Stallman (RMS) and Open Source Initiative’s Eric Raymond:

“RMS’s best propaganda has always been his hacking. So it is for all of us; to the rest of the world outside our little tribe, the excellence of our software is a far more persuasive argument for openness and freedom than any amount of highfalutin appeal to abstract principles. So the next time RMS, or anybody else, urges you to “talk about freedom”, I urge you to reply “Shut up and show them the code.” (Raymond, 1999b)

It is not philosophical or political principles, but the excellence of the software that should convince, which points to quality ideals based on an industrial logic. As an alternative to the domestically oriented cathedral style, where wizards were leading a tight, closed tribe of skilled hackers, Raymond proposed the “Linus Torvalds’s or the bazaar style of development – release early and often, delegate everything you can, be open to the point of promiscuity” (Raymond, 1999a, p. 30).

The justificatory arrangement that previously was focused on civic logic had now become more dynamic. There is a continuing presence of both inspirational and popular logic as part of the bazaar. Skilled “hacking” is still appreciated, and inspirational value of open source software would depend on spontaneous and passionate initiatives, like Linus Torvalds initiative to develop Linux in order to learn how operating systems work (Torvalds and Diamond, 2001). The popular logic was strengthened due to the growing movement. Skilled programmers could gain reputation and fame among a high number of peers, if they succeeded to pass the peer review systems with their contributions of code. However the introduction of a market logic somewhat challenged the universal claims of a previously dominating civic logic.
5 Emerging Justificatory Arrangement in Contemporary Firms

Previous sections give a background that makes it possible to describe contemporary integration of FOSS in professional software development from the perspective of which logics are chosen and how they are justified when meeting existing justification arrangements in the companies.

5.1 Inspirational Logic Reframed

In many of the studied companies the inspirational logic is used to justify FOSS, with references back to previous justificatory logics in the FOSS movement. It is common that developers justify their use of open source by referring to how it enhances their engagement and help them seize control over and improve the quality of software, as well as enable them to make use of their ‘artistic capability’ to realize visions. However, there are changes in how this logic is framed. Instead of finding visions and inspiration rooted in being part of a movement struggling against proprietary software for a higher cause, FOSS is justified as a tool that makes the professional programmer more independent and capable at work. A software developer in a pure-play company argues:

“I enjoy sharing and helping others [in the Joomla community]. If they share with me I want to share with them. That is different from just buying software and using it. This is a way of life. It is fun to work with; both at home in private and here at work. You learn new things.” (Open source web company programmer)

Inspirational justification is present but reinterpreted from being based on movement ideals of authenticity, to embrace individuals’ professional engagement and empowerment as a professional programmer. Open source is justified by its capacity to liberate the individual – a good cause – that makes both work and leisure more challenging and fun. Hence, it was seen as important that firms should not undermine open source as a liberating force for the developer when appropriating it into a professional context.

5.2 The Decline of Domestic Logic

It is striking how the respondents downplay the importance of gurus from the early stages of the FOSS movement when they justify their engagement. Those who worked with FOSS at these companies stressed that they were not “religious” about ideas of open source values and practices. The early movement was criticized as rather domestic, and there was little loyalty towards FOSS for “historical” reasons. Avoiding proprietary solutions was not seen as a goal in itself. If needed by the customers, proprietary solutions can be used:

“There is a tension between the GPL [Gnu General Public License] and business which has consequences for what we can do and what we want to do. At the end of the day the company must earn money to survive. Richard Stallman has a very idealistic view of the world, which is admirable. But if one considers it from a business perspective one realizes that it is not feasible in practice.” (Open source service platform and application provider)

It should be emphasized that there was a historical knowledge about previous justification regimes among the respondents, and contributing to FOSS was generally seen as a morally good thing. Still, a more pragmatic approach was justified mainly by also referring to market logic.

5.3 Reinterpreted Popular Logic

The popular logic central to the initial open source movement related to the reputation that was gained when programmers invented new and exciting projects, solved generic problems or got their contributions of code through the peer-review system and into the main code branch. Popularity built on respect attributed by the community. The more popular a project, the more status gained for the project owner as well as for the individual contributing programmer. The ideological leaders of FOSS were all famous for their contributions to the codebase of the commons.

According to the interviewed programmers the companies had transformed this popular logic in different ways. One strategy was to hire programmers with community track record and use this as a marketing strategy when packaging offerings to customers. This way of understanding popular logic transformed the justifying value base from "community respect" to "market success". The argument behind this reasoning is that an open source company's
probability to succeed with a software development project increases with the programmer's success as a FOSS developer. Hiring programmers greeted by the community will gain both the company and its customers.

A similar line of reasoning was found among programmers who used this reinterpreted value logic to trade competence gained in a community for competence required in the professional life by using their open source projects as showcases when applying for positions as professional software developers.

5.4 Market Logic Challenging Possessions

Several of the studied companies had the public sector as target for their business proposals, and they justified their business by being a resource helping the public sector to become more in control of their strategic investments. Being specialists on open source they could assure that the public sector could reach its goals of achieving a more open and transparent software strategy. They used the idea of open source as a different way of working where the customer would have the control over the product, which normally is not the case with proprietary software. A programmer in a pure-play company argue:

“It’s a nice and clean way of distributing software that let the customer decide what to do with their code. It is also fair because no one can cheat on the customer and deliver crap. Since it is open everyone can see what’s inside. Also we can collaborate to find bugs and stuff like that. Generally people like to help.” (Open source web company)

A difference in relation to how Boltanski and Thevénot (2006) outlines the market logic is that justification for these firms does not rely on claims of possession but on openness as the main asset for competing, which contrasts the proprietary approach where openness normally would be regarded as a threat against competition.

However, in firms with a previous proprietary tradition a more complex relation to market logic could be identified. Firms that developed their business around patent portfolios naturally had strict arrangements regulating what the programmer was allowed to do in terms of using open solutions. Developers in this company therefore went through a formalized process governed by the patent department before they were allowed to use open source code in their software development.

5.5 Civic Logic Transformations

The civic logic that is identified in companies reminds partly of the early movement. Open source is seen as an asset strengthening the development of a “good society” that can solve user needs, a democratic approach to software development found in public sector discourse on FOSS. Tensions could occur between civic and market logics if the customer would not subject to a community’s long-term vision:

“We always write agreements with the customer about the fact that everything we do in order to give them better functions etc. will be part of the community in the end. However, this also means that we as core developers have a big responsibility to review and accept the stuff that is written. [...] We never develop any customer specific solutions, we always develop stuff that may easily be configured in a way that suits many different organizations.” (Open source web company)

The company was heavily involved in developing the system they sold and their goal was that every customer should adhere to this logic and see their own needs as subordinate to the needs of the community. This civic logic touches upon ideas on citizens’ rights and the public sector’s independence from proprietary interests. Civic logic is used as a way to justify that customers must respect the community’s agenda.

5.6 Open Sourcing the Industrial logic

It is not surprising that the interviewed programmers invoke an industrial logic since it justifies efficiency, quality and the need for expertise, ideals that also justify industrial values. However, as shown, industrial logic is not new in FOSS justificatory arrangements. Expertise and profound testing procedures also stand as guarantors for the efficiency of community based peer-produced high quality software. In the interviews this theme is elaborated. The developers do not just see themselves as efficient and result oriented experts, they also combine this with inspirational logic imported from the community based open source movement. Thus, an important argument is that
the flexibility provided by FOSS has made it possible to reach goals faster and with higher quality than in-house developed proprietary software, with increased efficiency and decreased cost as a result.

“Our only true advantage really is that our customers who trust us know that we always deliver. They can just ask a question, for example “we want a system that has these functions, is there anything out there?” And then we can go out in the world to see if we can find something to start build upon. Really, that is what I love about this job; it is so easy to show something that immediately can be discussed, which is a major advantage when you are into user driven software development. You don’t have to write specifications.” (Open source web company)

As the quote implies open source software development is perceived as an engine for pushing industrial efficiency and innovation marked by high technological standards even further by engaging in co-creation of software. However, even if open source is associated with high quality and seen as an innovative potential in most firms, a more concerned approach is identified in companies with a proprietary tradition. Instead of using FOSS in close collaboration with the customer, it is viewed as a useful mean for solving advanced problems in well-defined project groups. In accordance, the industrial logic that emerges, especially in hybrid companies, embraces an image of developers working as scientists in industrial labs. Hence, an instrumental approach to open source as a tool for industrial research and development focusing company needs can be identified, where developers work with concrete problems in their labs and only indirectly contribute to technological progress compared to direct involvement in the FOSS agenda.

6 Discussion

The studied historical periods and the contemporary set of interviews with 30 professional software developers will now be discussed in relation to the order of worth framework developed by Boltanski et al. (Thévenot, 2001; Boltanski and Chiapello, 2005; Boltanski and Thévenot, 2006) from the perspective of how professional software developers justify FOSS when introduced in their work practice. The result shows that developers create a justificatory arrangement that draws from, abandons or reinterprets previous FOSS justificatory logics. Table 2 summarizes the three identified arrangements.

Civic logic is the most continuous over time followed by popular and industrial logic. Civic logic is reinterpreted in each period. In the early movement the value logic was based on the mobilization of hackers to fight emerging proprietary software development. During the phase of pragmatic FOSS civic is reinterpreted and openness becomes a more generic and inclusive value. In the emerging value logic of contemporary software development in companies civic is connected to the idea of an innovation that serves “a good cause”, which has been formulated in different ways in previous periods. Except for the early movement where an inspirational logic dominates, the industrial value logic continues quite stable – also in terms of content – throughout the studied periods, based on principles of efficiency, quality and reliability in software development. The popular value logic by which credit and esteem in the opinion of others form the value base is recognized in all periods but has undergone interesting transformations. In the early movement reputation mainly was a matter for the internal community. This value base becomes more general and wide in the pragmatic justificatory arrangement. Different approaches were found among the developers, from a deep involvement in community reputation building to business orientation and policy making. Here we also find a new approach where popularity can be a merit that is highly valued and sometimes be traded between community and company. This means that the popular value logic can inhibit several possible interpretations, which makes it resilient.
<table>
<thead>
<tr>
<th>Justification logics</th>
<th>Justificatory arrangement of early movement</th>
<th>Justificatory arrangement of pragmatic FOSS</th>
<th>Justificatory arrangement in contemporary firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspirational</td>
<td>Hacking as technical artistry and problem solving as an end in itself</td>
<td>Hacking as technical artistry and problem solving as an end in itself</td>
<td>Hacking transformed from art to scientific software development in the lab (hybrid)</td>
</tr>
<tr>
<td>Domestic</td>
<td>Loyalty in closed, tight communities with informal hierarchical structures</td>
<td>Openness strongly enforced, justified by leaders recognized by the community</td>
<td>Mostly absent (hybrid). Fragments of faithfulness to early movement leaders and values (pure play)</td>
</tr>
<tr>
<td>Popular</td>
<td>Importance of reputation and fame among peers in the community</td>
<td>Importance of reputation and fame in wide contexts of communities in business</td>
<td>Reputation and esteem derived from FOSS competence is a highly valued merit (pure play and hybrid)</td>
</tr>
<tr>
<td>Civic</td>
<td>Mobilizing hacker movement to defend the value of openness against emerging proprietary interests in software development</td>
<td>Openness valued as a good, coexisting with proprietary software</td>
<td>Firms promoting the value of “civic innovation” to develop the good society through the market (pure play)</td>
</tr>
<tr>
<td>Market</td>
<td>Market logic is absent</td>
<td>Mobilizing openness to develop competitive software</td>
<td>The value of competing with openness on the market (pure play and hybrid)</td>
</tr>
<tr>
<td>Industrial</td>
<td>Industrial logic is absent</td>
<td>The value of mobilizing the crowd to enhance large scale industrial quality and efficiency</td>
<td>The value of openness to enhance efficient software innovation and production (pure play and hybrid)</td>
</tr>
</tbody>
</table>

Table 2: Summary of justificatory arrangements in three periods of FOSS.

The domestic justification logic, which during the two first arrangements is strong and based on an appreciation of tight social relationships, clearly disappears as FOSS enters contemporary firms. The inspirational logic first show continuance but becomes reinterpreted by the interviewed developers, from artistry to valuation of inspiration as a contributor to scientific problem solving in development labs. Market, finally, as justification logic is not visible in the early movement’s community oriented FOSS. The debate between the Free Software Foundation and the Open Source Initiative signifies the introduction of a justification based on market logic, which to a large extent is in tandem with a civic logic of justification promoting the role of openness to cope with market failure in the software development sector, and thus improve the market.

By comparing the historical development of justification logics related to FOSS it is possible to identify how value logics structure the integration of FOSS in the studied companies. The results show that different justificatory logics become resources for the developers. We found three approaches for how such resources were used: inheriting, abandoning and transforming value logics. Building a justificatory arrangement for FOSS can thus be viewed as ongoing justification work in organizations (Jagd, 2011) were different logics are negotiated to form an arrangement that can become successful in that particular context.

Boltanski and Thévenot (2006) argue that arrangements can be weak or strong. Weak arrangements consist of contradicting value logics. When logics support each other a stronger alliance occur. In the data presented value logics shift over time in a way that for some areas create strong alliances. As shown the interplay between inspirational and industrial logic, and between the civic and market logic, turn them into strong justificatory logics in contemporary firms. The inspirational logic identified enabled the studied developers to realize their ability for artistic and visionary problem solving. In a similar way, the market logic innovates new ways of approaching the market to compete with free software and open standards. Furthermore, the civic logic has paved the way for a
more autonomous customer and user perspective, supporting a market logic that emphasizes common good rather than proprietary strategies.

The practical implication of the analysis is that an organizational design that successfully can incorporate FOSS must be able to understand and manage orders of worth in a way that builds strong arrangements where justificatory logics can come to play and interplay in various ways. Previous FOSS history works as a resource for such endeavors. In the contemporary business driven arrangement where market and industrial logics are dominating, the historical core of FOSS still seem to be important to the justification work done in firms. The study thus depicts an interesting interplay between these logics, forming a new ground for business in the intersection of movements and corporations.

7 Conclusion

In this paper we have shown how the order of worth framework can be applied to understand more of how justificatory arrangements structure FOSS implementation in software organizations. By using the order of worth framework the study shows that several justification logics overlap and become resources when valuing FOSS in professional software development. This understanding can inform corporations that want to adopt FOSS to gain strategic advantages beyond mere efficiency. We also believe that the framework could be applied to analyze open and distributed development efforts in a wider sense, but this needs to be further researched.
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<table>
<thead>
<tr>
<th>TITLE</th>
<th>CROWDPUSHING: THE FLIP SIDE OF CROWDSOURCING</th>
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Abstract

Activities and initiatives of co-creation are traditionally seen as a way for organizations to gain value through the involvement of certain actors in their environment. We notice an implicit assumption in current theoretical conceptualizations that co-creation is initiated and driven exclusively by organizations. However, it appears that co-creation activities may also be driven by third-party actors outside organizations. Based on interviews and secondary data from a public transport company in Stockholm, Sweden, we noticed that third party developers of services, that gained a large and diverse user base, were driving co-creation activities with the respective organization. Subsequently, based on our findings, we introduce the term "crowdpushing" to denote externally driven co-creation activities and frame four propositions to describe how co-creation activities are motivated and driven. Our findings contribute to a broader understanding of co-creation and have implications for its design and deployment.

Keywords: Co-creation, Crowdpushing, Innovation, Open Data, Third Party Development, Public transport.
1 Introduction

In February 2009, a swift decision was made at a Stockholm-based public transport company to halt their web site deployment due to a perceived on-going denial-of-service (DOS) attack which has persisted since the new web site went public. Further investigation revealed that the source of the server overload was not a deliberate attack, but rather a non-sanctioned travel planning application that was utilized by thousands of users and heavily relied on the no longer available formatting of the previous web site design. Subsequently, once the previous web site design was restored, the gadget resumed normal behaviour and the problems ceased. This incident stimulated the present study by raising questions such as what forces were at play to cause this situation? How did such massive activity pass under the radar of the company? Could the company anticipate and avoid the widespread unauthorized reuse of its data? Should the company encourage such co-creative activities?

Openness and exchange are inherent in co-creative approaches to digital innovation. Co-creation in the context of organizations and people is often seen as an organizational initiative that aims to gain competitive advantage through the involvement of a certain type of actor in organizational processes. The involvement of people may have different exchange formats and outcomes. For example, in co-production, people co-produce the product or service that they consume in exchange for added degrees of freedom. However in crowdsourcing, people provide organizations with new useful ideas in exchange for some monetary or immaterial rewards. So far, co-creation has often been seen as a joint activity in which organizations lead and people follow. In contrast, this paper describes an emerging variant of co-creation in which actors in the environment lead and organizations follow.

In what follows, we report on a study of distributed involvement in innovation at a public transport company in Stockholm, Sweden. We investigated an open data initiative of the company and found that it was shaped to a large extent by the use patterns and on-going engagement of numerous clients who utilized “unauthorized” applications that were built by independent third-party developers who found ways to construct services which better fitted the users’ needs. This finding was unanticipated considering the common expectation that open data or any co-creation initiatives are led by the host organization which tend to remain in control over the process, as in any other planned strategic manoeuvre. In this case, however, in spite of the initial strategic intent of the organization to curtail and if possible to thwart third-party attempts to reappropriate the company’s data, hundreds of thousands of users who chose to rely on non-sanctioned services in their everyday life created a crowd-based thrust that forced the company to give in and to provide open and unrestricted access to portions of their data.

In view of the current literature that portrays co-creation exclusively as an internally-driven strategic choice, where organizations actively approach actors in their environment and get them engaged in some joint activities, our observations suggest that we need to assess and conceptualize an alternative type of co-creation that is externally-driven by third party actors who are backed and supported by an engaged user base crowd. To this end we bring forward the notion of crowdpushing. We define crowdpushing as a coercive public demand that compels an organization to engage with external interested parties in anticipated acts of co-creation. We argue that crowdpushing is enabled by the ubiquity of mobile devices, related platforms and wireless data networks and that it is contingent on the emergence of third party actors who have an interest in developing interfaces to the organization’s resources.

The remainder of this paper is organized as follows: we first review the related literature on the relationship between organizations and crowds in the context of co-creation. Next, based on interviews and secondary data, we present a case study of crowdpushing. Building on our findings, we offer a set of propositions that differentiate between internally and externally driven acts of co-creation and conclude by suggesting implications for practice.
2 Theoretical background

A major theme within contemporary organizational research is concerned with how organizational boundaries are opened for exchange and how user value is co-created to a greater extent with a wide set of actors (Prahalad & Ramaswamy, 2004; Normann & Ramirez, 1993). In order to be successful, co-creation must provide increased value for all involved parties. Therefore, understanding the key to co-creation success must draw on the motivations of the relevant stakeholders to engage in the process. These motivations may be placed on a continuum that spans from gaining a concrete finite reward to gaining a capability or affordance (Figure 1). For example, whereas crowdsourcing illustrates a reward-based motivation on one hand, smartphones, web 2.0 services, and open-data initiatives illustrate affordances-based motivation on the other hand. Naturally, there are instances in between these two poles, such as living labs (Bergvall-Kareborn et al., 2009) that are partly motivated by gaining rewards and partly by gaining affordances.

Rewards Affordances
Crowd-
sourcing
Co-
Produced 
Services

Motivation

Figure 1. The range of motivations in co-creation

Rewards-based motivation refers to both economic value as well as immaterial value. For example a quite spectacular rewards-based co-creative relationship can be observed in crowdsourcing (Howe, 2006), in which organizations draw on the value produced by a collective intelligence (Surowiecki, 2005). Through platforms like Innocentive and Top Coder, organizations are given access to an abundant set of independent contributors, where even marginal contributors are able to provide them with otherwise unattainable knowledge (Jeppesen & Lakhani, 2010). In crowdsourcing, organizations typically initiate a ‘broadcast search’ by disclosing information about the problem at hand and inviting solutions from anyone who can solve it (Jeppesen & Lakhani, 2010). As individual members of the crowd submit potential solutions, the organization rewards (financially or through other means) the providers of those solutions that they find the most appropriate. Thus, in crowdsourcing the organization retains the control over how to proceed with the suggested solutions. In this sense, crowdsourcing seems - when it works - to take the best out of two worlds by drawing on the collective wisdom of the crowd while maintaining control over how the proposed ideas and solutions are used.

While research on crowdsourcing has highlighted how rewards-based co-creation works in favour of organizations, we see other, more continuous approaches to co-creation. The affordances-based motivation refers to co-creation of a capability of some sort, e.g. the ability to co-design and customize a service such as a smartphone. Even though a smartphone is sold to the customer in a fully operational default state, its design allows major modification (Germonprez et al., 2007). Thus, after obtaining a smartphone, the typical user often engages in a secondary design process in which s/he modifies the smartphone by applying personalized settings, applications or even operating systems. The design of smartphones allows any user to co-produce the service for it to meet situated and emergent needs (Germonprez, et al., 2011). Affordances-based motivation may also be the ability to co-create content, e.g. through web 2.0 applications. For instance, by using a wiki-based documentation for frequently asked questions about a product or service, users are able to add or alter substantial information based on their personal experiences (Wagner & Majchrzak, 2006). Furthermore, affordance based motivation may be the ability to view and modify data (Kuk & Davies, 2011). One example is Application Programming Interfaces (APIs) that enable organizations to provide third party developers with programmable interfaces to their data repositories. Through this structured data access organizations encourage and empower third party developers to co-produce new services which may use data in unanticipated contexts or visualized it in an innovative way (Kuk & Davies, 2011).

While existing theoretical conceptualizations of co-creation have emphasized motivation as an important dimension of co-creation, next we present our empirical investigation which revealed driving force or thrust as another critical dimension in understanding co-creation activities.
3 Research Method

Case studies are suitable in particular for the exploratory research of a complex phenomenon that requires in-depth on-site investigation (Dubé and Paré, 2003). We investigated the underlying phenomenon using the case study method. More specifically, we used a single exploratory case study to explore a novel and underexplored phenomenon. As we have yet to see theoretical conceptualisations of crowd-driven approaches to co-creation, building on Yin (2009) and Darke et al. (1998), we find a single exploratory case study to be a suitable approach.

The focal organization in this paper is Storstockholms lokaltrafik which we label here Stockholm public transport company (SPTC). SPTC is owned by the county council of Stockholm and has a board of politicians. SPTC holds the overall responsibility for infrastructure, ticketing and customer information about the public transport network. SPTC’s main operations have been subcontracted since 1993 to bus, train, metro and light-rail operators such as Veolia Transport and MTR Corporation. On a daily basis 700 000 customers make use of the transport network of SPTC. Together with other public transport companies in Sweden, SPTC owns the Association for Public Transport Companies (APTC), which is a company that provides nationwide ticketing and nationwide journey planning.

We chose to study SPTC because it demonstrated a case of crowdpushing. Through a variety of data sources we were able to follow the process in which SPTC has turned its approach to data access from a strictly controlled policy to open access with very few restrictions, and how this change was influenced by public demand. Furthermore, access to data and intimate knowledge the target organization, which is crucial in case study research, was secured by one of the authors who was a previous employee of SPTC. Overall, data included interview transcripts and internal documents such as presentations, e-mail conversations and other relevant documents as described in Table 1.

Respondents were selected both from personnel who worked at the target organization during the time period studied and from companies and individuals who tried to gain access to company data from SPTC during this period of time. In order to select a relevant set of respondents, the authors initially identified four phases of the process within the organization. Potential respondents relevant for each phase were identified and put into the initial set of respondents. Most of the respondents were identified as relevant to more than one phase. In total 13 semi-structured interviews were conducted using a pre-crafted interview protocol. To elicit the respondents’ views on the unfolding of the organizational shift of perspectives regarding open data and cooperation with third party developers, the interview started with broad questions in this vein. To further understand the details of this process, a number of significant events related to the relevant phases were then brought up and discussed in detail.

All interviews have been audio taped and transcribed. All transcribed audio material and reports have been coded using Atlas.ti, a data analysis software package. Transcribed utterances and other text materials addressing the scope of research have been identified and coded accordingly. Given the disruptive nature of the changed policy, we approached the data analysis through a lens of punctuated change (Newman & Lyytinen, 2008). Such a lens allows researchers to understand critical incidents (Flanagan, 1954) which significantly alter socio-technical trajectories within the studied setting and the interventions the organization initiates as a response (Newman & Lyytinen, 2008).

The data collection approach used had some limitations. The potential number of relevant respondents was limited because only a small fraction of the employees at the company were engaged in the phenomenon under investigation. To enhance the limited number of respondents, the initial set of respondents was complemented by a snowball sample (Sarantakos, 1998), that is, at the end of each interview, the respondents were asked to name other persons who may be able to contribute to the study. In order to reduce problems related to selective descriptions or problems in recalling certain actions relevant to the story, we also triangulated the interviews with historical e-mails and documents from the company (Eisenhardt, 1989). Equipped with a priori knowledge based on these documents before conducting the interviews, we were able to bring up events not mentioned by the respondent at the end of the interview in order to refresh the respondent’s memory.
Table 1. 

<table>
<thead>
<tr>
<th>Data Type</th>
<th>N</th>
<th>Data Source Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews</td>
<td>8</td>
<td>Interviews at SPTC with Head of the Passenger Information Dept Head of Internet services, IT-project manager, Business developer, IT-system administrator, Head of Business Development, IT-system administrator, IT-controller</td>
</tr>
<tr>
<td>Interviews</td>
<td>3</td>
<td>Interviews at APTC with CEO, CIO and Head of Business Development</td>
</tr>
<tr>
<td>Interviews</td>
<td>2</td>
<td>Interviews with third party developer of the two leading smartphone applications</td>
</tr>
<tr>
<td>Documents</td>
<td>16</td>
<td>E-mail conversations at SPTC</td>
</tr>
<tr>
<td>Documents</td>
<td>5</td>
<td>Presentation material of SPTC</td>
</tr>
<tr>
<td>Document</td>
<td>1</td>
<td>Strategy document of SPTC</td>
</tr>
<tr>
<td>Usage statistics</td>
<td>2</td>
<td>Detailed usage statistics for the two leading applications</td>
</tr>
</tbody>
</table>

Table 2. 

4 Crowdpushing at work: The case of Stockholm Public Transport

The analysis of the case data revealed four key phases (each triggered by critical events) related to crowdpushing, as described in the following section and summarized in Table 2.

<table>
<thead>
<tr>
<th>Phase/Date</th>
<th>Description</th>
<th>Critical Event</th>
<th>SPTC Organizational Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Travel data services go live</td>
<td>Dynamic travel data becomes available to the public via the company website (mobil.sl.se, personalized services, real-time information)</td>
<td>All customers were referred to the web site and encouraged to use it</td>
</tr>
<tr>
<td>09/2007</td>
<td></td>
<td>Subsequent requests of third-party developers for data access</td>
<td>Denial of all requests and development of a clear policy aiming to control directly the dissemination of all public data</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Crowdpushing: Unsanctioned services gain popularity</td>
<td>The emergence and increasing adoption of unauthorized third party services</td>
<td>No organizational response. Services developed by third party developers are ignored.</td>
</tr>
<tr>
<td>11/2008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 3</td>
<td>Service malfunction</td>
<td>Web services malfunction due to apparent Denial of Service (DoS) attack following architectural change of the company website</td>
<td>Launching investigation to identify the source of attack and to develop proper security measures.</td>
</tr>
<tr>
<td>02/2009</td>
<td></td>
<td>Discovering that the source of malfunction is not DoS attack, but rather unsanctioned applications used by thousands of clients</td>
<td>Attempting to bind the third party developers with legal agreement</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Open access to data</td>
<td>Realizing that the company has not been successful in binding third party developers, and that with no legal leverage the only workable solution to regain control is through the provision of a public API</td>
<td>Changing data access policy and reaching out to third party developers with a public API</td>
</tr>
<tr>
<td>09/2011</td>
<td></td>
<td>Third party developers adopt the newly available API</td>
<td>Promoting the services provided by third party developers and embracing the developers as part of their provision of information</td>
</tr>
</tbody>
</table>

Table 2. Summary of the critical incidents
4.1 First phase: “We want them to come to www.sl.se”

The delivering of timely and relevant information assisting travellers to go from point A to B has been a core mission for the SPTC for decades. In the late 1990’s the company began a series of large and visionary IT projects aiming to provide functionality such as interactive journey planning, real-time departure information and disruption information. Among the services offered was a mobile website (mobil.sl.se), ability to save preconfigured trips and favourite stations on the web site and a real-time web page for computer desktops. The main hub (signs at bus stops and stations excluded) through which all digital services were offered, was the company web page www.sl.se.

“It was made in the traditional way, systems for presenting information at our own webpage and our own signs, and everything had to be huge and big. We were building space rockets, and then things takes a lot of time.” (Head of Internet services, SPTC)

As the project progressed a growing interest from external parties emerged. Typically they wished to present information about public transport through alternative media channels. For instance the largest yellow pages service in Sweden wished to publish the location of bus stops in their map service. However, these proposals were refused and pushed back:

“Several parties got in touch to me and expressed that they wanted to build things with our data, and that they wanted to cooperate with us. It was this and that, everything from screens at refrigerator doors to very local travel planners. […] I was pretty quick to say no to them since we didn’t have the resources, technology nor the right type of thinking for that kind of collaboration.” (Head of Internet services, SPTC)

The internal strategy not to provide information to external partners was motivated in terms of control. If other parties were to create their own services SPTC would lose control over how the information was presented to passengers which, in the case of e.g. incorrect information, could lead to dissatisfied customers and ambiguities with regard to the company trademark. Further, allowing free access would contradict other goals such as potentially selling the information in the future:

“We were afraid of how our information was presented when we have no control over it. [...] We just wanted them [our customers] to come to www.sl.se” (IT-controller SPTC)

“Well, it was like some policy at SPTC that we did not want to share any information, since someone else could then do something that was better than what we provided.” IT-system administrator SPTC

In September 2007 APTC, initiated an export of data (including data from SPTC) to Google, thereby making nationwide coordinates of bus stops and stations in Sweden available through Google Maps. SPTC reacted promptly and contacted APTC in order to clarify that SPTCs data were not to be distributed to third parties. At this stage, the strategy was clear and firm – SPTC did not accept other parties to present information about public transport in Stockholm.

“[SPTC] watched a presentation where Google showed their information, and the reaction was like ‘How the hell did you get this information?’ And when they answered ‘Through APTC’ the ball was set in motion. [...] It was then that SPTC showed that as soon as something happened that was beyond their control, in any other channel or by someone else, it was all negative. It was one hundred percent ‘What the hell, we don’t have any control over this, so we’ll put an end to this.’ It was reflex behaviour that ‘this must be removed, remove it immediately!’” (CEO, the Swedish Association for Public Transport Companies)

“Suddenly we had become side-lined by our own service company that we paid fees to, and afterwards we are told that they basically have signed a commercial contract [with Google]. Then my eyes started to glow, I can tell you that.” (Business developer, SPTC)

As APTC was controlled by formal agreements and through ownership it was possible for SPTC to regain control over how information from SPTC was used and the export to Google ceased.
Second phase: "We’ve lost control"

During 2008 a growing number of external services suddenly appeared. In spite of the policy at SPTC that information about public transport was not to be provided through external parties, these unsanctioned services gained a large user base. The services were created without any permission from SPTC and the information for those services was screen scraped (extracting selected parts from SPTC’s webpage) from existing services provided at the company website. For example, information from the journey planner system and the real-time information system started to appear through a number of applications for iPhone, Android, Windows Vista Gadgets and similar services for Macintosh computers. The most popular application for iPhone was distributed through Apple App Store and became available to iPhone users for the first time on November 9th 2008 and rapidly gained a large number of users. The application was created by a student in Stockholm as a hobby project, without any formal agreements with SPTC.

“The fact is that this is something of a hobby project so we felt like it’s fun to do something, not to get involved and try to get into various agreements to the right and left. So then I solved the problem so to speak. [...] It worked great. [...] I have thought that if one has a fairly large user base it’s not as easy to dismiss my application with ‘no, but we do not want anyone else to access or view our information’” (The developer of the leading iPhone application)

For Android a number of services emerged in a similar way, and in this case too it happened without prior permission from SPTC. The most popular service for Android was called “STHLM Traveling”

“It was pretty straightforward because I lived outside Stockholm, so I needed to have something that took me from point A to B when I was in the city. And something that was quick and easy and so that I did not have to go through the website. [...] In a simple and intuitive way really. That was my motivation to build it and that is what it still is. [...] That many people used it and got in touch was extremely fun.” (The developer of the leading Android application)

As SPTC became aware of the new services available and the screen-scape technology used for getting data, different types of actions were discussed internally. One application was investigated from a legal perspective regarding data ownership and trademarks, but no action was taken.

“I think people were a bit shocked actually, ‘Oh, we’ve lost control’” (IT-project manager, SPTC)

“Suddenly we became aware that this is something that is ongoing and it has been ongoing for several years but we did not know about it. Well, knew about, that’s no secret that they did but there was just nobody at [SPTC] who had reflected upon that they did it.” (Head of Business Development, SPTC)

As the external services increased in popularity and use, without SPTC taking any action, it became more and more apparent within the organization that the prior position not to share information was unsustainable:

“We thought that whatever action we took, it was not possible to stop this in the long run. [...] The only way to gain value to our brand was to make data available.” (Head of Passenger Information Department, SPTC)

Third phase: “We had to write adapters and my God what misery it was.”

One of the new services, externally developed without permission from SPTC, was programmed to get information from the real-time information system on a regular basis. However, if the information was not delivered within a certain timeframe, the system was again asked the question. This bad way of handling errors in the code of the gadget, together with an extensive distribution of the gadget through the Microsoft Windows Vista Gadget gallery, created a critical situation for SPTC. When the real-time information system was slow in answering requests, this resulted in a large number of questions from the Gadgets distributed to thousands of computers running Microsoft Windows Vista. This could for example occur in the case of bad weather conditions with a large number of passengers searching for information or when new internal systems were deployed at SPTC.

“We noticed that there were problems with the real time information for the commuter train, and that the database server suddenly went into high gear as the CPU was like running at like one hundred percent. Then we started to explore a little bit and found out that it was this gadget that caused problems. We saw that it made a lot of calls
because it sent a parameter that we normally do not use. The gadgets are all open source so we could see that the gadget sent the parameter. And in this way we could reduce the number of requests to the database. Then everything was okay for a while, until it completely started to run amok, and completely killed our servers... This was when we deployed our new interface of the company webpage, even though we were entrusted with a very powerful server environment. The complete webpage went down just eight, nine hours after launch and it took very long time until we really could deduce the whole thing and fix it. So I mean of course it has cost the company an enormous amount of money.” (IT-system administrator SPTC)

As a consequence of the issues with the externally developed services, an internal process was initiated to formulate a new strategy. Formally, this process consisted of three workshops ending up with a strategic document named “Guidelines for cooperation on passenger information”. This document stated that SPTC should now reach out to external developers in order to manage the external channels and services. The new strategy nevertheless came with restrictions on usage and who could use the information. All external requests should be handled and matched up against certain criteria, retaining some control on SPTC’s behalf. The document also highlights the importance of the SPTC Trademark and that SPTC should be presented as provider of the information in the third party services. The new guidelines were decided in the management team after some discussions about the economic value of the information:

“We really thought for a while that we had a commercial opportunity. That we could sell this information. [...] It was this sudden awakening when we realized that, first we thought that we could get paid for this, and yes the people out there was very much interested in it. But if we demanded payment, [people] would ensure that they had access to that information anyway. To think that we could sell it, the idea was useless. They would just get the information from the journey planner at all times anyway.” (Head of Business Development, SPTC)

The consequence of the new strategy was that developers of existing screen scraping applications would sign agreements with SPTC. Hence, the developers of the most popular applications were contacted and had to sign an agreement in order to prevent SPTC from taking legal actions.

“We came to meet SPTC and started talking. [...] It was of course long, big contracts with many things we had to sign. [...] There were requirements for how the information would be distributed [...] ‘You may only use it for a travel planner’ and all that. I felt that it was much about trying to protect so that someone else not could get the data. [...] It was not allowed to store anything on the [users’] phone and so on. [...] It prevented me from doing stuff that I wanted to do.” (The developer of the leading Android application)

Nevertheless, even though SPTC had opened up the possibility of getting information by signing an agreement, new problems occurred. Firstly, it was not possible to provide a good technical solution replacing the screen scraping technique.

“It was well-sealed containers, I would say. Then we had to create the APIs in retrospect for a system that was not really built for APIs. We had to write adapters and my God what a misery that was.” (Business developer, SPTC)

Secondly, the new strategy required considerable overhead to manage a growing number of agreements as well as an increasing number of technical questions raised by external developers - it was difficult to design an organization that could serve external requests in line with the demands.

“I think that what I feel I’ve missed it is actually a good regular contact with SPTC. [...] Pity that it did not work but we got it on Monday’ and just ‘Okay’. They shut down the office on Friday afternoon and it feels like you want to say ‘Yes, but come on, there are many people out there using these APIs’” (The developer of the leading Android application)

4.4 Fourth phase: “An initiative for open transport data”

At the end of 2010 a joint project between the Swedish Association for Public Transport companies and SPTC was formulated. The aim of the project was to create a more sustainable and less time consuming way of distributing information to third party developers. At this time SPTC had signed more than 25 agreements and there was an emerging need to find more efficient ways to manage existing and new relations, both with regard to technical solutions and the dialogue with the external developers. From the association’s point of view, the project was a
Co-creating Innovations

project for the industry of public transport in Sweden, with a result that could be used by several of the owners of the association. In this case, it was also beneficial to communicate with developers as a united industry distributing open information about public transport in a common way for the whole of Sweden.

“We had limited resources at the IT-department and the IT-department were concerned that if we were to do those things ourselves we would have to spend more time, have yet another one thing to manage, provide documentation etc. [...] It sounded like a brilliant idea to do this together with other companies that think in the same way.” (Head of Internet services, SPTC)

“It's good to work together so that you get all those APIs under one roof so to speak. And also we can share a technical solution. [...] And then we do not ourselves need to go ahead and develop solutions.” (IT-system administrator SPTC)

In September 2011 “Trafiklab.se -- an initiative for open transport data” was launched as a result of the joint project between the two organisations. The solution was described as an initiative to open up information about public transport in Sweden to external service developers. In the external communication about the initiative, external services like the leading application for iPhone are highlighted as examples of what can be achieved when opening up information.

“[The most popular iPhone application] is a prime example of that is not necessarily we at SPTC who best can produce useful digital services for travellers. We hope that this initiative will lead to many more smart services to accommodate different types of travellers, says [Head of Internet services, SPTC].” (Joint press release from the association and SPTC, September 12 2011)

At www.trafiklab.se it is possible to access the information from SPTC and get documentation by registering an account directly at the website as well as the possibility of posting questions and providing feedback to SPTC. Merely one week after launching trafiklab.se more than 160 third party developers had registered in order to get access to the API’s (to be compared with the 25 legal agreements the approach in phase 3 had rendered).

5 Discussion

As stated in the introduction of this paper, one objective of the study was to solidify and extend knowledge about the drivers of co-creation. Whereas the current literature portrays co-creation exclusively as an internally-driven strategic choice, where organizations actively approach actors in their environment and engage them in some joint activities, the case of SPTC suggests that we need to assess and conceptualize an alternative type of co-creation that is externally driven by third party actors who are backed and supported by an engaged user base crowd. In other words, we can broaden our understanding of co-creation based on the identification of the driving force that propels the resulting joint activity, or the directionality of its thrust which may be internally or externally driven.

To that end, Figure 1 can be extended with an additional thrust dimension. As described earlier in the paper, based on the literature, the motivation to engage in co-creation activities can be seen on a continuum from rewards (e.g. crowdsourcing) to affordances (e.g. co-produced services). However, our case data underline that the thrust – i.e. the propelling force of co-creation activity – can also be driven by entities located outside the boundaries of an organization and beyond its control. Figure 2 portrays the revised space of co-creation activities that includes both the motivation and thrust dimensions. In what follows, we present an extended view of co-creation that builds on the expanded model.
The most frequently described co-creation activities are driven by organizations and motivated by rewards. For example, crowd participation in crowdsourcing is motivated by the rewards offered in the challenge (Jeppesen & Lakhani, 2010). This observation leads to our first proposition:

**Proposition 1:** Internally driven reward based co-creation is likely to be successful

The SPTC case data suggest that we cannot apply a similar proposition to affordances based co-creation. In contrast, we find several examples in our dataset of how organizationally driven co-produced services failed. For example, even though SPTC offered mobile services through its mobile web site, people with smartphones seemed to abandon these organisationally offered services and instead turn to unsanctioned services offering additional affordances. Further, as SPTC eventually acknowledged that they needed to establish relationships with third-party developers, they initially approached them with unacceptably stiff legalistic. As a consequence, most of the third party developers simply ignored SPTC and continued to use unsanctioned data channels.

Whereas in the case of SPTC, internally driven affordances based co-creation failed, the literature exhibits several instances of co-produced services where such internally developed technology is rolled out successfully to end-users and able to serve situated needs (Germonprez et al., 2007; 2011). We suggest that success in instances of affordances based co-creation depends on thrust and user base complexity. As illustrated in the literature, organizationally driven affordances based co-creation within the realm of a particular technology (e.g. a single platform) and a more uniform user base population is likely to be successful. However, as more new platforms emerge and the user base population becomes more diverse, the host organization (as demonstrated in the case of SPTC) simply cannot meet the diverse technical as well as functionality demands of the market population. Subsequently, failing to meet the diverse needs has far-reaching consequences that result in failure. This leads to the second and third propositions:

**Proposition 2:** Internally driven affordances based co-creation for homogenous user populations is likely to be successful

**Proposition 3:** Internally driven affordances based co-creation for heterogeneous user populations is likely to be unsuccessful

Finally, externally driven affordance based co-creation is likely to be successful. As revealed in our observations, third party developers and the crowd compelled the company to engage in co-creation (as happened with the
establishment of trafiklab.se). The SPTC case also suggests that the external forces were mobilised effectively only as the user base became more heterogeneous and the demands more complex. This leads to the fourth and last proposition:

**Proposition 4:** Externally driven affordances based co-creation for heterogeneous user populations is likely to be successful

5.1 Implications for practice

The results of the study provide several insights for the design of co-creative activities. Organizations who wish to deploy co-creative activities need to identify and acknowledge the motivation of the target population. Motivations may run from finite reward-based incentives to the acquisition of perpetual affordances. Further, successful deployment of co-creation activities requires an a priori understanding of the nature and level of complexity of the target population. Based on the study, we suggest the following: In cases in which the target population is motivated mainly by rewards, the design and execution of the co-creation activity can be driven by the host organization. Similarly, if the target population is motivated by affordances and the user base population is relatively homogenous in terms of functionality needs and technology in use, again the organization may drive the effort in increasing value for involved parties. However, if the target population is motivated by affordances and the user base population is relatively heterogeneous – that is, it has diverse functionality needs and it utilizes diverse platforms – then intense involvement of third party developers in designing and orchestrating the co-creation activities is critical for their success. Overall, and particularly in the cases of heterogeneous user base, partnering with external third parties, drawing on their resourcefulness, and including them in the value chain of the co-creation activities may offer substantive benefits to the host organization that subsequently can partially or fully withdraw from dealing with end-user capabilities. For example, in our case, SPTC has stopped developing all smartphone applications, yet the company is able to serve successfully the current diverse user base of mobile devices.

Any successful co-creation endeavour is based upon establishing win-win relationships between all parties involved. In crowdpushing, where by design third party developers take a dominant proactive role, the available resources at the organizational boundary play an important role in establishing such relationships. This is a critical point and organizations must pay careful attention to designing interfaces that cater to the third party developers’ needs and to the appropriation of the necessary resources that allow them to serve the user base and to create value for all. Moreover, as demonstrated by the SPTC case, organizations need not only to understand the incentives and to meet the needs of the co-creators, but also to refrain from posing unnecessary restrictions and constraints. Failure to do so may not only hamper co-creation but also steer away the independent developers towards alternative and unsanctioned resources. In summary, we believe that the key to successful co-creation activities lies in an active, reciprocal dialogue that provides a basis for win-win relationship among all stakeholders.

6 Conclusions

We have explored the drivers of co-creation and the relationship between an organization and its co-creating crowd. Building on single-case data from a Swedish public transport company, we found that co-creation as an activity can be driven by forces external to the organization, something that has so far gone unnoticed in the literature. Subsequently, we introduced the notion of crowdpushing, a type of co-creation that is externally-driven by third party actors that are backed and supported by an engaged user base crowd. Given that the basis for research presented in this paper is a single case study, there is a need for further explorative studies on crowd-led co-creation activities, as well as rigorous testing of the hypotheses presented in this paper. Moreover, we see a need to reach a deeper understanding of how to design the resources necessary to support successful crowdpushing activities.

Given what we witnessed in the SPTC case, crowdpushing may lay bare entirely new possibilities in which an organization can help in creating value for their customers. Nevertheless, while we can envision the possibilities that crowdpushing might bring, we do not maintain that crowdpushing is the only mechanism in play in the context of co-
creation. Rather, we hold that anticipating crowdpushing and designing for it ahead of time can mitigate some pitfalls in the deployment of co-creation activities, let alone being a source of much value for all.

civic is connected to the idea of an innovation that serves “a good cause”, which has been formulated in different ways in previous periods. Except for the early movement where an inspirational logic dominates, the industrial value logic continues quite stable – also in terms of content – throughout the studied periods, based on principles of efficiency, quality and reliability in software development. The popular value logic by which credit and esteem in the opinion of others form the value base is recognized in all periods but has undergone interesting transformations. In the early movement reputation mainly was a matter for the internal community. This value base becomes more general and wide in the pragmatic justificatory arrangement. Different approaches were found among the developers, from a deep involvement in community reputation building to business orientation and policy making. Here we also find a new approach where popularity can be a merit that is highly valued and sometimes be traded between community and company. This means that the popular value logic can inhibit several possible interpretations, which makes it resilient.

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References


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Abstract

In many instances, customers are seen as one of the key resources for new product development (NPD), as they often have deep product knowledge as well as experience and creativity potential gained by regular product usage. From knowledge management perspective, customers’ input to NPD is manifested in different forms of knowledge. Customers’ input to NPD typically reflects their needs and desires (need information) but may also represent suggestions describing how ideas can be transferred into marketable products (solution information), in some cases it even leads to radical innovations (leading edge information). In order to internalize customer knowledge, in theory different methods are discussed. However, little is known about these methods’ effectiveness and efficiency to transmit customers’ knowledge to firms. This research identifies a total of 15 methods with the help of a systematic literature review. By systematically analyzing these methods, we found that there are methods within which customers are involved only “passively” in NPD, as well as methods that enable a more “active” customer integration. This study exhibits that the methods which enable an active customer integration, compared to methods where customers are integrated only passively in NPD, are more suitable for attaining customer knowledge within innovation development.

Keywords: Knowledge Management, Customer Integration, Open Innovation, Co-Creation, New Product Development.
1 Introduction

Considering the increasingly dynamic environment primarily due to advancing competitiveness, new technologies as well as shorter product and innovation cycles, the continuous development of innovations has become indispensable. However, various empirical studies highlight the high failure rates of new products, especially in consumer markets (Urban and Hauser 1993; Crawford 1987; Ernst 2002). It is therefore obvious that management is highly interested in detecting ways that enable the development of successful innovations. A review of old and recent literature reveals that the reduction of innovation failures and the improvement of the return on funds invested in new product development (NPD) are mainly determined by the capability of these innovations to meet customers’ wants and needs (Moore 1982; Davidson 1976; Martin and Bush 2003). In the course of time it has been recognized that the creation of successful innovations requires the compounding of knowledge from various perspectives, including especially the knowledge of customers, as these are most suitable for revealing their wants and needs (Bergman et al. 2009; Leonard and Sensiper 1998). Customer knowledge has become indispensable for developing innovative products (Su et al. 2006).

Gassmann et al. (2005), and Lengnick-Hall (1996), amongst others, suggest that absorbing customer knowledge through customer integration into NPD strengthens a company’s core competencies. In the context of customer integration, customers creatively contribute and cooperate within the different phases of the innovation process (Zwass 2010). This approach, often referred to as “Open Innovation” (von Hippel and Katz 2002; Chesbrough 2003), becomes more and more important in innovation development (Bretschneider et al. 2008). As a consequence, in the past, various methods that allow engagement of customers in NPD have been developed (Füller and Matzler 2007; Lilien et al. 2002). The application of customer integration methods enables companies to attain extensive information from customers. Customers can provide need information that reflects their desires and wishes, as well as solution information which manifests itself in concrete improvement suggestions or solution ideas. Certain customer integration methods also ensure acquisition of sticky information which refers to customers’ latent knowledge, and leading edge information which embodies highly innovative knowledge from lead users (Eisenberg 2011; Reichwald and Piller 2009).

In literature, numerous research articles have investigated different customer integration methods (Leimeister et al. 2009; Jeppesen 2005; Ebner et al. 2009; von Hippel 1986). Nevertheless, hitherto, there has not been a compilation of the various customer integration methods based on a systematic literature review. Thus, the actual number of methods, which are deployed in innovation management, has not been ascertained yet. This aspect becomes crucial, considering particularly the progression of customer integration methods in the light of information technologies. In this connection, especially the Internet as an immersive and multimedia-rich technology with low costs of mass communication allows companies to interact with external sources in a more (cost-) effective as well as interactive manner. Furthermore, despite intensive research on the different customer integration methods, an elicitation of the appropriateness of the existing methods to internalize the different types of customer knowledge is still missing. Existing customer integration methods are all different in their nature; however, the central purpose of all methods is to attain knowledge from customers and internalize that knowledge into innovation development. Hence, the question arises as how appropriate existing methods are to fulfill this purpose.

In view of this, this paper seeks to fill the outlined research gaps by addressing the following research questions:

1. What kind of customer integration methods can be identified within the NPD literature?
2. How suitable are the particular methods for internalizing customer knowledge?

The rest of the paper is structured as follows. In section two, we present the methodology for the literature search and analysis before we outline the identified customer integration methods. Section three first describes the framework for the derivation and explanation of information that is crucial in the context of co-creation within NPD. Here, we then present the results of the literature analysis by assessing the appropriateness of the existing methods for internalizing customer knowledge. Finally, conclusions as well as an outlook for future research conclude the paper.
2 Literature Review

2.1 Methodology

Due to its importance regarding the progression and the eventual success of enterprises, innovation is an intensively researched area (Gianiodis et al. 2010). Since the involvement of customers in innovation processes has gained greater importance over the years, much research has been conducted concerning various customer involvement methods. In this context, especially within the research field of open innovation, customer integration methods have been thoroughly analysed. Given these facts, a systematic and exhaustive literature analysis becomes more and more important (Webster and Watson 2002). According to Torraco (2005), the design of the procedure of a literature review is to be intersubjectively verifiable in order to maintain the scientific value of the literature analysis (Berkovich et al. 2011). Hence, in the following, we explicitly show our procedure in identifying the relevant literature regarding customer integration methods following the approach of Webster and Watson (2002).

We deployed a three-stage approach to identify an extensive set of academic studies upon which our review is based. First, we conducted a search of key strings in the EBSCO, Business Source Premier, EconLit, JStor and Science Direct database, as well as in the Google Scholar search engine. We chose these databases because they allow access to a comprehensive set of scholarly publications, especially within the research fields of marketing and (IT-) management, where innovation management is allocated. In the literature, the term “customer integration” is often used synonymously to the term “customer involvement.” Due to the fact that customer involvement – in contrast to customer integration – is a highly comprehensive term, which therefore is seldom explicitly used as a keyword in abstracts, we used two different search strings: First, we used the search string "customer involvement OR user involvement AND innovation." Thus, we narrowed the range by adding the keyword “innovation” as we searched for studies within innovation research. Further on, we performed another search using the string “customer integration OR user integration OR open innovation OR user innovation.” Drawing from the sample of articles from the first stage, subsequently, in the second stage, we enlarged our search by using forward and backward citation indices. We continued this procedure until we identified an exhaustive set of studies (Gianiodis et al. 2010). Concerning the timeframe, we searched the literature from 1980 up to 2011, since the involvement of customers in the innovation process started to attract interest in the academic business literature from about the 1980s (see e.g., Rosenblad-Wallin 1985). Apart from these areas, research articles and books also depict a relevant object of analysis, as they condense substantial research findings. Hence, using the mentioned key strings, in the third stage we also searched on Google Books.

Subsequently, we applied two boundary criteria to identify the relevant literature. First, concerning the identified research articles, we solely included papers published in peer-reviewed scholarly journals, since the terms customer involvement, customer integration, and especially open innovation, have gained major attraction in the popular press and other nonacademic print media (Gianiodis et al., 2010). We then analysed each paper and book, including only those which explicitly addressed methods involving customers in the innovation process.

2.2 Results

In total, we identified 105 literature sources upon which our analysis is based. Within these papers and book sections, a total of 15 customer integration methods were identified. Five of these methods (namely, Toolkits, Idea Communities, Idea Competitions, Lead User Workshops and Focus Groups) directly relate to the context of open innovation, whereas the other ten methods (namely, Surveys, Interviews, Reclamation Management, Boundary Spanner, Empathic Design, Concept Test, Product Clinic, Security Trading of Concepts, Quality Function Deployment, Listening In and Information Pump) are covered more extensively in the marketing literature. To obtain a better understanding of the subsequent analysis of the identified customer integration methods regarding their appropriateness to internalize customer knowledge, they are at first briefly described.

1 Due to limitations regarding the number of pages, the identified studies cannot be listed and outlined here.
The Survey is the most disseminated method used in practice as well as in research to gather customers’ opinion, respectively customer knowledge (Reichwald et al. 2004). Here, interviews can be carried out personally, telephonically or by mail (Hemetsberger and Füller 2009). Ordinarily, surveys are standardized due to the fact that managers try to capture an overall or average view of customer knowledge by interviewing numerous customers. A less standardized method is the Complaint Analysis within which customers submit information according to their dissatisfaction with offered products. Contrary to surveys, here customers initiate the information transfer process (Stauss and Seidel 2005). Besides complaints, they can also provide wishes, suggestions or improvement ideas regarding existing products (Berry and Parasuraman 1991; Brockhoff 2003). Relevant customer information can also be gathered by direct customer contact as it is done within the Boundary Spanner approach. Here, field workers record relevant customer information in the course of their direct contact to clients. Afterwards, the acquired information is analyzed systematically. Reid and De Brentani (2004), as well as Johlke et al. (2002) found that in this way, information that is essential for innovation development can also be acquired.

In addition to these methods, in customer research the observation of customers is also a common approach. In this context, two methods are applied within innovation management: Empathic Design and Product Clinic. The aim of these methods is to observe noticeable issues, behaviors and characteristics of customers. From these findings, specific customer needs and requirements are derived for product development. In the scope of the Empathic Design method customers are observed while using products in a natural environment (Leonard and Rayport 1997; Evans et al. 2002). As opposed to this, within the method of Product Clinic, customers deal with specific products in a laboratory setting while they are observed (Wildemann 1999). Subsequently, the participating customers are asked about their experience with the provided product. This monitoring method is applied particularly in the automotive industry (Schuh 1991). Another method, which is widely used in practice, is the Concept Testing. Here, prototypes, design drafts and concepts are presented to selected customers, who in turn evaluate the presented objects (Moore 1982). Security Trading of Concepts, Information Pump and Listening In represent similar methods which, however, are conducted virtually. Within the first method, prototypes or concepts are traded as ‘securities’ in an exchange-like business situation. The higher the price of a product concept, the better is its chances to succeed in the market. In this way, customers’ preferences can indirectly be ascertained (Hemetsberger and Füller 2009). Information Pump is a method within which customers are encouraged by playful means to state their opinions and preferences regarding a product concept which is shown virtually (Prelec 2001). In this context, the interactive gaming can be implemented in various ways. However, the main goal of this method is to gather many unconventional ideas regarding a specific concept. These ideas can in turn be used within innovation development. Within the scope of the Listening In method, a virtual configurator proposes customers several concepts which are graphically illustrated and simultaneously valuated by the customers (Dahan and Hauser 2001). Based on the valuation, the configurator develops new concepts, which are valued again in a second round. This procedure continues for several steps. In this way, concept specifications that best reflect customer desires are captured. In contrast to these currently developed methods, the Quality Function Deployment is a rather classical, though wide-spread method for product development which was originally conceptualized in 1966 by Yoji Akao. Within this concept, it is assumed that the company already has an innovative idea and that the evolutionary development of that idea will be oriented on customer needs (Daetz et al. 1995; Huovila and Serean 1998; Kaulio 1998). In other words, customer needs are the basis for the further development. In the first step, customers are interviewed about their needs and requirements regarding the underlying innovation idea. Here, they must provide appropriate judgments regarding any possible peculiarity of the idea, respectively regarding the product which will result out of that innovation idea. The contribution of the different characteristics to the overall rating is determined by means of a conjoint analysis. Subsequently, the determined customer requirements are transferred in technical specifications. As a result, the use of QFD, which is based on very detailed customer requirements, provides qualified insights on the customer-oriented design of a product (Urban and Hauser 1993).

The Lead User approach is a well-established method that, in its modern form, aims to systematically identify innovative, highly advanced customers or users – so-called lead users – and to integrate them in NPD by organizing workshops within the company (von Hippel 1986; Eisenberg 2011). In the scope of these workshops, lead users together with company staff generate ideas and elaborate these into final concepts (Urban and von Hippel 1988). The Focus Group method is very similar to the lead user approach. However, the difference lies in the target group which is integrated in the innovation development: Within the focus group approach, ‘ordinary’ customers – instead
of lead users – are assembled in innovation workshops (Dahan and Hauser 2002; Bristol and Fern 1996). Ideas Competitions and Innovation Communities are two customer integration methods that are primary used to generate innovative ideas in the first stages of the innovation process. According to Leimeister et al. (2009), an ideas competition can be described as an invitation of a company to its customers to submit contributions to a certain topic within a predefined period of time. The submitted ideas are evaluated by a review committee, which also selects the winners of the campaign. The competitive character of an ideas competition motivates customers to produce a winning idea that is innovative and possibly even unique (Ebner et al. 2009). Ideas competitions are predominantly used to expand the source of potential new ideas. The same applies to Innovation Communities, which occasionally are referred to as ‘idea communities’. Here, customers generate ideas and collaborate with other customers within an internet-platform. Customers have the opportunity to submit ideas, to connect with idea contributors that submitted similar or complementary ideas and to elaborate ideas in collaboration with other members (Bretschneider et al. 2008). Consequently, within innovation communities various networks are formed that collaboratively elaborate matured innovation ideas, which are more qualitative compared to those initially submitted. As a result of the usage of this method, companies will generate a rich content of viable innovation ideas (West and Lakhani 2008).

Different from the hitherto described customer integration methods, Toolkits for User Innovation are mainly used for conceptualizing new products. This method proposes that customers autonomously innovate by using a special instrument – the ‘toolkit’ (von Hippel and Katz 2002). These tools enable customers to create designs of new product innovations or product variations according to their individual needs and preferences. The toolkit is usually an internet platform or a software application that is provided by the manufacturer (Jeppesen 2005). However, the provided toolkit can also inherit various raw materials or ingredients that are needed to construct a corresponding product (von Hippel and Katz 2002; Franke and Piller 2004). Eventually, the resulting concepts are used by the company as a basis for further product development.

3 Evaluation of Identified Methods

As the previous literature review has shown, various methods have been developed whose purpose is to acquire customer information regarding innovation ideas, initial and finished product concepts. In the following section, we present a framework upon which the literature analysis and evaluation is based. The goal is to present different information types through which customer knowledge can be transferred into the innovation process. In Section 3.1, these various information types are described, whereas in section 3.2, the identified customer integration methods are analysed regarding their appropriateness to attain customer knowledge.

3.1 Framework

The results of the literature review show that by applying customer integration methods, customers can be involved in different activities within NPD. For instance, customers can assess and generate innovative product ideas, or they can be involved in the creation and evaluation of first concepts or prototypes. This approach is often referred to as ‘interactive value creation’ (Reichwald and Piller 2009) or ‘value co-creation’ (Zwass 2010). Thus, within customer integration, not only information regarding customer wants and needs is generated, but customers also provide various solutions concerning different activities within the innovation process. Customer integration methods are used to internalize customer knowledge in order to identify customer wants and needs, as well as to use the innovative potential of customers. Generally, knowledge is transferred by information (Wallace, 2007). In this paper, following the insights provided by Reichwald and Piller (2009), we deploy a framework which encompasses different information types and their effect on efficiency and effectiveness on value co-creation. According to Von Hippel (1994) and Reichwald and Piller (2009), amongst others, mainly two different information types are required from external contributors within value creation processes: need information and solution information. Need information refers to customer needs and preferences, as well as to specific requirements of customers regarding specific products (von Hippel 1994). Customer need information is based on the experiences of customers with existing products and may lead to incremental innovations. However, this kind of information may also reflect the desires and needs that have not been met by products offered on the market. Given this, need information can also lead to
radical innovations. The more need information is extracted from customers, the more suitable the innovations are to meet customers’ wants and needs. However, within some customer integration methods (e.g., surveys), customers inherit a passive role because they are able to only state their need information. Here, concrete improvement suggestions or solution ideas are not considered. Solution information, in contrast, embodies knowledge on how a problem can be solved by a certain product specification. This knowledge manifests itself in concrete suggestions or statements on how need information can be translated into definite product concepts. Thus, by varying existing or raise own solutions, customers can also actively participate in value creation.

Füller and Matzler (2007) and Jeppesen (2005), amongst others, argue that customers are often not able to express their needs and desires because these are sometimes implicit and unconscious. They can be – as is known from the domain of knowledge management – difficult to express (Krcmar 2005). This kind of information is referred to as "sticky information" (von Hippel 1994). “Stickiness” is defined by von Hippel (1994) as “the incremental expenditure required to transfer a unit [of information] from one place to another, in a form that can be accessed by the recipient. When this expenditure is low, information stickiness is low; when it is high, stickiness is high.” The higher the stickiness, the more iterations and “trial-and-error”-cycles between a company and its customers are needed to transfer implicit knowledge within innovation NPD (Franke and Piller 2004). However, in order for new products to be successful, in addition to the conscious needs and wants, innovations must also address the unconscious desires of customers. Access to sticky information builds the basis for the development of radical innovations.

Within innovation management, it is widely known that especially lead users may generate radical innovation ideas (Eisenberg 2011; Lilien et al. 2002). Lead users are characterized by high involvement in a specific area; they inherit utterly innovative needs. Their preferences and desires regarding a specific product field are vastly advanced compared to those of average users. They inherit valuable knowledge and can therefore provide worthwhile need, as well as solution, information. The information stemming from lead users we denote as leading edge information. However, a major issue is that lead users are difficult to identify, as they are exceptional customers due to their characteristics (von Hippel et al. 2006). Especially in the scope of certain customer integration methods, such as surveys, complaint analysis, or the quality function deployment, lead users are only considered as a representative, respectively, statistical factor.

In conclusion, there are two relevant information types that are essential within NPD, namely, need information and solution information. In this context, need information stands for effectiveness (Reichwald and Piller 2009). This is due to the fact that new products ought to fulfill customer requirements – and therefore meet their wants and needs – ‘better’ than existing products. Considering an ideal-typical NPD process – from the identification of customer needs over ideation and concept development to the final market launch – need information are primary necessary in the phases of customer need identification and ideation. The more need information is attained within these two phases, the more effective is the innovation development, thus ensuring that the new products meet customers’ needs. Compared to need information, solution information stands for efficiency in value creation and refers to the issue of how to actually develop the ‘right’ products, respectively the products that meet the identified needs (Reichwald and Piller 2009). By generating plentiful, as well as adequate solution information, the efficiency of value creation can be enhanced due to the fact that solutions regarding different issues within NPD are available. Thus, solution information is indispensable for the development of first concepts or final products as well as for market launch as within these two phases solutions are required. However, in this context, sticky information and leading edge information are also valuable. These two information types are subspecies, as they can embody need, as well as solution information. Customers inherit unconscious needs that are valuable for the first two phases of NPD, as well as tacit solution knowledge which is relevant for the phases of concept development and market launch. Meanwhile, leading edge information is a valuable input for all phases of innovation development and positively affects the effectiveness as well as the efficiency of NPD. The subsequent illustration encompasses the issues outlined in this section and depicts the framework of this study.
3.2 Evaluation

A major goal of this study is to determine the appropriateness of the previously identified customer integration methods for internalizing customer knowledge. Meanwhile, within co-creation, customer knowledge is transferred through different types of information (need information, solution information, sticky information and leading edge information). Hence, based on a thorough examination of the findings obtained from the systematic literature search, the identified customer integration methods are analyzed regarding their appropriateness for internalizing these information types in NPD. However, first of all we found that there are methods within which customers are involved only “passively” in the innovation process, as well as methods that enable a more “active” customer integration. Within “passive” customer integration, customers are assigned to solely provide information about their needs and desires. Von Hippel (1988) describes this as the manufacturer-active paradigm, where the manufacturer discovers customer needs and then develops and implements innovative ideas, whereas customers “speak only when spoken to.” This concept is in contrast to the customer-active paradigm, which becomes apparent within the scope of “active” customer integration. Here, customers actively take part in various tasks within NPD by performing activities which used to be executed by the internal R&D, such as idea generation regarding new products, or development of concepts and prototypes.

Table 1 summarizes the analysis results for the various customer integration methods. Subsequently, the acquisition of the previously described information types via the several methods is explained in detail.

<table>
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<th>Solution information</th>
<th>Sticky information</th>
<th>Leading edge information</th>
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<td>Product Clinic</td>
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<td>●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Concept Testing</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Security Trading of Concepts</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Information Pump</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Figure 2. Information types within value co-creation (Adapted from Reichwald and Piller 2009).
Co-creating Innovations

<table>
<thead>
<tr>
<th>“Active” Customer Integration</th>
<th>Full access</th>
<th>Partly access</th>
<th>No access to information type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening In</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Quality Function Deployment</td>
<td>●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lead User Method</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Focus Group Method</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Ideas Competitions</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Innovation Communities</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Toolkits for Innovation</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
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Table 1. Analysis of customer integration methods for their appropriateness of internalizing the various information types

Need information can be acquired by providing customers the possibility to evaluate existing solution ideas and to state their preferences regarding those ideas. Except for the method of empathic design, need information is covered by all customer integration methods. By evaluating solutions within surveys and concept testing, or by posting contributions in idea communities, customers are able to provide information regarding their needs, desires and preferences (West and Lakhani 2008; Bretschneider et al. 2008). In comparison to this, by using toolkits for user innovation, customers are only able to partially express their needs as they develop concepts that correspond to personal desires. However, here customers do not have a chance to compare different solutions or ideas with each other and therefore they cannot state personal preferences. The same applies to the two approaches of boundary spanning and security trading of concepts. Meanwhile, within empathic design users are solely observed while using a product. Thus, customer needs cannot be gathered since customers have no possibility to state their desires and preferences.

The literature analysis has shown that methods within which customers are integrated actively in NPD ensure full access to solution information as within all of these methods, customers have the opportunity to contribute their own solutions and suggestions, which describe how these ideas can be transferred into marketable products (Blohm et al. 2010; von Hippel 1994). The lead user method, the focus group approach, as well as innovation communities facilitate innovation managers to benefit from the compounded knowledge of various customers due to the fact that in the frame of these methods, customers have the chance to jointly elaborate specific solutions or ideas. Passive integration methods, where observation is used – namely, empathic design, product clinic and concept testing – partially allow access to solution information. This can be explained by the fact that while testing a certain product, customers may generate new ideas or methods regarding its usage and application. However, all the remaining methods are not suitable for obtaining solution information, since in this connection customers are involved just passively in innovation activities. Active involvement of customers, in terms of enabling customers to alter existing ideas or actually contribute their own solutions, is not supported by these methods.

One way of detecting sticky information is offering the opportunity to ‘experience’ a solution (Füller and Matzler 2007). This can be realized by providing tools with which customers can ‘try’ a product concept, or even create concepts or prototypes by themselves. These tools can be IT-based, e.g., programs for product configurations, or they might consist of real modules with which various product or service concepts can be designed (Franke and Piller 2004). However, sticky information is hard to acquire, since from the outset it is difficult for customers to articulate this kind of information. This is particularly evident considering our findings, which show that within passive customer integration only three methods are partly suitable for recalling sticky information; namely empathic design, product clinic and concept testing. Here, by enabling customers to experience concepts or prototypes while testing them, customers’ latent needs can be partly discovered. Experiencing a solution is not possible within innovation communities, ideas competitions, lead user or focus group workshops. However, in the scope of these methods, customers are able to run trial-and-error cycles since they have the opportunity to contribute suggestions as well as to alter their solutions or prototypes after having had a critical look at them. Nevertheless, toolkits for user innovations are the only method with which sticky information can be fully accessed. By self-designing and simultaneously experiencing concepts and its features, customers are able to realistically assess whether the new product idea fulfills their latent needs (Jeppesen 2005; Franke and Piller 2004). While designing, customers usually run several iterations until they finalize their individual concept which reflects their wants and needs.
Finally, in the scope of our literature analysis, we also examined the appropriateness of the various customer integration methods to capture leading edge information. The findings show that methods within which customers are integrated passively in NPD are not suitable for recalling leading edge information. This is due to the fact that here all involved customers are regarded as a representative, respectively statistical factor. Thus, only average values (e.g., the valuation of specific ideas) are considered, so that leading edge information falls by the wayside. In the frame of ideas competitions, innovation communities, and toolkits for user innovations, leading edge information may partially be identified; however, here advanced ideas and concepts are not systematically selected and subsequently elaborated. The lead user method is the sole method which is appropriate to fully access leading edge information. However, this result is less surprising since the lead user method was developed for the purpose of identifying lead users and fully using their innovation potential (von Hippel 1996).

In conclusion, most of customer integration methods are generally suitable for recalling need information. However, customer integration methods, where customers are only integrated passively in NPD, are just slightly suitable for recalling solution information and sticky information, whereas the knowledge of lead users cannot be accessed by this means. These results are less surprising since these methods (e.g., survey, quality function deployment) were pre-eminently developed to attain customers’ needs and desires. Nevertheless, based on our findings, product clinics and concept tests are the most suitable methods for partly recalling the different information types at once. This rating is justified by the fact that within these two methods, customers have the opportunity to test, respectively experience a concept, to evaluate it and also to contribute suggestions regarding the underlying concept. Furthermore, we established that by means of active customer integration, need and solution information can most widely be attained, whereby a broad identification of sticky information and leading edge information is ensured as well. In this connection, lead user methods are best suitable for attaining customer knowledge. This result corresponds with the fact that lead user workshops are quite popular in practice – particularly in industrial markets (Lüthje and Herstatt 2004) – and innovation research (Eisenberg 2011; Lilien et al. 2002). We thus conclude that customer knowledge can be attained more effectively if customers have the chance to actively participate in innovation processes.

4 Conclusion and Outlook

Customer knowledge has become a valuable input in innovation processes (Gassmann et al. 2005). Starting from research gaps regarding a systematic compilation and assessment of existing methods for internalizing customer knowledge in NPD, we systematically analysed literature to address these issues. We identified and outlined a total of 15 methods with which customer knowledge can be attained within innovation development. In conclusion, the underlying study, which is based on a systematic and in-depth literature analysis, shows that methods which enable an active customer integration, in comparison to methods where customers are integrated only passively in NPD, are more suitable for attaining customer knowledge within innovation development.

For innovation managers in practice, the underlying literature review serves as an overview of methods used to involve customers within innovation development. More to the point, the results of this study provide an assistance regarding the use of the various methods in specific contexts. Depending on the information type that managers tend to gather from their customers within NPD, our study depicts the appropriateness of different customer integration methods to address the corresponding information type. As for theoretical implications, this paper contributes to open innovation research by collating insights from different research disciplines (e.g., marketing, software engineering, engineering design, innovation management) and harnessing that knowledge for open innovation. The various methods identified within the literature review have been used for various purposes and in different settings, whereas within open innovation usually only four customer integration methods have been discussed – i.e., Toolkits for Innovation, Lead User Workshops, Idea Competitions, and Innovation Communities. Thus, this study enriches the field of open innovation by revealing customer interaction methods which allow customers to be involved in innovation development. Based on the findings acquired within this paper, implications for further research may be derived as regarding the presented results, a major question arises: Is there a chance to modify and consequently improve the existing methods, in order to enable a more effective access to customer knowledge? This issue seems to become crucial considering the fact that none of the existing method is suitable for
fully attaining the various information types presented in this study. Consequently, this depicts an interesting research issue especially in the field of IS research. Developing IT applications that support the existing methods might be a possible approach to address this research problem. For instance, modern virtual toolkits (e.g., 3D simulation tools) empower customers to experience innovations long before their design has been finalised, thus enabling a more effective acquisition of sticky information (Füller and Matzler 2007). Furthermore, combining the use of different methods or only specific aspects of various methods might be another possible approach for addressing the stated research problem. For instance, Piller and Walcher (2006) introduced so-called internet-based toolkits for idea competitions, where the toolkit approach is combined with the idea of competition. Further on, Hutter et al. (2011) and Ebner et al. (2009) conflate innovation communities with ideas competition. These are some promising approaches towards a more effective acquisition of customers’ innovation potential. Nevertheless, more intense research needs to be done in this direction.
References


INFORMS: Institute for Operations Research.


<table>
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<th>TITLE</th>
<th>UNDER THE PRESSURE OF OPENNESS: EXPLORING DIGITAL INNOVATION IN USER INTERFACE DESIGN</th>
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| SESSION CODE                 | CCI-2                                                                                 |
Abstract

In this study we are concerned with the ways digital components increasingly challenge preexisting work practices in traditional product development. By drawing on an in depth case study of an automakers attempt to respond to digital innovation, we explore digital innovation in a hardware regime. More specifically, we studied challenges connected to the specification process, and the difficulties of working with digital innovation in user interface design. Based upon our analyses of AutoInc, a world leading car manufacturer, we draw three overarching conclusions. First, specifying requirements for a digital material is in some ways a paradox. That is, the nature of digital innovation enforces agility both in terms of specification and use; it is, so to say, a volatile material. Second, we found that with two innovation regimes in one firm, different characteristic in forms of architecture, design and organizational structures need to coexist. This typically brings tensions between the urge for managerial control and the principles of openness. Last, this study indicates that fine-grained level of specifications may also force a shift in the locus of innovation. Thus, autonomy in the design process may be unintentionally narrowed.

Keywords: Openness, Digital Innovation, Interface Design, Automotive industry.
Co-creating Innovations

1 Introduction

During the winter of 2009, the management group of AutoInc, a world-leading car manufacturing firm, communicated that digital design and human machine interaction (HMI\textsuperscript{2}) design was to be considered as one of the leading cornerstones in developing AutoInc’s future car models. The focus on digital design was a consequence of the growing presence of digital displays in the driver area and the possibilities for increasing customization, differentiation and improving the driving experience with an exciting and appealing HMI.

By that time, the financial turmoil had made it clear that the automotive industry needed to break with its current innovation path and that digital technology would play a major role in redefining the industry (Thrun and Levandowski 2009). For AutoInc, the focus on digital technology was a historical decision that had grown from the movements of the market. Accordingly, AutoInc had the ambition to be a part of a growing development in user interface design and, in particular, boost innovation with the use of digital functionality (Leonardi 2010) and enable for open innovation (Chesbrough et al. 2006; Chesbrough 2003b; West and Gallagher 2006). As described by a manager: “...we want to be an ‘enjoyable’ brand, a concept that should be reflected in all attributes and functions. When it comes to user interface design this requires openness, we need to put away all the pointers such as ‘you are not wearing your belt’ or ‘you are about to drive off the road’, and focus on becoming more pleasant and emotionally enjoyable.”

To that end, the importance of what and how information was presented in the driver environment had always been a matter of cognitive load, human factors, safety and usability (Green 2003; Wierville 1993). With the articulation of the focus on digital user interface development however, AutoInc was in a process of changing old work structures as to open up for external innovation and exploration.

The automotive manufacturing industry has a strong hardware legacy, where development processes and organizational structures are typically adjusted and reflected in the physical product, i.e. the car (Andreasson et al. 2010). However, in the last 30 years, digital data has increased in cars, in fact already in 2002 over 80% of innovations in cars originated from software (Leen and Hefferman 2002). More so, software represents more than a third of the development cost for a car (Weber and Weisbrod 2003). Today, as new functionality requirements are increasingly connected to software, the automotive industry is facing several challenges in terms of changing innovation processes. Such challenges involve definition of key competencies, processes, methods, and tools (Broy 2006; Pretschner et al. 2007). As an example, institutionalized supplier relations are put under pressure with the increase of digital data (Mathiassen et al. 2007; Weber and Weisbrod 2003). A car is a complex product, consisting of more than 15000 components. While suppliers produce the majority of these components, an increasingly pressing issue is how to include and combine digital elements in hardware components produced outside the boundaries of the firm.

Against this backdrop, this article aim to elaborate on how digital innovation affects design practices of user interfaces for digital displays. The research question is formulated as follows: How does digital innovation effect design practices in a manufacturing firm (with open innovation ambitions)?

Drawing on the open innovation literature and HMI design, we are particularly interested in understanding changes in the specification process and the consequences of turning a previously tangible function (such as physical buttons and switches) into an increasingly digital material.

The remainder of the paper is structured as follows. In the following section we present a brief review of current research regarding digital innovation. This is followed with a presentation of our theoretical lens based on open innovation literature. In the third section we define our methodological approach and then continue with presenting

\textsuperscript{2} HMI is an abbreviation for Human Machine Interaction used in the automotive industry. It embraces the concepts of User Interface design and User Interaction design
the AutoInc case. In section five we discuss the case in regards to the openness construct. We end the paper with conclusions and implications for research and practice.

2 Digital Innovation

The digitization of products has changed whole industries. Consider for example, the radical changes in the camera/photograph industry (Tripsas 2009), the newspaper industry (Ihlström and Henfridsson 2005) and the mobile manufacturing industry (Selander et al. 2010). It appears as if what previously used to be self-contained objects with well-defined functionality and meaning are now increasingly open-ended, agile and dynamic (Remneland-Wikhamn 2011). In particular, with the increase of digital components, content, value and usage can change and converge from one minute to the other (Yoo 2010). In a car context, this could be exemplified by the infotainment systems that traditionally included separate systems, such as navigation, radio, CD player. Today those systems are integrated and converged in a single black box and a digital display in the center stack.

Digital innovation can be defined as the recombination of physical and digital components into new products (Yoo et al. 2010). This recombination process typically entails external exploration and encompasses the search of generating novel knowledge and exploring new opportunities (Vera and Crossan 2004; Yoo 2010). This includes the integration of diverse forms of knowledge, and the search for competence and information across internal and external stakeholders (Boland et al. 2007). More so, the possibility to reproduce digital content, at low cost and at a very rapid pace, force product developing organizations to change their logic in regards to control. Such control mechanisms need to be adjusted so that they follow the distributed development and production of digital innovation (Yoo et al. 2008). It has been suggested that the mode of control have to move from being centralized and hierarchical to become socialized “whereby organization members develop common expectations and shared values that promote likeminded decision-making” (Nobel and Birkinshaw 1998, p. 483). Hence, dynamic capabilities are increasingly relevant (Teece et al. 1997), as strategic processes within organizations are required to adjust and adopt to utilize possible digital options (Sambamurthy et al. 2003).

Digital options as a complement to already existing options require adjustments and alignments between two separate innovation paradigms, the digital and the physical. It has been suggested that when two innovation regimes need to coexist one has to consider different characteristics in forms of architecture, design and organizational structures (Svahn and Henfridsson 2012). For example, structures required for developing and producing a metal chassis for a car, look different from the structures required to develop and produce the HMI software. The development of a metal chassis usually follows a strict sequential order while the HMI software development process is non-linear. Moreover, it has been suggested that to succeed today, organizations need to enable and manage a state of constant creative conflict between internal and external design (Tushman et al. 2011). In particular, recent innovation research stresses the importance of external acquisition of new knowledge for exploration (Raisch et al. 2009) and open innovation processes (Cooke 2005).

By knowing and recognizing the potential of digital and open innovation, many car manufacturers today are increasingly providing in-car data to external developers (Ili et al. 2010). In view of the competition over automobile information services, openness is considered as a way of pushing service innovation closer to those who experience the needs and to develop new innovation networks with the potential to break with the past (Chesbrough et al. 2006; Van de Ven 2005). Illustrative initiatives, in regards to opening up for external resources and suppliers outside of the car manufacturer industry, have been executed in, for example, GENIVI (Macario et al. 2009).

Infotainment is a neologism for Information and Entertainment and has in the last couple of decades received an increased amount of attention due to the growth of digitized services and functions in cars, such as navigation, tire pressure information and lately, the possibility to watch movies in the rear seat.

GENIVI® is a non-profit industry alliance committed to driving the broad adoption of an In-Vehicle Infotainment (IVI) open-source development platform (http://www.genivi.org/ Accessed: March 27 2012)
3 Open Innovation in Product Development

The open innovation concept rests upon the assumption that an organization may benefit more when letting an organization's innovative activities and intellectual property be available for external organizations and stakeholders to use than if keeping it internal and have centralized controlling mechanism (Chesbrough 2003b). However, fully implementing and embracing the open innovation idea has shown to be hard, specifically in the beginning of projects when the product is untried and little, or no, information about profit possibilities exist (Chesbrough 2006). In particular, open innovation initiatives typically involve early stage ambiguity in project outcome and payoff.

Research suggests that the multi-layered and modular architecture of digital data, that enables open innovation in the first place, not only drives but even forces firms to form new relationships as to create value they cannot create on their own (Yoo et al. 2010). Thus, an open innovation agenda includes the simultaneous work by users and external developers to innovate and add value to different products (Von Hippel 2005). By providing software development toolkits (SDK) for anyone to use (von Hippel and Katz 2002) and distribution of internal data (Tapscott and Williams 2007), organizations hope to grasp innovative competence that rests outside the boundaries of the firm. For a car manufacturer such data would typically be in-car sensor data on different functionality such as speed, fuel levels, but also information about what music is being played or in what direction the car is heading. However, to enable an open innovation process one needs to reconsider the organization's attitude and stand towards, for example, control. Shifting from “we should control our intellectual property (IP) so that our competitors don’t profit from our ideas” to “We should profit from others’ use of our IP, and we should buy others’ IP whenever it advances our own business model” is necessary (Chesbrough 2003a, p xxvi).

The automotive industry is spending remarkable amounts on research and development (R&D) in their efforts to enable a more open approach to innovation, as with the GENIVI project. Simultaneously the industry is under pressure to dramatically reduce costs due to shorter product life cycles and price erosion (Ili et al. 2010). Recent research have suggested that the design and specification process is key in understanding the outcome (Chakraborty et al. 2010) and the development (Mathiassen et al. 2007) of new innovative design and open innovation. While typically seen as a way of creating possibilities for designing new products and applications, the specification process has also been a traditional way to control the innovation design process (Baldwin and Clark 2000). In traditional product development organizations, such as the automotive industry, much emphasis has been put on deciding early on specification for the product in order to control the functionality and secure quality (Baldwin and Clark 2000). The increase of digital data and dynamic design however, is increasingly forcing this process to change. In particular, digital data brings agile ways to work, that is, requirements and specifications may change very late in the development process (Lenfle and Midler 2009). More so, digital characteristics such as reproducibility and programmability make digital components essentially different from solely physical artifacts (Yoo et al. 2010). By drawing on a single case study of the HMI group at Autolnc, a multinational car manufacturing firm, we seek to further understand the contradictions and consequences of open innovation and digitization on product development organizations.

4 Methodological Approach

We conducted a 6-month interpretive case study (Gerring 2007; Klein and Myers 1999) at one of the world’s largest automakers, Autolnc. With this approach we aimed to explore the empirical setting and improve the understanding of the complexities that emerge when digital content escalate in the innovation process.

During the last two years the development of user interfaces had received full attention at Autolnc. In fact, developing new innovative user interfaces solutions had become a core strategy at Autolnc and received a significant amount of resources. There were several reasons behind this increased focus on user interfaces. First, the instrument cluster was becoming increasingly digital emphasizing the importance of usability and cognitive load issues due to traffic circumstances. Second, user interfaces had become central in pushing digital innovations directly aimed at the user. Third, with the increase of digital data user interface development had become an important mean to communicate the brand towards customers. Last, recognizing that the in-car infotainment now competes
with the consumer electronics industry required a radically new approach, where open innovation was considered as one important strategy.

4.1 4.2 Data Collection

We used two main sources of data to trace Autolnc’s efforts to push open innovation in user interface development: (1) In-depth semi-structured interviews with employees involved in the user interface development process and, (2) workshops with employees and consultants at Autolnc as to understand the overall strategy of user interface development and digital innovation. A third data source included 21 different specifications (requirement documents) released internally at Autolnc during the years 2000-2011. Although this data did not become an important element for the published result in this study it provided important insights to us on the changing development and magnitude of specifications over time.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Amount</th>
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<tbody>
<tr>
<td>User Interface Manager</td>
<td>1</td>
</tr>
<tr>
<td>Interaction Design Engineer</td>
<td>3</td>
</tr>
<tr>
<td>User Interface Design Responsible</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
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The interviews, ten in total (see Table 1), were conducted during the months of May and June 2010. The respondents included a wide range of personal involved in the user interface development process, for example: User Interface Managers, Interaction Design Engineer, and Responsible for User Interface. The User Interface manger was responsible for all research projects before they transferred into development and production. Interaction Design Engineers included those working with implementing and specifying HMI requirements in different development projects. Those responsible for the user interface design, included product planners and managers working with overall design strategies coupled to the brand in general.

Table 1 Interviews

The interviews were semi structured and lasted on average one hour. All interviews were digitally recorded and transcribed. Key questions concerned issues related to the changing character of HMI design, requirement engineering, and difficulties/contradictions in working with an increasingly digital material.

Additionally, we conducted two workshops together with higher levels of management within the organization. The two different workshops discussed possibilities, consequences and challenges with open innovation and the increase of digital technology. The workshops also discussed how consumer electronics affect their customers and force Autolnc to take a new perspective on their product. The workshops took place in May 2010 and in November 2010 and lasted on average two hours. Seven managers from different areas within the automotive organization were represented at the first workshop while 12 managers were represented at the second workshop.

4.2 4.3 Data Analysis

Through iterative reading of the empirical data, the initial analysis phase started with thematic analysis (Fereday and Muir-Cochrane 2006) facilitated by open coding (Charmaz 2006). The open coding process involved naming and taking segments of data apart, a process that generated 181 descriptive codes. The second phase of the data analysis included clustering the data into coding families (Charmaz 2006). The descriptive concepts (initial codes), were clustered into six themes: User interface-development, Specifications, Tensions, Openness, Design and Tools. These themes guided us in finding an appropriate theoretical framework from which to analyze our data (Fereday and Muir-Cochrane 2006). More so, as to increase the overview of our data, we conducted network data displays following the recommendations of Miles and Huberman (1994). The network data display provided an overview of key events and links between them along with a better understanding of the case. The third phase of the data analysis included writing a thick descriptive case story (Geertz 1973; Langley 1999) as to isolate the core focus of the study. It allowed us to present the empirical data in a condensed but vivid and detailed form, including both practice and context data. We identified, in particular, three main challenges in the data material. These three challenges
were related to (1) software development, (2) changing tools, and last (3) renegotiating supplier relations. The thick description was presented to Autolnc to validate our understanding of the data material.

5 The Autolnc Case

The user interface group had grown dramatically within Autolnc. Not more than ten years ago, the user interface function was more or less dependent on two key persons specialized in ergonomics. In 2009, however, Autolnc communicated that user interfaces was to be a major strategic focal point. For the user interface group, this meant that Autolnc would put a lot of emphasis and resources on user interface development. The group was even expected to grow during the hard financial times of 2009-2010. The ambition of becoming leaders in HMI development and design could to some degree be considered as a historical decision. With long traditions of product manufacturing Autolnc had previously focused on hardware related issues, such as door handles and safety issues. The new strategic position of HMI development was recognized throughout the organization, a manager commented: “By now it [user interface design] is as important as our other trademarks… this creates ripple effects, and we need to change our work processes. Put simply, we do not have any (physical) products, we don’t work with hardware.”

Inspired by the movement of the market, Autolnc had realized that they needed to open up to external collaborations and change their old institutionalized work processes – this, in turn, created several co-evolving challenges. The user interface employees both wanted these changes but also felt the pressure of leveraging new innovative user interface design. Increasingly, this required new approaches to software development processes, new tools, and renegotiated supplier relations.

4.3 5.1 Software Development at Autolnc

The scope of HMI development includes the entire infotainment area. This area had gone through radical changes with the increase of digital products. In particular, services such as navigation, radio, telephone, music etc. is increasingly covered in the very same hardware. The convergence of different systems requires complex user interface solutions, and Autolnc struggled with finding user interface consistency between the different solutions to enable easy interaction. Accordingly, the very streamlined hardware legacy within Autolnc, needed to be adjusted to fit development of user interface software, an Interaction Design Engineer explained: “Software and hardware follow different business paths. Today we are dominated by engineers, and controlled by hard values. We need to embrace the new and make it sound reasonable to us.”

To clarify the new focus of HMI development, Autolnc made a strategic decision to divide user interface design in three new sub-domains; the keywords being that user interfaces was to appeal to enjoyable and emotional aspects of the driver experience. This was not an easy task as commented by an interface design responsible: “‘Hard’ functions are much easier to communicate and for the receiver to understand, so they typically get much more impact and penetration. That is much easier than presenting soft values and changing the development process.”

In particular, the HMI group experienced how managers from all over the organization wanted to have a say about the user interface design process and more so, the end result. With little or no knowledge in regards to software, and user interface software in particular, the managers slowed down the development process significantly as requirements and specifications were continuously renegotiated. A manager responsible for product planning of user interfaces explained the problem: “Fuel consumption, performance and things like that, crash worthiness and other stuff can be measured, but HMI is very emotional and that is what makes it fun. But this also means that managers up in the hierarchy want to be involved and have opinions, it slows down the process”.

It was not only the increase of digital functionality and software that was hard to understand and grasp. Rather, it appeared as if the understanding and agency in the software design process was limited, partly at least, by the lack of accurate tools to specify and design software requirements. A design engineer commented: “This is one of our
absolute weaknesses, why we are stubborn enough to hold on to the old requirement processes and tools. [...] It doesn’t fit with the new technology”

Thus changing tools to specify requirements became a central question in the pursuit to fulfill the goals of creating enjoyable and emotionally attractive HMI designs.

4.4 5.2 Changing Development Tools

The traditional tools available in the requirement and specification process included Word, Excel, Visio, Power point and “One Pager”. With the graphical focus on user interfaces, however, it seemed increasingly hard to visualize, in Word or Power point, emotional attractiveness and enjoyable experiences. In order to increase the possibilities of working in a more digital matter some of the user interface engineers started increasingly to communicate through Flash. An interaction design engineer commented: “We are increasingly working with images and what we want the customer to feel and experience when they enter the car...Flash helps us to illustrate our ambitions and ideas”

To further help the HMI group in advancing the HMI solutions, Autolnc invested in a new user interface simulator as to help visualizing new concept and ideas. With the simulator one could test and evaluate new concepts and suggestions in an agile manner. Despite this, it was soon to be noticed, that the specification process took significantly longer time than before – this was particularly due to three main reasons: first, with the new tools at hand, the user interface designers started to create specifications on an even lower level than before. In particular, they were able to decide upon the design themselves earlier in the process – thus limiting the creative impact of the external suppliers. To put it crudely, while aspiring for external innovation they found themselves increasingly exploiting their own internal creativity and knowledge. One of the managers commented: “Autolnc has a very traditional development legacy where everything is dependent on drafts and so on. It has proven very hard to change the requirement and specification process for user interface design and even making it useful”

Secondly, working graphically and with concepts such as “enjoyable” as a core value, the specification process became much more dependent on the judgment of individuals. Thus, nobody really knew what to specify for, and employees from all over the organization wanted to have a say about the HMI design. Last, while the new tools enabled for flexible and agile software changes, the new way to specify brought an increase amount of work. It appeared as if, with the “graphical way to work” the user interface designers were doing more or less the whole work and design themselves. An interaction design engineer described: “I guess it’s about control... if it’s not then I don’t know why we have the situation that we have today. Sometimes it feels as if we are making specifications on such detailed level that we might as well have done the whole thing ourselves”

The detailed level of specifications not only significantly prolonged the development process but also inhibited the autonomy in the design process for the suppliers, and other external stakeholders. Thus the new structure of the user interface group, in combination with the simulator, and the increasing use of Flash became the primary way to control supplier input and output.

4.5 5.3 Renegotiating Supplier Relations

The suppliers have had, traditionally at least, a very strong position in the development processes at Autolnc. As most large scale organizations these relationships had been developed over several years and followed a strong institutionalized pattern. More so, the work processes of the suppliers were to a large degree mirrored in the Autolnc organization. With the new tools at hand, however, the collaboration process had changed. “This new process [requirement specification] creates a lot of administration for Autolnc. Management have communicated that ‘we need to control this, own this, and we need to make specifications on the lowest levels’ they don’t realize that the suppliers use our specifications as an instrument of control. That is, they only do what they have to do, instead of doing what they know would be the best solution.”

This was troublesome for the user interface designers who increasingly aspired to work with partners outside the traditional car industry. Such shift of powers, from traditional suppliers to external developers was not made
Co-creating Innovations

possible. The inability to break free from traditional suppliers was the most important underlying reason, as user interface designers increasingly took charge of the design process. This was accomplished by internally developing graphical illustrations for supplier directions and guidance. Thus, the specification process was becoming less dependent on cooperation and collaborative design and more dominated by the user interface design group. Relating this to the initial ambitions to reach increased openness, the user interface design process seemed to be more controlled than ever before by the internal Autolnc designers. It appeared, by then, that the very concept of openness had shifted meaning. While initially communicating openness in terms of involving external innovators, openness was increasingly discussed in terms of designing for flexibility. A manager described: “We need to prepare us so that we can realize concepts and increase the flexibility in the user interface development process. We want to control the user interface process in a totally different way than before.”

The detailed level of specifications brought fundamental shifts in the power balance between suppliers and user interface designers specifying requirements. As indicated, historically, the suppliers had quite a say in the development process. Now the user interface designers more or less controlled the whole process.

6 Discussion

We set out to improve our understanding of how digital innovation effect design practices in a manufacturing firm. With this focus in mind, we conducted a case study of Autolnc’s efforts to change its user interface design processes and become more ‘open’. In what follows, we discuss the Autolnc case in relation to digital innovation and the openness agenda: First, the challenge of combining and working in two innovation paradigms and second, the challenge of balancing between counteracting strategies of openness and control.

6.1 Combining Two Innovation Paradigms

Initially, the Autolnc case illustrates the difficulties in combining two innovation paradigms. At Autolnc, the traditional way to specify requirements was based on a hardware tradition. This became particularly evident as the focus of user interface design turned from traditional ergonomics to more soft values such as emotional attractiveness and enjoyment. These new “soft” core values were to be implemented with digital means, however the user interface designers struggled with understanding how to specify such soft requirements. As suggested by Yoo (2010) and Andreasson et al. (2010) it appeared as if the increase of digital data required new capabilities and new work practices.

The traditional requirement engineering process was built on old institutionalized processes between traditional stakeholders. These collaborative relationships were, as suggested by Chakraborty et al. (2010) characterized by alliances and incremental knowledge sharing. Thus, the new emphasis on digitization and design created “communication gaps” (Mathiassen et al. 2007) and difficulties in reaching “collaborative sense making” (Chakraborty et al. 2010). These gaps existed both internally between the traditional interface designers and externally between the OEM (Original Equipment Manufacturer; i.e. other automakers) and the traditional suppliers. Much of the reasons behind these communication gaps rested in the separate design processes between the digital and the physical. Digital artifacts by necessity follow a non-linear design process, while physical components typically follow a strict sequential order (Svahn and Henfridsson 2012), this created a tension between design and task (Andreasson et al. 2010). More so, as the user interface design group received increased focus, several managers within the company wanted to be involved in the process. This typically slowed down the development and specification process.

4.6 6.2 Balancing between Openness and Control

Previous research highlights the possibilities and potentials in innovating with digital content and open innovation (Chesbrough 2003a; Tapscott and Williams 2007; von Hippel and Katz 2002). Yet, little research has been conducted on the challenges that established firms are facing when opening up their innovation processes (Chesbrough et al. 2006). Autolnc had ambitions to involve external stakeholders to enable open innovation but ended up controlling...
the process even more than before. In particular, the user interface group was increasingly expected to combine their knowledge with the development of digital design. While not knowing how to do this, the user interface design group started to work with new tools such as Flash in combination with the traditional specification tools. As a consequence, they continued to follow the traditional product innovation paths, focusing on early capture of requirements while exploiting internal industry and design competence (Andriopoulos and Lewis 2009; Jansen et al. 2009).

We found, as suggested by Floyd and Lane (2000), that the internal focus on control in developing specifications, contradicted the experimental and explorative promises that digital innovation may enable. It seemed as even though the aim of AutoInc was to become increasingly open in the design and specification process – the new tools and supplier relations forced them in another direction. Unsurprisingly then, the user interface designers unintentionally limited the opportunities for other external stakeholders to be involved in any phase of the innovation cycle. The outspoken strategy was to enable new relations with new stakeholders for a more exciting and modern user interfaces to customers. However the fine-grained level of specifications shifted the locus of innovation towards internal design. So, while the new tools enabled the user interface designers to better envision their design, it narrowed the supplier’s involvement in the design process. Rather than reaching out and explore new knowledge, AutoInc developed a short-time, control focus – thus, as suggested by Floyd and Lane (2000) contradicting the aim to reach decentralized innovation. More so, trying to specify soft requirements, even if new tools were implemented, took essentially longer time than before since no one really knew how and what to specify for. Additionally, the organizational knowledge about digital options (Sambamurthy et al. 2003) appeared limited. Even though ambitions existed to involve other external stakeholders and elaborate on their knowledge, the path they were following reflected a mindset of “internal exploitation” (Chesbrough et al. 2006) rather than external exploration.

Last, while AutoInc used the fine-grained specifications to control internally what was going to be included in their products and services the specifications were also used by the supplier as a way to control and guarantee the responsibilities between AutoInc and the supplier. As a consequence, the suppliers simply did what they were told, rather than what possibly would be the best solution.

7 Conclusions and Implications

Based upon our analyses of AutoInc, we draw three overarching conclusions. First, specifying requirements for a volatile invention such as user interfaces is in some ways a paradox. “Soft” values like “attractiveness” and “enjoyment” that are supposed to be implemented by means of a volatile material in a physical artifact is challenging. Second, we confirm that with two innovation regimes in one firm, different characteristic in forms of architecture, design and organizational structures need to coexist (Svahn and Henfridsson 2012). This, in turn, typically brings a discussion of control and governance. We found that while aiming to become more open in terms of innovating outside the boundaries of the organization, the user interface group moved in an opposite direction, specifying requirements on such a detailed level that the finally controlled the whole design process themselves. Last, this study indicates that fine grained specifications may shift the locus of innovation. Thus, the autonomy in the design process may be unintentionally narrowed.

This paper underscores the difficulties in moving from a traditional product development paradigm towards open and digital innovation. Open innovation theories; do not fully succeed in explaining the often somewhat contradictory consequences of open innovation. Our study suggests that a general framework is needed that incorporates such inconsistencies and contradictions.

8 Limitations and Future Research

This study had several limitations that point to future research directions. First, the conceptualization of the volatile nature of digital innovation is at an early stage of development and the discussion of materiality and more specifically, the “digital materiality” has only recently received larger attention (Barad 2003; Leonardi 2010; Leonardi
and Barley 2008). More research can reveal deeper insight to digital innovation in general and digital matters specifically. Further, the current version of this paper does not discuss the limits or deeper meaning of user interface design per se. That is, in future research we need to ask ourselves, not only what user interface is but rather where it is. Last, we recognize that this study is partly limited by its sole focus on the automotive industry and the fact that we studied only one organization. We believe that the AutoInc case, however, generates insights important for the continued investigation of digital innovation in manufacturing firms (Henfridsson et al. 2009; Yoo 2010; Yoo et al. 2010).
References


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<tr>
<th>TITLE</th>
<th>TOWARDS OPEN INNOVATION IN HEALTH CARE</th>
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<tbody>
<tr>
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Abstract

Many countries face severe challenges in health care, especially soaring costs. Innovative products and services are needed to help increase the quality of care and to reduce costs. In the field of rare diseases, which often is not attractive economically, the situation is even more serious. Building on extant research on open innovation, we use a design science approach to study an open innovation platform for rare diseases. Like many other open innovation practices, e.g. innovation communities and innovation contests, the platform is based on modern information and communication technologies, and is designed to be accessible from anywhere and anytime, thus supporting asynchronous interaction between the locally dispersed participants. Analysis of participation details, submitted innovative concepts, and content of communication shows acceptance by patients and other relevant stakeholders, e.g. family members, caregivers, and health care professionals. Activity on the platform, i.e. almost 200 innovative submissions, 800 comments, and more than 1,800 personal messages, is found to be helpful for collaborative innovation and emotionally supportive for participants. Generalizing from the special field of rare diseases, implications concerning the suitability of open innovation approaches in health care from a theoretical, methodological, and management perspective close the paper.

Keywords: open innovation, health care, rare diseases, integration, stakeholders
1 Introduction

Health care costs are soaring in several first world countries, such as the U.S., France, and Germany, consuming as much as 10 percent of GDP while increasing at about twice the rate of economic growth (OECD, 2010). This is partially due to an ongoing demographic change. In particular, Western countries witness diminishing birth rates and an increasing life expectancy (United Nations, 2009). Rapidly rising costs might be justified by increasing effectiveness or higher quality of care. However, in the U.S., for example, an estimated $700 billion out of the $2.5 trillion health care budget is considered wasted due to inefficiencies, overtreatment, and error (Kelley, 2009). Accordingly, higher spending does not per se lead to better outcomes for patients. This development calls for reconsideration of health care budgets and improvement of quality of care for patients. The health care sector, with its heterogeneous set of stakeholders, thus needs to put additional emphasis on innovation.

In the particular field of rare or orphan diseases, the situation is even more serious. Following the European Union Orphan Drugs Regulation (Eurordis, 2009), a disease is defined as rare if it affects less than 5 out of 10,000 people. From the low prevalence follows scarce medical knowledge, inconsistent therapy concepts, deficient operational guidelines, and problems in allocating responsibilities between healthcare professionals and patients (Bullinger et al., 2012). As this field often is not attractive economically, the private sector’s investments in research and development are limited (Denis et al., 2010). Conversely, those affected by a rare disease often gather large amounts of medical and experiential knowledge on their disease (Boote et al., 2006; The Lancet, 2008). They often become active in self-help organizations or even establish new ones (Borkmann, 2007). During their activities, patients and family members display innovative capabilities. For instance, a mother of a young woman with vaginal adenocarcinoma proposed to health professionals that it might have been caused by diethylstilboestrol (Boote et al., 2002). This example, seen from the perspective of researchers in open and user innovation, entail that patients and their immediate environment might become knowledgeable, intrinsically motivated experts. Their advanced market need and additionally, their important solution knowledge (von Hippel, 1986) hold important potential to develop novel products and services for the field of health care.

However, the health care sector at large has been quite hesitant to integrate different stakeholders in the development of novel solutions. While an increasing number of web 2.0 health platforms (Hartmann et al., 2011; Oh et al., 2005) are available for the growing number of Internet users that go online for health-related topics (Kummervold et al., 2008), these mainly focus on the distribution of health information.

In sum, rising costs for health care, a need for effective product and service innovation, and the online availability of knowledgeable experts for health care topics, calls for a solution that goes beyond current, informative health 2.0 platforms. This paper reports on a design-oriented approach to fill this gap by designing, developing, and evaluating an IT-based open innovation platform for rare diseases. Rare diseases are chosen as a unique field, which requires highly specific knowledge to develop novel solutions. Generalizing from this specialized field, we draw conclusions for the broad field of health care. The platform, targeting German stakeholders of rare diseases, has attracted more than 1,000 participants who have submitted almost 200 proposals, 760 comments, and 1,800 personal messages in the first four months of runtime. We show that the open health platform is well accepted by stakeholders in the field of rare diseases to interact, establish a sense of community, and most importantly, to submit, discuss, and collaboratively develop innovative solutions.

Research presented in this paper has the following goals:

1. From a theoretical perspective, we extend open innovation research by providing a first proof of concept on the possibilities of open innovation in the field of rare diseases as a way to increase integration of stakeholders.
2. From a methodological perspective, our study draws on a design science research approach to design, develop, and evaluate an open innovation platform for rare diseases.
3. From a practical perspective, our research shows opportunities and provides implications of opening up innovation processes in health care to interested and knowledgeable stakeholders.

Subsequent, extant knowledge on the health care system and open innovation are introduced. We then describe our research methodology and the empirical field. The final sections present the results of the evaluation of the open innovation platform and a concluding discussion.
Open Innovation in Health Care

2.1 Characteristics of the Health Care System

The global health care sector, which represents about eight per cent of the global economy, consists of very diverse stakeholders with sometimes conflicting interests (Kennedy & Berk, 2011). Five major groups can be distinguished: 1) *regulators*, e.g. national or regional regulatory committees; 2) *suppliers*, e.g. pharmaceutical and medical technology companies; 3) *payers*, e.g., statutory or private health insurances; 4) *care givers*, e.g., doctors, nurses, and other health professionals who provide care; and finally, 5) *patients* and *their families* as beneficiaries of care and informal care givers.

In terms of numbers, *patients* and *their families* are the largest group. They have gained significant experience, either through their own health records or through the ailments of relatives or friends. Nevertheless, health care suppliers and other stakeholders have been reluctant to open their innovation processes to patients and other interested and knowledgeable stakeholders like care givers, organizations that represent the interests of people who use health services, members of the public who may be the potential recipients of health promotion plans, -- and persons generally interested in questions of health care (Boote et al., 2006; Steininger et al., 2009).

Instead of integration of stakeholders, the majority of existing *health 2.0 platforms* focuses on information. Popular examples of health-related websites are WebMD, Yahoo Health, and Revolution Health\(^5\). These sites are mainly information resources for information seekers in the field of health care, ranging from general health advice to more detailed information, e.g. on lung cancer. Articles are typically reviewed by one or more physician editors before publication. Revolution Health also uses patient chat groups to disseminate information. More *community-oriented* health platforms often unite established patient support groups and rely on interaction among participants. For instance, Daily Strength and CureTogether\(^6\) focus on sharing knowledge, experience, and mutual support in discussion boards. Building on *exchange* of medical data among participants, PatientsLikeMe\(^7\) allows the upload of medical conditions to create a structured personal health profile. Metrics and graphs then allow for monitoring of treatments and the state of health. The for-profit platform allows other companies to reach out to patients, e.g. for trial recruitment, education purposes, or sentiment analysis. Summarizing, the main goal of these health 2.0 platforms is the distribution and exchange of information. Innovative output is not regarded as an important element.

2.2 The Concept of Open Innovation

Today, an organization’s ability to recognize and exploit useful knowledge from outside sources is seen as critical to its innovative capabilities (Cohen & Levinthal, 1990). While external sources of innovation may not completely replace internal sources, they are important to complement them. Thus, organizations can no longer act independently, but have to connect with different actors to acquire external ideas and resources that help them to remain competitive (Chesbrough, 2003; Dahlander & Gann, 2010). This approach of opening up traditionally closed innovation processes towards external actors has been coined by Chesbrough (2003) as ‘open innovation’.

Since the 1980s, scholars have highlighted the importance of users that actively take part in innovation activities (von Hippel, 1986). Recent studies confirm the importance of users as a source of innovation (Bogers et al., 2010; Fuchs & Schreier, 2011). In many cases, they are able to use their unique knowledge and expertise to devise cost-efficient innovations that can satisfy their own demands (Bogers et al., 2010). This has been found for the sports industry, e.g. in mountain biking (Luethje et al., 2005) or sailing (Raasch et al., 2008), where important innovations have been developed by users. Researchers have also found that in voluntary special-interest communities, e.g., a handicapped cycling community, users tend to support each other by revealing innovation-relevant knowledge as well as self-devised innovations without expecting monetary consideration (Franke & Shah, 2003). Studies on open

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\(^7\) http://www.patientslikeme.com
source software stress the importance of mutual support in user innovation activities (Bagozzi & Dolokia, 2006; Franke & Shah, 2003). Users may not only conceive innovative concepts, but also be able to commercialize their solutions without a supporting manufacturing firm (Bogers et al., 2010).

Many companies have recognized the potential of harnessing the users’ knowledge base and have begun to actively integrate them into their innovation activities. While poor connectivity has been a reason in the past that users were restricted to a passive role in new product development, today’s technologies enable cost-effective integration of users in the innovation process (Nambisan, 2002). Organizations use virtual communities to foster user-to-user support as well as user-driven innovation (Nambisan & Baron, 2010). Another innovation practice making use of the global accessibility of online platforms which also support asynchronous communication, are online innovation contests, in which participants compete for an award in solving an innovation-related task defined by an organizer (Boudreau et al., 2011). In many cases, these platforms also enable interaction among participants and thus support cooperative development of novel solutions (Bullinger et al., 2010; Hutter et al., 2011).

2.3 First Cases of Open Innovation in Health Care

In the field of health care, initiatives like the Archon Genomics X Prize\(^8\) demonstrate some principles of open innovation. The Archon Genomics X Prize is an open call, awarding $10 million to the team that first builds a device that is able to rapidly and economically sequence 100 whole human genomes at an unprecedented level of accuracy. While this initiative holds some similarities to an innovation contest, the level of task complexity reduces potential participants to scientists who are already working in medical research. This limitation in participation can also be observed for another kind of open innovation approaches in health care, taking place especially in the pharmaceuticals and biotechnology industry. Here, industry-industry and industry-university collaboration in innovative processes are considered as crucial and also are commonly practiced (Powell et al., 1996; Tapon & Thong, 1999).

Concerning other potential participants in open health processes, there is anecdotal evidence showing patients’ ability to develop sophisticated medical solutions. For instance, a British engineer diagnosed with Marfan syndrome designed his own heart implant which was better than other solutions and has later been implanted in 23 other patients (Zolfagharifard, 2011). This ability to come up with a medical solution is not limited to patients themselves. A high school girl in Maryland devised the Pain Free Socket, a prosthetic device that is intended to ease phantom limb pain in amputees, to help her father, a disabled veteran. The device, currently a fourth-generation prototype, has currently a patent application pending (Laporte, 2011).

This kind of user – someone who has a certain need earlier than others and also has the knowledge to find a solution that can satisfy the need – is termed lead user in innovation literature (von Hippel, 1986). Given the high intrinsic motivation of patients, their families, and other potential stakeholders in health care to acquire knowledge and find solutions to their problems, a broad base of (lead) user innovators in the field of health care can be estimated. While only few of them might be able to find solutions that can cure a disease, their knowledge and understanding of everyday needs might help to develop innovative concepts.

In order to provide patients and other stakeholders with the possibility to innovate, an IT-based open innovation platform for health care seems promising for three reasons. First, it has the potential to bring together the diverse stakeholders in the field of health care and to align their interests. Second, the platform fills a gap in existing health 2.0 platforms as it focuses on development of innovative solutions. Third, by design, development, and evaluation of a solution for rare diseases which are considered a particularly difficult context, conclusions for the broader field of general health care can be drawn.

\(^8\) \url{http://genomics.xprize.org}
3 Method

3.1 A design science approach

To enable interested and knowledgeable stakeholders to collaboratively develop novel products and services, and thus increase integration of stakeholders in health care, a design-oriented approach is applied to create an IT-based open health platform.

In design-oriented research, *artifacts* – artificial, man-made things – are the central objects of research (Simon, 1998). They are specially crafted in order to fulfill certain purposes and goals. Researchers then assess results by determining the degree to which the artifacts achieved the predetermined goals. Possible artifacts in IS research include: constructs, models, methods, and instantiations (March & Smith, 1995). The aspired research outputs we describe in this contribution are a *construct*, i.e. vocabulary to define problems and solutions, and an *instantiation*, i.e. the realization of an artifact in its target environment – the open health platform for rare diseases GemeinsamSelten.

In contrast to the well-defined and broadly accepted approaches found e.g., in the social sciences, there is no agreed upon procedure for conducting design-oriented research. However, there is consensus on the basic structure of design-oriented research (cf. Hevner et al. 2004; March & Smith 1995; Takeda et al. 1990). Since design-oriented research follows a problem-solving paradigm, the first step is to identify the problem and its context. Based on that insight, a possible solution is designed, defining the goals for the artifact and the desired outcome when putting the artifact to use. This artifact is then implemented in the next step of the process and put to use in the context it was designed for. Subsequent, the artifact is evaluated and conclusions are drawn and documented during deduction, e.g. as new input for another iteration. Table 1 below shows the research process and indicates where results of each step can be found in sections of this paper or in a different publication, respectively.

<table>
<thead>
<tr>
<th>Research Step</th>
<th>Description of research step</th>
<th>Section/ Publication</th>
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</thead>
<tbody>
<tr>
<td>Problem identification</td>
<td>• Theory-driven and empirically identified need for open innovation platform for health care</td>
<td>1 Introduction</td>
</tr>
<tr>
<td></td>
<td>• Research goal: proof of concept to increase integration of stakeholders in open innovation platform for field of rare diseases</td>
<td>2 Open Innovation in Health Care</td>
</tr>
<tr>
<td>Design proposition</td>
<td>• Theory-driven development of preliminary design</td>
<td>Design proposition is the focus of Adamczyk et al. (2011).</td>
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<tr>
<td></td>
<td>• Discussion of preliminary design with future users, i.e. patients and family members, representing different rare diseases</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>• Instantiation, i.e. GemeinsamSelten, of ...</td>
<td>3.2 GemeinsamSelten</td>
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<tr>
<td></td>
<td>• Construct, i.e. the concept of open health platform</td>
<td></td>
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<tr>
<td>Evaluation</td>
<td>• Assessing acceptance of the open health platform by stakeholders (details on participants)</td>
<td>4 Evaluation of the Open Health Platform</td>
</tr>
<tr>
<td></td>
<td>• Assessing (innovative) activity on the platform (details on submissions and content of communication)</td>
<td></td>
</tr>
<tr>
<td>Deduction</td>
<td>• Implications for the next instantiation of GemeinsamSelten</td>
<td>5 Discussion</td>
</tr>
<tr>
<td></td>
<td>• Implications for open innovation in health care</td>
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</table>

*Table 1. Process steps followed in this research (adapted from Takeda et al., 1990)*

While the paper covers nearly all process steps of the design science research process, the focus is on the research step ‘evaluation’ which assesses acceptance by and activity of the participants.
3.2 GemeinsamSelten

GemeinsamSelten\(^9\) is a German\(^{10}\) online platform designed to attract and activate stakeholders in the field of rare diseases, integrating them into the development of new products and services in health care. Going beyond existing self-help groups that typically focus on single diseases, the platform addresses all rare diseases. This setup is chosen because, across the great variety of rare diseases, patients and their families are often confronted with similar challenges (Bullinger et al., 2012). Furthermore, GemeinsamSelten explicitly invites interested people with diverse backgrounds, e.g. engineers, product managers, or students from different disciplines. From the stage of design proposition, representatives of different rare diseases (patients and family members) have been integrated in the design process to ensure additional benefit (Adamczyk et al., 2011).

GemeinsamSelten has been set up as an online platform to fulfill two central requirements of patients with rare diseases: access from everywhere and asynchronous interaction. Due to the rare character of the diseases, patients are often at large distances from each other; a condition often aggravated by restricted mobility. In addition, the health condition and treatments of participants interrupt their continuous presence on the online platform. The possibility to track discussions, e.g. after hospitalization, is hence a crucial requirement.

The concept of the open health platform is divided into three interlinked areas: (1) a community area where users a) can have their own public profile containing personal and health data as well as provide information on health insurance, doctors, and drugs, and b) are presented with information on new members, member activity, platform-related news, and more; (2) a problem area, where users can post general questions as well specific everyday challenges; and (3) a solution area, where users can contribute innovative concepts for health care. Submitted problems and solutions may be outlined in plain text as well as in attached text, picture, audio, and video files. Concerning interaction among participants, there are numerous possibilities in each area. In the community area, users can directly communicate with other participants by leaving a message on their personal pin board. Furthermore, users can discuss problems and solutions of other users. In the problem area and in the solution area, users can evaluate, link and comment on problems and solutions submitted by others. The instantiation GemeinsamSelten has been realized according to this concept.

Until late November 2011, the platform launched in late March 2011, had attracted more than 160,000 unique site visits and more than 1,100 registered users, who contributed almost 200 submissions, more than 800 comments on these submissions, and sent more than 1,800 direct messages.

4 Evaluation of the Open Health Platform

In design science research, evaluation tests the soundness and suitability of the artifact, focusing on relevance of built systems (Hevner et al., 2004). For the evaluation of the concept of the open health platform for rare diseases, we chose an observational method (case study observation) out of the five evaluation methods of design science in IS research (Hevner et al. 2004).

Data collection for evaluation covered the complete, anonymized log files of the platform GemeinsamSelten, personal messages exchanged between participants and comments on problems and solutions. Log files cover problems, solutions, qualitative as well as quantitative measures of comments and personal messages, which were tracked chronologically. Comments were additionally logged with the problem or solution they were submitted to, and with the participant submitting this comment. Personal messages were logged with the submitting and the receiving participant alike. Data was gathered from March to June 2011.

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\(^9\) The German name of the community ‘GemeinsamSelten’ approximately translates to ‘RareTogether’.

\(^{10}\) The platform is moderated in German, but accessible worldwide.
4.1 Participants

At the time of data collection, the platform had attracted 803 participants, i.e. patients and other interested stakeholders. Participants have very diverse professional backgrounds, e.g. nursing, engineering, business administration, medicine, and information systems. During registration, participants were asked to choose a role describing their association with rare diseases. Roles and their frequencies are presented in the table below.

<table>
<thead>
<tr>
<th>Self-attributed role of participant</th>
<th>Absolute number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>358</td>
<td>44.58%</td>
</tr>
<tr>
<td>Interested person</td>
<td>283</td>
<td>35.24%</td>
</tr>
<tr>
<td>Family member</td>
<td>92</td>
<td>11.46%</td>
</tr>
<tr>
<td>Innovator</td>
<td>19</td>
<td>2.37%</td>
</tr>
<tr>
<td>Healthcare employee</td>
<td>16</td>
<td>1.87%</td>
</tr>
<tr>
<td>Researcher</td>
<td>16</td>
<td>1.87%</td>
</tr>
<tr>
<td>Supporter</td>
<td>9</td>
<td>1.12%</td>
</tr>
<tr>
<td>Caregiver</td>
<td>5</td>
<td>0.62%</td>
</tr>
<tr>
<td>Physician</td>
<td>5</td>
<td>0.62%</td>
</tr>
<tr>
<td>Total (August 2011)</td>
<td>803</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 2. Roles of participants

When choosing the roles patient and family member, participants could also indicate the rare disease most relevant to them. 191 (30%) of these participants reported affiliation with a total of 145 different diseases; 259 patients and family members did not disclose a disease. Drilling down the 145 diseases, 119 diseases are registered by one patient or family member, 17 diseases are registered by two patients or family members, three diseases are registered three times, three diseases are registered four times, one disease is registered five times, and two diseases are registered by six patients or family members.

Total registration, distribution of the participants across the different roles, and in particular the coverage of 145 rare diseases shows that GemeinsamSelten is suitable to attract a broad set of participants. We accordingly judge adoption of the open health platform to be successful. From an open innovation perspective, the different roles and the represented 145 rare diseases represent a broad range of knowledge sources and different capabilities which can be combined to reach important innovation outcomes in the field of health care.
4.2 Submissions

The platform GemeinsamSelten has received 197 innovative submissions, among these 144 problem descriptions and 53 solution concepts. Table 3 below details submitted innovative solutions. To categorize solutions, three raters independently evaluated them and afterwards jointly discussed their ratings to resolve discrepancies.

<table>
<thead>
<tr>
<th>Solution category</th>
<th>Details on category</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical product innovation</td>
<td>Hardware products and technologies</td>
<td>16</td>
<td>30.18%</td>
</tr>
<tr>
<td>Virtual product innovation</td>
<td>Software applications for computers or mobile devices</td>
<td>17</td>
<td>32.08%</td>
</tr>
<tr>
<td>Service innovation</td>
<td>Services and organizational concepts</td>
<td>11</td>
<td>20.74%</td>
</tr>
<tr>
<td>Media innovation</td>
<td>Media coverage, information channels</td>
<td>9</td>
<td>17.00%</td>
</tr>
<tr>
<td><strong>Total (August 2011)</strong></td>
<td></td>
<td><strong>53</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

Table 3. Submitted innovative solutions

An innovation platform is first and foremost to be evaluated as suitable if it gathers innovations. In our field, 53 innovative solutions and 144 expressions of needs and requirements can be regarded satisfactorily. The table above shows that nearly a third of submitted innovative concepts are software or other virtual product innovations, i.e. applications for computers and mobile devices. Runner-ups are product innovations (30%) which include many technological concepts. Furthermore, eleven concepts of novel services or improved delivery of existing services and nine submissions of innovative media concepts were submitted. Figure 1 below shows some examples:

![Rare disease passport (physical product)](image1)
![Mobile Toilet (physical product)](image2)
![Open Street Map for rare diseases](image3)

Figure 1. Examples of submitted solutions

4.3 Content of communication

We analyzed communication content on GemeinsamSelten in order to better understand i) the motivation of the participants, and ii) the (innovative) content of their communication on the platform. To do so, we followed widely accepted analysis procedures for coding qualitative data (Ryan & Bernhard, 2000) and classified personal messages and comments with regards to content. Initial independent coding by two coders resulted in more than 300 first-order codes, e.g. ‘providing detailed information; advocating own contribution; etc.’. These were then condensed in 26 second-order codes, e.g. ‘defending contribution’. In a third step, twelve meta-codes were derived by summarizing: support, question, experience, information, attraction, platform, critique, comparison, evaluation, problem, own contribution, and usefulness. In the following, communication content of the open health platform is presented for personal messages, comments on solutions, and comments on problems.

**Personal messages.** At the time of data collection, 213 participants submitted 680 personal messages. We excluded the additional 774 welcoming messages by community members and community managers from the analysis. We found that mostly patients and interested persons are involved in personal messaging: Patients contributed 468 messages (68.8% of all personal messages), interested persons another 67 messages (9.9%). Messages were mainly used to support other participants, e.g. by providing advice regarding medication, nutrition, or physicians. An exemplary comment providing advice is: “[…] check out the prohormones dehydroepiandrosterone (DHEA) and vitamin D.” (personal message ID 1084; support)
Participants also used personal messages to ask various questions in order to obtain support, to get in touch with participants suffering from the same disease, or to be informed about personal or medical details. For instance, one patient would ask: “[…] is there an expert for the Sudek syndrome?” (personal message ID1106; information)

Comments on problems. For the 299 comments submitted to problems, it is particularly remarkable that a set of 75 participants stands out as main contributors. 214 or 71.6% of all comments were posted by patients while this group accounted for 44.6% of all participants. This is not surprising as patients have the broadest knowledge on diseases and the highest intrinsic motivation to discuss submitted problems.

Comments on problems were used to provide experiences, to ask questions, and to share information, e.g. on medical centers. Providing own experiences and asking for advice would read for instance: „My son suffers from the Legg-Calvé-Perthes syndrome […] and is bound to his wheelchair. […] I would be so glad, if he could do anything more than only go to physiotherapy and swimming.…” (comment ID 152; experience, question)

Comments on solutions. Comments on solutions cover more aspects than comments on problems, even though the total of comments on solutions is lower: A total of 28 participants has posted 67 comments, with participants who chose the role ‘patient’ submitting 43 (64.2%) and participants with the role ‘interested persons’ contributing 13 (19.4%) comments.

Content of comments encompasses codes presented above and included additional aspects. Participants used comments also to evaluate solutions of other submissions, e.g. in terms of usefulness. “In my eyes, this idea is generally a good approach. […] But I think that it is rather difficult to handle it. Where do you keep the passport? If you had a patient involved in a car accident, first responders could barely invest precious time to search the accident victim’s pockets for such a passport […]” (comment ID 34: evaluation, critique, question). Participants who had posted the commented solution then used comments to defend their own contributions, or to give more details, compare them with other solutions submitted to the platform or an existent solution on the market, and generally engage in a discussion on their submission.

It has been the goal of this research to support innovative interaction among diverse stakeholders. Extant research has found that a sense of community among the participants can lead to products and services, which are highly innovative (Bullinger et al., 2010; Franke & Shah, 2003; Hutter et al., 2011). Thus, the large proportion of mutual support found in the communication content on GemeinsamSelten is expected to foster the collaborative orientation of participants. Accordingly, the other contents of communication, e.g. sharing knowledge, providing experiences, and actually discussing innovative submissions, indicate collaborative innovative activities, which hold – or already realize – the potential for highly innovative outcomes.

5 Discussion

From a theoretical perspective, it has been the goal of our paper to extend open innovation research to health care. We show that our concept to integrate stakeholders in the field of rare diseases is feasible using open innovation practices. Establishment of an open health platform has enabled the collaborative development of innovative products, services and solutions by interested and knowledgeable stakeholders in the field. Compared to extant, mostly offline approaches (Boote et al., 2002 and 2006), our research on an open health platform shows a cost-effective and significantly fast possibility to enable the integration of stakeholders in health care research and development.

The open health platform GemeinsamSelten has been well adopted by diverse stakeholders representing 145 different rare diseases. While the majority of participants has attributed itself to the group of patients (45%), more than a third of total participants has registered as interested person (35%). This broad interest by the stakeholders of rare diseases in the open health platform confirms earlier findings. First, the tendency of Internet users to search health-related content online (Kummervold et al., 2008), and second, the possibility to cost-effectively integrate external sources into the innovation process (in the field of health care) by using modern technologies (Nambisan, 2002).
However, our findings go beyond extant knowledge: Regarding the activity on the open health platform, participants have shown that patients and family members with rare diseases are knowledgeable experts and hold an important amount of need information. Their different need information combined with expert solution information from other fields, has led to the innovative output of 144 challenges and 53 solutions. Solutions encompass 17 elaborated concepts for software applications, e.g. an open street map adaptation for rare diseases; 16 product or technology submissions, some as elaborate as the prototype for the mobile toilet; as well as 11 propositions for services and organizational concepts like a better care sharing network for patients with different rare diseases. The innovative results of the open health platform confirm our suggestion that development of novel products and services by a diverse set of innovators will be possible in health care – both for rare diseases and for the general field – as has repeatedly been shown in other areas (Bogers et al., 2010).

In addition to the innovative output, the participants engaged in community-building by exchanging supportive messages, information, and advice (cf., Bagozzi & Dolokia, 2006). The significant part of this exchange of experiences and knowledge on care giving holds the potential to increase quality of care as required by the patients. Participants have reported successful realization of solutions proposed by others – without the expensive qualification programs for nurses and their family members which are traditionally required for realization. Along with the findings of recent research in open innovation (e.g., Bullinger et al., 2010), this orientation of the participants towards collaboration and collaborative development of products, services and solutions holds the potential of highly innovative output in the future. Future research should focus on this innovative output and investigate in detail the participants, their relationships, and the resulting degree of innovation. It seems worthwhile to examine who initiates and who continues discussions on problems or solutions, and whether some participants are more active in contributing comments than in initiating.

Going beyond the actual activity of collaboratively developing novel products and services, scholars have recently stressed the meaning of social capital, i.e. the value of a network of social relationships, for knowledge transfer and innovation outcomes (Rass et al., 2011; Rost, 2011). In the context of this paper, rich networks that offer relevant knowledge from diverse sources as well as social aspects, like e.g. trust and mutual support, play a very important role. This perspective thus might offer a fruitful avenue for future research on open innovation in health care.

From a methodological perspective, this study uses a design science research approach (Hevner et al. 2004; Takeda et al. 1990) to design, develop, and evaluate an open innovation platform for rare diseases. Given the results of the platform and the resulting positive evaluation of the artifact, the use of a design-oriented approach can be deemed suitable. However, this article presents a single case study that offers initial findings which have to be validated in other samples. Future research should thus, seek for other, comparable approaches and conduct a multi-case study or try to validate our findings in a large-scale quantitative analysis.

From a practical perspective, this research illustrates the potential of opening up innovation processes in health care. As has been shown for the sports industry (Luethje et al., 2005; Raasch et al., 2008), active and knowledgeable users come up with innovative solutions independent of established manufacturers. Accordingly, the first instantiation of the platform has been designed to operate independently of major players in the field of health care, medical engineering, and insurance. However, in the future, companies in the field might increasingly realize the potential of opening up their innovation processes and taking advantage of the innovative potential of consumers by either harnessing the knowledge available in existing communities like GemeinsamSelten or by purposively establishing other, specialized or general, open health platforms.
References


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Abstract

Open innovation has become a fruitful approach to increasing the potential of innovation in organisations. Similar to traditional innovation, an open innovation approach can be characterised in three phases; namely idea generation, idea assessment and idea implementation/diffusion. While the academic community has begun to provide initial guidance for improving the various stages of the open innovation process, still little is known about how organisations currently assess ideas once they are collected. The potentially vast quantity of ideas collected through an open innovation approach has limited benefits to an organisation that is not able to categorise and assess ideas. Accordingly, in this study we carry out an exploratory survey among 331 managers to obtain a better understanding of idea assessment in practice. Our findings show, among others, that organisations investing in information systems for idea management have a higher satisfaction with the effectiveness of idea assessment, which is, in turn, associated with higher satisfaction with the innovation process overall.

Keywords: open innovation, user innovation, idea assessment, idea evaluation.
1 Introduction

Innovation is the bloodline of any organisation aiming to succeed in today's globalised economy. Hyper-competition and the fast spread of information force organisations to focus on their innovation efforts to be able to adapt and stay ahead of the evolving global market place (Schoonhoven et al., 1990). Traditionally, innovation was conducted in internal Research & Development (R&D) departments in organisations without any regard for external ideas (Lichtenthaler and Lichtenthaler, 2010). This closed approach to innovation, however, has over the years evolved into an open one in which ideas that are both internal and external to the organisation are considered valuable (Chesbrough, 2006).

Regardless of whether a specific innovation approach is open or closed, innovation is defined as a process through which ideas are transformed into new products, services or processes (Baregheh et al., 2009). It is typically seen as a three-step process that encompasses activities related to idea generation, idea conversion and idea diffusion (Hansen and Birkinshaw, 2007). In the first phase of the innovation process, organisations focus on creating a substantial set of ideas. The more ideas generated at this stage and the higher their quality, creativity, and applicability, the more chances the organisation has for successful innovation (Hansen and Birkinshaw, 2007). The ideas are then assessed in the second phase, with prioritised ideas converted into products or services, followed by activities increasing diffusion of the new product or service in the third phase. Accordingly, the success of an innovation process depends on how well the organisation is able to address each of the three phases.

While the traditional closed innovation approach is well understood in literature, further research is needed that guides how the three phases of the open innovation process can be improved (Pashkina and Indulska, 2011). Open innovation, which emerged as a paradigm only over the last decade, brings new challenges to the innovation process. It has a higher reliance on communication technology, the world wide web, social networks, and other technologies that connect organisations to external idea sources. This can potentially bring a broader and less specific set of inputs into the innovation process. Open innovation, therefore, calls for further research relating to the three underlying innovation phases. While the academic community has begun to respond to this gap in the body of open innovation knowledge, thus far mainly the idea generation phase received attention (Pashkina and Indulska, 2011; West and Bogers, 2011). However, while idea generation is critical, even with the best collection of ideas, an innovation process can still fail if the organisation does not have the appropriate idea assessment approaches in place.

In the context of open innovation, the issue of evaluating and integrating ideas has significant and different challenges than idea assessment in closed innovation approaches. In contrast to closed innovation, a successful open idea generation approach leaves organisations with the task to screen “hundreds of ideas generated by experts, employees, or consumers” (Toubia and Florès, 2007). The IBM Innovation Jam, for instance, generated 46,000 ideas, which needed to be screened for their relevance and feasibility (Bjelland and Wood, 2008). This process consisted of a multi-stage process involving a large group of volunteers that assisted in clustering and pre-selecting the ideas followed by a one-week review session with 50 senior executives and professionals. Blohm et al. (2011b) posit that constraints of time, budget, cognitive resources, and organisational structures limit an organisations absorptive capacity regarding such large amounts of ideas. According to Robinson and Schroeder (2009), it takes about $500 and four hours of staff and management time to evaluate one idea in a Fortune 100 company. In summary, there is a clear need for new methods, mechanisms, and tools for efficient idea assessment in open innovation approaches (Blohm et al., 2011b; Dahan et al., 2010).

Accordingly, given these challenges, in this paper we focus our research efforts on the idea assessment aspect of the open innovation process. We choose this focus not only because of a clear gap in literature but also due to the reliance of this aspect of the process on supporting technology. The large number of ideas collected needs to be stored and categorised, which typically is done with the use of an information system (an idea management system) (Nilsson et al., 2002). Due to the lack of empirical evidence in this area, this study aims to develop a better understanding of idea assessment practices currently in place in organisational open innovation processes, and aims to discover what information systems features and organisational approaches for idea assessment tend to be associated with higher levels of idea assessment satisfaction within an organisation.

We therefore undertake survey-based research that addresses the following research questions:
What is the current practice of idea assessment in organisational open innovation?
  o Which information system features are positively associated with improved idea assessment?
  o What organisational approaches to idea assessment are associated with improved idea assessment?

We proceed as follows: Section 2 outlines related work relevant to the topic of idea assessment. Section 3 justifies the research methodology selected for this study. Section 4 provides the results of the survey of the current landscape of idea assessment practices in organisations, with a focus on the information system and other organisational features that have the potential to increase idea assessment success. Section 5 discusses the implications of the data analysis for research and practice. Finally, section 6 concludes the paper and gives an outlook to future work.

2 Related Work

Several literature reviews in the field point to the importance of understanding the determinants of successful open innovation by analysing the organizational capabilities and processes across firms (Greer and Lei, 2011; Lichtenthaler, 2011). West and Bogers (2011) conclude, based on their review of 280 open innovation research papers, that most research on inbound open innovation is concerned with obtaining external innovations rather than with the subsequent phases of the innovation process. This is surprising considering that organisations with an inherently limited absorptive capacity (Blohm et al., 2011b) have to process an increasingly large quantity of external input (Dahan et al., 2010; Toubia and Flores, 2007). Despite the clear need for a better understanding of best practice idea assessment in open innovation, only a scarcity of research addresses this topic. West and Bogers (2011) thus identify a broad research opportunity in analysing “what happens to innovations once they come into the firm” (West & Bogers, 2011) and highlight the need for studies that measure differences in how firms derive value from external innovations.

While there is a lack of research on idea assessment, several studies have begun to tackle this topic in the academic community. In particular, they focus on technology support for idea evaluation. Hrastinski et al. (2010), for example, analyse a sample of 51 innovation management systems and find that 84% of the utilised systems contain features that support organisations in idea evaluation. Riedl et al. (2009) perform an analysis of 25 public idea portals and identify several aspects that support the different phases of idea management. In compliance with most of the existing literature, they identify ‘ratings’ and ‘grouping and clustering’ as two mechanisms to support structured idea assessment.

From the perspective of research on idea rating, studies have focused on assessment criteria (Dean et al., 2006), rating scales (Riedl et al., 2010), and various algorithms (Salminen and Harmaakorpi, 2011; Toubia and Florés, 2007). Several studies explore the potential of prediction markets or idea markets as a form of implicit rating (Bothos et al., 2009; Dahan et al., 2010; Kamp and Koen, 2009; LaComb et al., 2007; Soukhoroukova et al., 2012). Blohm et al. (2011b) compare the performance of both mechanisms in terms of evaluation accuracy and satisfaction. Riedl et al. (2009), focusing on idea categorisation, recognise that clustering methods are particularly helpful to organise large idea portfolios. Research in this direction explores methods that are based on human and machine intelligence to tag, classify or otherwise aggregate the open innovation input in order to facilitate subsequent idea assessment. For example, the IBM Innovation Jam applied a combination of text mining software and human categorisation to cluster the vast pool of collected thoughts (Bjelland and Wood, 2008). In similar vein, a recent study has turned to developing frameworks for directly structuring ideas at the time of contribution (Kain et al., 2011).

3 Methodology

Due to the lack of empirical evidence on the current practice of idea assessment, our approach of choice is an exploratory survey conducted in an online setting. A survey approach allows us to feasibly gather a large number of responses from geographically distributed areas (Singleton et al., 2009) and also provides the flexibility required
when the target participants are time-poor high level managers or C-level senior executives (e.g. CIO, CEO), as it is the case in this study.

In the following sub-sections we discuss the survey development process, the data collection and the subsequent approach for data analysis.

### 3.1 Survey Development

Due to the lack of prior empirical studies capturing the state of idea assessment in open innovation, our survey design relies on the limited existing literature combined with researcher input based on anecdotal evidence and consultation with academic open innovation experts (through a pilot survey). To develop the survey instrument, we design questions that address the core three areas highlighted in existing research (technology support for idea assessment, rating, and categorisation) and, in addition, incorporate questions relating to organisational aspects of idea assessment, as well as a variety of questions that aim to capture the success and effectiveness of idea assessment. Accordingly, in the exploratory spirit of the study, the survey instrument contains four distinct sets of questions as follows:

**Demographic questions.** Several questions capture the demographic landscape of our survey participants and the organisations they work for. Among others, we include questions relating to role and experience, the innovation budget of the organisation, organisation size and industry classification.

**Information systems questions.** We include a question relating to system functionality in order to explore the use of specific information system features for idea assessment. This also opens the ability to compare responses based on use, or lack of use, of information systems for idea management. We also include questions that explore obstacles that stand in the way of efficient idea assessment in an organisation, including IT-related issues.

**Organisational aspect questions.** We use categorical and ordinal scales to explore different organisational aspects of idea assessment. Mainly, the questions relate to the frequency of idea assessment, the percentage of ideas assessed, which criteria are used for assessment, how ideas are categorised and whether ratings are used.

**Satisfaction and effectiveness questions.** We rely on a 7-point Likert scale to measure the overall satisfaction with the innovation and assessment process. In addition, two questions specifically focus on the *effectiveness* of the idea assessment approach and the overall innovation process, respectively. Four questions are dedicated to capturing satisfaction levels with assessing the quality of the collected ideas, organising the collected ideas, categorising the collected ideas, and channelling the ideas to the relevant roles/areas within the company, respectively. An additional question measures the ability of the organisation to expose its employees to the collected ideas (measured by agreement Likert scale).

### 3.2 Data Collection

Given our focus on open innovation, we consider the well-informed target participants to be at the senior management and executive level in organisations. Accordingly, a survey broker was used to enable a more targeted approach to reach the relevant participants. Given the typically time-poor nature of such respondents, we chose to conduct a web-based survey that was easily accessible and available in any time/place situation. The survey was formatted in a way to also be accessible via mobile devices given the target audience. Overall 3241 participants were invited to respond to the survey. They were selected because of their senior and executive roles, as per the survey broker database, within organisations with an operating base in Australia. At the close of the survey, which remained open for two weeks, 667 responses were collected, resulting in a response rate of 20.5%. From this number of responses, we eliminated 76 responses that were incomplete, then a further 211 responses because the respondents no longer held roles that were deemed to be informed about the overall innovation practice in the organisation (i.e. not senior or executive management roles). A further 49 responses were filtered out because they indicated that the organisation in question did not participate in open innovation. Following this filtering process we were left with 331 well-targeted responses. While the response rate is relatively low, the overall number of responses is significant for data analysis. The data is also closely aligned with the typical industry distribution of organisations (Australian Bureau of Statistics, 2011), thus providing a good basis for exploratory work. We posit that
the response rate is low due to the target population that tends to be time-poor and hard to access in survey based research (Baruch, 1999).

3.3 Data Analysis Methodology

We use IBM SPSS Statistics (v19) to analyse the data. For categorical questions with nominal answers, we report the absolute and relative frequencies. Since absolute values are not meaningful for Likert scale data, we use these scales to compare different sub-groups based on the questions with a dichotomous or categorical scale (by forming two or more sub-groups for the comparison). Because Likert scales are ordinal, we use the non-parametric Mann-Whitney-Wilcoxon-U-Test (for two groups) and the Kruskal-Wallis-Test (for three or more groups). These tests are used to assess whether one of the two groups has significantly larger values than other groups within the data. The main test results are the mean rank (i.e. the mean position of the elements of one group in the ordered sequence of the population, and the test statistics U (Mann-Whitney-Wilcoxon) respectively Chi-Square (Kruskal-Wallis). These can be used to calculate the standard score Z and thus the p-value (significance level). These two non-parametric tests are similar to the T-Test or ANOVA for normally distributed data. However, given that a Kolmogorov-Smirnov-Test shows that our Likert scale data does not significantly follow a normal distribution (p < 0.001), we cannot apply the T-Test or ANOVA. Accordingly, we also report medians and quartiles rather than mean and variance.

4 Data Analysis

4.1 Demographic Data

The representative survey participant works in a for-profit organisation (75%) that has less than 100 employees (54%) with an average annual revenue of approximately $5 million. This most typical participant tends to be at managerial level (74%) with an average of 10 years of relevant experience. CEOs represent 11% of our respondents. Other, less typical respondents, work for non-profits (10%) and government (15%), many in small companies with 10 or less (26%) or 11-100 (28%) employees. Close to 30% of these participants work in large organisations – 10% having between 1,001 and 5,001 employees and 17% over 5,000 employees. Given the variety of organisational sizes, it is not surprising that the annual revenue is also distributed from below $1M (21%) to over $10M (39%). The organisations operate in a variety of industries, with the most frequent being: Retail Trade (19%), Manufacturing (11%), Health and Community Services (10%), Education (9%), and Construction (7%). Other than manager, some respondents have positions as CEO (11%) or project manager (9%).

From the perspective of innovation, 72% of the survey participants are directly involved in innovation or improvement initiatives/projects within their company. The (total) annual innovation budget (including internal and external innovation) is widely spread with an average of $150,000 per year. The results become more meaningful when considering the innovation budget in relation to the annual revenue. For 29% of organisations the innovation budget is less than 2.5% of the annual revenue, while 19% invest between 2.5% and 10% of their annual revenue in innovation. Only 7.3% of organisations have an innovation budget that is over 10% of their revenue.

4.2 Current Status of Idea Assessment

We approach the research question regarding the current practice of idea assessment in organisations by reporting the results of three categorical questions that allowed multiple choice responses. In these questions we aimed to explore whether the organisation uses specific criteria for idea assessment and, if so, which criteria are used, who is responsible for the assessment, how frequently ideas are assessed, what percentage of ideas is assessed, and whether information systems are used to facilitate idea management and assessment.

With regard to the use of specific assessment criteria (see Table 1), 33% of the organisations have no fixed criteria specified that guide the assessment process. The remainder of respondents rely on frequency of occurrence (29%), difficulty of implementation (31%), outcomes of a feasibility analysis (31%), or originality (18%) as criteria on which ideas are assessed. These percentages include organisations that use two (N = 55), three (36) or all four (9) criteria. In addition, six participants mentioned ‘cost’ as a criterion used in their organisation. Regarding the approach for
idea assessment (Table 2), the data shows that 39% of the organisations do not have a structured or regular process for idea assessment. Only a minority has a dedicated person (14%) or a dedicated board of people (31%) who are in charge of evaluating the ideas.

### Table 1 & 2. Organisational aspects of idea assessment (multiple choices possible; absolute and relative values are displayed).

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<tr>
<th>Frequency of occurrence</th>
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<th>29%</th>
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<tr>
<td>Level of difficulty of implementation</td>
<td>103</td>
<td>31%</td>
</tr>
<tr>
<td>Feasibility analysis outcomes</td>
<td>102</td>
<td>31%</td>
</tr>
<tr>
<td>Originality</td>
<td>60</td>
<td>18%</td>
</tr>
<tr>
<td>None</td>
<td>110</td>
<td>33%</td>
</tr>
<tr>
<td>One dedicated person</td>
<td>45</td>
<td>14%</td>
</tr>
<tr>
<td>A dedicated board of people (e.g., a group of managers)</td>
<td>103</td>
<td>31%</td>
</tr>
<tr>
<td>There is no structured, regular process for idea assessment</td>
<td>128</td>
<td>39%</td>
</tr>
<tr>
<td>Ideas are collected but never assessed</td>
<td>8</td>
<td>2%</td>
</tr>
<tr>
<td>Unsure</td>
<td>72</td>
<td>22%</td>
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</table>

In terms of the frequency of idea assessment, almost 20% of organisations do not assess the ideas they collect at all (Table 5)\(^\text{11}\), with a further 17.3% assessing ideas once a year or less frequently. Almost 24% of organisations assess their collected ideas every 6 months to 3 times a year, with the remainder of organisations varying between once a week (4.8%), 2-3 times per month (7.3%), once a month (19%) or once every 3 months (8.2%).

As shown in Table 3, only 20% (N = 68) of organisations manage their idea assessment practice supported by an information system, while over half (N = 184, 56%) do not use an idea management system, or any similar centralised support (e.g., a single Excel spread sheet) to manage idea assessment. 79 survey participants (24%) were unsure regarding this question and are thus excluded from IS-related analysis since the information value of their answers is limited. In the subsequent section, we explore whether there is a significant difference in the satisfaction with idea assessment between organisations that use an information system (idea management system) and those that do not. The many obstacles that are reported to stand in the way of efficient idea assessment in organisations are shown in Figure 3. It is clear that financial constraints are the most common hurdle for organisations – with 40% of the survey participants indicating cost of idea assessment being an issue. Lack of specific criteria for assessment was also an issue raised, among several others.

### Figure 3. Obstacles standing in the way of efficient idea assessment by the company (multiple choices possible).

\(^{11}\) There is a discrepancy in the responses regarding never assessing the collected ideas. When asking directly (Table 5), almost 20% confirm that the ideas are never assessed. We assume that in the general question (Table 2), these participants selected the unstructured process or unsure.
4.3 Factors Related to Perceived Effectiveness of Idea Assessment

4.3.1 Information System Features

In this section, we explore whether the availability of an idea management system in an organisation is positively associated with the perceived effectiveness of the idea assessment approach (see Table 3).

### Table 3. Effectiveness of idea assessment approach. Scale from “very ineffective” (1) to “very effective” (7). The 79 respondents that were “unsure” about the idea management system are not included in the table. The quartiles (25%, 75%) are underlined. The median is bold.

<table>
<thead>
<tr>
<th>Effectiveness of idea assessment approach</th>
<th>N</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>68</td>
<td>2, 3, 14</td>
<td>25, 18, 6</td>
</tr>
<tr>
<td>No</td>
<td>184</td>
<td>20, 30, 24</td>
<td>44, 45, 18</td>
</tr>
</tbody>
</table>

The results indicate that the median effectiveness increases from 4 to 5 if an idea management system is used in the company. The quartiles also increase in a similar manner. The non-parametric Mann-Whitney-Test shows that these differences are significant ($p < 0.001$).

Next, we analyse which features of idea management systems are associated with improved assessment effectiveness. The three features of “categorising of ideas” (available in $N = 75$ cases), “rating of ideas” ($N = 76$), and “frequency of occurrence” ($N = 46$) are considered. The results suggest that if the idea management system has at least one of these features, the effectiveness of the idea assessment approach (quartiles (4, 5, 5) for categorising; (4, 5, 5) for rating; (4, 5, 6) for frequency) are significantly higher than if none of these features are present ($N = 117$, (2, 4, 4)).

In addition to the effectiveness of the assessment approach, we also captured data regarding the participants’ satisfaction in regard to their ability to perform four aspects of idea assessment, namely, assessing quality, organising, categorising of the collected ideas, as well as channelling the ideas to the relevant areas within the company. For all four aspects, the existence of an idea management system significantly ($p < 0.001$) improves the level of satisfaction; from a median of 4 to a median of 5 or 6 (see Table 4).

### Table 4. Satisfaction Rating

<table>
<thead>
<tr>
<th>Satisfaction Rating</th>
<th>Mann-Whitney</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Rank</td>
</tr>
<tr>
<td>Assess the quality of the ideas collected</td>
<td>171.13</td>
</tr>
<tr>
<td>Yes</td>
<td>68</td>
</tr>
<tr>
<td>No</td>
<td>184</td>
</tr>
<tr>
<td>Organise the collected ideas</td>
<td>174.10</td>
</tr>
<tr>
<td>Yes</td>
<td>68</td>
</tr>
<tr>
<td>%</td>
<td>1.5, -2.9, 17.6, 32.4, 26.5, 19.1</td>
</tr>
</tbody>
</table>

12 If included, the 79 “unsure” respondents would result to quartiles of (3, 4, 5) which is significantly lower than “yes” (Mann-Whitney $p < 0.001$) but not significantly different from “no” ($p = 0.912$). These results remain consistent for the other categories analysed in Table 4); thus many of the “unsure” participants might in fact not use a system after all.
Table 4. Satisfaction with capabilities of the company. Scale from “very dissatisfied” (1) to “very satisfied” (7). The 79 respondents that were “unsure” about the idea management system are not included in the table. The quartiles (25%, 75%) are underlined. The median is bold.

Figure 4 & 5. Influence of idea management system on percentage and frequency of idea assessment.

The existence of an idea management system also has an influence on the two objective measures of how often and how many ideas are assessed (see Figure 2 & 3). The median of the percentage of ideas assessed significantly improves from “41-60%” to “61-80%” (U = 4318.5, Z = -3.845, p < 0.001) if an idea management system is used by the organisation. The median of the frequency of idea assessment also significantly improves from “2-3 times a year” to “once a month” (U = 3414.5, Z = -5.595, p = 0.000) if an idea management system is in place.

4.3.2 Other Organisational Factors

In this section, we evaluate which organisational factors have a positive association with effectiveness of and satisfaction with idea assessment. The first set of questions regard the frequency of idea assessment (Table 5). Our data shows that 28% of the organisations represented by our survey respondents never assess the quality of incoming ideas, or do so less than once a year. 31% perform this evaluation at least once a month; while the rest does so less often. The results also indicate that this frequency has a clear and significant association with all effectiveness and satisfaction metrics, three of which are exemplified in Table 5.
Effectiveness of idea assessment  | Expose employees to ideas  | Channel ideas to areas in company
--- | --- | ---
Never | 66 | 19.9 | 3 | 103.45 | 4 | 107.57 | 4 | 110.70
Less than once a year | 27 | 8.2 | 3 | 84.26 | 4 | 114.13 | 4 | 93.11
Once a year | 30 | 9.1 | 3.5 | 139.82 | 4 | 160.47 | 5 | 151.32
2-3 times a year | 36 | 10.9 | 4 | 152.28 | 4.5 | 166.83 | 5 | 153.94
Once every 6 months | 42 | 12.7 | 4 | 172.89 | 4 | 157.49 | 4.5 | 163.06
Once every 3 months | 27 | 8.2 | 5 | 215.04 | 5 | 185.59 | 5 | 206.15
Once a month | 63 | 19.0 | 5 | 223.82 | 5 | 212.13 | 5 | 215.46
2-3 times a month | 24 | 7.3 | 5 | 221.06 | 6 | 224.38 | 6 | 229.63
Once a week or more | 16 | 4.8 | 5 | 230.81 | 6 | 223.16 | 6 | 221.56
Total | 331 | 100

Chi-Square: 100.578 (df = 8; p < 0.001)  
Chi-Square: 66.395 (df = 8; p < 0.001)  
Chi-Square: 79.762 (df = 8; p < 0.001)

Table 5. On the left: Frequency of idea assessment in absolute and relative values. On the right: Effectiveness/satisfaction relative to the frequency of idea assessment. Differences tested with the Kruskal-Wallis Test.

For example, the satisfaction with channelling the ideas to appropriate areas within the company increases from a median of 4 to a median of 6 if ideas are evaluated more often. Similarly, the effectiveness of idea assessment is improved when frequency of idea assessment is increased.

A similar pattern is uncovered if we consider the percentage of ideas assessed by organisations (the following results not shown in a table or graph for space limitations). Twenty-eight per cent of our respondents indicate that only 20% or less of the submitted ideas are assessed in their organisation. Fourteen per cent indicate that between 21% and 40% of submitted ideas are assessed, with nineteen per cent indicating that between 61% and 80% are assessed, and a further nineteen per cent assessing 81% of the ideas or more. This percentage of assessed ideas has a clear association with the satisfaction and assessment metrics. Consistently, the more ideas are assessed, the higher the satisfaction. For example, when considering satisfaction with exposing employees to ideas, the median steadily increases from 2 to 6.

5 Discussion

The explorative results of our quantitative study have several implications for research and practice. As a prelude to this discussion, we first put idea assessment in the perspective of the overall innovation process. To do so, in our study we also measure the overall effectiveness of the innovation process (including idea generation and implementation). Our data indicates that this value is significantly correlated with the effectiveness of idea assessment (Kendall-Tau correlation coefficient $\tau = 0.668, p < 0.001$), suggesting that idea assessment is a very important phase of the innovation process. Thus, identification of any practices or tools/functionality that help improve effectiveness of idea assessment is also likely to improve the overall effectiveness of the innovation process.

All additional findings from our study presented in this section are highly significant with at least $p = 0.001$. However, because of the explorative nature of our study, these findings require further study.

5.1 Need for Information Systems in the Innovation Process

Many idea management systems for various target groups exist and offer different features – e.g., idea submission and evaluation (Hrastinski et al., 2010). Surprisingly, however, only 20% of the respondents in our study are aware that their company uses some form of an idea management system. While many organisations without such a system may not see the lack as an obstacle, our data consistently outlines the benefits of technical support of the
idea assessment process. Organisations using an information system are more effective in innovation overall and more satisfied with aspects such as organising, categorising, assessing, and implementing the collected ideas. They are also able to assess a higher quantity of the collected ideas in a much higher frequency.

Future work could investigate this discrepancy between clear benefits of using an information system and the lack of adoption of these systems within organisations and therefore improve the understanding for diffusion of these systems. More focus should also be directed to the utility of complex systems that have high theoretical value but are impractical because of high cognitive load (Blohm et al., 2011b) or financial constraints. Interestingly, having ‘too many collected ideas’ – a common problem reported in literature (e.g. Toubia and Florès, 2007) – is only encountered by a minority of our survey participants. Even if collective intelligence or crowdsourcing platforms are used, channelling these ideas to relevant areas in the company still relies on internal processes. Our survey results suggest that information systems can help with this process.

5.2 Organisational Factors and Idea Assessment

Our data shows that almost 40% of the participants’ organisations do not have a regular, structured process for idea assessment. These companies assess fewer ideas less frequently, leading to lower effectiveness. Alarmingly, almost 20% of organisations do not assess the ideas they collect at all. Besides a lack of time, some companies might see open innovation as a mere marketing instrument with the primary goal of engaging users in discussions about the brand; and thus the actual idea output is secondary. The reliance on one dedicated person for idea assessment, or a dedicated board of people, seems to be primarily moderated by the number of employees in the company (with the data showing no differences in satisfaction between these two approaches). Future research should investigate this aspect more closely, also taking into account different manager types, e.g. those rather looking for incremental ideas or breakthrough ideas (Vandenbosch et al., 2006).

While detailed literature exists regarding dimensions of idea quality (Blohm et al., 2011a; Dean et al., 2006), one third of our survey respondents report not having fixed assessment criteria, while only a third uses one criterion (equally distributed between frequency, difficulty, feasibility, and originality). Existing literature, however, indicates that complex rating scales are more efficient than simple scales (Riedl et al., 2010). Thus, the question remains which of the different dimensions is best suited in which cases, especially if financial or other constraints persist. Financial constraints are mentioned most frequently as an obstacle to effective idea assessment, but the acknowledgement of this obstacle does not lead to significantly lower satisfaction metrics. However, if these financial constraints lead to not having the right person available, or not being able to utilise an appropriate tool for idea assessment, and thus being unable to organise the ideas, satisfaction and effectiveness of the assessment process are reduced because fewer ideas can be properly assessed.

6 Conclusion

This paper contributes to the discussion of the current state of practice of idea assessment in open innovation initiatives. Based on 331 survey responses, the study explores what practices organisations currently employ in their efforts to evaluate incoming ideas and, specifically, what role information systems play in idea assessment. Our study finds that organisations using idea management systems – information systems dedicated to improving the practice of managing incoming ideas – are overall more satisfied with idea assessment, and, furthermore, more satisfied with their open innovation initiatives as a whole. When considering other organisational factors, perhaps not surprisingly, the study also indicates that more frequent idea assessment is associated with higher satisfaction levels for the diffusion of ideas through the organisation. Similarly, organisations that have practices in place that allow a higher percentage of incoming ideas to be assessed have a higher level of satisfaction with idea assessment and with the overall innovation process. So overall, the data clearly states the benefits of having a regular and structured idea assessment process supported by IT.

While the study presents the first empirical snapshot of idea assessment in practice, it is not without limitations. One limitation of our work is that the survey did not control for other possible alternative explanations, hence, some of our findings might be due to mere correlation rather than causal effects. However, the results are a good basis on
which to test many hypotheses in a more rigorous positivist matter. Another limitation stems from the target participants – the survey was only targeted at Australian corporations and the response rate was low, hence external reliability can be limited. However, the demographics of respondents indicate a good mix of executives from small and big companies, leading us to believe that the results will be similar in Western countries with similar corporate structures. In addition, given the exploratory nature of the study based on limited existing literature, question and measure development is a limitation of this work. Last, due to the limited survey length, we were also not able to go into much detail regarding many technical aspects of the idea evaluation process or how technology support is utilised in different aspects of idea assessment, the full assessment scales used, or the relation between internal and external evaluation (while we focus on open innovation only, we did not make a distinction between assessment of internal and external ideas). Many of these aspects could be better measured in semi-structured interviews rather than a quantitative survey. Future work could leverage the potential of a mixed methods approach that also employs qualitative instruments to generate additional insights that will further help increase our understanding of the phenomenon studied in this paper.
References


<table>
<thead>
<tr>
<th><strong>TITLE</strong></th>
<th>A CO-CREATION TOOL IN WALK-IN VIRTUAL ENVIRONMENT: MAKING PROSPECTIVE WORK VISIBLE</th>
</tr>
</thead>
</table>
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| **SESSION CODE** | CCI-3 |
Abstract

The focus of this paper is on user participation in product design process. Ours is a human-centred approach in which users’ expertise is acknowledged and which addresses the development of future products, rather than the current situation in users’ work. This type of user participation applied to co-creation is possible when the users’ prospective work is made visible. This paper presents a tool with which product users’ can experiment working with the product under design. As the product designers can observe the users’ actions with the tool, their understanding of the users’ work practice increases and their discussions with the users improve. The tool, VIP2M, is a virtual environment for prototyping a mobile working machine and constructing it in a walk-in virtual environment. We built it following the tradition of design science research and evaluated it by user tests. The study shows that virtual environment is a useful base for constructing appropriate tools for product users’ participation in the product design.

Keywords: Co-Creation, User, Walk-In Virtual Environment, Product Development, Work Practices, Virtual Prototyping, Design Science.
1 Introduction

User participation in product design process is a practical reality. Present Internet technology and online communities can be utilized for virtual co-creation of new products (Di Gangi and Wasko, 2009). However, the scientific roots of user participation in the design process are variable and include their connections to information systems (IS) and work development (Ehn, 1988, Greenbaum and Kyng, 1991), creation of new methods for aiding user participation in the design process (e.g., Kensing et al., 1998, Lenne et al., 2009) and tools for supporting communication between users and designers (e.g., Bødker, 2000, Luck, 2007).

One of the main challenges in user participation is the negotiation between the designer and the user of the product. The negotiation is problematic since the participants’ underlying assumptions are different (e.g., Davidson et al., 2001, Luck, 2007). In practice this means that the interaction is not easy, because designers and users do not have a common terminology. Designers often use technical terminology and dominate users (Kuosa, 2000). We have sought for a solution to that communication problem by constructing a virtual prototype which aids in making users’ work visible. The idea is that, instead of just describing their evaluations of a design, users’ can also show how they would do their work tasks with prospective machine. This idea is, on one hand, based on IS development and making work practices visible (e.g., Suchman, 1995, Simonsen and Kensing, 1997) and, on the other hand, on the potential of walk-in virtual environments (VEs) (Särkelä et al., 2009, Koutsabasis et al., 2012).

In our study, IS research is seen as a design science (based on Hevner et al., 2004), the purpose of IS research being to answer to the needs of practical reality, i.e. people’s and organizations’ needs. We attempt to find out how to overcome the communication problem between users and designers and seek the practical answer with developing a virtual machine prototype. This paper focuses whether users find the prototype so immersive that they can do their work with it. Following the guidelines of the design science, we construct and evaluate an artefact by utilising a scientific knowledge base (on co-creation and participatory IS development) and simultaneously adding new knowledge to the base.

The practical problem to which we aim to seek an answer in a multiphase study process is the co-operative design of mobile work machines, especially their control cabins. These cabins are complex entities in forest and mining machines for highly specialized purposes. The machines that are produced in small series are human-driven. Concurrent engineering is often needed because typically the machine and its control cabin are designed by different engineering teams. In this case, machine drivers and the mechanics are the product users. To make it easier to control the machines in a coherent and transparent manner and to provide a flexible working environment for the drivers in the cabin, their knowledge is used in the design process. Mistakes add to work time and may harm the machine, though the drivers do not make them if the cabin is well designed. Also the mechanics’ knowledge is needed in the design process to make the parts which need installations and maintenance easier to access. We have earlier made some tentative studies about using VE in product design from both product designers’ and product users’ point-of-view (e.g., Kuusisto et al., 2012). As they are promising we now started to study the idea systematically. This paper presents the first step of this research process: it focuses on how product users can do their work tasks with the virtual prototype, especially which technical feedback components are essential in such case.

This paper is structured as follows: first the scientific knowledge base on which the artefact is constructed is outlined. The knowledge base has information about research on user participation in IS development and making work visible there and also includes product co-creation studies. In Section 3 the constructed co-creation tool is outlined. The tool, VIP2M, is a virtual environment for prototyping a mobile working machine. The drivers of the machine can evaluate it, and the designers can observe how the drivers use VIP2M and how they talk about it later. Apart from constructing an artefact, a design science study should include its evaluation (Hevner et al., 2004). We evaluated the usefulness and immersivity of VIP2M with user tests. For finding an adequate level of VE components, we compared three alternative setups. The test users, procedure, data gathering and results are described in Section 4. In Section 5 our study is discussed, in accordance with the guidelines for design science in IS research by Hevner, March, Park, and Ram (2004). At the end of the paper, we make a concluding remark of the promising results in using VIP2M for making users’ work visible for the design process.
2 Knowledge Base about Product Users’ Participation in Design

User participation in the design process has a long tradition, but there is some disagreement about the exact extent of user involvement needed in the design work. On one hand, users are considered as informants who can supply facts about work procedures but who have hardly any design knowledge and, therefore, should have little to say about particular design issues (Olsson, 2004). Users stay in their own competence area, and designers’ task is to understand them and collect information for the design process (Steen, 2011). Here this approach is labeled Designers’ move towards users (Table 1). On the other hand, there may be user representatives who participate for years in design projects and learn the design practice. In that case, there is a risk that users become professional design experts and neglect the maintenance of their work expertise. (Olsson, 2004.) Thus, users are expected to participate in the design process and know how designers think and work. Here this approach is labeled Users’ move towards designers (Table 1) (Steen, 2011).

Besides of dividing the human-centred approaches to actors’ roles (whose work is focused and who is asked to be flexible), they can be divided by their focus on either presenting the present situation (what is) or future situation (what could be) (Steen, 2011).

<table>
<thead>
<tr>
<th>Concern for what could be</th>
<th>Designers’ move towards users</th>
<th>Users’ move towards designers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-creation</td>
<td>Co-design</td>
<td>Lead user approach</td>
</tr>
<tr>
<td>Contextual design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnography</td>
<td>Participatory design</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Different human-centred design approaches, with different starting points and emphases (based on Steen, 2011).

Some human-centred design approaches focus on users moving towards designers. Participatory design aims to give future users of a computer system a role in its design, evaluation and implementation. Participatory design has its roots in the 1970s in Scandinavia and was initiated by academics that cooperated with people from trade unions. (Ehn, 1988, Greenbaum and Kyng, 1991). Lead user approach is based on the observation that many ideas for new products originate in minds of innovative users and do not always come from professional designers. The lead user approach differs from participatory design by its orientation: the lead user approach is typically oriented towards commercial and business concerns, whereas participatory design is typically oriented towards concerns for democracy and emancipation. (Steen, 2011.) Co-design can be understood as an attempt to facilitate users, researchers, designers and others in creative cooperation, so that they can jointly explore and envision ideas, make and discuss sketches, and tinker with prototypes. In co-design, ‘everyday people, rather than customers and users, are the participants and co-creators who contribute as ‘experts of their experiences’. Co-design and participatory design have different starting points: in participatory design one can involve a group of people who currently work together and keep to their current practices (what is), whereas in co-design one can invite people who have never met before and start with an idea for a novel technology or a putative opportunity (what could be). (Steen, 2011.)

Some other design approaches focus on opposite perspective; designers moving towards product users. Also these types of approaches can have different aims based on their focus on the present situation (what is) and future possibilities (what could be). Ethnography focuses on the present situation. In it one attempts to look at naturally occurring situations holistically and from members’ point-of-view. Holistic observation here means that researchers and designers look at how people and their actions are embedded in social and cultural context. (Simonsen and Kensing, 1997, Steen, 2011.) Ethnography has been used in IS development from the 1980s to address some of the problems encountered when using interviews in requirement analysis to find out about user needs. The problems include misunderstandings which are based on users’ and designers’ different underlying assumptions (e.g., Davidson et al., 2001, Luck, 2007), unstructured users’ contributions, which include a mix of needs, suggestions, conditions, and problems (Bergvall-Kåreborn and Ståhlbröst, 2010), as well as the problem of allowing only some issues a say in our social milieu (Suchman, 1995). In the IS field, software development and evaluation for teamwork (Galegher and Kraut, 1990, Orlikowski, 1992) have been the early users of ethnography and proponents of making work visible.
For our purposes ethnography is useful as it focuses on people’s actions in context. We aim to create a tool with which workers’ work tasks can be observed. However, ethnography focuses on what is whereas we aim to create a tool which focuses on what could be. Contextual design is towards future products. It draws from ethnography and participatory design and is intended to help researchers and designers to observe people in a (work) context, to discuss their observations in a multi-disciplinary product development team setting, and to translate these observations into specifications for a new product or service. (Steen, 2011.)

Co-creation (originally, Emphatic design in Steen, 2011) provides designers access to users' experience of their material surroundings and the people in it. The term co-creation is based on the idea that consumers are active players who are co-creators of value and co-developers of their own personalized experiences (Prahalad and Ramaswamy, 2000). We shape the term co-creation into work context, when it means that a product user is able to personalize his/her experience to a level that is best suited to get his/her job done. Co-creation differs from ethnography by its focus on what could be. Furthermore, co-creation and co-design can be seen as different ways to bridge the gap between the world of designers and the world of users. In co-creation customers are seen as active players, so active dialogue with them is essential. For that the Internet is widely used, as mobilizing customers to use Internet chat rooms and consumers’ self-selecting virtual communities (Prahalad and Ramaswamy, 2000). Besides of discourse-oriented methods also more collaborative and design-focused, methods have been used to get users to think about a novel way regarding their future practice: e.g., role-playing (Steen, 2011), scenarios (Bødker, 2000) and visual images (Bratteteig and Wagner, 2010). It is necessary to consider the ways of creating trial use situations as part of the design process, so as to stage users’ hands-on experience with the future (Bødker, 2000).

Instead of discourse, we focus on methods with which users can show their actions with prospective products, as tasks include tacit knowledge which presenting in verbal form is hard or even impossible. To take users’ involvement to the early phase of the product design process, low-fidelity prototypes are used. Low-fidelity prototypes, such as sketches drawn on paper, are produced quickly and with a low cost, and thus they can be used in early phases of the design process (Yang and Epstein, 2005). When users test several low-fidelity prototypes, designers obtain more critical comments, which help to identify problems throughout the design process (Tohidi et al., 2006). Besides of paper sketches, also virtual prototypes can be used. They represent the design concept through a detailed computer simulation and may be more realistic than drawings (Yang and Epstein, 2005). Virtual prototyping enhances the effectiveness of high-fidelity prototyping because it can be faster and cheaper than physical prototyping. Virtual prototyping allows simulations and quick changes to the prototypes.

3 Constructed Co-Creation Tool: VIP2M

One part of the design science in IS research is the construction of an artifact. We created a co-creation tool, which supports the co-creation approach by showing how workers work with the tool that is under design. The tool is VIP2M in a walk-in VE. Making drivers’ work visible to designers gives an illustrative starting point to drivers’ and designers’ mutual discussions. Our solution differs from the earlier ones by focusing on how drivers’ will work with the machine that is under development; in our case the machine is simulated in VIP2M. Furthermore, one benefit of using VIP2M is that the machine prototype can be changed quickly and several alternatives can be tried, which also supports creativity and mutual understanding.

Walk-in VEs, such as cave-like environments, are enabling technology for co-creation. Influenced by interactivity and media richness, virtual worlds can increase telepresence or, shortly, presence (e.g., Steuer, 1992). Presence is often defined as a subjective experience of being in one place while physically situated in another (Suh and Lee, 2005). When a subject gets immersed in a VE, the medium providing the virtual world disappears from the conscious attention of the subject. This creates a perceptual illusion of non-mediation, i.e. presence. Presence can also be seen as resulting from interaction between a person and the environment. In our case, interaction with the synthetic world offers the subject a feeling of immersion, and the world of the computer becomes the world of the user (Coelho et al., 2006). In walk-in VEs, the sense of presence for the users is generated with different methods of sensory feedback known as the immersive components of VEs. A basic immersion component is a stereoscopic
three-dimensional (3D) view. Besides of 3D view, also sounds and different haptic and tactile displays are common immersion components.

We have made some tentative studies about using VE for product design. Our study about consumers’ interpretations of furniture prototypes in VE presented that some consumers focused on VE technology but some of them focused on the objective, i.e. furniture, design and interior (Kaapu and Tiainen, 2010). Also we have made an action research of making a VE tool for machine design (Kuusisto et al., 2012). Within this process we observed together with designers how machine drivers’ acted with virtual prototype and encountered that sometimes designers were surprised about the drivers’ actions. Our earlier experience on the studying the virtual machine prototypes encourage us to continue the study line. We decided to do it now structured and from all perspectives.

![Figure 1. An outside view of the loader which was prototyped in VIP2M.](image1)

![Figure 2. A view from inside the loader through VIP2M.](image2)

For our study, VIP2M was simulating a heavy loader used in underground mines (Figure 1). Its design process benefited from the practical work knowledge of drivers and mechanics. VIP2M is useful for making work visible, although, to the driver of the simulated machine, it only feels like a real machine in an authentic environment. This can be measured by evaluating the feeling of presence generated for the user driving VIP2M.

The technical environment which we used in the implementation of VIP2M is a walk-in VE. It consists of a three-wall rear-projection based system. It takes advantage of active stereo projection and optical head tracking, which is implemented with markers on the shutter glasses and 6 cameras. The audio environment comprises a 5.1 sound system. An essential part of VIP2M is the pneumatic motion platform with six degrees of freedom.

In the real loader the cabin is tiny. The driver sits sideways facing to the right side of the machine and s/he must turn his/her head left when driving forward and right when driving on reverse. The VE’s three walls are straight-angled, which makes it quite immersive. The awkwardness of the driving position is increased by the very limited view outside from the cabin (Figure 2). Especially the view forward is very constrained due to the large bucket, which blocks the line of sight almost completely in certain positions. Due to these kinds of factors, it is extremely important to have the eventual user of the machine take part in the design process.

To make VIP2M more realistic, there are some physical parts from the real cabin. The driver chair is similar to the chairs used in mining machines. Also the control joysticks correspond to actual controls of a loader. With the left joystick, the driver selects the driving direction and current gear as well as controls the orientation of the body of the machine. The right joystick is used for controlling the boom and the bucket. Most of the controls of the actual machine are present in VIP2M. However, the gas and brake pedals are electric, whereas in a real machine the brake is hydraulic. The control panel of the machine is a virtual one. It contains a display, which provides the driver with information about the state of the machine (e.g. driving direction, current gear, and revolutions per minute, RPM).
4 Evaluation of VIP2M

In design science type IS studies, once the artifact is constructed, its usefulness needs to be evaluated. Our target is to study how VIP2M fits to our targets from several perspectives. First, studying product users’ point-of-view question: How can users use the product prototype via the tool (that is this paper’s focus)? We aim to study later designers’ point-of-view (as how do designers interpret users’ acting with the prototype) and finally, when VIP2M is developed enough good based on the earlier research focuses, we will study its usefulness in design co-operation.

In this paper we focus on the first part, which focus on product users’ (i.e. machine drivers’) presence feelings while they are acting with VIP2M. That is whether the user can get a feeling of presence that would make him/her behave with VIP2M as if it were the actual machine. We organized user tests to explore users’ success in the driving task and their feeling of presence. As 3D VE affords a higher sense of presence than 2D VE (Nah et al., 2011), we made comparisons between them in our study. Furthermore, as the flow experience allows people to focus on their actions and produces high feelings of presence (Csikszentmihalyi, 1975, Särkelä et al., 2009), we evaluated the effect of the motion platform on the increase in the feeling of presence. Thus, in the test use, we compared three alternative VE setups.

Besides of comparing the three alternative VE setups, we also compared machine drivers’ presence feelings to the feelings of those who have never driven a heavy work machine. When their earlier experience differs, they have different reference point, so also their VE experience might be different. As we need to compare two dimensions (the type of user and the immersion of VE setup) we decided to use quantitative research methods. However, taking users to VE visit is time-consuming, so the number of test users must be low. For getting comparable data we used to methods in gathering data. First, the task performance of test users with different setups was measured. Second, a fill-in questionnaire was used for outlining test users’ own evaluations of the presence level.

4.1 Users in the Test

Since experience and familiarity with technology affects the generated sense of presence (Lee 2004), we wanted to find test users with different levels of experience and knowledge regarding the work task of the prototyped machines. We expected that some of the test users would have some earlier experience from driving heavy work machines and some others should have none. We searched for test users among university students as well as students and teachers of occupational updating training.

The test group consisted of 25 males, aged between 17 and 59 years, the average age being 30 years. All the test users had a normal or corrected-to-normal vision. The test users were categorized to Drivers and Non-Divers. This was done based on their own answer to the question: How often do you use or have used large, mobile work machines such as tractors or harvesters? Those who answered never or tried sometimes were labeled as Non-Divers, and those who answered having used mobile work machines a couple of times a month or more were labeled as Drivers. A total of 15 test users belonged to the Drivers category and 10 to non-drivers.

4.2 Test Procedure

As the aim was to evaluate whether VIP2M creates the presence feeling in its users, we made different combinations of the immersive components. The first setup of VE immersive components – labeled Plain – included only a 2D visualization in three walls. The second setup, Visual, included a 3D stereoscopic view and head tracking. The effect of head tracking is that the virtual view is coordinated with the movement of the user’s head. In VIP2M, the head tracking enables the driver to peek outside, through virtual windows, to see an object that would otherwise be blocked from view. The third setup was labeled Moving and included everything of the Visual setup and also the motion platform.

We split the test users to two groups so that each test user performed two test drives with different setups. The first group performed the first drive with the Plain setup and the second drive with the Visual setup. The second group performed the first drive with the Visual setup and the second with the Moving setup. All in all, 15 drivers and 10 non-drivers participated in the user tests. Due to technical problems automatic measurement by VIP2M did not work in five test drives, and those test drives had to be taken out from the analysis. Finally, six drivers used the
combination of Plain-Visual and five test drivers Visual-Moving; of non-drivers only three did the Plain-Visual and six the Visual-Moving drive.

The test was done individually. First, each test user got an introduction to the use of VIP2M and its controls as well as to the task they were asked to do with VIP2M. At the beginning, the test users saw the loader and the movements of the boom and the bucket from outside (Figure 1), because the view from the cabin was so limited that to understand how the boom and bucket move would have been very hard that way. After introducing the VIP2M actions, the test users were allowed to drive freely for few minutes to get a feeling of VIP2M and its controls.

1. How much were you able to control events?
   
   Not at all   Reasonably  Perfectly
   1  2  3  4  5  6  7

2. How responsive was the environment to actions that you initiated (or performed)?
   
   Not at all   Reasonably  Perfectly
   1  2  3  4  5  6  7

3. How compelling was your sense of objects moving through space?
   
   Not at all   Reasonably  Perfectly
   1  2  3  4  5  6  7

4. How inconsistent or disconnected was the information coming from your various senses?
   
   Very incons.  50% consist.  Very cons.
   1  2  3  4  5  6  7

5. How much did your experiences in the virtual environment seem consistent with your real-world experiences?
   
   Not at all   Reasonably  Perfectly
   1  2  3  4  5  6  7

6. How completely were you able to actively survey or search the environment using vision?
   
   Not at all   Reasonably  Perfectly
   1  2  3  4  5  6  7

7. How much delay did you experience between your actions and expected outcomes?
   
   Very much  Some  None
   1  2  3  4  5  6  7

8. How quickly did you adjust to the virtual environment experience?
   
   I did not  After a while  Immediately
   1  2  3  4  5  6  7

9. How much did the visual display quality interfere or distract you from performing assigned tasks or required activities?
   
   Very much  Somewhat  Not at all
   1  2  3  4  5  6  7

10. To what extent did you feel like actually being in a mine?
    
    Not at all  Somewhat  Completely
    1  2  3  4  5  6  7

Table 2. Questionnaire for evaluating the user’s presence level.

Each test user drove two test runs. The driving task in each test run was the same: the driver was supposed to drive into a pile of rocks, load as many rocks as possible in the bucket, drive a few hundred meters to the unloading zone, and empty the bucket. The driving task included driving in both directions and making some sharp turns in narrow mine corridors. The combination of narrow corridors and a limited view from the cabin made the driving task quite challenging, resembling the conditions in reality. In defining the test use, our purpose was to make the driving task as realistic as possible. Task performance was evaluated by measuring the time taken for the driving task, the amounts of rock loaded in the bucket and unloaded at the end (these might differ due to dropping of some rocks while driving), and the number of times the virtual loader collided with the mine walls.

After each run, the test users evaluated the level of presence with a questionnaire. The questions were picked from the Presence Questionnaire (Witmer and Singer, 1998), as it is a well-known method to evaluate presence. Only the questions that fit well the VE, VIP2M and task in these experiments were chosen. The last question (Table 2) is not from the Presence Questionnaire, but it was added to find out how realistic the user’s feeling of actually being in a mine was. A Likert-type seven-point-scale format was used. The results were analyzed by averaging the scores of each driver and non-driver. The statistical significance of the results was examined with one-way between-subjects ANOVA.

4.3 Results of User Test

The results of the user test show whether VIP2M gave the feelings of presence and whether there were differences between different immersive setups or between the users based on their earlier driving experience. The summary of the analysed data is presented in Table 3. The first columns present the type of users and the setups which they used in driving tasks: first there is a division based on users’ background to drivers and non-drivers, followed by the number of test users and the name of the setup of VE immersive components.
The next two columns (labelled *The amount of rock* and *Hits*) present the data that was collected by VIP2M. The first number in the amount of rock shows how much rock the driver got into the bucket and the second number how much s/he transported to the unloading zone (some of the rock fell off during the drive). These numbers show that drivers with the Moving setup got the most rock whereas non-drivers with the Moving setup the least. It seems that activating the motion platform helped the experienced drivers to load rocks, while inexperienced drivers found the work just as hard as with the Visual setup.

The other variable which was measured by VIP2M was *Hits*, which contains the average number of times the loader collided with the mine corridor walls. The collisions with the bucket as well as those of front and back parts of the machine body were detected and summed together. Naturally, each time the machine bumps into a wall, dozens or hundreds of collision data points are usually generated. Successive collision data points were considered as belonging to the same collision event. Thus each number indicates a distinct event. Besides of the average (AVG) also the deviation (STD) was calculated. These show that the number of hits increased with the number of immersive components. This means that the driving task became more difficult as VIP2M became more immersive. Also the time of driving was measured, but as the test users were not told that they should do the tasks as quickly as possible, the analysis of time is not meaningful.

The last column (Presence) presents the average results for the questions concerning user’s presence level (questionnaire in Table 2). From the results we see that the switch from the Plain setup (2D view) to the Visual setup (3D view with head tracking) did not significantly affect the generated sense of presence. On the other hand, the Moving setup (i.e. activating the motion platform) did increase the feeling of presence. The differences are bigger within drivers. This is remarkable since having earlier experience on driving heavy machines they can compare their VE experience to a real one.

The user test of VIP2M indicates that the prototyping machine, in addition to a visual image, also needs to have a moving platform for its drivers. The differences between experienced and inexperienced users appear only with the Moving setup, especially with the amount of rock. Furthermore, the feeling of presence increases in the drivers’ group when the moving platform is activated. It seemed relevant to the test users that they felt the movements of VIP2M. Based on these results we suggest that realistic movement of the prototype creates a strong feeling of presence. So, keeping in mind the limited resources we have for developing VIP2M, a moving platform is probably a better investment than improvement in the resolution of graphics.

Both drivers who have experience on driving a real machine to which compare the virtual one, and non-drivers without such experience participated to user test. The results presents differences between drivers’ and non-drivers’ feelings of presence in using VIP2M. The differences are a good point, as it presents that earlier experience effects on the driving experience with VIP2M.

<table>
<thead>
<tr>
<th>Test groups</th>
<th>#</th>
<th>Setup</th>
<th>The amount of rock</th>
<th>Hits</th>
<th>Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>into bucket</td>
<td>transported</td>
<td>AVG</td>
</tr>
<tr>
<td>Drivers</td>
<td>6</td>
<td>Plain</td>
<td>3880</td>
<td>3550</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual</td>
<td>3570</td>
<td>2490</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Visual</td>
<td>3720</td>
<td>3720</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moving</td>
<td>5020</td>
<td>4350</td>
<td>13.0</td>
</tr>
<tr>
<td>Non-drivers</td>
<td>3</td>
<td>Plain</td>
<td>3940</td>
<td>3850</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual</td>
<td>4320</td>
<td>4100</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Visual</td>
<td>1700</td>
<td>1480</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moving</td>
<td>2010</td>
<td>800</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Table 3. Summary of user test results.
5 Discussion

This paper presented a design science IS study about creating and evaluating VIP2M. It was created to support product users, as the mobile work machine drivers’ participation in the product design process indicates, so that they can present how they would do their work tasks with the prospective product. In this paper, we have outlined what VIP2M is and how it is evaluated. Now we discuss the results based on the guidelines for design science in IS research by Hevner, March, Park, and Ram (2004).

The first guideline states that a design science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation (Hevner et al., 2004). In our case, VIP2M was constructed. It is a VE construct and includes a VE application with physical components. The constructed VIP2M is an outline, sketching researchers’ idea of a co-design tool to a concrete level. It was made for research purposes and for the visualisation of the idea. Further development is needed before taking it to business use for co-design work. The development work continues in a spin-off company of our research project.

The second guideline states that the objective of design science research is to develop technology-based solutions for important and relevant business problems (Hevner et al., 2004). In our case, the organizational problem to which a solution is searched, is a co-operative design, in which product users can participate, based on their own experience and knowledge. The business case which we studied was the design of mobile work machines and their cabins, and the users whose participation in the design process was requested were machine drivers. We needed to develop a tool and a co-creation method in which machine drivers can participate temporarily and without any design education. Our solution was a method which belongs to the co-creation approach and which includes a tool, VIP2M, with which the drivers can show how they will work with the product under design.

However, at the moment we are in the beginning with shaping the solution to the business problem of co-creation. The development of the tool VIP2M which supports co-creation with product users is just one part of finding the solution to business problem. The other part is to change the design process so that there is space for product users’ (i.e. drivers’) experience. Co-creation research literature (e.g. Prahaland & Ramaswamy 2000) deals partly this problem, but there is still considerably to do with it. We continue that work in the future steps of VIP2M development.

The third guideline states that the utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods (Hevner et al., 2004). In evaluating VIP2M we used controlled experiment. In the user test, 25 test users (drivers and non-drivers) performed a driving task with VIP2M. Their successes in the tasks were measured, and their own evaluation of the presence was asked and analysed. However, this kind of user test outlines only one aspect of the tool. For opening wider picture interviews about users’ experiences with the tool and designers’ interpretations of virtual prototypes are needed. We continue the study and focus later also qualitative studies.

The fourth guideline states that effective design science research must provide clear and verifiable contributions in the areas of design artifact, design foundations, and/or design methodologies. An IS design study can give three kinds of research contributions: most often the contribution is an artifact itself, but then the artifact must enable the solution of unsolved problem. The other possible contribution is a creative development of novel, appropriately evaluated constructs, models, and methods of instantiations. The third possible contribution is a creative development and use of evaluation methods and new evaluation metrics (Hevner et al., 2004).

In our case, the contribution is the designed artefact, VIP2M, which includes both application and physical tools in a walk-in VE. VIP2M makes it possible to users (i.e. machine drivers) to try how they could do their work tasks with the machine that is under development. The ideas of VIP2M give a basis for the development of a co-design method for a novel solution on how product users can participate in the product design process from the users’ own perspective. This kind of solution makes it possible that users’ expertise gets some space within product design process; this solution overcomes communication problems which are based on differences in users’ and designers’ underlying assumptions and language. However, this is a start of a research and development line and just the future will show if it will be fulfilled.
The fifth guideline states that design science research is derived from the effective use of the knowledge base of both theoretical foundations and research methodologies (Hevner et al., 2004). In our case, we utilized knowledge about different types of human-centred design approaches, especially of the co-creation approach. Furthermore, we used the research tradition of the methods of controlled experiment and statistical data analysis in our test use.

The sixth guideline states that the search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment (Hevner et al., 2004). The design of VIP2M includes several iteration rounds, which include several evaluations, as well. The development and evaluation continues.

The seventh guideline states that design science research must be presented effectively both to technology-oriented as well as management-oriented audiences (Hevner et al., 2004). The results have been presented during the research to the business partners, but the scientific publishing of the results is just in the beginning. The technical side of VIP2M has been presented to the VE research community (Kuusisto et al., 2011) and to the machine design community (Kuusisto et al., 2012). This paper focuses more on the human-centred design directed to the academic IS community.

6 Concluding Remark

This paper is the first step in a research line which aim is to support product users’ participation in product design process. The theoretical base is co-creation, which is a design-oriented approach focusing on what could be and provides the space for workers’ participation with their own expertise (e.g., Steen 2011). Traditionally co-creation research focuses on discourse with customers, for example, via Internet chat rooms (Prahalad and Ramaswamy, 2000). However, some work cases include lots of tacit knowledge, which workers’ cannot present in verbal form. For this situation we created a tool, VIP2M, which enables product users to experiment working with the product under design.

In this paper we presented the first step, which outlined experienced and non-experienced drivers’ testing alternative VE setups of mobile work machine. This was done for finding the immersion level of VIP2M which is enough to create drivers’ presence feeling, which is needed for users to behave as they were acting with a physical tool. Our user test indicated that besides of 3D stereoscopic view especially motion platform is crucial when a design of moving work machine is prototyped in VE. The test expressed the significance of moving platform in two ways: experienced drivers made the best transporting results with it and their presence feeling was clearly higher with that setup.

Our user test of VIP2M presented that product users (in our case, machine drivers) have a presence feeling, which enable their behaving similar than with physical tools, for example, using their work skills with virtual prototype. We suppose that these findings are possible to generalise to other similar kinds of VEs. The result of our user test is promising for using the VE tool for showing how product users would do their work tasks with the prospective product. This means a new solution to communication problem which complicates users’ participation to product co-creation. We aim to continue to study the usefulness of VIP2M in co-creation. We have presented VIP2M to collaborative mobile work machine companies and we have got promising feedback from designers. The next research step will be studying how designers’ understand workers’ actions with VIP2M and what benefits they see of using VIP2M in product design. The final step will be using VIP2M in actual machine design process. It is promising that we can to carry out those steps as we already have collaboration with machine companies. Furthermore, during constructing VIP2M some researchers of our team created a spin-off company for continuing development and productisation of VIP2M.
References


<table>
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<th>TITLE</th>
<th>PARTICIPATION AND CONTROL IN ONLINE COMMUNITIES: COMPARING THREE CASES OF USER INVOLVEMENT IN SERVICE NETWORKS</th>
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Abstract

This paper aims at investigating three different scenarios of user involvement in service networks. In particular, we chose a heterogeneous network of small and medium sized enterprises (SME), where firms form the network and users are the employees of those firms, a health care network, where hospitals and physicians are institutional members of the network and the role of the “user” is assumed by patients, and an open source service network (OSSN), where open source firms are institutional members of the network, and both employees of those firms as well as free developers may be considered “users.” Based upon qualitative interviews we find transparency and perceptions of regulations and control to be important for institutional actors in service networks. As such, this study provides recommendations to service network managers and service network members that intend to make use of user’s knowledge by means of collaborative tools and online platforms.

Keywords: Service Networks, User Involvement, Open Service Innovation, User Innovation
1 Introduction

Based upon the seminal work of von Hippel (1988), various authors have emphasized the shift from purely manufacturer-centric to a more customer-active and user-centric paradigm of innovation creation (e.g., Baldwin et al. 2006; Jeppesen and Frederiksen 2006; Ogawa and Piller 2006). Thus, instead of keeping the innovation process closed until the product is ready for a user test phase, innovative firms increasingly try to include users in early stages of the innovation process. In recent years, the emergence of phenomena such as Web 2.0, social software, and blogs has intensified the consideration of the user’s role within the innovation process and thus the importance of users’ knowledge for basically two reasons: (1) because the technology enables firms to capture user knowledge more easily, and (2) because users are willing to provide their knowledge, mostly unasked and for free (Wasko and Faraj 2005).

As a consequence of technical achievements on the one side and willingness to share information and knowledge on the other, numerous virtual online communities have been created that are intensively used by firms to get access to information that was formerly hidden (West and Lakhani 2008). Firms can access this information either passive (e.g., reading customer’s blogs), active (e.g., offering own blogs for customer’s feedback), or they can even interact with members of online communities such as in the case of online idea contests (Hutter et al. 2011). Interaction among members of an online community, in turn, can lead to the production of innovative ideas and even to the production of ready-to-market innovation such as in the case of open source software (Lakhani and Von Hippel 2003). Consequently, Bogers et al. (2010) refer to the phenomenon of innovative ideas that emerge because of interaction among members in online communities as community innovation.

In summary, a community of people with shared interests that provide their knowledge for free and do not have to be stimulated to do so, comprises an inherent value to various groups (e.g., firms, non-profit organizations, etc.) in various scenarios (e.g., product innovation, service innovation, process innovation). However, whereas research has given much attention to the relation between firms and customers/consumers as well as to product innovation in the context of user and community innovation (cf. O’Hern and Rindfleisch 2010), comparatively little research has addressed relations other than firm-customer relationship scenarios. Additionally, we observe a lack of studies pertaining to user involvement in service and process innovation.

This paper aims at closing this research gap by investigating three different scenarios of user involvement in service networks, that is, “a network intentionally created and formally organized to pursue residual referral revenue for the member firms” (Koza and Lewin 1999, p. 639). The peculiarity of service networks is that value creation and capture is distributed among network members. In addition, interests of including individual users into knowledge exchange in online communities may differ among service network members. However, different interests result in an increased need for control (O’Mahony and Bechky 2008). Thus, it is important to know how service network members (i.e. firms or non-profit organizations) rate the benefits from accessing user’s knowledge as well as the level of control they judge as necessary to preserve their interests.

This study assumes an ex-ante perspective rather than an ex-post perspective. In other words, instead of investigating observable behavior of users once an online community exists, this research considers expectations of user involvement of those who plan to make use of users’ knowledge in service network scenarios. Thus, three cases were chosen where a network of institutions provides services and considers fostering exchange both (1) between members of the service network and (2) between users and members of the service network through online collaboration. For each case we conducted in-depth qualitative interviews with representatives of institutional actors within the service network about their expectations and perceptions of control. As such this research helps to identify impediments to involve system users in collaboration as well as service network members’ expectations from integrating users.
2 Conceptual Background

2.1 Community Innovation and Idea Generation in Service Networks

The recognition of user communities as means to innovate beyond firm boundaries has lead to numerous publications in recent years (West and Lakhani 2008). For example, researchers have investigated scenarios in retail banking (e.g., Oliveira and Von Hippel 2011), windsurfing (Shah 2000), healthcare (e.g., Nambisan and Nambisan 2009), and open source software (e.g., Lakhani and Von Hippel 2003). In some cases, community members have even started to promote and market their own ideas, an action that is commonly referred to as user-entrepreneurship (Shah and Tripsas 2007).

However, in order to fully understand the concept of community innovation in (service) networks, one has to distinguish interactions between firms and communities from intra-community interactions (West and Lakhani 2008). In addition, since firms increasingly have started to assign own employees to engage in communities, firms have become parts of the community which makes a delineation of community boundaries difficult (Dahlander and Wallin 2006).

Despite the academic challenge to describe what constitutes “the community”, it is widely accepted that communities generally benefit from technological movements such as the Internet. In contrast to bi-directional email exchange, in collaborative scenarios known as Web 2.0, community members can build their own profile and create virtual rooms in which they can interact with each other. However, the fact that firms or their representatives may equally be engaged in online communities yields interesting implications for knowledge flows: In the absence of Web 2.0 technologies, knowledge flows existed between organizations and between organizations and their direct affiliates, but not between organizations and affiliates of other organizations. For example, knowledge has been exchanged between firms, and within firms but not between firms and employees of other firms (Figure 1, left). With Web 2.0 new forms of knowledge exchange in networks are possible that, in turn, may lead to co-creation of ideas and services (Berry et al. 2006) (Figure 1, right).

![Figure 1. Different Forms of Knowledge Flows](image)

With respect to service networks, the service offered by member A is complemented by the service offered by member B. Community innovation in this context – when enabled by technologies (Grace et al. 2008) – embraces service innovations that emerge conjointly from institutional member (e.g., firms, non-profit organizations) and users (i.e. service receivers) and which pertain to the network rather than to single members or users. As such, this innovation mode fulfills the requirements to be named open service innovation (Chesbrough 2011).

In summary, Web 2.0 technologies or platforms enable knowledge sharing between groups that has formerly not been possible. However, increased options of knowledge flows and exchange might increase individuals’ and organizations’ wish for control. For example, if employees of firm A are able to communicate and share knowledge with employees of firm B, CEOs of the each firm are likely to control the knowledge that is exchanged (Schaarschmidt et al. 2011). Thus, while much knowledge exchange and idea generation occurs undirected beyond the control of firms in online communities and service networks especially, those firms or organizations that intend to benefit from online communities must also consider their options to control knowledge exchange.
2.2 Organizational Control in Communities

Control as understood in organization science is only necessary if group members pursue divergent interests (O’Mahony and Bechky 2008). In cases were interests are completely convergent, no control is needed since all group members pursue the same goal. However, usually interests among group members differ, such as in the case of online communities, and result in principal-agent relations. Ouchi (1979) has developed a framework that captures various approaches to control as a function of knowledge of the transformation process and the ability to measure output (Figure 2).

Figure 6. Organizational Control Framework (Source: Ouchi 1979, p. 843)

Knowledge of the transformation process refers to a supervisor’s knowledge about the task employees have to fulfill. Ability to measure outputs refers to the possibility of measuring the employees output (e.g., produced pieces per day). In combination both dimensions form a framework of control based on whether or not a supervisor possess knowledge about the transformation process and whether or not a person’s output is measurable. For example, workers in a factory usually underlie the authority of their direct lead workers who know how tasks have to be performed. Additionally, the workers output is measurable. Thus, the ability to measure output is high and knowledge about the transformation is perfect, which implies that both an outcome based and a behavior based control approach is possible (Ouchi and Maguire 1975). In situations where knowledge about the transformation process is incomplete such as in the case of sales, behavior control is not appropriate and control based on output measurement preponderates (Andersen and Oliver 1987).

However, control as posited by Ouchi (1979) pertains to organizational contexts where employees are bounded by legal labor contracts and are embedded in hierarchical command chains. In online communities it is by far more difficult to control behavior and output. Dahlander and O’Mahony (2011) argue that for open source projects it is possible to distinguish control over indivi

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Organizations that intend to benefit from online communities by establishing an online platform for a service network tend to influence what happens within the community but are unable to control the individual by means of labor contracts. Thus, in accordance with Dahlander and O’Mahony (2011), organizations are most likely to control the content rather than controlling individuals. However, neither how organizations (in their role as service network members) perceive the necessity for control nor which modes of control they prefer has been in the focus of research yet.
3 Research Approach

3.1 Research Method and Objectives

Because the topic of this research with the focus on service networks is regarded as comparatively new, we used a case study design (Eisenhardt 1989; Yin 2003) and qualitative interviews (Schultze and Avital 2011) to address the identified research gap. The interviews have been transcribed and content analysis has been applied. Our coding scheme was based on concepts such as openness, control and fear to lose influence. We chose our cases according to several distinguishing aspects. For example, service networks pursue different aims in relation to knowledge exchange and consist of different institutional actors and different individuals that can be considered system or network “users” in the sense of user and community innovation (e.g., Henkel and Von Hippel 2005). Distinguishing aspects, though, embrace the relationship between institutional actor and network user, service innovation need, as well as access to the network.

According to these distinguishing features we chose a SME network, a healthcare network, and an open source service network (OSSN). Concerning innovation need, SME networks as the one we chose (see 3.1.1) perceive the need to innovate in non-competitive scenarios such as work-life balance for employees (e.g., Schaarschmidt et al. 2011). Regarding a healthcare network’s innovation need, innovations in healthcare organizations are typically new services, new ways of working and/or new technologies (Länsisalmi et al. 2006), but within a service network, innovation is pertaining to the way how the service is delivered (Herzlinger 2006). The innovation need for OSSN can be traced back primarily to the need of aligning different services from different members (Feller et al. 2008).

Concerning access to the network for users, an SME network is comparatively close since users must be employees of member firms. Access to healthcare networks is usually open but in order to be considered a patient, a user has to be ill which is why we classified a healthcare network as semi-open. Finally, OSSNs are open for firms (that usually pay a member fee) as well as to users.

With respect to the relationship between users and institutional actors, the relationship between SMEs and employees is characterized by a contractual relationship. Patients are not contractually dependent on physicians since theoretically they have the right to chose. However, relationships between physicians and patients are characterized by trust and high transaction costs. The relationship in the case of the OSSN is twofold. Developers that are employed by firms utilize a contractual relationship while free developers utilize a rather open relationship to institutional actors such as open source firms. Table 1 provides an overview of case characteristics.

<table>
<thead>
<tr>
<th>Institutional Actors</th>
<th>SME Network</th>
<th>Healthcare Network</th>
<th>OSSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Actor</td>
<td>For Profit Firms</td>
<td>Hospitals / Doctors</td>
<td>For Profit and Not For Profit Organizations</td>
</tr>
<tr>
<td>Network Users</td>
<td>CEO</td>
<td>Doctors / Physicians</td>
<td>CEO</td>
</tr>
<tr>
<td>Access to Network (User)</td>
<td>Employee</td>
<td>Patient</td>
<td>Developer / User</td>
</tr>
<tr>
<td>Innovation Need</td>
<td>Service for Employees</td>
<td>Service Delivery</td>
<td>Service Combination</td>
</tr>
<tr>
<td>Institutional Relationship</td>
<td>Closed</td>
<td>Semi-Open</td>
<td>Open</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Institutional Actor-User</th>
<th>SME Network</th>
<th>Healthcare Network</th>
<th>OSSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractual relationship between employees and firms</td>
<td>Non-contractual patient-physician dependency</td>
<td>Partly contractual relationship between firms and employees; Partly non-contractual between free developers and the OSS project</td>
<td></td>
</tr>
</tbody>
</table>

| Table 1. Overview of Case Characteristics |

3.1.1 Case 1: SME Networks

The context of our first study is the ‘WirtschaftsForum Neuwied e.V.’, a regional network of SMEs in the north of Rhineland-Palatinate in Germany, which consists of roughly 120 SMEs employing about 10,000 workers. It was
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founded in 2002 and comprises companies primarily from the industry and business sector in the surrounding area of Neuwied. The regional network is heterogeneous in structure regarding respective size of the cooperating companies, represented branches, products and services and technological affinity. The collaborative activities thus focus on non-competitive areas (e.g. education, energy saving) and aim at fostering information and knowledge transfer between the cooperating firms as well as enhancing cooperation and business relations. The majority of this exchange is initiated or driven on the executives’ level only, while employees are barely integrated into the collaborative work. However, the ‘WirtschaftsForum Neuwied e.V.’ tends to focus on the integration of the employees’ level to generate collective solutions for daily work life problems.

For our study 15 CEOs out of 15 member companies of the “WirtschaftsForum Neuwied e.V.” were interviewed on a basis of an interview guideline. The interviews were directed at determining the goals and requirements of SMEs cooperating within a regional network in relation to employee involvement.

3.1.2 Case 2: Health Care Networks

In our second study we consider the ‘BrustZentrum Mittelrhein’, a breast cancer centre in the north of Rhineland-Palatinate, which was founded in 2005. As a result of political decision, seven regional hospitals are grouped together into a network in order to ensure an evidence-based, high quality care of patients with breast cancer. The cooperation between the hospitals is based on contractual arrangements as well as legal regulations. Thereby the cooperating partners undertake to follow the national and international guidelines for breast cancer care as well as to participate on certification procedures. Further contracts with selected specialists from the ambulatory sector regulate a qualitative, guideline-oriented service delivery with closely related partners of the supply chain. In addition the centre strives to foster the collaboration with physicians and specialists of the ambulatory sector in order to produce a seamless and continuous care according to the patient’s needs.

With regard to our qualitative study, seven guided interviews were conducted with five physicians (gynecologist) and two clinicians of the breast cancer centre (chief physicians) on the basis of a semi-standardized questionnaire. The interviews focused on determining the collaboration between the physicians, the breast cancer centre, and the patients along the supply chain.

3.1.3 Case 3: Open Source Service Network

Open source software\textsuperscript{13} firms usually are specialized and cannot offer complete solutions which is why they have started to create Open Source Service Networks (OSSN) in order to be able to offer customers a complete stack of solutions and thus to deliver the full range of services the customer demands. Feller et al. (2008, p. 476) define an Open Source Service Network (OSSN) as “a network of firms that collaborate in order to service customer software needs based on open source solutions.” In this regard, OSSNs can offer access to all types of services that a user firm needs.

In our third study we focus on an Open Source Foundation located in Nuremberg, Germany, as an example of an OSSN. The foundation exhibits more than 100 member firms and started in 2006. Although formally acting as a foundation, it positions itself as an OSS network. The foundation runs several projects that are dedicated to “hot topics” such as Cloud Computing. However, other projects revolve around aspects of interoperability and OSS software stacks.

Considering our qualitative study, four guided interviews were conducted with CEOs of member firms of the OSSN on the basis of a semi-standardized questionnaire. The interviews focused on determining the collaboration between firms and firms on the one side, and firms and the OSSN on the other.

Table 2 provides an overview of our interviews.

\textsuperscript{13} Open Source Software (OSS) is an alternative to proprietary software in that the software as well as the software code is available for free (Lakhani and Von Hippel 2003).
Table 7. Overview of Interviews

<table>
<thead>
<tr>
<th>Case</th>
<th>Interviewees</th>
<th>Number of Interviewees</th>
<th>Duration of Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>SME Networks</td>
<td>CEO’s of SMEs active in an SME network</td>
<td>15</td>
<td>90-120</td>
</tr>
<tr>
<td>Healthcare</td>
<td>Doctors from both the ambulant and stationary sector</td>
<td>7</td>
<td>30-45</td>
</tr>
<tr>
<td>OSSN</td>
<td>CEO’s of OSS Software Vendors</td>
<td>4</td>
<td>45-75</td>
</tr>
</tbody>
</table>

3.2 Research Results

By means of comparing three different cases, we identified three issues that provide general statements concerning user involvement and participation of companies in service networks as well as the companies’ level of control for participation.

(1) Asymmetrical relationship between institutional actors and network users

The first general issue refers to the involvement of the network users into the collaborative work. According to the research results, which are listed below, we can assume that each service network maintains an asymmetrical relationship between its institutional actors and network users. Information is a common factor, which causes this asymmetrical relationship: The institutional actors possess information about the network and decide which information they pass to the network users.

**Case 1 SME Networks:** The results of our first study show that the employees are not integrated into the collaborative work. It can be suggested that a majority of employees is not informed about the existence of the network. The executives maintain the information and decide which information they forward to their subordinates. As a result, an information lack on the employee-side arises, which causes an asymmetrical executive-employee relationship concerning the SME network.

“I admit that I do not forward any information about the network to my employees. In my opinion most of the employees do not know that the “WirtschaftsForum” exist.” (C1-I1: executive)

“I do not know what my employees should exchange there. They have to concentrate on our business. That is why I decide which information about the network they receive.” (C1-I7: owner)

**Case 2 Health Care Networks:** Since medical know how is necessary to decide on adequate service delivery, a lack of medical qualification on the patient-side causes an asymmetrical doctor-patient relationship. In this regard patients defer decision-making responsibility to the doctor (Shackley and Ryan 1994). The system user is thus dependent on the decisions of the institutional actor. Nevertheless, the user maintains the possibility to choose between different service providers and services. In the context of our study, the institutional actors direct the system users through the service delivery network. Thereby the doctors provide as much information as needed, so that patients gain incomplete information vice versa:

“I do not give her any more information about the ongoing therapy, except she demands for them. In her special situation too many details just confuse.” (C2-I1: gynecologist)

“The patient just knows that she will be treated in a hospital that is specified for breast cancer care”. (C2-I4: gynecologist)

**Case 3 Open Source Service Network:** Although Open Source, as a development approach, is famous for its collaborative, distributed nature and culture of gift exchange (Lakhani and Von Hippel 2003), OSSNs pursue commercial aims. The reasoning beyond OSSN is that since no value can be generated from OSS directly, OSS vendors offer services to OSS such as implementing, customizing, and maintaining the software (i.e. productization) (Fitzgerald 2006). However, OSSNs consist of different types of vendors with different aims and different levels of technological and marketing knowledge. This heterogeneity is considered both an advantage and a challenge:
“The value of our association [name removed] is fundamentally different for different groups: software vendors, service providers, universities...” (C3-I2: software vendor, EIB)

“We share lots of goals such as promoting open source software and communicating its quality but when it comes to the business level, some of us are simply competitors.” (C3-I1: software vendor, ERP)

(2) Immediate benefits through partnerships concerning the core business

The second issue illustrates the imperative to establish a win-win situation for the cooperating partners in order to ensure the willingness to collaborate. A win-win situation just arises if immediate benefits are generated, which refer to the companies’ core business. In this regard, companies perceive a need for control that comprises the requirement to realize immediate benefits from cooperation.

While health care networks define goals of the cooperation and functions of the institutional actors via regulations and contracts, the goals of SME networks or OSSNs and the role of their cooperating firms are vaguely defined by contrast. As a result, the institutional actors of health care networks perceive immediate benefits from cooperation, whereas actors of SME networks or OSSNs lack of identifying direct benefits for their company. Hence position and role of each company has to be defined and/or represented within the network: The establishments of partnerships that allow for providing comprehensive customer solutions provide one possibility to position a company within the network.

Case 1 SME Networks: Although SME networks concentrate their activities on an information and knowledge transfer concerning non-competitive issues, the member firms are primarily interested in gaining short-term economical benefit from cooperation: From the executives’ perception a “win-win” situation for all cooperating partners just arise if (1) partnerships of suppliers can be established within the network in order to create comprehensive business solutions for customers and (2) services are exchanged between the member firms. For this purpose they need relevant and useful information on the other firms as well as the possibility to represent their own company in order to communicate core business and services across the network.

“All companies just can gain money from the network if we all know: Who is doing what? Who provides which conditions? Is it profitable to buy from a member firm?” (C1-I1: executive)

“It would be useful if I could access on an address pool that contains information about the members. My company needs electricians, carpenters, tillers that I could find there. So it will be easier for me to provide broad services to my customers.” (C1-I4: owner)

Case 2 Health Care Networks: On the basis of regulations and contractual arrangements, responsibilities and service delivery are defined within the supply chain. This causes a mutual state of dependencies between the service providers, which forces them to collaborate: Hospitals are dependent on physicians, since physicians admit their patients to them. Physicians are dependent on hospitals due to their limited possibilities for treatment and their responsibility for patient care after hospital stay. Hence cooperation generates a win-win situation for all institutional actors.

“I would become angry, if my patients are not coming back to me. If they stay in hospital, I would take my consequences. Everyone knows that the hospitals should not spoil their chances with the physicians.” (C2-I3: gynecologist)

“The physicians know that they need the hospitals due to their limited possibilities.” (C2-I2: clinician)

By means of arranging service delivery within a network, the actors obtain the possibility to provide complete patient solutions along the supply chain. As a result health care networks generate direct value when they act as basis for offering comprehensive services according to the patients’ needs.

“We have to pull together to ensure a good treatment for our patients” (C2-I1: gynecologist)

“The physicians do not want the patients to stray somewhere. They want that I take responsibility for them.” (C2-I5: clinician)

Case 3 Open Source Service Network: Member firms are concerned about the benefits de novo firms actually gain by becoming a member. The OSSN is in a recursive-circular situation because they need the fee of new members to
grow and to pursue its aim but at the same time new members can only be attracted once the network provides a benefit to those firms.

“In order to attract new member, web site visitors directly must find potential benefits for themselves.” (C3-I4: software vendor, Data Security)

“We will lose members (or at least their activity) if we cannot provide them the benefits we claim to provide” (C3-I3: software vendor, ERP)

(3) Request for regulations within collaboration

The last issue leads to the assumption that service networks require control by means of regulations that organize and coordinate the collaborative work. In this regard user involvement in service networks require a high level of control in order to preserve the company’s interests.

Case 1 SME Networks: The SME network lacks of regulations with respect to the information and knowledge exchange, resulting in a high need of control on the executive level. Hence cooperation stagnates and employees are still kept away from cooperative activities. In addition to a general overview about the member structure of the network, the executives ask for network-wide policies that meet their information security needs and that arrange a goal-oriented exchange.

“The exchange of confidential information is delicate. How can I exert influence on this exchange and who ensures some safety arrangements so that I can be sure about my information?” (C1-I5: executive)

“Exchange might occur all-around the network and anybody wants to add her or his own knowledge. But the question is: is this kind of exchange constructive, or does it require some more regulations?” (C1-I4: owner)

Case 2 Health Care Networks: Our second study shows that strong regulations of service delivery within the network minimize the need of control.

“I know that everything works well” (C2-I2: gynecologist)

Consequently we can state that regulations replace control. In turn, if the actors’ needs and requirements for collaboration are not entirely met, the actors perceive disorganization within the network.

“The chief clinician – and not an assistant doctor who is coincidentally occupied in the hospital at that time - should be responsible for the first and final connection with the patient. Otherwise there is a high risk that too many different languages are spoken” (C2-I3: gynecologist)

“The oncologist, the gynecologist and the family doctor want to see the patient. But who will take the responsibility for the patient’s aftercare? I have no influence on that!” (C1-I2: clinician)

Case 3 Open Source Service Network: Regulations pertaining to the investigated OSSN itself are in their infancies. Few representatives of member firms are heavily engaged while others only show up at yearly meetings. The engaged persons heavily influence the functioning of the association, but not necessarily the functioning of the service network. The problem for the OSSN primarily lies in the fact that Open Source implies participation and democracy, but when it comes to the delivery of services, which basically is the only option to generate revenue in Open Source contexts, people tend to protect their shares. Thus, although the aim of OSSN is to conjointly offer solutions to professional customers, the single member firm aim to retain control over their products and services.

“Decisions concerning our products will entirely be made here!” (C3-I2: software vendor, EIB) [Here refers to the room where the interview was conducted; the firm’s headquarter]

4 Implications for Technical Platform Design

Community innovation in service networks refers to the idea of using the creativity and innovative ideas of the community members. Service innovations thus emerge conjointly from institutional actors and users that are part of the network. Given this context, using Web 2.0 technologies implies consequently breaking down innovation processes to the network user level and thus systematically opening up a heterogeneous and broader knowledge
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base to idea generation. In this regard, we examined the relationship between institutional actors and their network users, as well as the level of control for cooperation and user participation within service networks by means of three case studies.

The main implication for technical platform design can be summarized as follows: Overcoming the asymmetrical relationship between institutional actors and network users requires transparency about the service network and its participants on the platform. Concurrently, the institutional actors’ needs for control have to be met in order to preserve the company’s interests. Transparency and control form a contradictory relationship. With more transparency, the level of control is reduced while more control impedes transparency. Service networks and their institutional members therefore are challenged by the question of how to pursue control while enabling transparency. According to this statement we provide three general requirements for the design of technical (Web 2.0-based) platforms that focus on user participation in online communities:

1. **Transparency to overcome asymmetrical relationships between institutional actors and users**
   
   First of all transparency has to be ensured on the platform to overcome the asymmetrical relationship between institutional actors and network users. Transparency can be defined as availability of information about network structures, processes and actors. Given this context, the platform should provide information about the service network, its cooperating companies (company profiles) and network users (user profiles).
   
   Information availability has to be ensured by means of providing information as well as providing access to this information on the platform. Thereby the provision of information assumes the willingness of the institutional actors to share information across the organizational network. Concerning the need for regulations that organize the collaborative work, the willingness for sharing information might depend on policies that regulate the access to it.

2. **Mission statements to communicate immediate benefits across the network**
   
   Cooperation requires a mission statement that both communicates goals and responsibilities across the network and directly refers to the company goals of the cooperating firms. According to Pearse II (1982, p. 16) a mission statement defines “[…] the fundamental, unique purpose that sets a business apart from other firms of its type and identifies the scope of the business’s operations in product and market terms”. Thus a mission statement identifies the scope of the network’s business in order to determine its purpose and benefits for the participating firms. In addition to the mission statement, further information about the companies has to be provided on the platform that allow for defining the position and role of each company within the service network. This information should provide an overview about the companies’ business, branches and services.

3. **Having a man on the inside to regulate cooperative work**
   
   The need for control requires technical applications that coordinate and regulate both the access to the platform and the information and knowledge exchange (e.g. defined procedures for registration).
   
   According to Ouchi’s (1979) framework, in the scenario of user involvement in service networks, output is hardly measurable and knowledge about the transformation process incomplete. Thus, the remaining option is clan control. In turn, clan control only occurs if the level of divergent interests is minimized by, for example, common mission statements. Furthermore, firms that intend to protect their commercial interests should assign own employees to actively work in online communities as a “man on the inside” (Dahlander and Wallin 2006).
Since actual research on user involvement in inter- and cross-organizational innovation processes has focused on the relations between firms and customer/consumers so far, the aim of our paper was to examine both the relationship between institutional actors of service networks and their network users as well as the level of control for cooperation and user participation within these networks.

Therefore three cases of service networks were chosen that allowed for (1) identifying general issues concerning the participation of network users in cooperation and (2) determining the expectations from integrating users with respect to control. For each case we conducted in depth-qualitative interviews with representatives of these networks in order to find out their similarities and differences.

The interviews yielded that (1) each service network maintains an asymmetrical relationship between their institutional actors and network users and (2) the institutional actors perceive a high need for control within cooperation. The need for control comprises both the requirement to realize immediate benefits from cooperation as well as the request for regulations that organize and coordinate the collaborative work. Our results lead to recommendations to service network managers and suggestions of technical platform design that intends to support user participation within service networks. These recommendations encompass (1) transparency, (2) the formulation of a mission statement and (3) “a man on the insight” to overcome the asymmetrical relationships between institutional actors and network users and to meet the requirements for control.
References


<table>
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<th>TITLE</th>
<th>INNOVATION CO-CREATION IN A VIRTUAL WORLD</th>
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Abstract

The emergence of web-based technologies has radically influenced the ways in which individuals around the world communicate, represent themselves, share ideas, and otherwise interact with one another (Ward and Sonneborn, 2009; Rogers, 2003). In particular, these technologies allow people to communicate directly with one another and to share and shape their own experiences; as a result, customers and other organisational stakeholders are increasingly involved in the design of products and services (Ramaswamy and Gouillart, 2010, p. 102). During innovation co-creation specifically, customers take an active and creative role in the intentional and successful adoption and application of ideas, processes, products or procedures that are new to the adopting organization. This study carries out six case studies of innovation co-creation in the virtual world of Second Life. Virtual worlds allow users to engage in highly active and participatory forms of co-creation that are difficult if not impossible to replicate in other environments. The study explores collaborative processes used for innovation co-creation in virtual worlds. In particular, the study presents an analysis of behaviours used to facilitate innovation co-creation in virtual world projects and the factors that affect it. The study leverages this analysis to derive practical recommendations for virtual world users and virtual world designers that can be used to stimulate and support innovation co-creation in virtual worlds.

Keywords: Co-creation; innovation co-creation; virtual worlds
1 Introduction: from co-creating value to innovation co-creation

The interaction between the firm and the consumer is becoming the locus of value creation and value extraction. As value shifts to experiences, the market is becoming a forum for conversation and interactions between consumers, consumer communities, and firms... Informed, networked, empowered, and active consumers are increasingly co-creating value with the firm.

Prahalad and Ramaswamy, 2004, p. 5

Value creation is a core element of organisational growth and performance (Prahalad and Ramaswamy, 2004a). Value co-creation, in particular, is based on engaging customers directly with producers in the creation of value (Kambil and Friesen, 1999). More specifically, it refers to the process during which consumers take an active role and co-create value together with companies (Prahalad and Ramaswamy 2004b). Organisations’ increased interest in value co-creation is driven by the recognition that consumers are an important source of competence in organisations (Prahalad and Ramaswamy, 2000).

Initially, the concept of co-creation was applied to the creation of “everything of value, from simple processes to new products and services to the organization’s value chain or its role in its eco-system” (Ramaswamy and Gouillart, 2010). As practitioners have embraced the concept of co-creation, it has been extended so that it now refers to all stakeholders (employees, customers, suppliers, distributors, communities) rather than just customers (Ramaswamy and Gouillart, 2010). At the same time, scholars have increasingly focused on the manner in which innovation in particular is co-created in organisations (cf. Kohler et al., 2011; Ramaswamy et al., 2010; Giovacchini et al., 2009). Innovation is generally defined as “the adoption of an idea or behaviour that is new to the adopting organization” (Damanpour and Gopalakrishnan, 2001; Dewar and Dutton, 1986; Daft, 1982; Aiken and Hage, 1971). More specifically, it is concerned with the “successful implementation of creative ideas within an organisation” (Amabile et al., 2006, p. 25) or with the intentional introduction and application of ideas, processes, products or procedures that are new to (a job, work team or) an organisation and are designed to benefit the (job, work team or) organisation (West and Farr, 1990). This transition is driven by the view that the capacity to innovate is “the most important determinant of firm performance” (Crossan and Apaydin, 2010, p. 1154). Recent scholarly interest in the concept of living labs, for example, is based on allowing users to contribute to the co-creation and exploration of emerging ideas, breakthrough scenarios, innovative concepts and related artifacts14. Innovation co-creation is defined for the purposes of this study as a process during which customers take an active and creative role in the intentional and successful adoption and application of ideas, processes, products or procedures that are new to the adopting organization.

Co-creation in general and innovation co-creation in particular seek to take advantage of the increasing communicative affordances of web-based technologies (Giovacchini et al., 2009). The rise of online social networks, social media, and fully collaborative design environments, have led to the creation of a participatory web where consumer cultures give way to cultures of participation (Fischer, 2009). Here, the role of “the person formerly known as the ‘user’” has evolved (Saunders et al., 2008) just as the traditional boundaries between ‘producer’ and ‘consumer’ have been eroded (Benkler, 2006). A variety of terms have been used to describe the kinds of co-creative processes that are enabled by these technologies; these include collective intelligence (Lévy, 1997), crowd sourcing (Howe, 2006), peer production (Benkler, 2006), produsage (Bruns, 2008) and open innovation (Chesbrough, 2003; Chesbrough & Vanhaverbeke, 2006).

This burgeoning literature is a tangible manifestation of current interest in net-enabled co-creation but is largely dominated by proponents of it. Thus, there is a need for empirical research to investigate its claims and to establish the potential challenges and limitations of net-enabled innovation co-creation. IS researchers have long been held that the “very idea of an information system is to provide a means and an environment for human communication” (Lyytinen, 1985, p. 61) and collaboration (Ågerfalk et al., 2008, p. 1). Therefore, IS researchers are particularly well-placed to inform current research and practice in technologically-mediated innovation co-creation.

Virtual worlds for innovation co-creation

The Internet and related technologies have “radically influenced the ways in which individuals around the world communicate, represent themselves, share ideas, and otherwise interact with one another” (Ward and Sonneborn, 2009, p. 211). Where ‘cyberspace’ was once only a metaphor for computer-mediated communication, a kind of notional environment, it is now possible to literally immerse oneself in net-enabled digital environments such as virtual worlds.

Virtual worlds represent “a frontier in social computing with critical implications for business, education, social sciences and our society at large” (Messinger et al., 2009, p. 204). Virtual worlds are computer-simulated, spatial environments that support communication among multiple users who are represented by avatars (Jung and Kang, 2010; Holmstrom and Jakobsson, 2001). Contemporary virtual worlds are defined as online, immersive, interactive environments that are based on community, content creation, and commerce (O Riordan et al., 2009) and are used by somewhere between nineteen and twenty million people (Jackson and Favier, 2008; Castronova, 2007, pp. 33-34).

Virtual worlds have excited practitioner and scholarly imaginations for a variety of reasons:

(i) **From a technical perspective**, virtual worlds can be used to create simulations of the real world and also to invent simulacrums of realities that could never actually exist in this world (O Riordan, 2011, p. 294). The interactive and immersive capabilities of virtual worlds allow people to “implement their thinking into actual actions, which helps them to evaluate the success of their ideas, at minimum cost” (Ip et al., 2008, p. 1). Virtual worlds are therefore a kind of *actable information system* that enable the performance of actions and “permit, promote and facilitate the performance of actions by users, both through the system and based on information from the system, in some business context” (Goldkuhl and Ågerfalk, 2002).

(ii) **From a communications perspective**, virtual worlds extend the possibilities for (i) communication (Fetscherin et al., 2008), (ii) interaction (Chaturvedi et al., 2011; Mueller et al., 2010; Messinger et al., 2009), and (iii) for collaboration and co-operation (de Freitas and Veletsianos, 2010; Giovacchini et al., 2009; Fetscherin et al., 2008; Kahai et al., 2007). Thus, they can allow users to experience heightened levels of presence (Dalgarno and Lee, 2010; Hooker et al., 2009; Barnes, 2007) or immersion (Childs, 2010; de Freitas et al., 2010; Tampieri, 2009). This in turn can lead to a heightened sense of ‘flow’ (cf. Csíkszentmihályi, 1975), which is positively associated with creative action (O Riordan and O’Reilly, 2011; Amabile, 1996).

(iii) **From a social perspective**, virtual worlds have the capacity to profoundly affect our sense of self; our relationships with others; and our actions and interactions (O Riordan, 2011, p. 294). Research shows that online environments in general (Benbunan-Fich et al., 2002; Nunamaker et al., 1991) and virtual worlds in particular (Schouten 2010; Goh and Paradise, 2008; Giovacchini, et al., 2009) alter the dynamics of interpersonal communication and collaboration (O Riordan and O’Reilly, 2011). In particular, virtual worlds enable new kinds of electronically mediated social networks that are qualitatively different from traditional, real-world social networks (Kumar et al., 2010).

In terms of supporting innovation co-creation specifically, virtual worlds are seen as a “‘blank slate’ within which individuals and organisations can bring about novel, custom situations” (Berente et al., 2011). The built-in tools encourage users to “iteratively and interactively create almost anything imaginable, while sharing the act of creation with others” (Kohler et al., 2011). Fundamentally, virtual worlds are co-created digital environments (Cahalane et al., 2011) and the capacity of virtual worlds to stimulate creativity in thought and action is therefore qualitatively different from that of other kinds of digital environment (O Riordan, 2011, p. 294; de Freitas and Veletsianos, 2010). For these reasons, real-world companies have been exploring how they might apply virtual worlds in open innovation processes whereby customers and companies work jointly on new products (Giovacchini et al., 2009). Yet whilst the majority of existing research focuses on the potential of virtual worlds, scholars have also identified a number of challenges associated with virtual worlds relating to: (i) virtual world interoperability (Mennecke et al., 2008); (ii) platform scalability and stability (Mueller et al., 2011; Warburton, 2009); (iii) the user interface (Mueller et al., 2011); (iv) security (Mueller et al., 2011) and privacy (Boulos et al., 2007) issues; (v) legal (MacInnes, 2006; Noveck, 2004) and economic (Noam, 2008; Papagiannidis et al., 2008) issues. Therefore, there is a pressing need for empirical research to further explore the nature and impact of virtual worlds and to investigate the extent to which virtual worlds can be used to support (net-enabled) innovation co-creation.
Artifact design is a key IS research theme or objective (Benbasat and Zmud 2003; Orlikowski and Iacono 2001). In particular, highly dynamic, synchronous, and evolving nature of user-generated environment like virtual worlds “calls for special guidance on the design and management of the actual processes or activities that occur within these settings” (Kohler et al., 2011; Nambisan, 2009). Therefore, the purpose of this study is to contribute to research in this area by investigating innovation co-creation in virtual worlds. In particular, the study seeks (i) to investigate the manner in which innovation co-creation currently takes place, (ii) to establish the extent to which virtual worlds can be used to support innovation co-creation, and finally (iii) to use these findings to derive a set of practical recommendations that can be used to stimulate or support innovation co-creation in virtual worlds.

In order to achieve the research objective, a qualitative approach underpinned by a pragmatist perspective was selected. There is growing interest in pragmatism in organisational and information studies (Goldkuhl, 2004) and in IS research specifically (Ågerfalk, 2010). Pragmatism views thought as being intimately interwoven with action in a purposive context (cf. Scheffler, 1986, pp. 8-9) and “considers practical consequences or real effects to be vital components of both meaning and truth” (Hevner, 2010, p. 91). It is suitable in the context of this study given that innovation co-creation in virtual worlds is based on (avatar-mediated) action and interaction. A qualitative approach is appropriate given the exploratory nature of the study and because little is currently known about designing co-creation experiences in virtual worlds (Kohler et al., 2011). More specifically, a combination of participant observation and case study methods were used. A case study approach is considered appropriate as it is well suited to understanding the interactions between information technology-related innovations and organizational contexts and is the most widely used qualitative research method in information systems research (Darke et al., 1998). Participant observation was useful in allowing the researchers to experience Second Life as the participants do (cf. Marshall and Rossman, 2006, p. 79). The combination of participant observation with case study research was an especially powerful tool in terms of corroborating, validating and triangulating data in the unfamiliar research context of a virtual world.

Second Life® was chosen as a suitable research site for a number of reasons. First, Second Life meets with the definition of non-game oriented virtual world presented in Chapter Two. That is to say, Second Life is an online, immersive, interactive environment that is based on community, content creation and commerce. Furthermore, Second Life has a number of unique features that were designed to stimulate user-driven innovation. These include Second Life’s (i) marketplace, (ii) currency exchange service (the LindeX), and (iii) terms of service which grant users real-world intellectual property rights on their virtual creations (Ondrejka, 2004). Thus, Second Life is a particularly good choice for creative expression (Ward and Sonneborn, 2009). Finally, Second Life has become the de facto virtual world for commerce (Kim et al., 2008) and most virtual worlds studies in the IS field to date have therefore focused on Second Life (O Riordan, 2011).

Given that large-scale virtual communities consist of large numbers of sub-communities (Hagel and Armstrong, 1997), it was necessary to focus on a particular sub-community within Second Life. In qualitative research, the “validity, meaningfulness, and insights generated” are largely based on the information-richness of the cases selected (Patton, 1990, pp. 184-185). Therefore, Second Life’s educational community was chosen for the study. This decision was based on preliminary observations which indicated (i) that a large number of educational institutions actively use Second Life; (ii) that educators have been instrumental in creating many of the innovations in virtual worlds; and (iii) that this community is particularly eager and willing to engage with researchers.

The study’s focus on innovation co-creation suggests the need to be able to sample innovative cases. For this reason, the study adopted innovative educational virtual world projects as its unit of analysis. In this perspective, Linden Labs are the ‘producers’ of Second Life and university educators ‘consume’ Second Life. Innovation co-creation is therefore seen to take place when university educators use Second Life to develop innovative educational projects
within Second Life15. The researcher used a criterion sampling technique (cf. Patton, 1990) in order to identify innovative educational projects carried out in Second Life. More specifically, the researcher evolved a list of qualitative criteria (together with a points system) which was used to ‘rank’ projects in terms of their suitability for the study. Six case studies were carried out (summarised in Table 1).

<table>
<thead>
<tr>
<th>CASE</th>
<th>DESCRIPTION OF THE PROJECT</th>
</tr>
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<tbody>
<tr>
<td>BOF</td>
<td>Bring students into a virtual world; an intrinsically cybernetic and artificial cultural landscape, born of science fiction and inhabited by the virtual human in order to explore the implications of scientific and technical advances for the future of humanity</td>
</tr>
<tr>
<td>TEX</td>
<td>Leverage the unique affordances of Second Life to create educational materials that could not feasibly be created using other technologies and to package those materials by means of a Machinima video so that they could be published online for future use</td>
</tr>
<tr>
<td>IRT</td>
<td>Use Second Life to create demonstrations and simulations of animation algorithm concepts that are difficult or impossible to create in the real world</td>
</tr>
<tr>
<td>GAL</td>
<td>Use scenario-driven and problem-based learning to improve nurses’ skills in taking patient histories and undertaking physical examinations in real life</td>
</tr>
<tr>
<td>ZOM</td>
<td>Follow a structured and formalised research agenda over a three year period in order to incrementally develop and use a virtual laboratory in Second Life to teach lab and experimental skills to science students</td>
</tr>
<tr>
<td>OLY</td>
<td>Improve students’ chances of being hired as border control officers by allowing them to rehearse the role of a border control officer in a virtual border setting</td>
</tr>
</tbody>
</table>

Table 1. Summary of the case studies

Data collection and data analysis activities overlapped. Data collection was carried out between January and June 2010. Inworld site visits were made to each project. Guided interviews (cf. Patton, 1990) were carried out inworld and lasted an average of 90 minutes. Project participants in each case were classified as educators, developers or project facilitators and interviews were carried out with at least one educator, one developer and one project facilitator in each case. Interviews were recorded and transcripts were created to facilitate data analysis. Participant observation was carried out both prior to and during interviews; this was primarily focused on the activities of the educational community in Second Life but also involved more general explorations in Second Life. Its primary purpose was to more fully probe the possibilities for innovation co-creation using virtual worlds.

Data was analysed in accordance with Miles and Huberman (1994). This approach has enjoyed widespread use and is considered both elegant and systematic (Denzin and Lincoln, 1998, p. 40). Its core strength lies in its capacity to readily facilitate the customisation of (i) data reduction techniques, (ii) data displays and (iii) techniques used to draw and verify conclusions. Detailed case summaries, field notes, field memos, pattern codes, and methodological memos were produced during the early stages of the study and were repeatedly reviewed and revised during the study. In the latter stages of the study, case data was coded according to Miles and Huberman (1994) and these codes were used to construct a series of within-case and cross-case data displays in an emergent fashion (cf. Lincoln and Guba, 1985, p. 225). These displays constitute a tangible, traceable and explicit means of addressing the study’s research objective.

4 Presentation of research findings

This study’s research objective is to investigate innovation co-creation in virtual worlds. This section presents the findings of the study in relation to co-creation in six innovative educational projects carried out in the virtual world of Second Life. In particular, the section consists of two main components. The first component is a detailed etic or ‘outsider’ analysis of the actual behaviours of innovation co-creators in the cases. It begins by identifying and classifying 15 distinct behaviours that were used in the cases. At a higher level of abstraction, the analysis also

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15 In this context, students taking part in educational projects in Second Life are not seen to be centrally involved in the co-creation of innovations in virtual worlds and students are therefore not the primary focus of this study. Rather, students are seen as end users of innovations that have already been co-created by university educators working with Linden Labs in Second Life. This study’s point of departure is therefore quite unusual in comparison with existing research on education in virtual worlds (a review of which is outside the scope of this paper).
identifies three distinct patterns of behavior ('archetypes') across the cases. This analysis reveals that despite the social, communicative and collaborative affordances of virtual worlds, most teams favoured a self-reliant approach. The second component of the analysis presents an 'insider' or *emic* analysis of the main factors affecting innovation co-creation in the cases. In the final section of the study, the two components of the analysis are then combined in order to derive a set of practical implications for those seeking to stimulate or engage in innovation co-creation in virtual worlds and indeed other electronic settings.

4.1 Co-creating innovations virtually: a behavioural analysis

This section presents a detailed *etic* or ‘outsider’ analysis of the actual behaviours of innovation co-creators in the cases. The analysis is based on Table 2, which presents a numerical analysis of innovation co-creating behaviours in the cases. The table identifies 15 distinct behaviours and classifies them into four types. The columns list each case, showing how many individuals used a particular behaviour in each case. Individual behaviours are defined in Appendix A. These behaviours are conceptually similar to real life behaviours but are carried out in fundamentally different ways in Second Life. For example, the unique spatial and communicative properties of Second Life means that it is possible to carry out these activities more quickly than in real life and in some cases multiple behaviours can be carried out simultaneously.

**Endogenous exploratory behaviours** (opportunistic and open-ended behaviours carried out internally within teams or within teams’ locations in Second Life) included brainstorming, self-directed learning and DIY/practice. Real world brainstorming was typically used in early design stages and would often involve the use of a whiteboard to literally sketch ideas out. Inworld brainstorming typically took place once development work had actually commenced. Inworld brainstorming differed from real world brainstorming in the sense that the moment an individual had ideas, they could start to interactively experiment with them inworld. B.DEV explains that the big difference is that inworld, “you can start playing with it the instant you have ideas”. Self directed learning tended to be carried out on an individual basis but participants typically had colleagues or inworld contacts to turn to for advice and assistance. In terms of DIY / Practice, many participants had developed the earliest elements of their islands as a way to familiarise themselves with working in a virtual world. These earliest builds were often kept on the islands for posterity.

**Endogenous exploitative behaviours** (purposeful behaviours carried out internally within teams or within teams’ locations in Second Life) were the most common class of behaviours, manifesting in thirty seven instances across the six cases. The analysis suggests that whilst other kinds of behaviours were carried out on a discretionary basis, these types of behaviour were necessary to complete projects. In particular, endogenous collaboration was the most pervasive type of behaviour found in the study. Endogenous collaboration typically took the form of more experienced team members supporting more junior members by answering questions or providing input. Formal meetings were also commonly used. However, these meetings were held in the real world unless it was necessary to meet in the virtual world. Finally, pilot projects gave team members an opportunity to engage in experimentation and to practice the necessary skills to create in Second Life. These projects also served to provide educators with something ‘tangible’ that could be demonstrated to stakeholders.
Table 2. Analysis of innovation co-creating behaviours in the case studies

Exogenous exploratory behaviours (opportunistic and open-ended behaviours carried out outside of teams or teams’ locations in Second Life) were considered vital in terms of allowing study participants to gain new insights into how Second Life could be used. Yet even though much could be learned simply from visiting other educational locations in Second Life, participants suggested that it was also important to interact with other educators in Second Life in order to understand what educators intended to do as well as what they actually managed to accomplish. The table shows that exploratory exogenous behaviours were less commonly used than exploratory endogenous behaviours. Time constraints were frequently cited as an explanation for this. In addition, the analysis reveals that despite the communicative affordances of Second Life, study participants tended to rely on real world colleagues rather than on members of the broader Second Life community.

Exogenous exploitative behaviours (purposeful behaviours carried out outside of teams or teams’ locations in Second Life) were least commonly used in this study. The analysis suggests that it is difficult to collaborate exogenously (outside of one’s own team) in Second Life. Whilst educators in Second Life are happy to share resources, it seems that a number of study participants (e.g. G.EDU) had unsuccessful attempts to identify and partner with potential collaborators. There was a strong recognition in Second Life (and amongst study participants) that the ability to stimulate effective collaborations in Second Life is a skill in itself; both B.FAC and B.DEV described this as “community building”. This sentiment suggests that virtual world users face similar challenges to individuals working in distributed teams: they must work hard to overcome the challenges of communicating without face-to-face cues so that they can develop “collaboration know-how” in order to work effectively with others (Majchrzak et al., 2005) in the virtual world.

At a higher level of abstraction, three distinct behavioural patterns (‘archetypes’) appear in the cases:

(i) Purposeful self-reliance occurred where teams were primarily engaged in exploitative endogenous behaviours. This archetype manifested in three cases (BOF, ZOM and OYL) but is most clearly in evidence at ZOM. Here, the team deliberately built upon the previous experiences of ZOM in Second Life as part of an incremental and explicitly stage-based approach. Whilst BOF and OYL were also primarily focused on exploitative endogenous, these teams also maintained a secondary focus on exploratory (endogenous) behaviours.

(ii) Opportunistic self-reliance occurred where teams were primarily engaged in exploratory endogenous behaviours. This archetype manifested in two cases (TEX and IRT) but was most pronounced at TEX where multiple individuals within the team utilised these behaviours. At IRT, the team was primarily engaged in exploratory endogenous behaviour but maintained a strong secondary focus on exploitative behaviours.
Despite an opportunistically rather than purposeful approach, these teams (TEX and IRT) engaged in fewer behaviours overall than purposefully self-reliant teams (BOF, ZOM and OYL).

(iii) A balanced approach occurred at GAL where the team’s behavioural configuration was balanced with a slight skew in favour of exploitative exogenous behaviours. This configuration of behaviours represents a significant departure from the other cases where the emphasis was primarily placed on endogenous and exploitative behaviours.

Overall, endogenous behaviours were more common than exogenous behaviours. This finding seems to contradict existing research which advocates the social, collaborative and communicative affordances of virtual worlds. Yet the balanced approach adopted at GAL is a kind of proof-of-concept of virtual worlds, illustrating that exploitative exogenous behaviours can be effectively leveraged in virtual worlds even if there may be difficulties associated with doing so. In the final analysis, there were marked behavioural differences across the cases and whilst these differences may be partly explained by contextual differences in the cases, participants argued that there was no consensus on what could be effectively achieved in virtual worlds or on the best way to achieve it. This meant, in turn, innovation co-creation was non-formalised and resource-intensive.

4.2 Factors affecting innovation co-creation in virtual worlds

Though Section 4.1 indicates that study participants relied primarily on endogenous behaviours, this section presents substantial evidence that the utilisation of exogenous behaviours in a virtual world is uniquely conducive to supporting the co-creation of innovations but that particular barriers to collaboration must be overcome if these benefits are to be maximised. Table 3 identifies three key factors thought to affect innovation co-creation by study participants based on observations made during the study. Each factor is explained in terms of an emic or ‘insider’ analysis of participants’ interpretations of each factor.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Observation</th>
<th>Explanation</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sourcing inspiration</td>
<td>Participants underlined the idea that the work of others in Second Life was an important source of inspiration and motivation. O.DEV explained that he needed to “see the state of the art” in order to be able to do his best work</td>
<td>I.FAC explains that an awareness of the work of others is particularly important for creating understanding and meaning in a virtual world. This is because it is necessary to fully understand the technical constraints that may limit what can be created in a virtual world. Rather than limiting the imagination, I.FAC argues that “you become more open [as] the limitations of your own understanding go down”. This is especially important at present where virtual worlds remain an emergent and partially understood phenomenon. Similarly, O.FAC argues that one must understand how the virtual environment itself works but for him, it is particularly important to be aware of what others have already created in the environment if one wishes to innovate with(in) it. In this regard, innovation in Second Life is much like musical improvisation: “You need to know the script before you can break away from it” (O.FAC).</td>
<td>(+)</td>
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<tr>
<td>2. Opportunities for emulation</td>
<td>Emulation or imitation is an effective means of co-creating innovations in virtual worlds. At OYL and GAL, for example, teams generated new ideas by looking for “serious examples” (G.DEV) in Second Life and then adapting and refining those ideas</td>
<td>In Second Life, it is possible to visit, inspect and experience projects that have been created by educators from all over the globe at the click of a button. At the same time, digital goods can be readily bought inworld and in virtual marketplaces. For these reasons, O.FAC explains, it is remarkably easy to adapt and quickly “emulate great projects” in Second Life. O.FAC argues that “it takes longer if you wish to invent something completely new”. Study participants at GAL and ZOM suggested that it was important not to focus too much on what already is: the trick is to stay focused on “what is possible”. For this reason, innovating with(in) a virtual world is “less to do with what you can do than with what you can imagine” (G.PM).</td>
<td>(+)</td>
</tr>
<tr>
<td>3. New communicative affordances</td>
<td>The capacity to create interactive objects grants users the ability to engage in non-linguistic communication.</td>
<td>Many of Second Life’s most successful educational projects allow users to ‘live’ different moments in space and time or to literally experience sensory and perceptual distortions that are not otherwise easily simulated (e.g. UC Davis’ Virtual Hallucinations project). G.EDU explains that “there is an element of seeing is believing and certainly when you’re trying to get people to use it, if you can take them to other places and say ‘look, this is how they’ve used it here’”.</td>
<td>(+)</td>
</tr>
<tr>
<td>4. Impact</td>
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</table>

Table 3. Analysis of factors affecting innovation co-creation in the case studies
Conclusion: stimulating innovation co-creation in virtual worlds

This research project has yielded a wealth of rich observations on the topic of co-creating innovations in virtual worlds. In particular, this paper presents a detailed analysis that combines etic (Section 4.1) and emic (Section 4.2) perspectives on the factors and behaviours that lead to the successful co-creation of innovations in virtual world educational projects. Whilst open research designs effectively allow for the collection and analysis of rich observations in settings about which little is known, they bring with them significant difficulties in terms of deriving definitive conclusions (Nutt, 1984).

Therefore, Table 4 identifies three practical recommendations for innovation co-creators that arise out of a synthesis of the analyses presented in Section 4. Given the paper’s space constraints, it is difficult to express the exact linkages between the study’s findings and its recommendations. For this reason, the table’s second column clearly shows whether or not each recommendation is supported by the emic and etic analyses. In addition, the third column briefly describes the rationales underpinning the linkages between particular findings and the recommendations derived from them. Finally, the fourth column extrapolates some of the implications of each recommendation for virtual world designers. Taken together, the recommendations presented in the table direct innovation co-creators in virtual worlds to ensure that sufficient resources are invested to support ongoing inworld exploratory activity. In so doing, virtual world users can develop the practical knowledge necessary to fully understand the actual technical affordances and limitations of virtual worlds.

Overall, the analysis supports the view that virtual worlds are attractive for innovation co-creation. In particular, the analysis supports existing arguments in literature regarding the communicative affordances of virtual worlds. Yet as I.FAC observed, teams were “fumbling around in the dark” and as a result, innovation co-creation was a non-formalised and resource-intensive process. Whilst the recommendations presented in this section represent a starting point in terms of guiding future innovation co-creation efforts, there is a need for further research on fully leveraging the collaborative affordances of virtual worlds.
<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Derives from</th>
<th>Rationale and discussion</th>
<th>Design implications</th>
</tr>
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<tbody>
<tr>
<td>1. Ensure that sufficient time is taken to fully explore virtual worlds</td>
<td><strong>Emic analysis</strong> - Section 4.2</td>
<td>In Section 4.2, study participants underline the importance of exploring Second Life by means of exogenous exploratory behaviours in virtual worlds (particularly in terms of stimulating creativity and innovation), but the analysis in Section 4.1 demonstrates that these behaviours were least commonly used in the cases.</td>
<td>Virtual world designers should try to ensure that there is effective support for inworld exploration. For example, information about particular projects in Second Life is often shared inworld by word-of-mouth. This is because existing search and navigation mechanisms in Second Life remain <em>ad hoc</em> and are a difficult to use (particularly for inexperienced users). One possible means of stimulating the diffusion of innovations and information through inworld communication channels would be to develop new (inworld and/or online) community-level mechanisms.</td>
</tr>
<tr>
<td>2. Ensure that sufficient practical knowledge of virtual worlds is available</td>
<td><strong>Emic analysis</strong> - Section 4.2</td>
<td>Study participants underlined the need to remain tightly focused on what is possible in virtual worlds (rather than to focus specifically on what already is or on what is theoretically possible but infeasible given the environment’s technical constraints. For this reason, numerous participants emphasise inworld skill development. G.DEV explains that it can be “difficult to get involved in the ideas of virtual worlds” when people “don’t have the time or the interest or the skill... [when] they struggle with the technology”. Conversely, where this can be accomplished, the rewards can be substantial: O.FAC argues that people can learn “certain skills very effectively in a virtual world and those skills translate into a real world testing situation”</td>
<td>Virtual world designers should attempt to minimise the effort required to acquire practical knowledge of virtual worlds, particularly for new users. It may be possible, for example, to accelerate learning by developing and promoting high-quality inworld training courses.</td>
</tr>
<tr>
<td>3. Continue to focus on tools and techniques that support self-reliance in teams</td>
<td><strong>Emic analysis</strong> - Section 4.2</td>
<td>Study participants argue that effective collaboration in virtual worlds can stimulate synergies within teams. For example, G.FAC argues that each person at GAL discovered different things but they learned much more as a group. However, participants also acknowledge that it is difficult to create truly effective collaborative relationships in virtual worlds especially with other groups. Thus, fully self-reliant approaches to innovation co-creation were adopted in five of the six cases.</td>
<td>In the short term, virtual world designers should continue to ensure that individuals and teams can effectively work autonomously, because of the unique challenges associated with fully leveraging the collaborative affordances of virtual worlds. In the longer term, virtual world designers must develop a robust understanding of the barriers preventing fully collaborative approaches to innovation co-creation in virtual worlds.</td>
</tr>
</tbody>
</table>

**Table 4**

*Practical recommendations to support innovation co-creation in virtual worlds*
References


References