Technology Innovation Management Review

May 2014

Service and Innovation

Welcome to the May 2014 issue of the *Technology Innovation Management Review*. This month's editorial theme is Service and Innovation. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

The *Technology Innovation Management Review* (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints – from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others – to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

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Editorial: Service and Innovation

Chris McPhee, Editor-in-Chief

Risto Rajala, Marja Toivonen, and Mika Westerlund, Guest Editors

From the Editor-in-Chief

Welcome to the May 2014 issue of the *Technology Innovation Management Review*, in which we revisit the editorial theme of Service and Innovation. As in our April issue, our guest editors are **Risto Rajala** (Aalto University), **Marja Toivonen** (VTT Technical Research Centre of Finland), and **Mika Westerlund** (Carleton University), who have done a wonderful job in soliciting enough high-quality submissions for two issues on Service and Innovation. In total, we have 10 articles devoted to this theme: five in the April issue (timreview.ca/issue/2014/april) and another five in the May issue.

Our June and July issues will be unthemed, and we welcome submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies. Please contact us (timreview.ca/contact) with article topics and submissions, suggestions for future themes, and any other feedback.

We hope you enjoy this issue of the TIM Review and will share your comments online.

Chris McPhee
Editor-in-Chief

From the Guest Editors

This is the second of two issues on Service and Innovation that put forward the pivotal role of services in today's economic growth. The inspiration for these issues draws from the global interest in service innovation and the enabling technologies, processes, and knowledge resources across industries. Interaction of knowledge resources is a necessary driver of service innovation. Along with the developments of technology, the creation and management of knowledge have emerged as core themes of service innovation.

Technology as an enabling driver and knowledge as the focus of exchange are considered equally important resources in service innovation. However, the quality of interaction among participants in service systems will ultimately determine the success or failure of service innovation. Value creation through service innovation often takes place in multi-stakeholder settings, which call for resource integration through social interactions. Nevertheless, the processes, organizational structures, and contingency factors catalyzing value creation in multi-actor interaction in both intra- and inter-organizational settings have not been sufficiently explored.

The theoretical backgrounds of the articles are rooted in multiple disciplines, taking in technology studies, industrial marketing, management, and general innovation studies. The April issue (timreview.ca/issue/2014/april) introduced user-centric service in a variety of innovation contexts and investigated its social dimension. This issue continues to synthetize knowledge on service innovation by focusing on the interconnectedness of products and value creation activities, intellectual property, innovation practices, and the methods of interaction in collaboration in service systems.

We hope that this issue of the TIM Review will shed light on service innovation, which is important for both research and practice. The articles included in this issue represent studies carried out mainly in European countries, but also in other markets, especially in Asia. Furthermore, the issue has an interesting diversity in terms of industrial settings and methodological ap-

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proaches. Many of the findings are generalizable across contexts and industries, irrespective of the geographical area.

In the first article, two authors from Sweden – **Patrik Ström** from University of Gothenburg and **Mirko Ernkvist** from the Ratio Institute – investigate the product and service offerings in the Chinese online gaming industry. Online gaming has become a compelling industry for investors and entrepreneurs, especially in Asia. The industry's evolution in China demonstrates the complexity of the growth of this industry through various knowledge and production networks. Although Chinese companies have not been among the first movers in this industry, many of them have managed to move up the value chain within a few years, from operators of foreign-developed games to primary game developers. The authors argue that Chinese companies have managed to grow by utilizing the strategic control of services, player preferences, and responsiveness in their networks, translating the gained control into evolutionary improvements of their game offerings.

In the second article, two authors from Germany – **Matthias Gotsch** from the Fraunhofer Institute for Systems and Innovation Research ISI in Karlsruhe and **Christiane Hipp** from the Technical University Cottbus – present an empirical approach to measuring innovation outcomes through the analysis of trademarks in knowledge-intensive business services. With rooting in previous empirical investigations in other industries, the authors show that a trademark may be used as an innovation indicator. Based on the results from a survey of almost three hundred companies, the authors emphasize the role of trademarks in protecting intellectual property pertaining to knowledge-intensive services. Furthermore, they suggest that trademarks serve as adequate indicators to measure service innovation outcomes across knowledge-intensive business sectors.

The third article, by **Heidi Korhonen** from the VTT Technical Research Centre of Finland, discusses the transformation of industrial operation, from providing services as add-ons to industrial production toward providing services as solutions. She investigates the phenomenon from the perspective of the service-dominant logic, which emphasizes value co-creation in actor-to-actor networks. This study pays special attention to organizational structures and practices in industrial operation. The empirical case illustrates a development program of a Nordic manufacturer of arc welding equipment, showing how the manufacturer has become more customer and service oriented. Also, Korhonen discusses the implications of the service-dominant logic for innovation practices and argues that similar patterns can be expected to take place in many other industrial companies.

In the fourth article, **Silvia Gliem**, **Janny Klabuhn**, and **Nadine Litwin** from the Brandenburg University of Technology Cottbus-Senftenberg, Germany, analyze the interaction between technological development and service innovation in high-technology industries. Building on an extensive literature review, the authors show that the early studies of service innovation brought in the results of technological innovation to the realms of services. By analyzing a variety of theoretical approaches to technology-service interaction, the article deepens the understanding of innovation in the area of services. The authors analyze a number of case studies representing different service industries and differing technologies. Their findings reveal several factors in technology-service interaction, including the kind of technology involved in the innovation activities, the stage of development of the technology, and the type of service.

In the last article, **Madeleine Gray**, **Mikaël Mangyoku**, **Artur Serra**, **Laia Sánchez**, and **Francesc Aragall** discuss public service innovation in the European living lab context, with a focus on the Integrating Design for All in Living Labs (IDeALL) project. The authors argue that innovativeness may not be a sufficient catalyst in bringing new products to market, or in the development of public services that really meet people's needs. They discuss the outcomes of a number of experiments related to designing services with users in real-life settings. These experiments shows how different collaboration methods can help innovators to develop solutions that genuinely meet user requirements. The article provides perspectives to using such methods and analyzes their use in the investigated cases. By doing so, the article helps businesses and public bodies to discover and test innovation approaches based on living labs.

We hope that you will enjoy this issue and that you will find the outcomes beneficial for the future research of service innovation and in the practice of service business development.

Risto Rajala, Marja Toivonen, and Mika Westerlund
Guest Editors

Editorial: Service and Innovation

Chris McPhee, Risto Rajala, Marja Toivonen, and Mika Westerlund

About the Editors

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. Chris holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa and BScH and MSc degrees in Biology from Queen's University in Kingston. He has over 15 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

Risto Rajala, D.Sc. (Econ) is an Assistant Professor in the Department of Industrial Engineering and Management at Aalto University in Helsinki, Finland. Dr. Rajala holds a PhD in Information Systems Science from the Aalto University School of Business. His recent research has dealt with management of complex service systems, development of digital services, service innovation, and business model performance. Rajala's specialties include management of industrial services, collaborative service innovation, knowledge management, and design of digital services.

Marja Toivonen is Research Professor at VTT Technical Research Centre of Finland, her specialty being service innovation and service business models. She is also Adjunct Professor at Aalto University in Helsinki, Finland. Marja has written several articles on service-related topics and been an invited speaker in many international conferences focusing on these topics. She is a council member of the European Association for Research on Services (RESER), and she is a member of the European Union's 2013–2014 High-Level Expert Group on Business Services.

Mika Westerlund, D.Sc. (Econ) is an Assistant Professor at Carleton University's Sprott School of Business in Ottawa, Canada. He previously held positions as a Postdoctoral Scholar in the Haas School of Business at the University of California Berkeley and in the School of Economics at Aalto University. Mika earned his doctoral degree in Marketing from the Helsinki School of Economics. His doctoral research focused on software firms' business models and his current research interests include open and user innovation, business strategy, and management models in high-tech and service-intensive industries.

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Keywords: service innovation, service business development, value creation, innovation practices, collaboration, online gaming, value chains, knowledge-intensive business services, intellectual property, trademarks, innovation indicators, service-dominant logic, service design, living labs

Product and Service Interaction in the Chinese Online Game Industry

Patrik Ström and Mirko Ernkvist

> *"Having an office in China, we have advantages in the ability to develop games cheaply and the ability to develop games rapidly. The China office is very efficient in terms of speed."*
>
> Interviewee and manager of an online game company

This article examines the rapidly-growing online game industry in China, which is a prime example of the changing regional landscape of new creative industries in East Asia. The industry's evolution in China demonstrates the complexity of the growth of this industry through various knowledge and production networks. Despite the fact that Chinese companies were initially a second mover in this industry and had limited technological competence, they managed to move up the value chain within a few years, from operators of foreign-developed games to game developers. The catch-up process in this creative industry has differed from traditional manufacturing industries, which reflects the responsiveness and close proximity between product and service as key elements of the online game experience. This article conceptualizes this product–service offering in the industry and highlights its requirement for a widespread geographical network, as well as close proximity and responsiveness between elements of the network. In the empirical study of the growth of the Chinese online game industry described here, we argue that Chinese companies have managed to grow by utilizing the strategic control of service, player preferences, and responsiveness in this network, and translating this control into constant incremental improvement of their game development offering.

Introduction

With technical abilities and strong innovation systems, countries can gain competitiveness in economic development (Lundvall et al., 2006; Masuyama & Vandenbrink, 2003). The rapid economic growth of countries in East Asia and Southeast Asia is pushing these economies towards a situation where services and creative industries make an increasing contribution a greater contribution to gross domestic product (Daniels, 2005; Ström & Mattsson, 2006; UNCTAD, 2008).

Since the mid 2000s, there has been a global shift in the geography of production in the creative industry. While established centres of creative industry production in the United States, Japan, and Europe remain strong in creative industries, new regions have focused on the opportunities in newly emerging creative sectors. As a result, "…new forms of cultural production are expanding rapidly in what until recently was commonly referred to as the 'periphery' of global capitalism" (Lorenzen et al., 2008). In East Asia, one of the most interesting creative sectors to exemplify this global shift is the rapidly growing online game industry, where technology-intensive services are prominent. There are two main types of online game: i) massively multiplayer online games (MMOG) and ii) casual online games. In MMOG, which initially dominated the market, thousands of people can play a game simultaneously in virtual worlds on computer servers, often over the course of many months. Usually, casual online games are less complex than MMOG and are played on social networks, browsers, and mobile phones. Some of the most successful MMOG have over one million active players,

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but due to server capacity limitations, they may be distributed over a number of server database partitions, or shards, in different geographical regions.

Revenues for the worldwide online game market in 2012 were estimated at $21 billion USD (DFC, 2013). Japan has traditionally been the East Asian industrial leader in game software for video games, arcade games, handheld games, and mobile phone games (Johns, 2006; Izushi & Aoyama, 2006). However, since the late 1990s, the new online game industry has been the most rapidly-growing segment of the global game industry (Lehdonvirta & Ernkvist, 2011). In the online game sector, the regional leadership of Japanese game companies has been challenged by new companies from Korea and China. Even by 2009 the online game markets in Asia outside of Japan account for over half of the worldwide online game market (Lehdonvirta & Ernkvist, 2011). Korea was initially the largest market in the region, but through rapid growth in recent years, China has become the largest market. The market size for Chinese game market increased to 83.17 billion RMB in 2013 ($13.4 billion USD). Online games dominated the market, with the largest segment being PC online games (53.66 billion RMB), followed by browser-based games (12.77 billion RMB), mobile phone games (11.29 bn RMB), social network games (5.41 billion RMB), and single player games (0.9 billion RMB) (GPC, 2014). In total, an estimated 338 million users were accessing online games though personal computers and 225 million users accessing online games though mobile phones (CNNIC, 2014). Online games have become the focus of "cultural consumption" by China's younger generation.

The regional shift that has taken place in the supply side of the industry is just as interesting as the demand-side shift. The supply side has been characterized by increasing competitiveness of domestic Chinese online game companies from the private sector. Initially, Chinese game companies were predominately service operators for online games that had been developed by foreign, mostly Korean, online game developers (Chung & Yuan, 2009; Ernkvist & Ström, 2008; Ren & Hardwick, 2009). However, over time, the revenue share of Chinese-developed games in the domestic market has increased, from around 15 percent in the early stages of the industry in 2003 (iResearch, 2005) to a level of 60 to 65 percent (Table1). The recent international expansion during this period represent a new focus of China as an exporter in new emerging creative industries.

Table 1. Chinese market for domestically developed games and export

Year	Market Size of Domestically Developed Games (bn RMB)	Market Size of Foreign-Developed Games (bn RMB)	Share of Domestically Developed Games (% of total market revenues)	Chinese Game Export (bn RMB)
2005	2.26	1.51	60%	–
2006	4.24	2.3	65%	0.04
2007	6.88	3.68	65%	0.06
2008	11.01	7.37	60%	0.07
2009	16.52	9.10	65%	0.11
2010	19.30	13.07	60%	0.23
2011	27.15	15.70	63%	0.36
2012	368.10	–	–	0.57
2013	476.60	–	–	1.82

Sources: CGPA (2009), GPC (2014)

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In general, the online game industry is characterized by a few games comprising the majority of the market, a relatively complex and time-consuming development process, and operational service of successful games spanning over many years after initial release (Castronova, 2005; Hosoi, 2004; KGDI, 2006; Mulligan & Patrovsky, 2003). Revenues in the industry are typically derived from business models that are based on time or virtual items.With time-based business models, revenues are either derived through monthly, flat-fee subscriptions or through fees based on the amount of time users spend playing the game. With business models based on virtual items, the basic functions of the game are free for the players, but revenues are derived from the sales of virtual items and services within the game.

In China, the creative industry is now the target of increasing interest from private industry and policy makers that had earlier earlier had been concentrated in the manufacturing sectors around the processes of development and economic growth (Hartley & Keane, 2006; Hartley & Montgomery, 2009; Keane, 2007; O'Connor & Xin, 2006). With the growth of the knowledge economy and related services, the creative and cultural industry is seen as a sector of potential growth both in terms of employment and economic contribution, and it is seen as a way for China to transform its material productivity, mainly from manufacturing into innovative productivity in knowledge-intensive sectors (Ernkvist & Ström, 2008; Keane, 2007). Despite the rapid growth of the online game industry in East Asia, the geographical dynamic and industrial development of this new sector of the creative economy in China has thus far received limited attention in academic studies. Some of the few exceptions include Chun and Yuan (2009), who have studied the industry through a Porter framework; Ren and Hardwick (2009), who have analyzed the strategic alliances of foreign game companies with Chinese online game companies; Ernkvist and Ström (2008) and Cao and Downing (2008), who have studied the political economy of the Chinese online game industry; and MacInnes and Hu (2007), who have focused on business models in the industry. However, studies have not yet focused specifically on the how Chinese companies have managed to increase their competitiveness in this creative industry, taking into account how the specific industry context (i.e., the development and service of online games) has shaped this development. As China struggles to strengthen its presence in more creative industry sectors, a closer study of the online game industry, which is at the forefront of this development, could give insights into the dynamics, challenges, and underlying reasons behind this regional shift in the geography of creative industries.

For research to contribute to the conceptualization and understanding of creative industries, "...strategic knowledge in the cultural industries must be situated in the analysis of particular organisational fields; not simply imported from other sectors or industries" (Jeffcutt & Pratt, 2002). The aim of this article is to make a contribution to the conceptualization and empirical understanding of the online game industry and its rapid growth in China. In terms of conceptualization, the aim is to outline the specific organizational field of the online game industry – the network of different actors in the industry and the specific requirements for development, operational service, and consumption of online games in China. In terms of empirical understanding, we seek to answer two major questions in relation to the development of the Chinese online game industry:

1. What have been the specific factors behind the rapid growth of the online game market in China since 2001?

2. What specific conditions for the increasing competitiveness of domestic companies in the Chinese online game industry have enabled them to increase their development competence?

By combining conceptual and empirical understandings, we aim to study the industry´s growth on a broader scale by examining the complexity of the product and service interaction at the firm-level, an area which we argue is vital for the market acceptance of an online game. The article is based on a number of primary and secondary sources, including interviews with representatives of East Asian game companies and industry actors, governmental reports, company annual reports, company conference calls, and industry reports from analysts.

Online Games: A Complex Creative Industry

Previous research has outlined the conditions for development of video games and offline computer games (e.g., Aoyama & Izushi, 2003; Johns, 2006; Tschang, 2005). However, an online game is different in the sense that it is not a packaged good that is finished after development; rather, it is constantly refined and expanded over several years after the launch. Hence, the game is highly dependent on the operational service capabilities of the game company. The rapid technolo-

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gical change characteristic of the industry and complex product and service interaction call for a holistic network approach in order to capture the development of the industry. The network approach has been developed and used in studies on how companies connect to each other through activity links, resource links, and actor bonds (Håkansson & Snehota, 1995). Although the network approach has been mainly applied to manufacturing, attempts have also been made to extend the approach to service-oriented industries (Bryson et al., 1993; de Vries, 2006; Sharma, 1991; Ström, 2004). Being a newly established and growing industry, the online games industry relies heavily on the network-based approach with a mixture of activities, resources, and actors.

Earlier studies of creative industries have focused on analyzing the employment structures (Power, 2002; Pratt, 1997), structural analyses (e.g. Jeffcutt & Pratt, 2002; Scott, 2004, 2006), and relations between different parts of creative and video game industries (Aoyama & Izushi, 2003; Izushi & Aoyama, 2006) or video game production networks (Johns, 2006). The interconnectedness characterizing many of the creative sectors also exists in the online game industry. Additionally, the online game industry is characterized by urban agglomeration with continued technical and organizational change serving as driving forces (Ernkvist & Ström, 2008). The development of the industry shares many aspects put forward in evolutional economic geography and its emphasis on the nature and evolution of complex network structures that are created on different spatial levels involving companies, individuals, and institutions. (Boschma & Martin, 2010; Glückler, 2007; Maskell & Malmberg, 2007). The fluid coordination environment and tacit dimension of knowledge creation generates spatial structures where local "buzz" is important (Bathelt et al., 2004; Storper & Venables, 2004). Furthermore, the product and service interaction of the industry enhances the relational complexity on different spatial levels. Jeffcutt and Pratt (2002) specifically discuss the complexity of creative industries, arguing that they are characterized by "dynamic contact-zones that are inter-operational and inter-disciplinary – providing a territory that is hybrid, multi-layered and rapidly changing" (Jeffcutt & Pratt, 2002). The uncertainty regarding the market acceptance of creative products means that companies in many creative industries are involved in an interpretative design process in close collaboration with users to determine what combination of design attributes would prove successful (Lester & Piore, 2004). For games, this design approach represents a form of producer-driven co-development process where the game company is involved in an ongoing interpretative design dialogue with the users (Grabher et al., 2008). This design dialogue is more intense and prolonged in the online game industry in which the game is constantly expanded and altered, even after its release, through recurrent expansion packs during the operational lifespan of the game that could last more than a decade.

Nevertheless, the demand environment in the industry and its preferences are difficult for companies to understand and can be highly heterogeneous. Similar to other creative industries, different groups of users have different interpretations of what is considered "cool, beautiful, or exciting" (Lawrence & Philips, 2002). The heterogeneous and complex demand environment of creative industries creates additional challenges in online games within their respective social communities. For online games, successful operation depends on management of the community in order to attract new players and increase the retention of existing players. Bond-based and identity-based attachments to a group have been found to be important aspects of online communities (Ren et al., 2007). These motivations for group attachments are deliberately modified by game companies through game design changes during the development and service of the game. The uncertainty regarding the market acceptance of creative products means that companies in many creative industries are involved in an interactive design process in close collaboration with users to determine which combination of design attributes would prove successful for the online community (Lester & Piore, 2004). For online games, this approach represents a form of producer-driven co-development process where certain user groups act as lead users in an ongoing design dialogue before, as well as after, the launch of the online game service (Grabher et al., 2008; Morrison et al., 2004; von Hippel, 1986). The ongoing dialogue with users during operational service of online games shapes the game companies' views regarding what constitutes successful performance factors of their games.

Product and Operational Service Interaction of Online Games

During the development phase, game companies have the option of either trying to develop a game in-house or license a game developed by an external game developer. For online games developed in-house , companies are reliant on technological as well as creative skills. The development process includes efforts from graphic artists, programmers, game designers, quality

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assurance personnel, and managers. More complex games, such as the so-called "massively multiplayer online games" (MMOGs), usually have a costly and long development period of two to three years, whereas casual online games are typically less complex and operate under a shorter development time (NCSOFT, 2006; KOGIA, 2008). Employees with extensive experience in developing online games help minimize problems in the complex development process (Mulligan & Patrovsky, 2003). In-house game development increases the possibilities for controlling and launching new versions and upgrades of a game, rather than being dependent on licensing agreements. Self-developed games also strengthen the ability of the game company to proactively monitor and counter hacking activities and initiate minor fixes in order to supply a well-operating service experience. Dissatisfaction with game reliability is a major self-reported reason for gamers quitting a game in surveys from China (iResearch, 2005). Self-developed games also enable games and expansion packs to be developed specifically for the preferences of any particular market.

The alternative to in-house game development is to license a game developed by another game company. Usually, this approach requires a substantial upfront licensing fee as well as royalty revenue sharing during operation of the game. Although the upfront licensing fee varies, due to different contracts, the royalty revenue sharing has usually been 20 to 30 percent of revenues for MMOGs, and 20 to 40 percent of revenues for casual games (Shanda, 2008). Although licensing could enable a company to gain access to a game with high technological quality and popular game design, it also exposes the company to some potential operational service problems, which would be more easily handled with an in-house developed game. Usually, the developer of the game retains the source code of the game itself. Game operators who lack access to the source code are reliant on the ability of the developer to update the game and respond to any code and design problems that might arise (Ren & Hardwick, 2009). In our interviews with game companies, the relationship between the game developer and the game operator was considered crucial in order for the operator to rapidly respond to potential problems in the game and to be able to make changes in the game according to the preferences of the local market.

This product and service interaction is evident in the development phase. Game companies often implement design features based on an established notion of user preferences that they have derived from earlier game operation experience. However, the most important part of the product and service interaction occurs during the later part of the development process, when companies carefully adjust their game design and features according to user feedback in alpha and beta testing phases of the game. According to our interview subjects, a game is not launched before the game company is confident that it has made all necessary design changes to meet users' requests.

Operational Service, Distribution, and Marketing

The official launch of a game occurs at the end of the development period after users have provided feedback. Successful online games have a lifecycle of many years after being launched, during which constant service is necessary to retain current users and attract new ones. The network of operating service for games requires seamless interaction between a number of services with different providers, as illustrated in Figure 1 and described in Table 2.

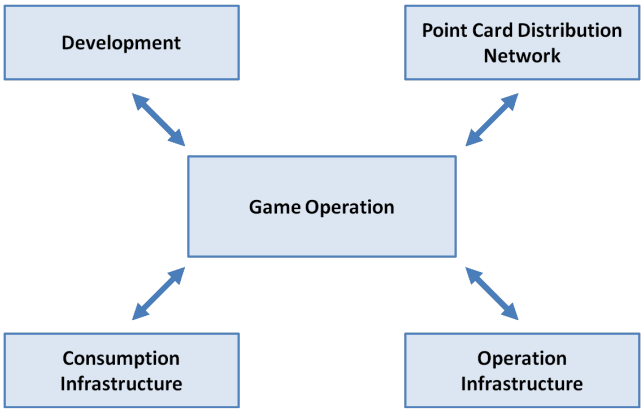

Figure 1. The service network for online games in China

Online game companies need to maintain a high level of customer service, and they need to provide constant support in relation to payments, technical issues, and claims. The game company needs to deliver a community service and a sense of belonging to players in order to keep them interested throughout the operational service period. An online community and social interaction for players are as important as the technical abilities of the game. Games should be updated regularly with new content, features, and services in the form of game expansion packs, virtual events, and new game items in accordance with the users' requirements (Mulligan & Patrovsky, 2003; Zackariasson & Wilson, 2004). In such an online community, the motivation for play

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Table 2. Service provider functions for online games in China

Function	Providers	Services
Development	External game developer or in-house game development by operator	• Develop the online game and constantly expand and refine the game design during operation • Fix bugs, cheating and hacks vulnerabilities in the game • Develop new virtual items and services for operator
Point card distribution network	External game point card distributors or game operator	• Distribute game point cards that users could use to pay for virtual items and services in the game. • Distribution alternatives: Sales of physical or electronic game point cards through Internet cafés and other venues; sales directly to consumer by credit cards or other payment services

Game operation	Game operator company	• Organize special events in the game world to attract players
		• Service and manage the virtual item trade and economy
		• 24-hour service to monitor the game and handle player complaints and issues
		• Various forms of online and offline marketing efforts to attract players
		• In-game service through game masters
		• Customer service lines and help desk
		• Service interaction with other functions:
		  ○ Constant feedback with external or internal game development function to improve the game, to prevent hacking and cheating, to produce new virtual items and services, and to introduce game expansion packs
		  ○ Marketing, promotion, and interaction with customers through physical events and Internet cafés
		  ○ Sales of electronic or physical game point cards through network of Internet cafés or through external distributors
		  ○ Interaction with provider of technological infrastructure to adapt server and bandwidth requirement with the size of the rapidly changing user base of the game

Consumption infrastructure	Internet cafés, ISPs, and PCs for consumers.	• Internet cafés provide a social "third space" for online game consumption
Operation infrastructure (e.g., computer servers, bandwith)	ISPs, third-party technology providers	• Provide technological infrastructure for fast and reliable game operation in an environment of a rapidly changing game user base

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can be multifaceted. Achievement, relationship, immersion, escapism, and manipulation have all been found to be important user motivations for playing (Yee, 2007). Online games are also important social platforms, with a high proportion of players forming online and offline friendships (Cole & Griffiths, 2007).

This kind of extensive community service is specific to online games and has not been needed in other parts of the game industry. Companies need a specific capacity to deliver services, including close linkages and social relationships with customers and suppliers (Normann, 2000). Innovation in service tends to be continuous and the knowledge creation of service companies is more reliant on the network and tacit know-how gained through interaction with customers whose preferences often are difficult to interpret and poorly specified (Tether, 2005). The ability to create an online game world in which players can enjoy socializing and receive continuous service so they stay and enjoy their game experience is a capability from which leading online game companies derive a large share of their competitive advantages (Fahey, 2005).

A large network of servers is also a prerequisite for game operation. Game companies therefore often use larger external server providers. In order to operate the game cost-efficiently, companies seek to minimize the bandwidth and server requirements of the game, which usually contribute to a significant part of the operational cost of the game, as shown in the annual reports of game companies and a report by Mulligan and Patrovsky (2003).

The financial revenues generated by the games also require an extensive network. The most common way to collect individual game fees in China is still the use of physical game point cards that players purchase, although credit card payments have increased over time, as shown in the annual reports of game companies. The distribution network of these cards through Internet cafés and other market channels is important for a game company to reach as many potential users as possible. Many of the largest Chinese online game companies have created their own distribution networks for game point cards, which have increasingly relied on electronic sales systems at Internet cafés and other distribution points to sell electronic game point cards at higher margins. It has been estimated that the game companies' distribution costs for physical game point cards are 30 percent of revenues, compared with about 12 percent for electronic sales system and 5 percent for sales directly to the customer through credit card payments (iResearch, 2005). Smaller game companies that lack the resources to create their own distribution networks rely on external game point card distributors in exchange for a share of the revenues (iResearch, 2005). The larger game companies also usually offer a range of games through major game portals, which has the potential advantage of offering economies of scope both in terms of operational service of the games and the marketing and distribution of game point cards. Hence, an integrated service platform could be provided for all the games with cost and quality advantages for customer service.

The Growing Online Game Industry in China

Table 3 describes the factors that have contributed to the rapid growth of the online game industry. The combination of demand-side and supply-side factors have contributed to the growth of the market. On the demand side, the growth of the underlying technological infrastructure for online games, the regulatory landscape of the industry, and the relatively high industry barriers to piracy are factors that have enabled the growth of the industry (Ernkvist & Ström, 2008). On the supply side, factors related to increasing development and operational service competence among Chinese game companies have contributed to the growth of the market.

Table 3. Major factors contributing to the growth of the Chinese online game market

Supply-Side Conditions	Demand-Side Conditions
• Increasing development and operational service competence among Chinese game companies • Games developed towards the local preferences • Operational service and business models based on local preferences	• Growth of technological infrastructure for game regulation • Barriers to piracy

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Growth of technological infrastructure

The rapid growth of the broadband infrastructure, personal computers, and Internet cafés in China has contributed to the technological foundation that fuelled the Chinese market for online games (Li, 2003; Qiu & Liuning, 2005). Hence, China's ambitious information-technology infrastructure plans have, albeit unintentionally, been an important factor behind the growth of the online game market. By 2005, China's personal computer market had become second only to the United States in terms of absolute numbers, with an estimated 67.4 million personal computers in use, although the aggregate penetration in China was only 5.2 per 100 persons by this date (Gartner, 2006).

Internet cafés provide an important venue for online game consumption and, initially, were the single dominating consumption venues for online games in China. They provided cost-efficient access to online games for many young adults, but were also considered important social "third spaces" besides home and school/work in which users can play the games without the control of parents and at the same time socialize with friends (Liu, 2009). Although increasing household penetration of personal computers has intensified competition, and regulation has tightened in recent years, Internet cafés still provide an important venue for consumption of online games (CNNIC, 2009, 2014; Liu, 2009; Qiu & Liuning, 2005).

Reduced piracy and regulatory obstacles

Before online games, companies developing games in Chinae ncountered difficulties due to the presence of legal obstacles and piracy. Console video games have never been able to grow due to a Chinese regulation that makes them illegal. Although offline games for personal computers are legal, the high levels of piracy have been a barrier to development of a domestic industry and the market value for offline games has remained low.

The games themselves reside on costly servers, which make piracy more complicated. Moreover, barriers are also higher because the games themselves involve considerable operational service elements from the game operator, something that piracy servers have more difficulty in offering. Some piracy servers for online games exists, but our interview subjects reported that their impact on the market has been relatively limited so far.

Understanding the legal position of online games in China has also been a prerequisite for growth. The Chinese government has imposed several forms of regulation regarding the design of the games themselves and their services since the inception of the industry. The Chinese government has sought to create a strong domestic online game industry through the use of industry policies that are often ambiguous, and at the same time, government officials have expressed concerns about the societal, cultural, and political consequences of online games (Ernvist & Ström, 2008). Due to a techno-nationalistic policy to strengthen the control of the new medium, and the growth of domestic game companies, foreign companies are not allowed to operate online games in China. Foreign investors are prohibited from owning more than 50 percent of the equity of a Chinese entity that provides content services on the Internet (The9, 2006). Combined with governmental regulatory licensing procedures for online games in China, which have often favoured domestic game companies, this techno-nationalistic policy has supported the transition towards an increasing share of domestically-developed online games in China.

Increasing development and operational service competence

The catch-up process of Chinese game companies is difficult to understand without considering the interaction of online game products and services. Due to Chinese regulations, foreign companies are not allowed to operate online games in China and must make money through licensing or joint ventures with local Chinese game operators. Compared to Korean and other foreign online game companies, many new Chinese game companies were initially far behind in terms of development capabilities, although they are quickly acquiring capabilities in operating and servicing online games. In recent years, this gap in development capabilities between Chinese and foreign companies has been decreasing (iResearch, 2005; Pacific Epoch, 2006).

The growth of domestically-developed Chinese online games that followed was the result of both a technological catch-up process over time, as well as the ability of these companies to turn their operational service skills and knowledge of the local market into a competitive advantage. As a result of the catch-up and expanding Chinese market, the annual reports of leading Chinese online game companies reveal rapid growth in revenues and increasing export in recent years.

Competition to attract the best creative and technically skilled employees is fierce in this environment and employee movement between companies is high. As a newly emerging industry, game developers have been

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highly focused on the emerging, young creative class in China. A survey from 2007 revealed that the average ages within Chinese game companies were 26 years for employees, 28 years for middle managers, and 30 years for CEOs (Sina, 2008). In order to attract and retain the best talents, several companies offered stock options for key development personnel. The salaries for more advanced development positions such as programmers, producers, and designers are high in relation to the income levels of other industries in China's metropolitan areas. The lack of experienced game developers was also visible in many of the first efforts by Chinese online game companies to develop their own online games. Several development projects failed and many companies had difficulties developing more technologically complex 3D online games. Over time, the Chinese online game companies increased their experience and some game companies also developed their own proprietary game engines that could speed up the development process. Besides the technological catch-up process, operational service capability has played a key role in the rapidly-increasing competitiveness of Chinese-developed online games. The operational service capability of Chinese online game companies to rapidly respond to market feedback and target local preferences had the effect of increasing the competitiveness of these companies, but this shift towards Chinese-developed online games was accelerated by a shift in the business model for online games. Initially, the online game market was dominated by technologically complex MMOG whose revenues were derived from a time-based model, primarily aimed at dedicated, "hardcore" players. Since 2005, the business model has been making a gradual shift towards more casual online games that generate revenues from the sales of virtual items and services in the game. The business model continued to flourish, but Chinese regulation regarding controversial gambling-related aspects of the model have been developed over time (Ernkvist & Ström, 2008).

Conclusion

The fast-growing online game industry has rapidly become one of the most important sectors within creative industries in Asia during the last decade. The rapid growth of the domestic Chinese online game industry is a perplexing development that is in sharp contrast to the relatively weak competitiveness of China in other creative industries.

In outlining the conditions for the growth of the Chinese online game industry, we have analyzed the industry's development and the value chain of online games, which has become increasingly complex. This complexity stems from the required interrelation between product development and services in online games, which demands a clear strategy and distinct capabilities both in the area of product development and in determining which services are required to develop, launch, and operate a successful game. The core of the service offering is the ability to constantly develop and support the social community in the game, while product development of the game itself requires access to both technological and creative skills.

The complex product and service interaction of the online game industry means that it is highly vulnerable to disruptions that result in interruption in the interaction of the two parts. A technologically sophisticated game will still fail commercially if it has problems in the operational service, or if the game itself is not continually expanded according to the demands of its heterogeneous player base. Although Chinese online game companies initially lacked competitiveness in the technological aspects of product development, they now enjoy a competitive advantage in the operational service aspects of online games. This competitive advantage refers to both the geographical reach of their service operations and their ability to interpret and respond to the evolving and heterogeneous demand preferences for online games in China. The close relationship between product development and service offering of the company was a prerequisite for the games that were designed from the beginning to be constantly developed according to the interpretation of the users' changing and heterogeneous preferences.

It remains an area for future research to determine if the online game industry has been a special case in China, or whether this catch-up strategy can be applied to other creative industries as well. What this industry case suggests is that the geographical service network of domestic Chinese companies creates an ability to respond to and interact with users that could provide them with tacit knowledge and comparative advantages in development, even if they have a comparative disadvantage in production technology. Although this approach might not be applicable to all creative industries to the same degree as in online games, the role of user participation and social networks has increased in many creative sectors during the last decade. The increasingly important role of users as co-developers in creative industries and the intensive knowledge flow between users and producers that characterizes many new creative industries might imply that elements of

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the catch-up process in the online game industry is applicable to other creative industries as well.

This research has necessitated the closer analysis of the industry network that connects the interaction of product development and service operations in the evolution of new creative industries. Research that focuses only on supply conditions in the development of creative products might overlook the role of access to and interaction with the local and heterogeneous market for the development of creative industries over time. Given that this study is an initial attempt to increase the understanding of the growth of the Chinese online game industry, further research on this rapidly-expanding sector of the creative industry in Asia is needed.

About the Authors

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Mirko Ernkvist wrote his PhD in Economic History on discontinuous technologies in gaming machine manufacturing. After his dissertation, he spent two years as a JSPS postdoctoral researcher at the University of Tokyo, Japan, focusing on the formation of technology-intensive companies and industry policy in the game industry, involving studies of the game industry in Japan, Korea, and China. He has studied the policy implication of the emergence of virtual economy for the World Bank. In 2012, Dr. Ernkvist joined the Ratio Institute as a Wallander Postdoctoral Researcher. He is currently involved in research about technological change and deregulation of industries.

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Using Trademarks to Measure Innovation in Knowledge-Intensive Business Services

Matthias Gotsch and Christiane Hipp

> *"Branding the innovation can potentially help make the innovation visible, communicate its features, and provide credibility and substance to the perceived innovativeness of the organizational brand."*
>
> David Aaker
> Author of *Innovation: Brand It or Lose It*

We present an empirical approach to measuring service innovation on the company level through the analysis of trademarks. Prior empirical investigations in several industries have shown that a trademark may be used as an innovation indicator. This article explores the use and relevance of trademarks by conducting a survey in the knowledge-intensive business services (KIBS) industries with 278 participating companies. Our survey results explain the use of trademarks as a way to protect innovation and intellectual property for KIBS. In sum, we show that trademarks can be described as adequate and useful indicators to measure new service innovations in the KIBS industries. Additionally, we show that trademarks have the potential to overcome weaknesses of traditional measurement concepts towards KIBS innovation and might make special surveys redundant in the future.

Introduction

Due to the lack of adequate innovation indicators, it is not trivial to measure the innovativeness of the services sector in general (Abreu et al., 2010), and of so-called knowledge-intensive business services (KIBS), which are profoundly related to information and knowledge, in particular (Miles, 2000; Toivonen & Tuominen, 2009). But for all stakeholders, such as entrepreneurs introducing new services, researchers focusing on innovation measurement, as well as policy makers considering support programs for service companies, it is important to have reliable indicators on a company level to applicably compare industries and regions regarding their recent intensity of service innovation.

Because service providers do not produce material goods, in the past they were often classified as non-innovative (Pires, et al., 2008). This view is mostly due to the unsuitability of many traditional innovation indicators, such as R&D expenditures. The indicator's high explanatory power for the manufacturing sector is not necessarily transferable to the services and KIBS sector (Abreu et al., 2010). Also, the non-patentability of many service innovations compromises the significance of patent indicators. Fundamentally, many of the innovation indicators used in the past could be questioned regarding their suitability for KIBS innovation.

Trademark analysis offers a possible solution to overcome the existing weaknesses of traditional innovation surveys and measurement concepts that were mainly developed for manufacturing industries (Hipp & Grupp 2005). Previous empirical investigations have shown that trademark analysis may be used as an alternative approach (e.g., Amara et al., 2008; Gotsch & Hipp, 2012; Mendonça, et al., 2004). The analysis of trademarks could contribute to an improved understanding of innovation in services that goes beyond traditional survey-based indicator concepts (Schmoch, 2003). By doing so, researchers as well as policy makers and entrepreneurs can learn about the possibilities and limitations of trademarks as a new innovation indicator in order to better describe, understand, and benchmark innovation activities in the KIBS industries.

Using Trademarks to Measure Innovation in Knowledge-Intensive Business Services

Matthias Gotsch and Christiane Hipp

Knowledge-Intensive Business Services and Innovation

KIBS are firms that provide knowledge-intensive services for other business firms. Since the mid-1990s, interest in KIBS in particular has grown, as reflected in a growing number of publications dealing with their special characteristics (Schricke et al., 2012). KIBS are service companies that provide knowledge inputs mainly to the business processes of other organisations. Examples of KIBS industries include computer services; research and development (R&D) services; legal, accountancy, and management services; architecture, engineering, and technical services; advertising; and market research (Miles, 2005).

KIBS combine knowledge from different sources (Hipp, 1999) and are increasingly considered to be major users, originators, and transfer agents of technological and non-technological innovations. They play a major role in creating, gathering, and diffusing organizational, institutional, and social knowledge in other economic sectors (Iden & Methlie, 2012). The KIBS sector has a role as a knowledge-producing, knowledge-using, and knowledge-transforming industrial sector (Schricke et al., 2012). For this reason, Czarnitzki and Spielkamp (2003) characterize KIBS as bridges for innovation.

However, just because KIBS play an important role in the innovation system of a region, country, industry, or value chain and are often considered as co-producers of innovation for their clients (Hauknes, 1998), this does not necessarily mean that KIBS are highly innovative on their own. Rather, it could be that some KIBS are much better at helping their clients to innovate than in managing their own innovation processes (Christensen & Baird, 1997), therefore it is also important to observe and measure innovation happening inside KIBS companies.

The Oslo Manual for the collection and interpretation of innovation data is a widely used reference for service innovation and classifies four innovation forms: product, process, marketing, and organizational innovation (OECD, 2005). Depending on their specific field of activity, innovation in KIBS may consist of new products and technologies (e. g., customization of software), new processes (e. g., new forms of delivering services), as well as new organizational types or marketing procedures (Schricke et al., 2012). Therefore, service innovation is indeed captured by the Oslo Manual to some extent, but compared to technologically oriented processes in the manufacturing sector, innovation in KIBS is shaped by certain specificities (Tether & Hipp, 2002). For instance, the innovations often are of intangible nature and are characterized by a strong connectivity to customers as production and consumption take place simultaneously (Schricke et al., 2012). The nature of innovation within KIBS is mostly project based, ad hoc, and interactive (Toivonen, 2004). The high importance of human capital results from the fact that, according to Strambach (2008), knowledge is embodied in the people and embedded in networks, while R&D departments in the usual sense are very rare among KIBS (Kanerva et al., 2006).

Innovation Indicators

For entrepreneurs, managers, and policy makers, it is interesting to evaluate impact and leverage effects of KIBS industries and innovations. But how can we measure them in order to better understand, guide, and manage innovation activities? To measure something that cannot be recognized directly, one can use specific indicators, which provide at least an indication of reality (Gault, 2007). Indicators use empirically ascertainable variables to represent different latent quantities that are not directly measurable. Because their predictive power is limited, all indicators should be used restrictively and interpreted carefully (Kleinknecht et al., 2002). Nevertheless, the use of science, technology, and innovation indicators has greatly increased since the 1990s (Lepori et al., 2008), in part because of two interrelated events. First, access to digitized databases has made the collection and analysis of data easier. Second, there has been a corresponding interest in the use of indicators in politics, business, and society.

Indicator data can be collected in various ways, and so the choice of methodology is critical. The data for most indicators can be collected using either empirical surveys or publicly accessible databases. Indicators that can be determined only through empirical surveys are primarily related to internal company resources such as investment in human resources or turnover with new services.

Indicators commonly used in the manufacturing industries typically relate to R&D activities or patent counts (Pavitt, 1982). In the context of a linear innovation model, R&D was established as the source of innovation, and was supported by a relatively simply constructed measurement concept. The Frascati manual standardized and harmonized this R&D-based approach (OECD, 2002). Acs, Anselin, and Varga (2002) point out: "Measures of technological change have typically involved

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one of the three major aspects of the innovative process: (1) a measure of the inputs into the innovation process, such as R&D expenditures; (2) an intermediate output, such as the number of inventions which have been patented; or (3) a direct measure of innovative output."

Patents as indicators of intermediate output are still among the most commonly used innovation indicators (Smith, 2005). Because intellectual property rights, such as patents, are recorded in centralized databases, it is relatively easy to access related indicator data (Flor & Oltra, 2004). Although technological change is not exclusively based on R&D activities or patents, these input and output indicators are often used as single variables for measuring innovation activities, thereby allowing statistical bias to influence the analysis (Kleinknecht et al., 2002).

Innovation in KIBS, as defined in this article, is multidimensional. For example, service innovations often are not generated in special departments (Kanerva et al., 2006), but during daily work in cooperation with customers (Gallouj & Windrum, 2009) or in time-restricted project groups (Howells & Tether, 2004), and they are not necessarily connected to R&D investments. Therefore, a traditional R&D investment indicator is not applicable for KIBS innovation. Instead, human capital, team work, networking and cooperation, customer integration, and the specific role of information technology are important input factors for the success of a service innovation (Tether & Hipp, 2002).

Also, the innovation process in services does not necessarily aim to acquire or generate technical know-how. Therefore, patents have major weaknesses as indicators of service innovation (Coombs & Miles, 2000). Miles Andersen, Boden, and Howells (2000) point out that protection strategies used in the service sector differ from those of manufacturing companies. The authors argue that service companies have grown up without a formal protection culture, and, therefore, most innovations are not protected in the traditional sense. "Innovation studies have tended overwhelmingly to focus on the manufacturing sector. Similarly, research linking together innovation and the intellectual property rights system has been almost exclusively centered on patenting, with its emphasis on protecting physical artefacts centered on new products and processes" (Miles et al., 2000).

Summing up, because innovation in services can take multiple forms, it can be difficult to measure it using traditional input and throughput indicators (Camacho & Rodriguez, 2008). Coombs and Miles (2000) evaluate traditional indicators and measurement concepts as especially disadvantageous for the assessment of service innovation, especially in highly innovative KIBS. Abreu, Grinevich, Kitson, and Savona (2010) argue that "the complexity and variability of the innovation process means that new and different indicators will be appropriate in different sectors of the economy […] though these may make it harder to compare sectors". In this context, Abreu, and colleagues (2010) develop four criteria to be considered as desirable for a new innovation indicator: accuracy, longevity, comparability, and ease of collection. In this article, we propose that these criteria can be met with an indicator based on intellectual property rights, namely trademark registrations. Trademarks are registered with publicly available databases of state authorities; therefore, they are saved over long periods and comply with international regulations (WIPO, 2006). In the following section, we will explore trademarks in detail to illustrate how they might be suitable innovation indicators for KIBS.

Trademarks as Innovation Indicators in Knowledge-Intensive Business Services

Intellectual property strategies for innovative service firms can be linked to the wider development of the strategic assets or core competencies of such firms (Prahalad & Hamel, 1990). One of the potential measures to protect intellectual property for service firms is the use of trademarks. A trademark is a legally protected symbol, which has two main functions. The first function is to clearly distinguish the products and services of one company from those of other firms (WIPO, 2006). We call this the distinction function of a trademark (Greenhalgh & Rogers, 2007), which is primarily used to inform and help potential customers. The second function is a protection function, which means that the trademark serves as a protection of intellectual property and gives monopoly rights by prohibiting other companies from operating with similar or identical trademarks in similar or identical markets (Millot, 2009).

The distinction function of a trademark can help to overcome difficulties resulting from the immateriality of services. Due to limited opportunities to assess information, customers often focus on key information and look for alternative assessment standards (Mangàni, 2006). In this case, a well known and trusted trademark can serve as an indicator of the expected overall quality performance of the service and, in this

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way, reduce the perceived risk of purchase and provide security (King, 1991). Aaker (2007) states that "branding the innovation can potentially help make the innovation visible, communicate its features, and provide credibility and substance to the perceived innovativeness of the organizational brand."

The protection function is more competition oriented and refers to the comparatively simple interchangeability of many services (Mangàni, 2006). Because of this ease of imitation, the need arises to differentiate the offered services. The use of trademarks does not provide full protection against imitation, because the trademark does not protect innovation or novelty in itself; nevertheless, it gives some monopoly rights (Davis, 2005). Moreover, a strong and well-known mark can discourage potential new competitors from entering the market (Aaker, 2007). The trademark increases the barrier to market entry, because high levels of investment would be needed to enter the market (Jensen & Webster, 2004).

The origin of trademark protection can be traced to the gild practices of the Middle Ages. According to Besen and Raskind (1991) "the initial purpose of trademark protection was to make it illegal to pass off the goods of another artisan as those of a guild member." Today, trademark protection also includes the possibility of achieving a mark for service activities. Mangàni (2006) identifies five reasons for the increasing economic importance of service trademarks: i) structural changes in developed economies, ii) market liberalization, iii) increased tradability of services, iv) decreased direct customer contacts, and v) increased quality competition.

A classification of the different forms of service trademarks is possible based on the service object that is primarily protected by the trademark (Flikkema et al., 2010). Common branding strategies apply for a single service (single brand), a bunch of similar services (family brand), all services of the company (umbrella brand), or the company itself (company brand). Registering a trademark gives the company a monopoly on its use, usually for a period of ten years. The registration of the mark can be renewed at any time, but its actual use in the marketplace must be shown (Blind et al., 2003). Trademarks can be registered at the national, regional, or international level. An example of a regional authority is the Office for Harmonization in the Internal Market (OHIM; oami.europa.eu), which grants community trademarks for protection in the member states of the European Union. Worldwide protection is available at the World Intellectual Property Organization (WIPO; wipo.int), at least for signatory countries of the Madrid Protocol (tinyurl.com/66pm8af).

Dealing with the question of whether trademarking could signal innovative activity, prior investigations found a correlation between trademarks and productivity (Greenhalgh & Rogers, 2007) or stock market value (Sandner & Block, 2011), as well as between trademarks and innovation (e.g., Amara et al., 2008; Schmoch, 2003). In a next step, other researchers tried to use trademarks as an indicator of innovation (e.g., Gatrell & Ceh, 2003; Malmberg, 2005; Mendonca et al., 2004; Millot, 2009; Schmoch & Gauch, 2009). For instance, Päällysaho and Kuusisto (2008) found that companies introducing services generally use some kind of protection measure. Thereby, trademarks are primarily used to differentiate a firm's own services from potentially competing services. In particular, when patent protection is not possible, trademarks seem to have a positive impact on innovation success (Schmoch, 2003). Gotsch and Hipp (2012) already showed that international distribution markets, competitive market environments, and highly standardised services increase the number of trademark registrations. Therefore, KIBS with these characteristics are more likely to register trademarks than other companies.

However, there are also arguments against the suitability of trademarks as an innovation indicator. For instance, services that have only a low level of innovation could also be protected by trademarks (Davis, 2009), which may reduce the statistical value of a trademark indicator. Moreover, trademarks are only indirectly linked to innovation (Blind et al., 2003). Primary motives for trademark applications could be to increase the level of public awareness or to support competitive strategies of the company. There are also other formal and informal protective measures in addition to trademarks. According to the situation and the need for protection, different measures are appropriate. Amara, Landry, and Traoré (2008) classify protective measures depending on the tangible or intangible nature of the product and the implicit or codified form of connected knowledge. In this framework, patents are mainly important for material goods with codified knowledge. But, due to the immateriality of services and rather implicit form of knowledge used, trademarks are an essential protection mechanism for service innovations by KIBS.

To protect their innovations, service businesses have adopted a wide range of alternative practices for intellectual property management and protection, which

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are tailored to the specific needs of service innovations. Hipp and Bouncken (2009) describe strategic protection measures as essential tools for preventing misuse or imitation by competitors. These informal and strategic measures for intellectual property protection (e.g., secrecy, lead-time advantage, or complexity of design) are obviously not centrally registered like formal intellectual property rights (e.g., patents, trademarks, copyrights, or industrial designs). To understand how KIBS register trademarks, it is important to understand why business services use trademarks as a protection measure. Given that trademark registrations are supposed to be indicators of innovation, we aim to determine whether or not trademarks are used primarily to protect new products and services. Accordingly, we developed related hypotheses, which we tested by conducting a survey of KIBS, as described in the next section. The hypotheses were as follows:

Hypothesis 1: *KIBS use a bundle of formal and informal protection measures to guard their intellectual property.*

Hypothesis 2*: KIBS register trademarks primarily to protect new products and services.*

A Survey of Knowledge-Intensive Business Services

In our survey, the sample of KIBS includes companies based in Germany and listed in the MARKUS company database provided by Bureau van Dijk and the Credit Reform Association. The item definitions correspond to recommendations given in the Oslo Manual (OECD, 2005) concerning the measurement and interpretation of innovation survey data. A pretest with ten experts from appropriate firms enabled us to optimize the questionnaire. The main survey was carried out as an online survey with a sample of 6,176 KIBS. The return rate after follow-up was 278 KIBS (4.5%), which is in line with other similar Internet-based surveys conducted in Western countries. Below, we present the results of the hypotheses we tested using independent regression models of the survey data. Details of the research design and data handling can be found in Appendix 1.

The first hypothesis develops assumptions concerning the appropriate use of formal and informal protection measures to guard the intellectual property of KIBS. In order to test the hypothesis, we developed an empirical model with a dependent variable reflecting the innovation success of the firm. As a proxy variable of innovation success, we use the share of turnover achieved with new services (i.e., market introduction during the last three years). The results regarding the usefulness of intellectual property protection measures is ambiguous. Although the use of trademarks and industrial design as intellectual property rights have positive and significant effects on innovation success, no such effect is found for either patents or copyrights. Given that patents and copyrights do not have a positive or significant effect on service innovation, and industrial design registrations cannot be evaluated in detail, as can trademark registrations, we can conclude that trademarks best fulfil the criteria of an innovation indicator compared to other protection measures used in the model.

None of the informal protection tools, which we believed to be very important, were statistically significant in our model; even lead-time advantage has a non-significant negative effect on innovation success. The use of informal protection measures may be important for the firm, but because there is no record or registration of their use, they cannot easily be used as an innovation indicator. Special surveys would be necessary to obtain the required information on informal protection measures. Because registered trademarks indeed may be an indicator of service innovation, it becomes even more important to understand the reasons for trademark registration and why business services use trademarks as protection measure. Therefore, we test the second hypothesis that deals with questions concerning the purposes for which firms register trademarks.

All participants of the KIBS survey were asked to give their reasons for registering trademarks and to rank the importance of those reasons on a scale of one to five. The results illustrate that the protection of new products and services is the most important motive for registering a new trademark. For greater precision, we estimated two regression models with the number of trademark registrations as dependent variable. Both models came to the same conclusion: the only variables with significant positive effects on trademark registration are those that protect new products and services. None of the other variables in the simplified models were significant. Therefore, we conclude that the primary reason for KIBS to register trademarks is to protect their newly introduced goods and services against imitation by their competitors.

Research Limitations and Future Research

Indicators provide only an indication of reality, not a direct and complete measure, and are likely to be imperfect. However, the use of patents as an innovation

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indicator in manufacturing industries is a conventional and very similar approach. In this context, an indicator based on intellectual property rights, such as trademark registrations, best fulfils the desirable criteria for an innovation indicator: accuracy, longevity, comparability, and ease of collection. But, even if the relationship between trademarks and KIBS innovation is made clear, larger problems remain.

Obviously, there are difficulties in the data consolidation, depending on the brand strategies selected by particular companies. Depending on whether a company is pursuing a single, family, or umbrella-brand strategy, one trademark application can represent just one or several innovations. Sectoral differences between KIBS industries and weaknesses in the international comparability also exist. Therefore, further research is needed for a full assessment of trademarks as an innovation indicator for KIBS.

Future research could also match trademark databases with corporate databases. The information contained in corporate databases (e.g., information on individual balance sheets, amount of intangible assets) could add a variety of new insights. An enhanced consideration of intangible assets, which give information regarding the monetary value of trademarks, can generate knowledge about the meaning and importance of individual trademarks and would increase the significance of the innovation indicator.

Research Contribution and Managerial Implications

The goal of this article was to show that trademarks are suitable as indicators of KIBS innovation because they provide information about innovation activities and innovation success. Given that there are few other adequate indicators for service innovation activities, the use of trademark registrations as an additional indicator is certainly promising.

First, our study shows that the interrelation between trademark registration and innovation success is positive and statistically significant in the KIBS sector. These findings are in line with Schmoch (2003) and Amara, Landry, and Traoré (2008), who also found a relation between trademarks and innovation for KIBS, and with Flikkema, de Man, and Wolters (2010) who investigated the entire services sector.

Second, we show that trademarks are usually registered by KIBS to protect new products and services. Other motives seem to be of secondary importance, hence there appears to be a connection between trademarks and new services. This finding corresponds to other research on this topic. For instance, Davis (2005) showed that, because of the ease of imitation of services, the need arises to protect services by registering trademarks, which provide at least some protection against imitation. In fact, a trademark does not protect innovation or novelty in itself, but according to Aaker (2007), a strong and well-known trademark can discourage potential new competitors by increasing the barrier to market entry.

According to Acs, Anselin, and Varga (2002) a huge disadvantage of survey-based innovation measures is the emerging cost to generate data and the danger of subjective answers. As a result, the development of appropriate, easy to use, and low-cost indicators to measure innovation in the KIBS sector is certainly useful. Trademarks are a promising alternative indicator to fill this existing gap, because trademark registrations are available in public databases. The great advantages of indicators that can be extracted from databases are the relatively low overhead costs and the comparability of results. The data relating to innovation indicator does not need to be collected discretely, but can be extracted at a suitable location (e.g., a trademark registration database). Thus, special surveys in KIBS industries could be redundant in the future.

Furthermore, KIBS practice can benefit from these results. Entrepreneurs and managers, as well as policy makers, can use trademarks as an innovation indicator in order to better describe, understand, and benchmark innovation activities in the KIBS sector. By doing so, they can identify the degree of innovation in particular industries and derive the degree of competitive rivalry among existing firms. Based on this information, entrepreneurs can decide to whether or not to enter or exit a specific market.

As survey results also have shown, it seems advisable for companies to protect all new service innovations with trademarks. Because a trademark can be registered in a straightforward manner and gives the trademark owner a monopoly on its use, trademark registration should be incorporated in every competition strategy, both for incumbent firms as well as startups. On the basis of these suggestions, entrepreneurs and managers can create better and more successful ventures. By doing so, the use of trademarks as an additional indicator could also contribute to an improved innovation model for business services.

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Appendix 1. About the Research

Our online survey yielded 278 responses, which corresponds to a 4.5% response rate. In evaluating the representativeness of our survey, we conducted a unit-non-response analysis to assess whether there are differences between responding and non-responding firms. A standard method to estimate possible differences is a comparison of rapidly responding to late-responding companies, because the latter are most similar to the non-responding companies (Armstrong & Overton, 1977). If both groups show no statistically significant differences, it can be assumed that the survey is representative. In the present case, we used the amount of turnover and the number of employees to compare the two groups. In addition, we carried out a Kruskal-Wallis test to check whether samples differ in the expected value of an ordinal variable, in this case the sector membership of the enterprises. There were no statistically significant differences between the comparison values of the two groups regarding turnover of the companies, number of employees, or sector membership, so we conclude that the survey is representative.

In the case of item-non-response, a complete case analysis was used, which in the regression models consequently ignores the records where one or more of the characteristics is a missing value (Wooldridge, 2009). By doing so, for analysis purposes, only the respectively complete data sets are used.

Research design of first model

The model is partly based on an approach by Rammer (2007), who analyzed the importance of various protective measures, but did not make a distinction between services and KIBS. However, to achieve meaningful results in the very heterogeneous services sector, such a distinction appears essential. Therefore, the present model concentrates on KIBS and additionally accounts for different KIBS industries. We choose an ordinary least squares regression analysis to test the first hypothesis. Because the dependent variable does not have a normal distribution, a Box-Cox transformation (Box & Cox, 1964) was carried out to stabilize the variance of the variable. Table 1 presents the summary statistics and description of the variables used in the model.

For the explanatory variables, we first constructed a dummy variable for each formal intellectual property right that reflects whether the firm uses the protection measure. Trademarks are considered as an additional protection tool, so other intellectual property rights are also taken into account in the model. As informal or strategic measures, we included secrecy, lead-time advantage, and complexity in design, all of which were operationalized as dummy variables that indicate the use of the specific strategic protection tool.

We also controlled for several factors that may influence our dependent variable. The degree of competitiveness is reflected by the number of competitors in Germany. Innovation input is expected to influence innovation output, so we include innovation input in the model, represented by the level of innovation expenditure in relation to the firm's turnover. Firm size is reflected by the number of employees in the KIBS firm. In addition to the explanatory variables, we created dummy variables for the different KIBS industries. To avoid a heteroscedasticity problem, we conduct a robust regression analysis, which is presented in Table 2.

We calculated the variance inflation factors (VIF) to test for multi-collinearity of the explanatory variables. All variables show uncritical values with a mean VIF of the explanatory variables of 1.33. However, a possible existence of endogeneity or simultaneity between dependent and explanatory variables cannot be completely excluded and has to be considered during data interpretation. Seeing the control variables in the model, all show expected signs, with the exception of the amount of competitors, which must be investigated in detail. For the number of competitors in Germany, we observe a very low effect. Within an alternative regression analysis with the exclusion of one extreme value of the variable, only the coefficient is significant because of this specific runaway. Therefore, we must be very careful in interpreting the coefficient for the number of competitors, but the model in general is not influenced.

Research design of second model

All participants of the KIBS survey were asked to give their reasons for registering trademarks and to rank the importance of those reasons on a scale from one to five. The results are shown in Figure 1.

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Table 1. Descriptive statistics of variables used in the first model

Variable	Description	Mean	S.D.	Min.	Max.
Turnover with new services	*Percent of turnover achieved with services introduced in the last three years*	*46.47*	*7.46*	*0*	*100*
Use of trademarks	Firm uses trademarks as protection tool	0.45	0.50	0	1
Use of patents	Firm uses patents as protection tool	0.21	0.40	0	1
Use of copyrights	Firm uses copyrights as protection tool	0.28	0.45	0	1
Use of industrial designs	Firm uses industrial designs as protection tool	0.04	0.19	0	1
Use of secrecy	Secrecy is used for protection	0.35	0.48	0	1
Use of lead-time advantage	Lead-time advantage is used for protection	0.45	0.50	0	1
Use of complexity	Complexity is used for protection	0.35	0.48	0	1
Competitors in Germany	Number of competitors in Germany	1 196	8 992	1	10 000
Innovation expenditures	Total innovation expenditures/turnover	16.16	15.29	1	80
Number of employees	Number of persons employed in the firm	71.12	153.29	3	1 045

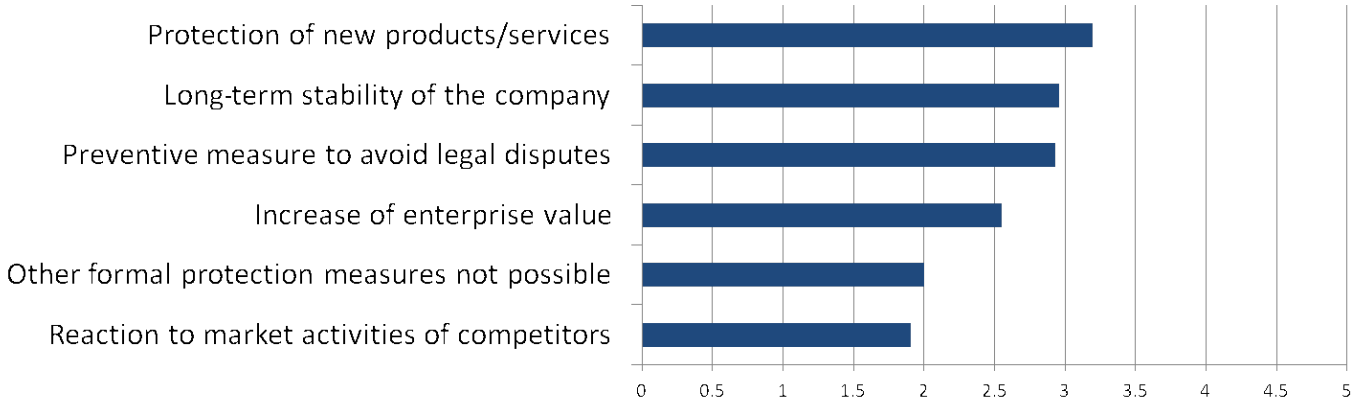

Figure 1. Importance of reasons for KIBS to register trademarks

Answers of responding firms considered in model 3 (n=96), response options ranked from low importance (0) to high importance (5)

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Table 2. Results of the first model

Item	Turnover with new services
Use of trademarks	2.53*
Use of patents	-0.71
Use of copyright	-1.88
Use of industrial design	5.41**
Use of secrecy	0.90
Use of lead-time advantage	-0.80
Use of complexity	1.56
Competitors in Germany	0.000088***
Innovation expenditures	0.059
Number of employees	-0.011***
Publishing of books, periodicals, and other publishing activities	-5.07*
Software publishing	-0.055
Computer programming, consultancy, and related activities	-0.067
Data processing, hosting, and related activities; web portals	-5.55*
Architectural and engineering activities	-4.17**
Technical testing and analysis	0.38
Research and development on natural sciences and engineering	0.56
Research and development on social sciences and humanities	5.13*
Observations	130
R^2	0.267
F	6.41
Prob > F	0.00

OLS regression with KIBS Survey, showing coefficients.
Dependent variable is Box-Cox transformed. Sector "Others" serves as base.
Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

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To make more precise statements, we first estimated an ordered logistic regression model to examine the impact of a range of explanatory variables on a dependent variable that takes a finite set of ordered values. This process conforms to the first alternative to ordinal-scaled trademark registration with five response options as the dependent variable. In the second alternative, we use a continuous variable that reflects the number of trademark registrations of the firm. This process conforms to the numeric scaled trademark registration as the dependent variable. In this case, we chose a tobit regression analysis over the more common least squares method, because the dependent variable has a censored distribution with a lower threshold of zero percent trademark share on the protection measures. As explanatory variables, we limited the model to the response options presented in Figure 1 and company size, measured by number of employees. Of course, this limitation leads to a model that is not comprehensive, but it is effective to examine the motivations for trademark registrations. Table 3 shows the values of all used variables.

The r-squared values, which are the proportions of variability accounted for by the explanatory variables used in the statistical model, are very low in both alternatives. However, because there is no claim to be complete, according to Verbeek (2009) the comparatively low r-squared values can be ignored in this case. The second alternative also results in a comparatively low significance of the whole model (Prob>chi-square=0.12) due to the fact that our model is consciously and artificially limited to the given response options and therefore completely ignores other explanatory variables. The results of the regression models are presented in Table 4.

Table 3. Descriptive statistics of variables used in the second model

Variable	Mean	S.D.	Min.	Max.
(3a) Trademark registration (ordinal)	*2.28*	*1.21*	*1*	*5*
(3b) Trademark registration (numeric)	*13.96*	*109.00*	*0*	*1 100*
Protection of new products/services	3.25	1.66	1	5
Long-term stability of the company	2.96	1.57	1	5
Preventive measure to avoid legal disputes	2.93	1.58	1	5
Increase in enterprise value	2.59	1.45	1	5
Other formal protection measures not possible	2.02	1.38	1	5
Reaction to market activities of competitors	1.93	1.15	1	5
Number of employees	70.32	152.78	1	1 044

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Table 4. Results of the second model

Reason for Trademark Registration	Trademark Registration (ordinal)	Trademark Registration (numeric)
Protection of new products/services	0.47**	29.51*
Long-term stability of the company	-0.11	-11.17
Preventive measure to avoid legal disputes	-0.23	19.35
Increase in enterprise value	0.28	2.41
Other formal protection measures not possible	-0.01	-11.34
Reaction to market activities of competitors	-0.28	-9.22
Number of employees	-0.0006	-0.032
Observations	96	96
Chi-squared	14	10.26
Pseudo R^2	0.052	0.012
Prob > chi-square	0.051	0.17
Uncensored Observations		61

Ordered logistic regression with KIBS Survey; Tobit regression with KIBS Survey, showing coefficients.
Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

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Widening the Perspective on Industrial Innovation: A Service-Dominant-Logic Approach

Heidi M. E. Korhonen

> *"Any existing structures and all the conditions of doing business are always in a process of change."*
>
> Joseph Schumpeter (1883–1950)
> Economist and political scientist

The servitization of industry has progressed from services as add-ons to services as solutions. Today, industrial innovation needs an even broader perspective that moves towards service-dominant logic. This logic emphasizes value co-creation in actor-to-actor networks and requires new organizational structures and practices in industry. The article presents the case of a Nordic manufacturer of arc welding equipment that has gone through an extensive development program to become more customer and service oriented. An innovative offering created during the program is analyzed as an example in order to gain deeper insight about the concrete application of service-dominant logic in business. In addition to the outcome perspective, the article discusses the implications of the service-dominant logic for innovation practices. The article illustrates the behaviour of cutting-edge servitizing manufacturers and argues that similar behaviour can be expected to become a necessity in all industrial companies with large structural changes.

Introduction

There is a constant need for manufacturing to renew itself due to competition. Today, renewals are driven in particular by intangible assets such as human capital, intellectual capacity, and service provision. Since the end of the 1980s, manufacturing companies have added services to their offerings in order to create closer and more long-lasting relationships with their clients. However, it has been common to implement this practice – called "servitization" (Vandermerwe & Rada, 1988; Neely, 2008; Baines et al., 2009) – in a way that has not changed the basic view of the primary role of the provider in the emergence of value. Value has still been seen as something created in production and then delivered to clients (Michel et al., 2008). It was not until Vargo and Lusch (2004, 2008) presented their argument about the necessity of a new service-dominant logic that the central position of customers in value creation began to gain ground. According to service-dominant logic, this position is based on the fact that value is revealed only when goods and services are used and when an individual good or service acquired from a single provider is linked to other goods and services acquired from other providers. The last mentioned process of resource integration is an indispensable part of value creation and is carried out by the user as well as the provider. Consequently, value is always co-created: the provider has to make its best effort to facilitate the emergence of value via purposeful goods and services, but the realization of value takes place in the use context.

Service-dominant logic links the value logic to the production of both goods and services. It considers the reciprocal nature of value creation a more crucial phenomenon than the production outputs in the form of individual goods and services. According to Vargo and Lusch (2004), goods and services are important, but value is not their inherent property; they are first and foremost conveyors of competences for the benefit of another party. Other authors, analyzing the implications of service-dominant logic from managerial viewpoints, have pointed out that this view should not lead to diminishing the importance of goods and services –

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they do not go away. Rather, they must be designed around co-creation of human experiences through multi-sided interactions (Ramaswamy, 2009, 2011). In the service context, the formulation of value propositions is of particular importance because they are the entities based on which customers make purchasing decisions (Maglio & Spohrer, 2013). Finding a way to link the views of service-dominant logic with the concrete production outputs is essential for the current development in the servitization of manufacturing.

Although most innovation research has focused on product and process innovations, present discussion calls for a broader notion of innovation (Tidd et al., 2001). This discussion returns back to the definition of innovation by Schumpeter (1934), who laid the ground for studying innovation as a socioeconomic evolutionary process resulting in new combinations of resources. His categorization of innovations is wide and enables the analysis of renewals at different levels: products and methods of production; sources of supply and exploitation of new markets; and methods of organizing business. The service-dominant-logic view on innovation – based on value co-creation practices – has much in common with the Schumpeterian views. In addition to products and services, which manifest value co-creation practices, service-dominant logic advises firms to focus on the overall value-proposition design. This approach can be seen as a systematic search for business model innovation from the provider's perspective (Maglio & Spohrer, 2013).

This article studies: i) how the view of value as co-created can be applied to widen the perspective on industrial innovation and ii) what are the implications of this widening for the development of innovation practice. The study has been carried out as a single-case study of a Nordic welding equipment manufacturer that has gone through an extensive development program to increase its innovative capability in a more customer- and service-oriented direction. The program has led to the development of several offerings that represent a novel type of industrial service business.

To understand the current development in industrial innovation in detail, we will analyze the development of one specific offering in our case company. We will use this example to illustrate the relationships between industrial service innovations as add-ons, solutions-based innovations, and innovations based on service-dominant logic. We will then discuss innovation practices for systematically and efficiently producing innovations consonant with the view of value as co-created.

This article is structured as follows. We first explain the background and theory to better understand innovation as a co-development process and as novel outcomes and practices. We then describe our methodology and case selection. After this, we analyze the new innovative solution and discuss the innovation practices used in its creation. We finish our article by discussing the managerial implications of widening the perspective on industrial innovations.

Innovation in the Light of Service-Dominant Logic

In the history of manufacturing, innovation was seen primarily as a matter of technological development, and services were regarded as an unavoidable expense. The current synthesis approach suggests that service innovation brings neglected aspects of innovation to the fore (Coombs & Miles, 2000). Service-dominant logic is consistent with the synthesis approach, but it brings novel understanding to the discussion. It can be understood either as an innovation theory or as an approach for leveraging other discussions on innovation. In this article, we take the former viewpoint and point out its implications for the practice of innovation management.

Industrial companies often start servitization by developing services to support products (Oliva & Kallenberg, 2003). However, when their service business matures, they no more consider services as mere add-ons to products, but innovate services supporting customers (Mathieu, 2001). Customer centricity has often led to providing solutions, in other words, individualized and interactively designed offers for complex customer problems (c.f. Evanschitzky et al., 2011). In solutions, products and services are integrated and the relationship between the buyer and the seller is close. Instead of the traditional approach of managing services as a separate function, manufacturers may turn their entire business to service logic (Grönroos & Helle, 2010). The involvement of customers may take place both in the innovation process and in the joint creation of value.

Despite the change, servitization alone does not seem to represent a panacea for manufacturers (Baines et al., 2009). The service-dominant-logic approach includes the ideas of the synthesis perspective and solution business, but it widens the scope of the discussion. In particular, service-dominant logic broadens the view from a provider–customer dyad to a broader system of actors (Vargo & Lusch, 2011) – an approach that has been rare in service innovation research (Carlborg et al., 2013).

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Also, in addition to operand resources that require action taken upon them to be valuable, service-dominant logic stresses the primacy of knowledge and technology because they are capable of acting on other resources to contribute to value creation (Vargo & Lusch, 2004). Further, service-dominant logic emphasizes the role of institutions – social rules and norms that both constrain and enable behavior – as resources that are needed for actors to co-create value. Markets can be seen as institutionalized solutions of resource application to human problems or needs. The way in which novelties become stabilized (i.e., institutionalized) in the markets is one of the most interesting issues in innovation according to service-dominant logic. Here, the view is very similar to the current emphasis of general innovation research on the diffusion (not only invention) of innovations.

These new insights are in line with innovation studies that highlight innovation as processes and practices (Gallouj, 2002; Lundvall, 2007). Innovation can be seen as a path dependent co-development process, and its outcomes include the adoption of new practices. We now use the service-dominant-logic theory in order to better understand the wide perspective on innovation from these points of view.

Innovation as a co-development process

Service-dominant logic emphasizes social institutions and therefore encourages the study of practices – "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding" (Schatzki, 2005). Value co-creation takes place through the enactment of practices in systems at micro, meso, and macro levels (Akaka et al., 2013). These practices and systems cannot be created from nothing, but are recreated by integrating existing resources in novel ways. As Arthur (2009) puts it, novel technologies arise from existing technologies. In order to better understand the wide concept of innovation, technology should be understood in a broad way, as an operant resource and "as a set of practices and processes, as well as symbols, that contribute to value creation or fulfill a human need" (Akaka & Vargo, 2013). The most enduring and prevalent practices can be referred to as institutions (Giddens, 1984).

Value propositions are made about new practices for value co-creation, but it is in the use phase when the practices are enacted and come to being. Therefore, the resource integration for innovation occurs through both value proposition and value determination phases (Akaka & Vargo, 2013). There are parallels between value proposition and determination in service-dominant-logic theory and invention and innovation adoption in general innovation-diffusion theory (c.f. Rogers, 2003). Service-dominant logic strives to incorporate the issues of contextual value and multiple actors to the phenomenon. In most cases of industrial innovation, both the value proposition and determination involve multiple stakeholders instead of just one and are affected by the institutional landscape.

As has been described above, innovation is not a one-directional development activity by any single actor. Instead, it is co-development between the different actors of the service system. Innovation is a path-dependent and recursive process. It can be understood as mutual learning between actors and as the emergence of corresponding value co-creation systems, again implying that social capital matters – it has an important impact on a company' innovative capability.

In service-dominant logic, one of the most important operant resources is entrepreneurial spirit (Vargo & Lusch, 2006) – the mental capabilities for resource integration characteristic of entrepreneurs. Based on this, and in line with Schumpeter (1934), we accentuate that anyone can act entrepreneurially and stress its meaning for innovation. Innovative activity can be characterized as an actor's entrepreneurial search for new beneficial configurations for resource integration that emphasizes operant resources. Entrepreneurs search for change, respond to it, and exploit it as an opportunity (Drucker, 1964). This process of search and experimentation always involves uncertainty. Therefore, instead of trying to predict uncertain markets, experienced entrepreneurs co-develop novel markets with committed stakeholders (Read et al., 2009).

All humans participate in value co-creation through the repeated reproduction of institutionalized practices in their daily activities whether or not they do it entrepreneurially. The activity of co-development differs from this activity of co-creation. Co-development is proactive search for new actors, resources and configurations, making new kinds of value propositions and reciprocally assessing other actors' novel value propositions. It is a purposive activity aimed at transforming the structure of value co-creation in interaction with others. Actors can appreciate co-development either instrumentally through the appreciation of its aims or intrinsically through the appreciation of participating in the social interaction per se.

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Innovations as novel outcomes

Scholars that study service-dominant logic are cautious when it comes to discussing innovation outcomes because such an approach easily leads to goods-dominant logic. Yet, goods and services, and activities and processes, still remain (Ramaswamy, 2011). Also, it is the resulting impact that determines whether innovation makes us better off or not. Therefore innovation as resulting novel practices and their concrete manifestations as, for example, products and services should not be ignored.

Edvardsson and Tronvoll (2013) see the results of innovation as new practices. They emphasize structuration (Giddens, 1984) and view innovation in service-dominant logic as changes in social structure that allows actors to co-create value. These changes stem from new configurations of resources or new knowledge of shared rules and norms. We agree with this view and characterize innovative outcomes as new value co-creation practices embedded in social structure. The new practices can either enable customers to attain something or relieve customers from something (Michel et al., 2008). They can address different benefits and even different level benefits than the old practices. The benefits may vary for different stakeholders. New levels of value are addressed, for example, when focus is shifted from efficiency to effectiveness or when the experiential and meaning-laden nature of value is emphasized. Service-dominant logic also stresses that operant resources such as skills and knowledge can be embedded in the offering with the purpose of making customers smarter.

The novel practices are often crystallized in concrete entities such as products, services, or technologies. Humans make observations through their physical senses, and they depend on their bodies as a means to act and participate in any social interaction. They have a limited view of the actions of others and of the consequences of their own actions and the actions of the actor-to-actor network as a whole. Products, services, and technologies are resources that aid humans by extending their senses and capability to act. They always have some physical manifestation that works as a medium enabling the human-to-human interaction for value co-creation. However, only an experience can be appreciated as an end itself (Holbrook, 1999). Therefore, value is not an inherent property of products, services, or technologies. Instead, they are manifestations and enablers of practices: configurations of resource integration that can be further integrated for enhancing value co-creation in social interaction.

All the forms of innovation originally proposed by Schumpeter (1934) can be considered to be *novel value co-creation practices*. Therefore, service-dominant logic as an innovation theory is wide enough to include all innovations, including new markets and reorganization of industries as well as new products and services.

Methodology and Case Company

Service-dominant logic is young as an innovation theory, and there is a clear need for more practically relevant knowledge about its implications for innovation management. In particular, we want to illustrate how it widens the perspective on industrial innovation and what effect this widening has for the innovation practice in industry. A case study is a suitable methodology for us because it fits especially well with answering "how" or "why" types of questions (Yin, 1994).

We first use our empirical case study to illustrate and concretize how to further widen the abstract idea of an innovation. We analyze the sample offering using service-dominant-logic theory to clarify the resulting innovations as novel value co-creation practices. Then, we further discuss the innovation practices used in creating this type of innovation.

Our case company is a Nordic manufacturer of arc welding equipment and a provider of solutions for highly productive welding. It has gone through an extensive development program to increase its innovative capability and to turn from an equipment company to a more customer- and service-oriented direction. It is an entrepreneurial and innovative company serving the high-end market. It has own offices in 15 countries and a strong dealer network with export to 80 countries. It has about 650 employees and its global revenue totals 120 million euros a year.

The company has developed services previously. We assess the company's earlier level of servitization as mainly a supplier of machines and add-on services, with some solutions for specific uses or user groups. During the development program, the company took clear steps to a more mature solutions-provider phase. These steps include development of customer centricity, incorporation of customers' voice, and the development of a wide range of new integrated product and service offerings focused on supporting customers' value creation processes. Service logic now better encompasses the entire company and proper attention has also been given to customer relationship management. In addition to these qualities of a solutions pro-

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vider, the company has been able to develop certain level of preparedness and capabilities necessary for a company that wants to apply service-dominant logic in its innovation efforts.

Data collection

Our empirical data was collected from the company's extensive development program taking place during 2011-2013. The author, together with a larger research group, has been involved in the program since its beginning. Case data has been collected from various sources, including meeting notes, slide presentations, memos, process descriptions, conceptual descriptions, web pages, and observations. Every half a year, the author together with colleagues has written a thorough report about the progress of the development program, utilizing detailed material. These reports have also been used as data for study. In addition to the data collected as part of the development program, three company representatives in high management positions and two customer representatives were interviewed. The author has had a dual role in the process. The research group – including scholars in innovation management, service-dominant-logic and strategic renewal – has brought its expertise to the development program together with several other expert groups, and affected the change in the company's business and innovation practices.

Case Findings

In our theoretical discussion, we ended up with a view of innovations as novel value co-creation practices embedded in social structure. They come into being as customers and other relevant actors accept value propositions and enact them. In order to better understand industrial service innovations from this perspective, we now analyze a new offering created by the case company and then discuss our empirical findings on innovation management.

Analysis of a systemic industrial service offering

We find the offering an enabler of new value co-creation practices and summarize the main points of this analysis in Figure 1. The offering is a system for managing quality and productivity of welding work. It links together different modules or sub-offerings that fit together and can be used either together or separately. The modules are complementary, having the potential to become more valuable as more modules and actors are integrated together. The offering includes physical products such as welding machines and barcode readers, and services such as consultation and training, but it is best understood as a systemic, multi-actor value-proposition design capable of assisting customers in their value creation by making them "smarter" through the smart knowledge and connections it contains.

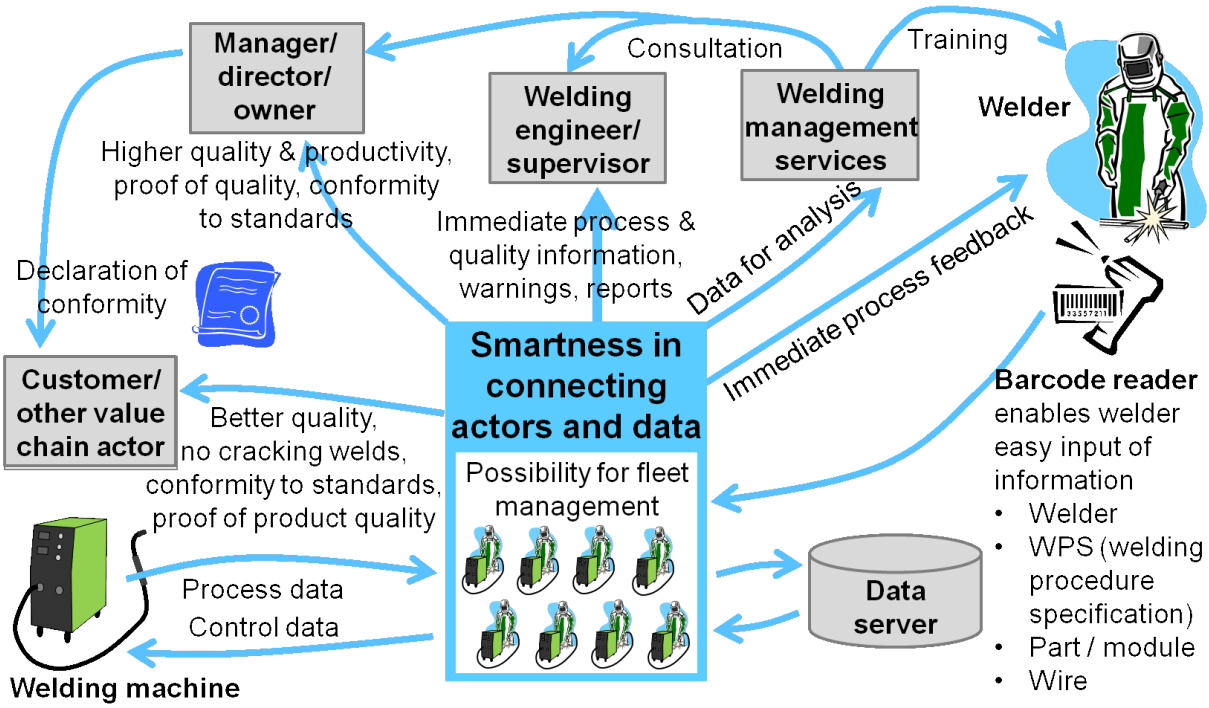

Figure 1. A systemic offering as an enabler of new value co-creation practices

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We now discuss this value proposition by starting from the lower left corner of Figure 1 and moving counterclockwise. We then further discuss institutions and other aspects of the offering not visible in the figure.

Welding machines are a basic product offering of the case company. They are physical manifestations of resource integration practices carried out by the case company. Customers integrate welding machines as resources in their own welding processes. However, value creation in welding work relies heavily on welders' competence and their compliance with welding procedure specifications. Welded joints are often safety critical, yet their metallurgic microstructures cannot be properly studied with non-destructive testing methods.

As a major benefit compared to welding machines alone, the systemic offering can be used to collect all welding data and to monitor compliance with welding procedure specifications for quality control. Because process data is collected and stored in *a data server*, it can be integrated with other information for quality and productivity improvements. An essential enabler of novel practices is *a barcode reader*. It allows *the welder* to easily input important quality parameters into the system. Due to the barcode technology, it is easy for the welder to adopt the new quality-control practices. The system also gives the welder immediate process feedback about their own work.

The data can also be used as a resource for the case company's *welding management services* production, such as training and consultation. The data and the different reports and services are also an important resource for *the welding supervisor* as the system facilitates and automates production management. At the company level, *the owner* benefits through better quality and improved productivity, which lead to reduced costs and higher throughput. For the company, it is also very important that welding quality and conformation to welding procedure specifications can be verified. Quality problems of safety-critical welded parts can cause substantial liabilities. *Customers* of the welding shop can further utilize the declaration of conformity while doing business with final customers. Welded parts and their quality can be tracked throughout the production chain. Naturally, customers also benefit directly through better quality and the resulting safety for people and their value creation processes.

The offering allows for new practices of fleet management on the shop floor, and even globally. It connects together different data resources and actor resources, which enables smart value co-creation practices in a networked business environment. Therefore, it is a systemic value proposition design.

The system draws on many institutionalized practices of welding industry as resources, including arc welding technology and the use of welding procedure specifications. It also utilizes the institutionalized practices of information technology such as barcodes. The servitization of industry is also an important norm and a resource for welding management services.

An especially important institutional change in the welding industry is the rapid spread of quality management practices as an industry norm. Welded seams are safety critical and there is a global trend of emphasis on safety issues. Accidents such as the Gulf of Mexico oil spill have had a major effect on the required safety precautions in many industries and especially in the offshore industry. Europe is adopting new quality standards for welding. CE marking will be required for all steel and aluminum structures sold within the European Economic Area. The offering facilitates conformity to the new standards. The institutional norm for quality management is further intensified by urbanization and the rapid growth of the Chinese market. Due to the high demand, there is a global shortage of well-trained welders. The quality management tools help welding companies to cope with the high demand when there is a shortage of personnel.

Institutional inertia often makes it difficult to induce changes in practices of systemic value co-creation. However, institutions not only constrain behaviour – they also enable it. The offering under study has been designed to meet the demand created by a major change in the institutional landscape of the welding industry. It does not try to fight major institutions, instead it utilizes them. For example, one of the first customers adopted this innovation in order to take proactive development steps, improve operations, and be well prepared for CE marking. Also, many of its large customers required operation almost at the level of the CE marking.

The offering can be viewed as designed around human value co-creation. Products, services, and technologies are an indispensable part of the design as enablers of human-to-human interaction. In this case, the main enabler of higher value creation is information technology that makes actions of the welder as well as functioning of the welding machine visible for other stakeholders across time and space. The offering embeds smart technology that helps each stakeholder utilize this knowledge and act smarter in his role.

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As an important difference to the typically dyadic value propositions of solutions business, the novel offering represents a multi-stakeholder value proposition for welders, welding engineers, managers, customers of the welding shop, and the provider of welding management services. The offering supports the interactive value co-creation between the different stakeholders at least as much as it directly supports the value creation of each individual stakeholder.

As the stakeholders accept the value proposition and adopt the new value co-creation practices, an innovation emerges. The innovation is not the offering per se, but the enactment of new practices by the different stakeholders. The offering is an enabler. The new products and services are critical enabling components that need to be created before the innovation as novel practices can take place. However, products, services and technologies as such are not sufficient development targets. Development efforts need to be aimed at systemic value co-creation.

The example represents a gradual shift towards service-dominant logic. The offering differs from typical solutions offerings and resembles a service-dominant-logic offering due to its value proposition that supports joint value co-creation of multiple stakeholders and due to the way it utilizes the systemic market dynamics created by the wider institutional change. It also leverages knowledge and technology the way that is stressed by service-dominant logic.

The analysis of the offering illustrated how the adoption of service-dominant logic widens the perspective on innovation. We will now discuss the innovation practice used in its creation. Our elaboration on it is brief because, as a dynamic capability, it is a sensitive issue.

Understanding context and searching for win-win-win

A view of systemic complementarity between multiple actors instead of a provider-customer view becomes obvious in the offering example presented above. The search for such win-win-win is a complex and uncertain task for which theory suggests an entrepreneurial approach. For this search, the company has developed shared organizational capability for understanding customers and proactively utilizing this understanding for new offering development, as the following quotation from a senior manager at the start of the program tells us:

"It is not enough to know customers' present needs… Customer satisfaction surveys tell us about past and present… we need to go further in thinking and develop a proactive approach."

A consultative sales model is an important entrepreneurial element of the innovation process that was developed. Sales people learn about customers' different contexts and proactively widen the discussion on possible sources of value in their search for mutually beneficial solutions with customers. They need to have a certain level of consulting capability in order to sell the smart offerings and consulting services. It is not easy for all seasoned sales people to learn the new approach. However, sharing success stories helps sales people learn from each other's experiences and widen their minds to new creative value propositions. Special attention has been given to ensuring that all sales people have proper skills in consultative sales and on developing tools for learning the new skills.

When developing multiple-actor value systems, insight needs to be gained about stakeholders in multiple roles and how they experience value creation and value destruction. In our case these multiple roles include welder, welding engineer, owner, service provider, dealer, and the customer of the welding company. All these actors each have their individual context that has an influence on their service experience. A very important part of this context is the everyday practices of these actors. For example, the case company uses an ethnographic approach that is suitable for studying the everyday practices, contexts, and experiences of the different actors. Also, other methods such as questionnaires are used and integrated into the critical process points of the research, development, and innovation process. The front office is used for searching weak signals. The case company has also organized its innovation process so that it can create a very extensive and deep understanding of its customers on multiple levels, for example, an understanding of customer's people, customer's business, the tools used, and the context.

Co-developing value co-creation systems

Firms depend on their relationships with their external environment for innovation. This dependency emphasizes the importance of social capital and long-term relationships with other innovative agents. The case company has built extensive external networks and long-term relationships to support its innovation activity. It has carefully chosen strategic research partners to collaborate with and to tap into important information sources. As an example, the development program involved a multitude of research organizations and companies to provide rich expert knowledge.

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The offering enables a change in the value co-creation system. From the provider's view, it can also be seen as a business model innovation. The idea is expressed in the following quotation from a senior manager discussing markets in different cultures:

"It is not the machines and their use, instead it comes more from business models and the whole system – how you offer support and how you do pricing. The machines are not that radically different and it accentuates contextual circumstances – the whole business model and how you approach through different channels – how the business runs."

Technology, products, and services are not developed for their own sake; instead, they are developed to fill critical gaps so that value propositions can be made that fit the social context. In order to do this, the development program joined together technology development, business development, customer research, and organizational development. This approach proved to be a very successful research and development concept.

Conclusion

The servitization of industry has advanced from services as add-ons to services as solutions. The next logical step for industry is to widen its perspective on innovation based on the view of value as being co-created. It is a systemic and human-centered view that sees innovations as new practices in social interaction. First, this approach will be adopted by the advanced companies that want to be in the forefront of development. In the future, however, industry will face large structural changes, partly due to the positive forces of the knowledge society and new technologies such as the Internet of Things, robotics, and additive manufacturing – and partly due to more negative forces such as the coming shortage of resources and the need for a more sustainable economy. In the phase of large structural changes, a wider innovation concept that includes new market structures and the reorganization of industries is a necessity. Service-dominant logic can provide this wider innovation concept.

Companies that wish to adopt service-dominant logic in their innovation activities can start by aiming their innovation efforts at the development of new systemic value co-creation practices. New innovation capabilities are needed for creating a deep insight of multiple-stakeholder situations and an understanding of institutional forces. In addition to these new capabilities, practices of entrepreneurial search and co-development need to be developed. Systemic change can be facilitated by identifying critical gaps of the system and developing technologies, products, and services to fill them. They are important enablers of human-to-human value co-creation and as such remain an integral part of innovation outcomes in service-dominant logic.

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The Promoting Force of Technology for Service Innovation in High-Tech Industries

Silvia Gliem, Janny Klabuhn, and Nadine Litwin

> *"The advance of technology is based on making it fit in so that you don't really even notice it, so it's part of everyday life."*
>
> Bill Gates
> Former CEO and Chairman of Microsoft

This article focuses on the interaction between the development of technology and service innovation. It goes "back to the basics" by analyzing the first theoretical contributions to the service innovation literature from the late 1980s. These contributions were heavily technologically oriented: they aimed at bringing the results of technological innovation to the realm of services. More specifically, we focus on the model of "reverse innovation cycle" on one hand, and on the first innovation-specific categorization of services on the other. The latter introduced the division into supplier-dominated, production-intensive/scale-intensive, and science-based services. Our purpose is to examine in which ways these theoretical approaches could promote our understanding about the new phenomena of technology-service interaction in innovation. In the second part of the article, we apply these approaches in five case studies that originate from different service industries and that differ in size and technologies. The findings of the analysis demonstrate that the applicability of the approaches to the case studies depends on several factors including the kind of technology involved in the innovation activities, the stage of development of this technology, and the type of service.

Introduction

The field of service innovation has been acknowledged, amongst others, as an emerging field of research within service science, and it is considered to be autonomous from traditional innovation research conducted in the manufacturing industry (Hipp & Grupp, 2005; Miles, 2010; Toivonen & Tuominen, 2009). Nonetheless, the quantity and variety of contributions to the field of service innovation in comparison to traditional innovation research lag behind (Wang et al., 2010). Advances in understanding of service innovation would enable researchers and firms to design more appropriate and target-oriented service innovation processes (Rubalcaba et al., 2010). Vargo and Lusch (2004) went further by proposing a new perspective on service science in general. They argue that concepts of innovation research should not evolve from manufacturing industries. Instead, they emphasize the wide-ranging applicability of a service-centered perspective. For both a traditional and a service-centered perspective, there is no doubt that technology is one of the promoting forces that drive service innovation (Kandampully, 2002).

In this article, we depict the promoting force of technology towards service innovation in high-tech industries. Therefore, through this research, we ask: in what ways are service innovations driven by technology?

In answering these questions, the remainder of the article is structured as follows. First, we present two widely adopted and influential models of service innovation: i) the reverse innovation cycle model of Barras (1986a, 1986b) and ii) the typology of service innovation of Miozzo and Soete (2001). Next, we review literature that complements these two models. Then, for the purpose

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of evaluation, we map five case studies originating from the high-tech industry to the two models of service innovation. Finally, we discuss the managerial implications.

Barras' Reverse Innovation Cycle

Barras' model of the "reverse innovation cycle" has been generally regarded as the first actual theory on service innovation (Gallouj, 1998; Toivonen & Tuominen, 2009). Even though it is highly technologically biased, it has continuously aroused interest among those service researchers who have sought a strong linkage from service innovation to the general innovation theories. It is based on the "dynamic model of process and product innovation" by Utterback and Abernathy (1975), which shows the relationship between the forthcoming products of a firm from one product lifecycle stage to another and the adaption of a firms' innovative behaviour. The further a product proceeds in its lifecycle, the more likely it is that firms' focus on innovation activities shifts from product to process innovation. For service industries, Barras (1986a) predicts a reverse trajectory for this cycle, which is divided into three stages:

1. Firms adopt new technologies originating from a product innovation process and prove their spectrum of applicability. Mainly, their application results in incremental process innovations to increase efficiency and decrease costs.

2. Uncertainty concerning the adopted technology is eliminated. As a result, internal processes related to the application of the adopted technology are to be improved. Technology is still used for process innovations; however, in comparison to the first stage, the amount of incremental innovations declined, whereas radical process innovations aiming at quality improvement accumulate.

3. Product innovations are developed on the basis of the technology adopted in the first stage. If the development of product innovations is not done by firms themselves, it will be outsourced.

The reverse innovation cycle model of Barras was reviewed by several researchers (Gallouj, 1998; Tether & Howells, 2007; Uchupalanan, 2000) who raised four issues with the model, as described below.

First, the focus on technology as a single factor liable to influence service innovation is criticized (Gallouj, 1998). Other factors, such as experiences and knowledge accumulated during former innovation processes (Uchupalanan, 2000), were not taken into consideration. However, Barras includes these factors as drivers or restraints of the technology adoption process but not as influencing factors on service innovations (Barras, 1986a, 1990). Furthermore, by focusing on technology, Barras expels service innovations that do not contain technology, such as franchise systems.

Second, using Utterback and Abernathy's dynamic model of process and product innovation as a foundation, Barras adopted the differentiation between incremental and radical process innovation, and product innovation, which is considered problematic within the research community (Gallouj & Savona, 2009; Salter & Tether, 2014; Uchupalanan, 2000). Barras (1986a) addressed this problem and determined product innovations in services as "so different in nature and mode of delivery from more traditional forms of services that they can meaningfully be described as new service products." However, Barras only offers indications for determining whether a service innovation is a process or a product innovation (Gallouj, 1998). More precisely, Ettlie, Bridges, and O'Keefe (1984) state that "the strategy-structure causal sequence for radical innovation is markedly different from the strategy-structure sequence for incremental innovation." In other words, the extent to which an innovation makes organizational changes necessary, for example by the inclusion of customer learning, can be used as an indicator for the determination of the innovation type. This assertion is supported by Perks, Gruber, and Bo (2012), who characterize radical service innovations as powerful enough to cause fundamental changes in the structure, processes, and environment of an organization.

Third, focusing on information and communication technologies (ICT) as well as limiting the analysis to financial, business, and local government services creates doubts about the universal validity of the model (Tether & Howells, 2007).

Fourth, the reverse innovation cycle cannot be observed ex ante. Only if a service firm adopted a technology and went through all stages, can it be concluded (ex post) that the reverse innovation cycle was undergone. In addition, Barras (1990) himself acknowledged that the pace of technology adoption will vary between service industries, which makes analysis difficult. Further, the substitution of one technology by another and the outsourcing of research activities linked to the adopted technology will interrupt or stop an industry from undergoing the reverse innovation cycle (Gallouj,

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1998). These assumptions are supported by Uchupalanan (2000) who found that the Barras' model is only one of many possible innovation trajectories.

Service innovations developed by firms outside the service sector are not encompassed by Barras' model. For these particular cases, Cusumano, Kahl and Suarez (2006) developed a model that builds upon Utterback and Abernathy's model by including a fourth stage, which displays the shift from process to service innovation. The role of technology for service innovation is not determined in this model. It can, but must not have an influence on service innovation because, apart from technology, service innovation can originate out of accumulated knowledge, for example, about the behaviour of customers.

The review of innovation cycle models showed that the influence of technology is manifold: technology can be seen as a requirement for developing service innovations. This requirement applies, for example, to firms in the manufacturing industry that offer maintenance or repair services for their products. Likewise, technology is a starting point for the initiation of service innovation processes.

Miozzo's and Soete's Typology of Service Innovation

Miozzo and Soete (1989, 2001) developed the first typology for innovation in service firms focusing on the influence of ICT. Their work is based on the taxonomy by Pavitt (1984, 1991), who analyzed innovations over three decades but did not assign services an appropriate role in innovation (de Jong & Marsili, 2006; Gallouj & Savona, 2009). Miozzo and Soete's typology consists of three types. The first type comprises firms of small size, including science-based firms and specialized suppliers. Software industry and business services are allocated to this type. Next, there is the supplier-dominated type, which is represented by public and social services, as well as services close to home. Finally, there is the scale-intensive type, which is divided into two subtypes: physical networks and information networks. Logistics and wholesale belong to the scale-intensive type using physical networks. Financial, insurance and communicational services represent the scale intensive type using information networks. The authors emphasize the interrelations between the manufacturing and service industries. Services using information networks influence the development of technologies by signaling future demands to manufacturing industries, especially in terms of technologies that improve their networks in use. Furthermore, technology does not have to originate in manufacturing industries; for example, firms belonging to the science-based type and specialized suppliers can be developers of technology.

The typology of Miozzo and Soete (1989, 2001) was empirically validated by Evangelista (2000). His results show slight differences in comparison to the theoretically derived typology of Miozzo and Soete. The supplier-dominated type converted into a technology user consisting of logistics, waste management, retail sale, and tourism. Evangelista states that the allocation of logistics as scale-intensive, physical-networks-based type is also reasonable. Advertisement, banking, and insurance are considered to be interactive and IT-based instead of scale-intensive information network based. For these particular service industries, innovations neither originate from the adoption of technology nor from firms' own development. Instead, they are created on the foundation of obtained and accumulated knowledge. Science-based and specialized suppliers representing research and development and consulting services stayed the same.

De Jong and Marsili (2006) developed a corresponding taxonomy for small and medium-sized firms. They identified four types, but due to the objects analyzed, they introduced a resource-intensive type in place of a scale-intensive type. Firms belonging to the resource-intensive type often emphasize budget expenditure and effort for the development of innovation.

The taxonomy of Vence and Trigo (2009) divides the service sector into three types. There are industries of low innovation intensity, presented by wholesale, for example. Further, there are technology-intensive service industries of medium innovation intensity, such as financial services. Knowledge-intensive service industries, such as consultancy, are considered to be highly innovation intensive.

Taxonomies and typologies demonstrate the attempt to deal with the complexity and variety of services. However, the typology of Miozzo and Soete lacks the inclusion of non-technological innovations or at least the consideration of factors that are interrelated with technology and therefore potentially influential (Tether et al., 2001; Tether & Tajar, 2008).

Although the reverse innovation cycle model by Barras and the typology of service innovation by Miozzo and Soete were published more than ten years ago, our review demonstrated that they are frequently discussed

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models in the service innovation literature and provide the basis for many newer works. Both Barras as well as Miozzo and Soete focused their analysis on ICT. By this approach, they narrowed the validity of their models to a certain group of technologies and stage of development of these technologies. Applying these models to up-to-date ICT and other technologies, such as robotics, will expand the validity of the models, uncover potential for modification, and provide a revised starting point for the future development of new models of service innovation.

Research Methodology

A multi-case study method was chosen because it allows us to include and combine heterogeneous sources of information (Baxter & Jack, 2008), such as interviews and data from annual reports of companies. Further, processes that continue over time and might have had different starting points, such as development processes, can be examined in detail with this approach. Interconnections between processes also can be considered (Yin, 2003). The study of multiple cases should provide an insight into the diverse shapes and characteristics of one examined phenomenon and permit us to deduct robust conclusions (Eisenhardt, 1989; Yin, 2003). In this article, five cases are analyzed. The sources of information for making up the cases vary between personal interviews (Case 1 and Case 2), literature research (Case 3 and Case 4), and data from a university research project (Case 5). The technologies examined in the cases had different starting points of development and are interwoven. For instance, ICT started developing in the middle of the 20th century and operated as an enabler for the development of other technologies, such as robotics.

We analyzed the cases in three steps. First, we want to prove whether service firms are technology adopters when developing service innovations or technology developers. By this, we will clarify that technology actually is a force of promoting nature to service innovation. Second, the cases will be mapped to Barras' reverse innovation cycle model. Therefore, we need to differentiate between incremental and radical process innovation, and product innovation. Third, the applicability of the typology of Miozzo and Soete for service innovations and later modifications is to be evaluated focusing on the basis of the information obtained from the first and second steps of analysis. The focus is set on the congruency of the results of service innovation anticipated by the typologies and taxonomies and the actual results in the different case studies.

Case selection

The main selection criterion for the case studies was the application of a technology to or within a service process that was not used in this combination before. In other words, all service innovations analyzed within a case would not have been developed without technology or a combination of technologies. Further selection criteria included the context (i.e., business-to-business, business-to-consumer, or both), the size of firm, and the type of service industry. A selection of cases that differ from each other in the above-mentioned criteria was considered to be valuable according to the advantages of the multi-case method. The case selection covers a broad range of service firms and a wide variety of services.

The technologies considered as influential within the five cases range from robotics (two cases), automation technology (one case), information and communication technology (one case), and additive manufacturing (one case). All case studies are set in different high-tech industries, produce different services, and differ in size. Two of the firms are small (1–49 employees), one of the firms is medium-sized (50–249 employees), and two of the firms are large (>250 employees) (cf. Audretsch et al., 2009). Three cases are set in a business-to-business-context. These three cases also can be found in a business-to-consumer-context, but the firms presented in these cases offer their service exclusively to business customers. Two firms presented in the case studies provide their services to business and private customers. Table 1 provides an overview of the five cases, which are described in greater detail in the following section.

Case Descriptions

Case 1: Automation technology in car rental services

Customers of car rental services are often time-sensitive business travelers. At locations where many people wish to rent a car, for example, at the airport, delays can occur. With the help of automation technology, a worldwide car rental service developed an automatic car rental machine, which facilitated the car rental process in various ways. Customers can go directly to the car park where the machines are set up. Via touchscreen they initiate the rental process. The car keys can be taken out of the automatic car rental machine by pulling out a solid metallic cylinder. Customers returning the car go through a similar process.

Case 2: ICT in postal services

To most of us, email services are an essential part of our private and working lives. At the same time, customers

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Table 1. Overview of the five case studies

	Case 1	Case 2	Case 3	Case 4	Case 5
Description	Automation technology in car rental services	ICT in postal services	Additive manufacturing in dentistry	Robotics in logistics	Robotics in industrial laundry services
Firm size	Large	Small	Small	Large	Medium
Operating context	B2B & B2C	B2B	B2C	B2B & B2C	B2C
Innovation	Automatic car rental machine (rental kiosk) for independent car rentals and returns	Email service for secure sending and receiving of legally binding emails and electronic documents	Stereolithography technology for manufacturing dental splints	Unloading robot for incoming freight containers	Service robot substituting manual operations
Type of innovation	Process	Product	Process	Process	Process
Motive for innovation	• Increase in competitiveness • Satisfaction of customer needs	• Expansion of the range of products • Adaptation to market conditions	• Satisfaction of customer needs • Process optimization	• Reduction of load on employees • Process optimization	• Reduction of risk of health and safety in the workplace • Process optimization
Development of innovation	• Internal	• Internal • Frame specified by government	• In collaboration with specialized suppliers	• Internal • In collaboration with research institutes	• In collaboration with specialized suppliers and research institutes
Type of technology	• Automation technology • ICT	• ICT	• Additive manufacturing • ICT	• Robotics • ICT	• Robotics • ICT
Sources of technology	• Specialized supplier	• Own research	• Specialized supplier	• Research institute • Specialized supplier	• Research institute • Specialized supplier

of email services are not aware of their privacy protection. Therefore, governments determined that some documents, such as tax assessment notices or articles of association, cannot be sent via email. Instead, they must be in written form. The German government decided that, in some cases, the obligatory written form can be substituted by a qualified electronic signature. The service firm presented in the case provides this special email service for firms. The email service contains several modules. Apart from a basic module consisting of the mailbox, additional modules can be obtained for end-to-end encryption, qualified electronic signature, and storage.

Case 3: Additive manufacturing in dentistry

People with bruxism or teeth grinding suffer from headaches, dental abrasion, and jaw pain (Carlsson et al., 2003). Therefore, the production of custom-fitting, indi-

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vidual dental splints is gaining more importance in dentistry (Hoffmann, 2003). The traditional approach to fabricating dental splints is complex and time consuming; it begins with taking a dental impression of the client's teeth, which is then used to create a plaster cast, upon which the dental split is constructed (Polzin & Seitz, 2012). Additive manufacturing, or in this specific context stereolithography, is capable of facilitating this process significantly and further improving quality and fitting accuracy (Chengtao et al., 2006; Salmi, 2013; Van Noort, 2012). It constitutes a means of production that is crucial for the improvement of the whole service process that aims at the provision of patients with dental splints. Instead of taking a dental impression, additive fabrication begins with a computed axial tomography (CAT) scan of the client's teeth, which is used to create a 3D model of the dental splint, which is then printed using a stereolithography machine. Compared to the traditional approach, which takes from 4 to 10 days, the entire process of additive fabrication takes between 10 and 20 hours. The combination of additive manufacturing and ICT, presented by the CAT scan, permits to shorten the whole service process of producing a customized dental splint in terms of production time and feedback loops necessary to guarantee the proper fit of the splint.

Case 4: Robotics in logistics

In the packaging centre of a transport and logistics service provider, packages are sorted before being delivered to customers. Employees work in shifts 24 hours per day and 7 days per week to deliver packages as fast as possible. Cargo of incoming delivery trucks has to be unloaded by hand and put on a conveyor belt to be delivered to another delivery truck (Scholz, 2006; Vahrenkamp, 2005). Two issues threaten the health and safety of employees in their workplace (Echelmeyer et al., 2009; Schmidt & Rohde, 2010): i) large and heavy packages, such as automotive parts, have to be unloaded by hand and ii) stacks of packages can become unstable and fall onto employees. To confront these problems, a worldwide operating provider of transport and logistics services developed an unloading robot in collaboration with public research institutes. Once in position, a scanning system enables the unloading robot to recognize the exact location of the packages inside the truck and tells the robot where to grab them. The unloading robot is capable of unloading between 450 and 600 packages per hour (Echelmeyer et al., 2009).

Case 5: Robotics in industrial laundry services

Industrial laundries are well known for their automation systems (Vickery, 1972). Furthermore, radio-frequency identification (RFID) technology has lately been widely implemented (Cangialosi et al., 2007). However, due to high levels of complexity and multiplicity, manual work is still required. Employees within industrial laundries servicing hospitals have to deal with heavy loads of laundry. Furthermore, they are exposed to highly contaminated and possibly infectious laundry items, especially when opening laundry bags by hand. A group of German researchers developed a service robot that partly substitutes manual work processes in industrial laundry services. For instance, the robot automatically opens laundry bags, reads RFID tags that are sewed in to the laundry items, and carries them to the conveyor belt. Heavy and wet laundry items can easily be processed, even during peaks of demand.

Case Analysis

In every case, technology was significant for service innovation. In fact, in four cases (1, 3, 4, and 5), a combination of two or more technologies formed the foundation for service innovation. ICT formed part of every one of these combinations. Although only five cases were considered and only one service innovation is based mainly on ICT (Case 2), the predominance of these technologies for service innovations is well represented in our study and coincides with the results of previous research (Higón, 2011; Jiménez-Zarco et al., 2011; Scupola & Tuunainen, 2011).

With regard to our research question, which concerned the ways in which service innovations are driven by technology, our cases indicate a variety of approaches. In Case 3, technology was adopted from the manufacturing industry, in particular from sectors dealing with mechanical engineering and frequently using prototypes, or other customized, prefabricated parts. In Case 1 and Case 2, technology incorporated in the service innovation was developed by the firms' own research and development departments. Two firms collaborated with public research institutions (Case 4 and Case 5). However, basic know-how of these technologies was adopted in each of the five cases. Robotics know-how (Case 4 and Case 5) was probably adopted from branches of industry using assembly devices, whereas know-how of automation technology (Case 1) was obtained from plant engineering and construction.

When applying the Barras model to our cases, we used the indicators included in the model, which led to debatable results. Our analysis will demonstrate that the indicators offered by Barras' model in some cases are not sufficient for determining whether an innovation is

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of an incremental or radical nature. According to Barras, the car rental services case can be characterized as a radical process innovation that significantly improves the quality of the service process, for example, by reducing waiting periods. At the same time, this innovation can be considered an incremental process innovation. It does not result in substantial changes for the car rental service firm nor does it require the acquisition of knowledge by the customer given that automation technology has surrounded our everyday life for more than two decades.

In the second case, service innovation was developed on the basis of information technologies that are considered to be highly diffused within the service industry (Djellal et al., 2013; Gago & Rubalcaba, 2007). By creating an email service with security options that facilitate sending and receiving emails with legal validity – in other words, improving the quality of the service – a radical process innovation was developed.

Again, this case demonstrates that Barras does not offer clear-cut criteria for assigning an innovation to one of the phases of his reverse innovation cycle. For this specific case, one can also argue that an email service with a qualified signature is not an innovation at all. Instead, it constitutes an example of adoption and implementation of earlier innovations.

The fabrication of dental splints via additive manufacturing (Case 3) represents an incremental process innovation in dentistry services. Improvements of quality for customers and providers, for example, by improved fitting accuracy, are achieved. Considering the past, this case reveals that the introduction of the CAT scanning technology might have been a radical process innovation to dentistry services as the handling of this new technology – for example, the scanning facility itself and the data processing software – have had to be learned by employees.

For laundry services as well as logistics, robotics is integrated into the overall operating systems. The determination of the process innovation type for these cases is highly dependent on the judge's point of view. For customers of an industrial laundry service, a laundry processing robot remains invisible. Improvements in quality will be marginal, whereas improvements in terms of efficiency will be noticed. Referring to the continuous threatening of employees' health, a laundry processing robot would stand for a significant improvement of health and safety in the workplace. For customers, logistics might improve on behalf of the delivery speed. Dependent on the extent to which delivery speed has increased, customers will perceive the service innovation as an incremental or radical process innovation. Although, one has to keep in mind, that the operation of an unloading robot remains invisible for customers. For employees, an unloading robot has visible advantages, including improved health and safety in the workplace. For both cases, the improvement can be perceived as an incremental or radical process innovation. The criterion of customer learning cannot be applied to both of the cases because, for customers, the innovations remain invisible.

The assignment of the cases to Miozzo and Soete's typology is summarized in Table 2. The typology covers all service industries presented in the cases. However, Case 5 is problematic because industrial laundry services are not considered services that are "close to home". Instead, they are assigned as public or social

Table 2. Assignment of cases to the typology of Miozzo and Soete (2001)

	Case 1	Case 2	Case 3	Case 4	Case 5
Description	Automation technology in car rental services	ICT in postal services	Additive manufacturing in dentistry	Robotics in logistics	Robotics in industrial laundry services
Types	Supplier-dominated OR Scale-intensive with physical networks	Knowledge intensive/ specialized supplier	Supplier-dominated	Scale-intensive with physical networks	Supplier-dominated
Innovation types	Process optimization	Innovative products	Process optimization	Process optimization	Process optimization

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services. Both Case 4 and Case 5 used robotics and developed their service innovation in collaboration with public research institutions. Such a collaboration as a source of technology does not appear in the typology. However, in both cases, specialized suppliers originating in the manufacturing industry were granted a license to do further fabrication and maintenance.

Regarding the purpose of introducing a technology, the case data reflects Miozzo and Soete's expectations, except with Case 3, which does not fit. According to Miozzo and Soete's typology, Case 3 belongs to the knowledge-intensive type or specialized supplier.

Conclusion and Managerial Implications

Our case analysis demonstrated that technology has significant influence on the development of service innovations. Its characterization as a promoting force therefore is justified.

The reverse innovation cycle model of Barras, although not capable of displaying the dynamics of service innovation processes, demonstrates that service innovation and technology are interconnected. Further, the model indicates that the type of technology-service interaction results in different types of innovation. However, the indicators offered in the model of Barras are not sufficient.

A more precise approach to reflect the interconnections between service innovation and technology is the typology of Miozzo and Soete. It addresses the variety of the service sector and reveals technology-service interactions that are typical for certain service industries. Therefore, it enables managers to analyze and compare past technology-service interactions with present developments and conditions.

As the frontier between service and manufacturing firms blurs, future research has to deal with several fundamental questions referring to a service-dominant logic or the differentiation of process and product innovations and their characterization as incremental or radical. In this regard, the definition and measurement of intensity of innovation has to be reconsidered. At the same time, the measurement of productivity and quality of pre and post conditions of innovation has to be brought forward.

About the Authors

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Integrating Design for All in Living Labs

Madeleine Gray, Mikaël Mangyoku, Artur Serra,
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> *"Design as a driver of user-centred innovation contributes to getting good ideas to market. It enhances agile and focused product and service development … It facilitates the development of better, transparent and more effective public services and contributes to social innovation, thereby raising the quality of life for all citizens of Europe. And for complex societal problems, design offers people-centred approaches that can achieve better solutions."*
>
> *Design for Growth and Prosperity (2012)*

The European Union has identified innovation as a key driver behind business competitiveness and responsive governance. However, innovation in and of itself may not be sufficient to help businesses bring new products to market and to help governments shape public services that meet the real needs of citizens. The Integrating Design for All in Living Labs (IDeALL) project sought to identify and test methodologies for designing with users in real-life settings. The results of the experiments showed how different methodologies can be applied in different contexts, helping to provide solutions to societal issues and to create products and services that genuinely meet user requirements. In this article, we describe the methodologies used in the IDeALL project and provide examples of the project's experiments and case studies across four main areas: i) services; ii) health and social care; iii) information and communication technology; and iv) urban design.

Introduction

Innovation is often promoted as essential to the prosperity and indeed survival of European economies in global markets, as exemplified at a policy level by the European Commission's Innovation Union programme (tinyurl.com/2dxextn). With the rise of emerging economies, the Commission warns that its member countries may face chronic decline unless they can differentiate themselves through advances brought about by innovation. Yet, even though it may be tempting to view innovation as a magic solution, innovation in and of itself may not have a universally beneficial impact, as Rufo Quintavalle (2014) argues in his article titled "Food Doesn't Grow in Silicon Valleys".

On the macro-level, funding for research and development in Europe has not necessarily translated into innovation uptake in Europe (Curley & Salemin, 2013). On the micro-level, even in purely market terms, innovation is no guarantee of the success of a product or service, as Mulder (2012) has shown in this publication. Indeed, Gournville (2005) finds that, although "Innovation is crucial to the long-term success of many firms", "highly innovative products… fail at a greater rate than less innovative products", a phenomenon which he attributes to the need for a fundamental behaviour change that the adoption of such products requires.

Accordingly, we ask:

- How can companies lead the innovation charge while mitigating the risks of launching new products?
- How can public services evolve in such a way that they empower citizens without leaving any one group behind?
- How can design be a factor of change while leading innovation to the market?

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In this article, we describe the Integrating Design for All in Living Labs (IDeALL; ami-communities.eu/wiki/IDeALL) project, which aims to answer these questions. First, we describe how the European Union has begun to consider the discipline of design as a driver of innovation, and then we briefly explain two of the main themes of the project: design for all and living labs. Next, we explain the rationale behind the project and give examples of the methodologies collated and compared according to the different criteria used to classify them. We then provide examples and findings of some of the project's experiments and case studies across four main areas: i) services; ii) health and social care; iii) information and communication technology (ICT); and iv) urban design. Finally, we suggest further possible applications of these methodologies by other businesses and public-sector bodies.

Design as a Driver of Innovation

The European Commission has begun to address these questions at policy level in a number of ways, including a focus on non-technological innovation such as design. In 2011, it established a Design Leadership Board (i3s.ec.europa.eu/commitment/25.html), whose report *Design for Growth and Prosperity* (Thomson & Koskinen, 2012) includes recommendations aimed at enhancing design's "long-term contribution to smart, sustainable, and inclusive growth through increased competitiveness and the pursuit of a better quality of life". The report presents design as a driver of innovation, defining it as "an activity of people-centred innovation by which desirable and usable products are defined and delivered". By bringing the end user closer to the innovation process, the report argues, the risk of launching new products and services may be reduced.

Design for all, also known as universal design in North America, is a branch of design that takes human diversity into account so that anyone, no matter what their personal characteristics and including future generations, can access goods, services, and environments and hence can participate fully in society (Aragall and Montaña, 2012). Although technology brings new possibilities, it can be a barrier as well as a facilitator (Steinfeld and Maisel, 2012); design for all seeks to ensure that technological innovation is tied to social progress, as suggested by design-for-all professional Rafael Montes in an interview cited in the Design for All Foundation Awards brochure (Design for All Foundation, 2013).

Design for all emphasizes the importance of involving users in the design process, because this means the end result is more likely to meet their needs. This view has traditionally put the discipline at odds with the "lone genius" stereotype of the designer; however, as *Design for Growth and Prosperity* suggests, this model is becoming increasingly discredited, as "the complexities of innovation call for a truly multidisciplinary approach" that involves users at all stages. Although many designers adopt a design-for-all approach as a matter of principle, successes such as the OXO product range imply that it has a role in bringing successful innovations to market (Aragall and Montaña, 2012; Steinfeld and Maisel, 2012). Steinfeld and Maisel suggest that universal design can help companies bridge the gap between innovations brought about by research, such as the synthesis of a new material, to a successful product launch through a holistic development approach that focuses on the end user; this point is also illustrated in IDeALL experiment with the company Lékué, as discussed below.

The emergence of living labs has provided a mechanism for precisely this kind of multidisciplinary, co-creative approach, allowing companies to test products with users and public bodies to try new ways of providing services. Living labs allow design for all to make the logical step from user-centred design to user-driven design. Living labs generate not only new methodologies but also help to organize complex communities (e.g., including universities, local authorities, companies, and citizens) in co-designing solutions for complex problems. In that sense, living labs allow the design professionals to work with a co-design perspective, thereby enabling a more strategic approach that goes beyond the traditional client-by-client model. As Mulder (2012) and others suggest, by providing a real-life environment for the co-creation and evaluation of innovations, living labs allow complex problems to be identified and they enable the devlopment of solutions that will ultimately be more acceptable to a range of end users. Furthermore, thanks to new technologies and manufacturing methods, more channels for co-creation and evaluation have been made possible, as many commentators have noted, including the European Design Leadership Board in Design for Growth and Prosperity. However, the ability of living labs to facilitate user-driven design has not yet been fully embraced by small and medium-sized enterprises (SMEs), which make up 99% of businesses in the European Union (European Commission, 2013), or by public bodies who may be intrigued by Government 2.0 but are wary of the risks involved in changing their ways of operating.

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The Integrating Design for All in Living Labs (IDeALL) project was developed as a response to this challenge. One of six projects co-financed under the European Commission's Design-Driven Innovation programme (tinyurl.com/mpg3blx), it aimed to bring the design and living lab communities closer together and to identify within these communities the best ways to innovate with users in different contexts. Led by the Cité du design (citedudesign.com) in France, itself a design centre and living lab, the project consortium included design centres, living labs, educational institutions, and research centres, as well as the European Society of Concurrent Enterprising Network (esoce.net) and the European Network of Living Labs (openlivinglabs.eu). Among the living labs in the consortium and its supporting community were examples of the different types analysed by Leminen, Westerlund, and Nyström (2012) in this journal.

Responding to Vérilhac, Pallot, and Aragall's (2012) identification of "the lack of comparative studies on design methods involving users" as one of the barriers to "a more integrating approach of methods that could be used in a [living lab]", a comparative analysis of user-centred design methodologies was undertaken. The methodologies were compared using the following criteria:

1. The phase of the development process (research/ideation/prototyping/evaluation)
2. The duration of the methodology (short/medium/long)
3. The user level of involvement (low/medium/high)

This analysis showed how the methodologies might be useful in different contexts according to different requirements and restrictions, and methodologies can be searched by these criteria on the IDeALLwebsite (tinyurl.com/o6jeaxp). For example, a company wishing to develop a service might use the Service Innovation Corner methodology used by the University of Lapland or the Service Innovation and Design methodology from Laurea University of Applied Science. A company wishing to design and prototype a new product might use the Cité du design's *Laboratoire des Usages et Pratiques Innovants* (LUPI; Innovative Use and Practice Laboratory, tinyurl.com/qf5xgt7) methodology, whereas a company wishing to shift to a more user-centred business model overall might consider Francesc Aragall's HUMBLES method for user-centred business (Aragall & Montaña, 2012). In the subsections below, we describe some examples of these methodologies, which are summarized in Table 1.

Table 1. Summary of four example methodologies for user-centred design

Methodology	Phase	Duration	User Involvement
1. Service Prototyping	• Ideation • Prototyping • Evaluation	• Short	• High
2. 3H	• Research • Ideation • Prototyping • Evaluation	• Medium • Long	• High
3. LUPI	• Research • Ideation	• Short • Medium	• Medium
4. HUMBLES	• Research • Ideation • Prototyping • Evaluation	• Medium • Long	• Medium

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1. Service prototyping (University of Lapland)
The Service Innovation Corner (SINCO; sinco.fi) is a service prototyping lab at the University of Lapland in Rovaniemi, Finland. The SINCO lab helps visualise and concretize abstract services and experiences by using service design tools and prototyping methods. Service prototypes consist of pictures or videos that are projected to screens and also sounds, lights, and props (Figure 1). Service prototyping can be used in all stages of the design process but is especially valuable in the ideation or conceptualisation phase. The basic idea of prototyping is to concretize unclear ideas and to provide information for planning and decision making.

The methodology has proven effective in the following case study:
• Developing a new experience for the Rajalla Pa Gransen shopping mall (youtube.com/watch?v=GJHO9oZM1F8)

Figure 1. Users participating in a service prototyping exercise at the SINCO

2. 3H: Head, Heart, Hands-on (Citilab)
The 3H (Head, Heart, Hands-on) methodology uses the human body metaphor to describe a step-by-step user-driven innovation process. It is an open living lab methodology that has been specifically developed for the European CIP iCity project.

The methodology goes through three major phases of activity:

1. *Head:* identifying and mapping the actors of the community innovation system to provide protocols and tools to collect and understand the needs and barriers to participate.
2. *Heart:* consolidating all the relationships necessary to establish trust and commitment between all the stakeholders.
3. *Hands-on:* engaging the participants in the co-creation and development activity in itself. The final part of this activity includes an evaluation activity based on a client-driven set of indicators.

The 3H methodology favours multi-disciplinary teams; it is not restricted to a particular type of user. However, 3H has been developed by Citilab and has been tested in their citizen engagement activity. This in-house methodology has been adapted to the iCity project in order to engage its stakeholders, and to foster the co-creation of services in the public interest.

The methodology has proven effective in the following case study:
• iCity (icityproject.com)

3. LUPI (Cité du design)
The LUPI (Innovative Use and Practices Laboratory) is a user-centred co-creation tool conceived in the Cité du design. Inspired by research methods from the Cité du design research department, the LUPI's added value is its flexibility (it has been applied in the private as well as local government sector) as well as its short duration (three to six months), which is in line with the temporality of small and medium-sized enterprises. A LUPI project always consists of three phases:

1. Framing the issue (1 day): Partners share their issues and clarify them collectively. Throughout the day, with the help of designers and the project coordinator, these ideas are refined and a particular investigation track is chosen. When the issue is clarified, a typology of users is also defined in order to prepare the next phase of the LUPI project.
2. On-site observations (3 ½ days): The second phase is more immersive. LUPI partners are trained by the designers to capture and synthetize "hidden insights" during user interviews.
3. Sharing (1 day): LUPI partners present the collected insights from the on-site observations and interviews. After the presentations, an ideation phase enables the new ideas to be mapped with the help of the designers. Particular attention is givento concepts with strong strategic elements that may lead to sustainable business models.

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The most significant concepts generated from the last LUPI step are rendered in the form of a scenario title associated with a presentation pitch, which is illustrated by visual elements (e.g. sketches, videos, animations) (Figure 2). The storytelling medium is therefore the form of the final LUPI deliverable, which includes hypotheses assembled in a portfolio created by the designers (as a resource).

The methodology has proven effective in the following case studies:
• PLUG (*Plot de liaison à usage général*; tinyurl.com/orlrxr4)
• *Le "Robot lycéen"* (High school robot; tinyurl.com/ozqquqc)

4. HUMBLES (DfA Foundation)
HUMBLES was created by Francesc Aragall, President of the Design for All Foundation, who published the methodology in a book together with Jordi Montana from the ESADE Business Shool's Faculty of Business Administration in Barcelona, Spain (Aragall & Montana, 2012). The name of this human-centred methodology is derived from its seven iterative steps:

1. **H**ighlight Design for All opportunities
2. **U**ser identification
3. **M**onitor interaction
4. **B**reakthrough options
5. **L**ay out solutions
6. **E**fficient communication
7. **S**uccess evaluation

HUMBLES is adapted to the following typology of users: CEO, CFO, human resources, marketing, R&D, employees, customers, and consumers. Therefore, it is strongly adapted to the world of small and medium-sized enterprises. For gathering end-user insight, HUMBLES is quite effective on a quantitative level, because it is mainly based on surveys. On the downside, this method of collecting user insights limits the potential for qualitative insights.

The HUMBLES method is mainly focused on shaping the companies' strategies by human diversity and users expectations. The concrete tools to research the end users and to involve them in the design process vary for each business sector and company strategy. The methodology is particularly useful for changing companies' perception of the value of users as knowledge source.

The methodology has proven effective in the following case studies:
• Adopting Design for All at Lékué (tinyurl.com/qynuc8u)
• IDeALL platform (tinyurl.com/o57z9bo)

Figure 2. A visual element from a LUPI presentation pitch

Testing Methodologies in Real-Life Environments

With the aim of testing these methodologies and finding how they may be best suited to different contexts, experiments were carried out in the Rhône-Alpes region of France, Catalonia, Slovakia, Latvia, and Finland. Case studies showing additional applications of the methodologies were also collated on the IDeALL website (usercentredbusiness.com), allowing users to see examples of the methodologies in action, adapted to the requirements of the local context. The range of examples hints at the extent of the potential field of application for such approaches. A few examples, set out below, demonstrate how they can be used to address key social issues such as unemployment and skill mismatches, independent living for an ageing population, and the design of public spaces.

Service design
Service design is becoming an increasingly important sector, and good service design can result in increased customer loyalty. The two Finnish partners involved in the IDeALL project, Laurea University of Applied Sciences and the University of Lapland, are at the forefront of service design in Europe. Lapland's SINCO service-prototyping methodology is particularly useful for delivering mock-ups of services that immerse users in the experience before the service is fully designed. This methodology was used in an IDeALL experiment to explore ways to make a shopping centre more interactive and multisensory (Figure 3); the techniques included interviews, customer observation, surveys, and service prototyping. The shopping centre's manager

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Figure 3. SINCO Living Lab methods in action at the Ragalla shopping centre

commented: "Young people who grow up here can be seen as long-term clients for us. They use certain services now, but if they stay in [the] …area as grown-ups, they can continue to be our clients for a very long time".

Laurea's approach to service design was demonstrated through case studies collected for the project. These case studies provide examples of co-designing services that might be complicated or involve ethical considerations, such as creating home safety devices to support independent living in the Guarantee project (guarantee-itea2.eu) or designing the HeartBug (superecg.com), a kit to self-test heart arrhythmia.

Health and social care

With rising levels of obesity and an ageing population, the health challenges faced by European countries are familiar to many industrialized nations. Technology may lead to the creation of increasingly sophisticated healthcare solutions, but focusing on the user is essential if they are to be genuinely responsive and personalized.

Several experiments were undertaken in the area of healthcare as part of the IDeALL project, and they show how businesses and public bodies can select methodologies to respond to users' healthcare needs. Examples include the development of a smart pill dispenser, supported by IDeALL partner Medic@lps, and innovative orthopaedic supports developed using LUPI methodology in an experiment led by the Cité du design. The HUMBLES method for user-centred business was applied in an experiment involving Lékué, a Catalan company with a strong focus on innovation, which helped them to shift their business aims from "being a market leader in the production of silicon-based products", to "producing utensils which would support people to cook well and follow a healthy diet".

Information and communication technology

Information and communication technology clearly plays a pivotal role in this new co-creative landscape, providing both the paradigms (e.g., open source) and the tools (e.g., user-generated content-sharing networks). IDeALL consortium member Artur Serra (2013) divides living labs in Europe along two main lines: "those who are focused principally on helping companies to connect with user requirements, facilitating processes by which these requirements can be incorporated into the design of products and services" and those that "concentrate on opening innovation systems to the society in general, which we would call citizen laboratories". Although some of the examples cited above fulfil the first category, he classifies his organization, IDeALL-partner Citilab in the second.

Several experiments and case studies selected by the IDeALL project show how new technologies can open new possibilities for all users, as shown in the example of Barcelona Laboratori (barcelonalab.cat), an IDeALL case study that seeks to make the whole city of Barcelona into a living lab. Serra describes Barcelona Laboratori and the different use cases developed by Citilab of Cornella de Llobregat for the IDeALL as a project "to build a second generation of citizen laboratories involving both the current official innovation system (universities, research centres, large businesses) and new, emerging stakeholder, such as entrepreneurs, urban innovation communities, (arduinos, *fablabbers*, social innovators), extending this innovation potential to as many citizens as possible … through schools, cultural centres, retirement homes, not-for-profit organizations and more'". This ethos is exemplified in the IDeALL experiment the iCity project (icityproject.com), which seeks to open up cities' information infrastructure to promote the co-creation of public services in areas such as mobility, environment, security, and health, by developers. This example has used the 3H engagement methodology designed by Citilab, which may be instructive for local governments wishing to introduce smart technology into their area. They can use this approach to ensure that new services are responsive to residents' needs and that big data is used in a way that benefits citizens.

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At the local level, Citilab experiments have been directed towards equipping participants with the skills to adapt to a new digital economy and participate in the Internet of Things. *The Nuevos Artesanos* (New Artisans; nartesanos.citilab.eu) experiment, for example, was developed as a response to people with traditional craft skills finding themselves out of work. Combining programming and electronics workshops with a "do it yourself" ethos, participants were able to put their craft skills to use in the creation of smart items, documenting the process as they went along (Figure 4). Similarly, the *Inventa't la feina* (Invent your own job) experiment sought to find a solution to the situation in Mataró, which has some of the highest youth unemployment levels in Europe, by supporting young people to develop and assess their own business ideas.

In the Rhône-Alpes area, the *Agence Régionale du Développement et de l'Innovation* (ARDI; Regional Development and Innovation Agency) oversaw further experiments opening out technological innovation to a wide range of users. In the Webnapperon 2 (Web Doily 2; webnapperon.com) experiment by ERASME HOST, co-creation workshops (Figure 5) led to the "Web doily", which works with an RFID-equipped doily linked to a photo frame, allowing online content to be shared. It enables older users in particular to keep in touch with family and friends without needing computer skills. In another ARDI experiment, carried out by the *Laboratoire d'InfoRmatique en Image et Systèmes d'information* (Computing in Image and Information Systems Laboratory), users participated in workshops where they could take advantage of software and hardware capabilities offered by Arduino, Lego Mindstorms, and 3D printing to co-create a hub of connected smart items, leading to smart home automation that could improve quality of life.

Urban design

With an ever-increasing proportion of populations living in cities, coupled with changing conditions in industry and the pressures brought about by increasingly scarce resources, the need to create cities that are vibrant and sustainable, and that promote health and wellbeing is a key policy issue for many European nations. Accordingly, several IDeALL experiments have taken place in the urban sphere. In Saint-Étienne, several experiments used the LUPI methodology, where stakeholders such as local businesses were trained to work with users and the best qualified stakeholder was chosen to produce prototypes, such as the *Plot Urbain à Usage Général* (Urban Pillar for General Use) to develop street furniture.

Figure 4. Nuevos Artesanos at work during Citilab workshop session in 2014

Figure 5. Co-creation workshop during Web Doily 2 development

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An experiment in Slovakia, a country where, according to the Slovak Design Centre, the concept of design for all was not well known, showed how users could co-create public spaces based on real needs. The original idea was to come up with designs for street furniture, but this evolved into a more fundamental question: what do people want in public spaces? The Slovak Design Centre involved the following in the project: the City of Bratislava, designers, architects, an art academy, a university of technology, cycling and accessibility associations, a bicycle manufacturer, and a street-furniture manufacturer. Using a range of user-centred methods to gather and prototype ideas in the actual setting (Figure 6), the experiment was widely publicized in the Slovak press. By helping the city council work towards its sustainable transport objectives, the experiment to redesign a street gained their support, while simultaneously introducing a new generation of students to the idea of user-driven, design-led innovation.

Conclusion

Although technological innovation is crucial to remaining competitive in international markets, the results will only be adopted if they are attractive to end users. The IDeALL project has helped to demonstrate the potential of combining methodologies from the design for all and living labs domains in order to achieve innovations accepted by users. It has shown that, through this collaboration, some changes have been recognized.

Design for all has to move from user-centred methodologies to *user-driven* methodologies, as living labs propose. Considering the user as co-designers is a perspective that has been a key element of living labs since the beginning of that movement. In addition, users should be understood from a dual perspective: they are consumers but also citizens. On the other

Figure 6. Street for All experiment organized by the Slovak Design Centre (Photo credit: Jan Mytny)

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hand, living labs should recognize the need to include more professional design methodologies into their communities.

The IDeALL project has demonstrated that there is a wide range of user-centred design methodologies that can be adapted to different contexts and that can help provide solutions for societal issues, such as caring for an ageing population, obesity, and unemployment. Different methodologies will be of interest to different organizations: for example, businesses planning to deliver tailored services may wish to use service-design methodologies such as those used by the University of Lapland and Laurea University of Applied Sciences, whereas local governments may wish to consider methodologies such as LUPI to help co-design public spaces and at the same time support local businesses. Further experiments using these methodologies would help to determine different applications.

One of the most interesting results of the project has been the creation of a Master's course called "Smart Cities: Designing with Citizens" (tinyurl.com/oj25whv). Launched by the Design for All Foundation and BAU School of Design in Barcelona, this course aims to ensure that the smart cities of the future will be co-created with their citizens.

Finally, the project has also helped build a taxonomy of methodologies: a majority of the collated methods implicate the user at a high level at the ideation/conception phases, but gaps remain in the latter phases, such as prototyping.

The IDeALL consortium invites anyone interested in user-driven, design-led innovation to explore the user-centred business portal and provide feedback on how this can be improved to better meet their requirements: www.usercentredbusiness.com

About the Authors

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Artur Serra has been Deputy Director of the i2cat Foundation in Catalonia, Spain, since its creation in 2003. In 2006, he started from i2cat the project Anella Cultural (Cultural Ring), which connects the cultural community from five cities in Barcelona and Catalonia to a future Internet media infrastructure. He is a founding member of the European Network of Living Labs, and he organizes public-private-citizens partnerships fostering open innovation projects in Spain, such as Citilab.eu.

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