Management for Professionals

Tobias Redlich
Manuel Moritz
Jens P. Wulfsberg *Editors*

Co-Creation

Reshaping Business and Society in the Era of Bottom-up Economics

Springer

Management for Professionals

More information about this series at http://www.springer.com/series/10101

Tobias Redlich • Manuel Moritz •
Jens P. Wulfsberg
Editors

Co-Creation

Reshaping Business and Society in the Era of Bottom-up Economics

Springer

Editors
Tobias Redlich
Helmut Schmidt University
Hamburg, Germany

Manuel Moritz
Helmut Schmidt University
Hamburg, Germany

Jens P. Wulfsberg
Helmut Schmidt University
Hamburg, Germany

ISSN 2192-8096 ISSN 2192-810X (electronic)
Management for Professionals
ISBN 978-3-319-97787-4 ISBN 978-3-319-97788-1 (eBook)
https://doi.org/10.1007/978-3-319-97788-1

Library of Congress Control Number: 2018958164

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Testimonials

"A must-read for decision-makers looking to innovate their companies' business models—from ideation to marketing."

—Dr.-Ing. Michaela Colla, *K-GXI Leader—Industry 4.0 at Volkswagen*

"Simply put, co-creation is the future of work. With technology morphing the way we work and young people wanting to tackle problems that matter, co-creation is the sandbox where the world can come together to solve big challenges. Plus, co-creation rapidly delivers products with built-in market fit."

—Megan Brewster, *Vice President of Advanced Manufacturing at Launch Forth*

"Successful leaders will co-create the future. This book is an excellent starting point."

—Jürgen Bilo, *Managing Director co-pace GmbH, The Startup Organisation of Continental AG*

"Richly illustrated with real examples of co-creation as it happens, it challenges traditional in-house R&D."

—Johannes Rath, *CDO (Chief Digital Officer), SIGNAL IDUNA Gruppe, Germany*

"This is a very timely contribution by the leaders in this discipline from Germany. Co- creation is changing the way we live and do business. This book explores how this change happens and what is needed for a successful integration of this change. A must-read by decision-makers, business and engineering graduate school students and researchers."

—Tugrul U. Daim, *Ph.D. and PICMET Fellow Professor and Director of Technology Management Doctoral Program, Editor in Chief, IEEE Transactions on Engineering Management, Department of Engineering and Technology Management at Portland State University*

Preface

In 2016, we initiated a new format called "Interdisciplinary Conference on the Future of Value Creation" as we had identified an increasing need for multiple scientific perspectives on this matter. We were astonished by the insights from experts of very different disciplines ranging from engineering and economics to social sciences and law and immediately felt supported and encouraged that this is the right way to go.

However, one question was left unanswered: how to spread the word not only to the scientific community but also to the practitioners' world and invite decision-makers to discuss our issues? This book is one answer to that question.

We invited distinguished scholars and experts from various disciplines to share their thoughts and give very practical implications on value co-creation as we think that this concept lies at the very heart of recent developments in economy and society as a whole. We would like to thank all authors who contributed to this edited volume.

At the same time, we would like to encourage our readers to join and enrich the discussion on the future of value creation, thus raising it from an interdisciplinary to a transdisciplinary level beyond the scientific domain.

Hamburg, Germany

Tobias Redlich
Manuel Moritz
Jens P. Wulfsberg

Contents

Introduction: Co-creation in the Era of Bottom-Up Economics

Tobias Redlich, Manuel Moritz, and Jens P. Wulfsberg

1 Why Co-creation Matters

We are living through a very exciting time these days both in business and society as a whole. The *Forth Industrial Revolution* is about to transform every aspect of how we live and work at an enormous pace (Schwab, 2017). It also changes the way we produce and consume leading to a disruption of traditional industries and business models. Technology is at the very heart of this development: advancement in production engineering (e.g. 3D printing), materials science (e.g. nanotechnology) and computer engineering (e.g. artificial intelligence) in combination with information and communication technologies that globally connect people and devices enable new products and services and, thus, create new markets (e.g. Schwab, 2017).

Value chains and propositions will be rearranged, and new players enter the scene putting pressure on incumbents. In addition, socio-economic drivers (e.g. ecological footprint, sustainable production, (Post-)Millennials workforce) call for rethinking business as usual. Constantly, rapidly and agilely adapting and innovating, thus, is crucial for companies. The demand side has been changing, too. Raising consumer expectations such as personalization or user experience are fueling competition and consumers, globally interconnected and with ubiquitous access to data and information, are empowered turning from passive recipients of goods and services to highly active and demanding prosumers (e.g. Schwab, 2017).

At the same time, we are witnessing the democratization of value creation: evermore, people from all over the world are able and willing to participate and collaborate in value creation with or without corporate actors in online, offline or social communities and platforms, crowdsourcing initiatives and makerspaces. Basically, anyone who is interested can join and create ideas, solve problems, give

T. Redlich · M. Moritz (✉) · J. P. Wulfsberg
Helmut Schmidt University, Hamburg, Germany
e-mail: tobias.redlich@hsu-hh.de; manuel.moritz@hsu-hh.de; jens.wulfsberg@hsu-hh.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_1

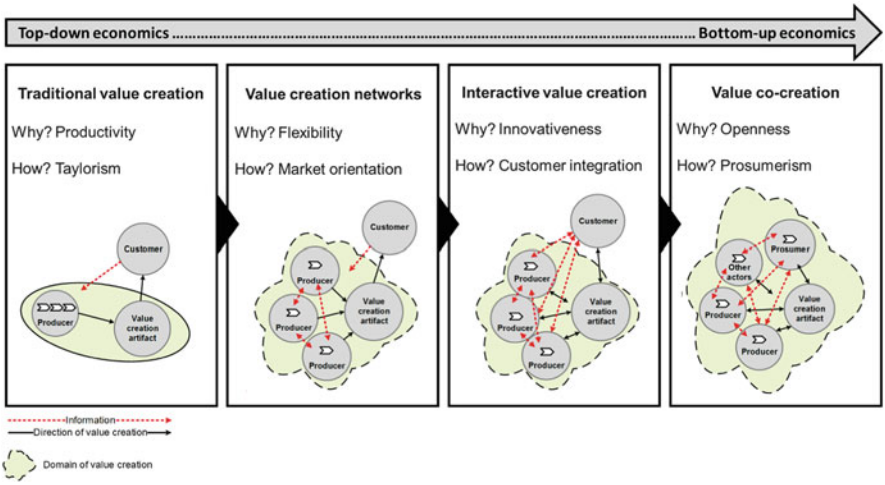


Fig. 1 Development from top-down to bottom-up economics (authors' own illustration)

feedback, provide services, buy/sell or rent/lent things, design products and even produce physical objects with access to cheap and easy-to-use means of digital fabrication (e.g. Rifkin, 2014; von Hippel, 2016).

Traditional producer-centric economic notions and management approaches fall short of providing suitable tools and strategies for companies in this turbulent environment and, thus, have to be reconsidered. Rather, different concepts like sharing economy, peer-2-peer production, open innovation, open production, crowdsourcing, user innovation, co-creation, open source innovation among others have evolved. These can be summed up under the theoretical framework of **bottom-up economics** (see also Fig. 1). It is characterized by a fusion of production and consumption, by open, distributed and networked structures and processes as well as participation and collaboration as the most intensive form of interaction between actors. (Redlich & Moritz, 2016).

2 How to Approach Co-creation

In this setting, the comprehensive notion of **(value) co-creation** represents a promising strategic approach for management and leadership. Originally introduced in the context of marketing by Prahalad and Ramaswamy (2004) and service science by Vargo, Maglio, and Akaka (2008), co-creation has been rapidly disseminating to other fields such as innovation, branding, retailing, production among others within the last 10 years (Leclercq, Hammedi, & Poncin, 2016).

In essence, co-creation can be defined as "joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically" (Galvagno & Dalli, 2014). It can be applied to any stage of traditional value chains from ideation

Fig. 2 Co-creation as comprehensive and interdisciplinary concept (authors' own illustration)

and design to production, sales and aftersales. Depending on the context, one can imagine a variety of forms of co-creation with different actors being involved/integrated (companies, customers, users, prosumers, communities etc.) in many ways (offline/online/both, long-term/onetime etc.). Hence, multiple perspectives are required to address arising issues regarding management approaches, business models, innovation processes and legal aspects among others (see also Fig. 2).

The goal of this book is to offer valuable insights into the world of co-creation of very different contexts and perspectives based on the latest results from interdisciplinary research ranging from social sciences to economics, engineering and law. We provide practical implications and best practices derived from case studies and examples from the corporate sphere and beyond. By doing so, we want to inspire managers and decision makers to rethink business and management practices for viable success in the era of bottom-up economics.

3 What You Need to Know About Co-creation

This edited volume covers three major areas to describe and grasp the concept of co-creation in its many facets. **Part I** focuses on various forms of **collaborative value creation** between different actors beyond or outside the corporate sphere. It elaborates on the theoretical concept of co-creation, but also provides a framework for implementation, e.g. through innovation contests. On the corporate level, innovation networks represent an effective means for collaboration between companies and, thus, should be included. Beyond online collaboration via platforms and communities, we also address

distributive manufacturing and the social side of co-creation via Makerspaces and FabLabs as a global phenomenon and a very promising approach to open production. Anyone is granted access to means of production to transform ideas into prototypes and products. It is the perfect place for co-creation between individuals, start-ups and corporate actors. Lastly, sharing economy and open business models via blockchain can be considered a form of co-creation too as individuals may easily enter the commercial sphere and corporate actors may adapt their business model.

In **part II**, we shed light on **open source ecosystems** as very intense forms of co-creation both in hardware and software. In fact, these are collaborative by nature. Especially in software, communities of self-organized and voluntary users from all over the world had and still have a huge impact on information and communication technologies. We talk about ecosystems rather than communities as corporate actors can be found in this domain, too. With advances in virtual/digital product development and production technologies, we observe a spillover of open source principles to the world of atoms (open hardware). Engineers, designers, students etc. that gather in online communities jointly work on products and projects that might one day put industries under pressure as in the case of software. With this development, new business models evolve that need to build up value propositions beyond secrecy and intellectual property (IP).

Finally, **part III** addresses **legal challenges of co-creation** that emerge by collaborating beyond corporate spheres and by using modern digital (production) technologies such as 3D printing. Organizations that want to make use of co-creation, thus, need to open up and share information with users. This generates a lot of tensions with traditional legal approaches, e.g. in the areas of IP or contract law that call for new strategies.

3.1 Part I: Collaborative Value Creation

Co-creating value with users in online communities is a promising path for idea generation and product development to follow, as *Moritz et al.* show. However, companies have to carefully manage people that they don't employ and, thus, a new management approach to the mutual benefit is required. *Branding et al.* look at open production sites (OPS) as a new and powerful means to corporate innovation by integrating external actors such as startups and tinkerers. *Lowe* argues the case for enabled by new digital means of production and product development that bear enormous potential for innovation, sustainability and democratized as well as local value creation. *Vorbach et al.* describe how co-creation can be applied by companies to generate a unique value proposition. Blockchain is another powerful technology that will have a huge impact on value creation practices and business models, *Tech et al.* claim. They present different concepts of open busines models (OBM) based on smart contracts. The Sharing Economy can also be interpreted as a form of co-creation between companies and users, *Fankhaenel* finds; however, one has to distinguish between different approaches and carefully select the right business model. When it comes to cooperation in innovation networks with different

stakeholders being involved, a new set of management tools and skills is required, *Thoma* argues; he proposes the F.A.I.R. process model for successful cooperation.

3.2 Part II: Open Source Ecosystems

Luthiger had a close look into open source software (OSS) communities with its developers and found that we can learn a lot about employee loyalty. Subsequently, he argues that companies have to provide an interesting work environment with project visions and challenges to find and keep motivated and skilled people within the digital economy. *Schrape* analyzed different open source software communities from an organizational perspective and finds that corporate actors play a major role in these communities. Thus, we can learn about different modes and levels of involvement of companies within the open source ecosystem. The open source movement has also arrived in the world of physical artifacts, also known as open source hardware (OSH). As in software, this phenomenon has a huge potential for collaborative innovation and product design and, thus, disrupts traditional approaches, *Mies et al.* find. *Winter et al.* present a fascinating case study of an open source resonance imaging device that was collaboratively developed by people from all over the world and that might revolutionize medical practice in both, industrialized and developing countries.

3.3 Part III: Legal Challenges of Co-creation

First, *Blanke-Roeser* addresses legal implications of 3D printing for patent law and patents, in general. He states that patenting entities and patent holders might face challenges in this matter and proposes potential solutions. *Beldiman & Fluechter* take an alternative perspective by providing a framework for companies that want to engage in an open hardware environment despite the need to protect innovations with patents. User-generated (and copyrighted) content created and adapted by users on online platforms and social networks like *YouTube* and *Twitter* is another critical issue for traditional business models and value chains in the media industry. *Appl & Homar* provide practical guidance for rightsholders under the current legislation. Last, *Koolhoven* focuses on platforms like we find the many in the sharing economy and elaborates on contractual situations between different parties being involved in the exchange of goods and services. She argues for a positive platform policy instead of overregulation by legislators.

References

Galvagno, M., & Dalli, D. (2014). Theory of value co-creation: A systematic literature review. *Managing Service Quality, 24*(6), 643–683.

Leclercq, T., Hammedi, W., & Poncin, I. (2016). Ten years of value cocreation: An integrative review. *Recherche et Applications en Marketing (English Edition), 31*(3), 26–60.

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing, 18*(3), 5–14.

Redlich, T., & Moritz, M. (2016). Bottom-up economics: Foundations of a theory of distributed and open value creation. In J.-P. Ferdinand et al. (Eds.), *The decentralized and networked future of value creation*. Berlin: Springer.

Rifkin, J. (2014). *The zero marginal cost society: The internet of things, the collaborative commons, and the eclipse of capitalism*. New York: St. Martin's.

Schwab, K. (2017). *The fourth industrial revolution*. New York: Crown Business.

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European Management Journal, 26*(3), 145–152.

von Hippel, E. (2016). *Free innovation*. Cambridge: MIT.

Tobias Redlich is senior staff engineer at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg and head of the working group *value creation systematics*. In his research, he studies bottom-up approaches to value creation such as open production and co-creation.

Manuel Moritz is research assistant at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg and member of the working group *value creation systematics*. His research focus is value co-creation in online communities with or without organizations involved.

Jens P. Wulfsberg is heading the Institute of Production Engineering at Helmut-Schmidt University, Hamburg. His research interests comprise new and interdisciplinary approaches to production engineering.

Part I

Collaborative Value Creation

How to Co-create Value with Users: A Case Study on *Local Motors'* Contest Community

Manuel Moritz and Tobias Redlich

1 The Era of Openness

Industry is facing the era of openness. Enabled by advanced and widely disseminated information and communication technologies value creation is becoming more open and collaborative and is, thus, challenging traditional economic approaches based on appropriation of knowledge and secrecy (e.g. Chesbrough, 2006; Rifkin, 2014; von Hippel, 2005). Hence, we find new patterns of value creation that are based on a certain degree of structural openness to integrate external knowledge and enable collaboration with external actors.

Let's look at the US-based tech company *Local Motors*, a compelling case of co-creation: By applying open source principles to car design and by means of a collaborative internet platform, they brought a new car on the street within two years and at a fraction of cost. Major components of the car (e.g. exterior, chassis) resulted from online collaboration of 2000 people from all over the world committed to car design and engineering. The car was sold then as a kit car with individually designed skins and customers (sometimes people who helped designing it) were invited to assemble the car themselves at one of *Local Motors*' micro factories allocated across the US. Today, the number of users on its platform climbed to more than 30,000 who can participate in different projects ranging from urban mobility to 3D-printed cars.

What we see here is that people from all over the world (customers, students, experts, tinkerers etc.) are willing and capable of co-creating value with a firm by means of online collaboration. This paradigm shift towards openness gave rise to the notion of **bottom-up economics**. It comprises concepts that require at least some degree of openness to allow for the exchange of knowledge beyond the organizational

M. Moritz (✉) · T. Redlich
Helmut Schmidt University, Hamburg, Germany
e-mail: manuel.moritz@hsu-hh.de; tobias.redlich@hsu-hh.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_2

domain and enable collaboration with external actors (e.g. open innovation, open production, co-creation, crowdsourcing, user innovation) (Redlich & Moritz, 2016).

By co-creating value with users along their value chain from marketing to R&D and sales, firms can increase their innovativeness, product quality and efficiency and, thus, outperform closed approaches (e.g. Winsor, 2005). However, users may benefit from interacting and collaborating with firms as well: They participate to be part of industrial value creation, to interact with their favorite brand or firm, to acquire new skills and learn, to have fun, to exchange ideas, to solve problems, but also to signal for jobs and earn money (Füller, 2004; Lakhani & Wolf, 2005).

Generally, two forms of web-based co-creation between firms and users stood out: co-creation with online communities or by means of (crowdsourcing) contests mostly hosted by intermediaries (Lakhani, 2016). These days, however, we also find hybrid forms, namely **contest communities** (Füller et al., 2014). Interestingly, the latter combines the best of both worlds: **competition** in contest settings to spur innovation and **collaboration** to serve social needs of users. Obviously, managing large-scale collaboration with people that are not being paid by a firm requires a different mindset and new management tools.

This part of the book introduces the concept of co-creation and contest communities as a new form of it. In particular, we shed light on the users that we can find in a contest community based on the results of a case study on *Local Motors*. Subsequently, we derive managerial implications and suggestions on how to get started with co-creation.

2 The Basics of Co-creation

2.1 Getting Clear About Co-creation, Open Innovation and Crowdsourcing

The concept of **co-creation** focuses on in-depth, long-term oriented collaboration between firms and external actors, e.g. intrinsically and extrinsically motivated people from all over the world who are committed to certain technologies, products or brands, with skills, experiences and knowledge that enable them to provide valuable input to a firm's value creation. It is about sharing of knowledge and exchanging ideas beyond firms' domains based on the presumption that being open to new ideas from outside enlarges a firm's knowledge base. Co-creation can be interpreted in many ways ranging from customer integration as a weak notion to collaborative product development with users as a strong notion (e.g. Prahalad & Ramaswamy, 2004; Roser et al., 2009).

Like **open innovation**, co-creation promotes inbound and outbound innovation processes that reach beyond firms' borders. However, co-creation is broader in the sense that it may be extended to other value creation activities beyond innovation. It also covers online communities (open source software/hardware, user innovation) where users jointly create value with or without firms being involved. Firm-user

interaction plays a significant role in co-creation while open innovation has a strong focus on B2B collaboration.

Crowdsourcing is another term that we hear a lot about these days. It can be understood as a weak form or a means of co-creation, namely "company-to-one co-creation" (Tekic & Willoughby, 2016). The goal is to tap new sources of knowledge from a heterogenous group of so-called "solvers" who anonymously and with little interaction submit solutions to a task or problem posted by the "seeking" firm in a contest setting (Howe, 2006). In most cases, neutral intermediary web platforms host and manage these (innovation, design, idea) contests and take care of the communication and transaction process between "seekers" and "solvers" (e.g. *InnoCentive*, *NineSigma*, *OpenIDEO*). Usually the best idea is awarded with a monetary prize. Crowdsourcing offers great potentials to gather many unconventional solutions in a short period of time at relatively low cost (Boudreau & Lakhani, 2013). Collaboration and communication between seeker and solver and among solvers, however, are very poor. From a firm's perspective, the goal is to solve an urgent problem and not to build up a relationship with the solvers. Thus, it is a rather short-term oriented co-creation approach.

Example

Netflix wanted to improve its collaborative filtering algorithm and offered 1 million dollars for the best solution from the crowd that would beat the firm's solution. More than 2000 teams submitted solutions with the best one exceeding *Netflix*' algorithm by 10%.

"Company-to-many co-creation" (Tekic & Willoughby, 2016) represents a more intense form of co-creation where organizations continuously interact with an online community of people that share a common interest in a product, brand or technology (e.g. *Lego*, *Linux*, *Dell*). In this case, the community is a valuable resource for a firm and users strongly influence the innovative output through idea generation, testing and feedback (Jeppesen & Frederiksen, 2006). Contrary to the principal-agent-relationship in crowdsourcing, the firm-user relationship is rather long-term oriented and based on cooperation of equal partners. Value is being co-created in the true sense of the word. In addition, these communities are more like social networks where users spend their free time to talk to each other, discuss ideas, share knowledge.

Example

More than 100,000 users gather on *Lego*'s Ideas platform. Anyone may suggest new ideas for *Lego* sets and, if an idea finds the support of more than 10,000 users, *Lego* will review and possibly market the product. In this case, the initial idea creator receives 1% of the revenues generated.

The lines between these concepts are blurry. Figure 1 highlights the differences between the concepts. Open innovation focuses on firms' R&D strategy that should be re-organized, crowdsourcing contests may help organizations to find solutions to

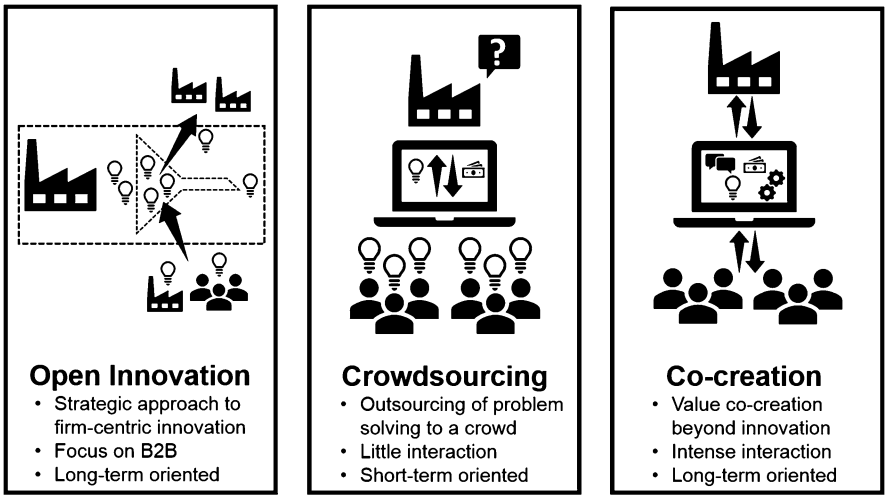


Fig. 1 Differentiation between concepts of the open paradigm (authors' own illustration)

a specific problem. Co-creation represents a more holistic concept that considers a firm as part of a value creation network. Beyond firm perspective, it also covers collaborative value creation in online communities without corporate involvement (e.g. *Wikipedia*, *Linux*).

2.2 Merging Contests and Communities

We focus on co-creation between firms and communities and, in particular, we are looking at so-called **contest communities** (Fig. 2). That means recurring and time-bound idea contests (similar to crowdsourcing) that are held within an existing community as this is a very promising direction to make use of both mechanisms: competition and collaboration (Bullinger et al., 2010; Hutter et al., 2011). It should be noted here that these contests can be sponsored by a firm different from the one hosting the community.

From a firm's perspective, it was shown that engaging with users via contests can be a powerful tool to improve innovativeness and lead to superior outcomes compared to traditional means. However, proper design of a contest (compelling task, duration, task specificity, prizes, attraction, facilitation, evaluation) is required to exploit its full potential (Adamczyk, Bullinger, & Möslein, 2012). Communication, motivation and trust were found to be very important success factors that call for careful attention (Ebner, Leimeister, & Krcmar, 2009).

From the participating users' perspective, we know that people participate in online communities and contests for many reasons, both intrinsically (e.g. curiosity, social interaction, learning) and extrinsically motivated (e.g. money, recognition,

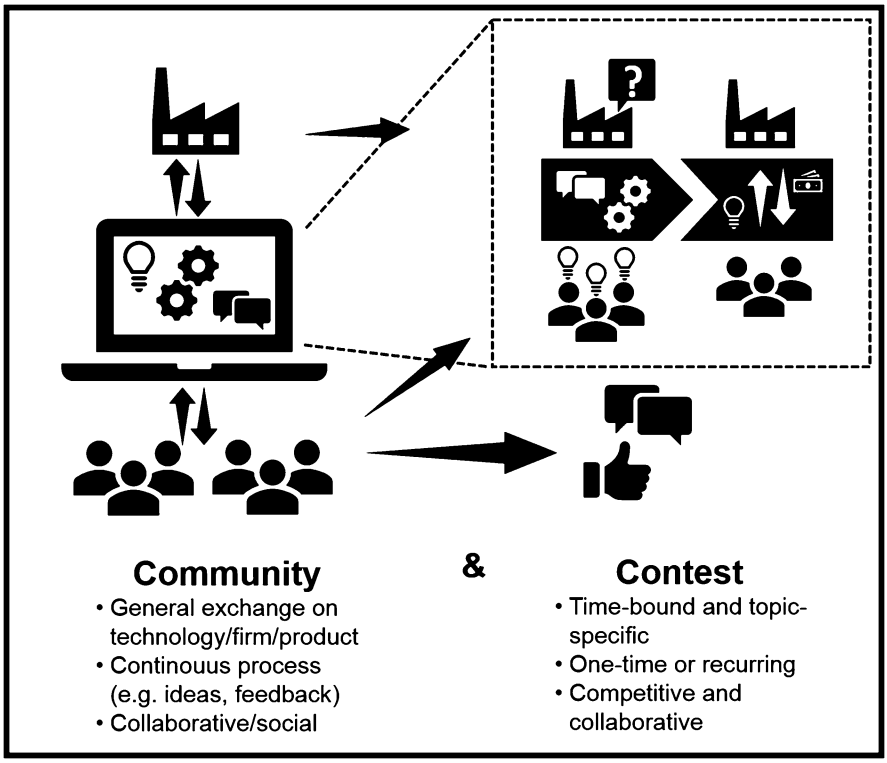


Fig. 2 Exemplary setting of a contest community (authors' own illustration)

reputation, job signaling) (Brabham, 2010; Franke & Shah, 2003; Füller, 2006). Thus, reward and compensation mechanisms need to be adapted accordingly depending on the goal and the scope of the contest and/or purpose of a community. Having a compelling co-creation platform is another crucial factor when it comes to user attractiveness.

Collaborative behavior in online communities (free revealing of ideas, sharing knowledge, commenting on other ideas) is very common (e.g. *Linux*, *RepRap*, *Threadless*) and can be found even in competitive environments like a contest (Bullinger et al., 2010; Hutter et al., 2011). However, within pure crowdsourcing contests where submissions will not be publicly revealed, but privately transferred to the sponsoring principal, collaboration between users is merely possible.

Innovation contest communities that combine both competitive and collaborative elements represent a new and promising contest mode with respect to attraction, motivation and outcome. Little research focusing on this specific configuration and the users that we find in these communities has been conducted so far. Hence, we present new insights from a case study to learn more about users that spend their time in contest communities.

3 Case Study: *Local Motors* and Its Community

3.1 Case Setting

Since its foundation in 2007, *Local Motors* has managed to build up a co-creation community of more than 30,000 enthusiasts from all over the world who collaborate along open source principles (sharing, collaboration) and by means of web-based toolkits.

Besides co-creating with users for their own product portfolio ranging from cars to motorcycles, *Local Motors* (these days also known as *Launch Forth*) hosts and manages contests (so-called "challenges") in partnership or sponsorship with other firms that want to make use of co-creation by tapping the creative potential of *Local Motors'* community (e.g. *Domino*'s Pizza Ultimate Delivery Vehicle, *DARPA* XC2V, Berlin Urban Mobility Challenge, *BMW* Urban Driving Experience). In this case, *Local Motors* acts as intermediary between the "seeker" who specifies the task and sets the challenge conditions (IP regime, prize, evaluation) and the "solvers" from their community similar to crowdsourcing contests. Contrary to pure crowdsourcing, however, *Local Motors* fosters collaboration between users as submissions will be fully disclosed at the very moment of submission and any registered user may add comments to submissions. Furthermore, community managers and representatives of the sponsoring firm give feedback and suggestions for improvement while the challenge is active.

This is a very promising configuration: Prizes attract people to participate and foster competition on the one hand. Collaboration between users, on the other hand, facilitates an enjoyable environment and a positive community culture where people inspire each other and exchange ideas which in the end increases the quality of the entries.

In 2016, *Local Motors* hosted the ***Airbus Cargo Drone Challenge*** on its platform in partnership with *Airbus Group*. The goal was to find new design concepts for a commercial drone that is able to quickly deliver urgent medical supplies. Specific requirements regarding design, size, weight, payload etc. had to be met. All relevant information of an entry was posted on a publicly accessible project page where other users could add comments. Nine Prizes in three categories ($117,500 in total) were awarded: The main prize (voted by *Airbus* executives), a Cargo prize (voted by industry experts), and a Community prize (voted by the users). Four hundred twenty-five entries were uploaded within 6 weeks and publicly revealed on the *Local Motors* platform.

The case of *Local Motors* is very interesting to demonstrate how different forms of co-creation can be applied. It also provides proof of concept for collaborative product development of high-tech products such as drones. It differs from other user communities (e.g. brand or consumer communities) as tech enthusiasts and subject matter experts (engineers, designers, entrepreneurs) gather in the community rather than customers. It is similar to an open source community where people jointly design and engineer products. In fact, many of the projects on the platform were initiated by users. Even if *Local Motors* hosts competitive contests, it still represents

a very collaborative environment as all posts and project related entries are publicly visible to encourage knowledge sharing and idea exchange.

In the following, we focus on the participants of the *Airbus Cargo Drone Challenge* and present results from research based on a survey, a social network and a content analysis based on the communicating behavior of users. We wanted to find out more about the users. Who are they? Why and how did they participate? What is important to them? If we find answers to these questions, we may derive adequate implications and strategies for firms who would like to tap into the world of co-creation.

3.2 Participants' Backgrounds

In this particular challenge, most of the users that submitted an entry were male and between 18 and 39 years old. People from more than 25 countries participated with Germany (20%) and USA (14%) in lead. About half of the participants were new to the *Local Motors* community. Regarding their profession, engineers and designers represented the majority, followed by tinkerers, entrepreneurs and students. These results are backed by an astonishingly high level of education: three out of four users at least held a bachelor's degree. Most participants pursued a regular job. In fact, nearly half worked full-time with 40 hours or more. Students and freelancers added up to one third.

These numbers show that we find many well-educated professionals in the community who besides a regular job seem to spend free time to participate in this challenge. For freelancers, the challenge offers good opportunities to expose their work and capabilities and, thus, to acquire customers. Students might participate to learn, to get in touch with a potential employer or to earn money.

The creative potential of the community for a seeking firm is huge: About 400 participating users with a broad diversity regarding skills, experience and origin spending many hours (sometimes more than 200 hours of work) on their entries as well as non-participating users who comment and give feedback. It is clear, though, that collaboration among such a heterogenous group of people calls for thorough community management and, thus, a new management approach that differs greatly from managing traditional inhouse R&D.

3.3 Motivation

The diversity of backgrounds and insights from literature encourage the assumption to find a mixture of extrinsic and intrinsic motivations. Asking users what drove them to participate confirmed this: we found intrinsic factors like solving problems, learning and fun prevailing over extrinsic elements like earning money, job signaling or competing with others which is interesting having in mind the "winner-takes-all"-setting of the challenge.

This mixture of driving forces supports the concept of a hybrid community where competition and collaboration co-exist. But again, we are facing problems getting community and contest management right. How do you make sure you serve all these needs that sometimes seem contradicting? On the one hand, you want to encourage people to release their work early, to give feedback to other entries and help each other to increase the overall quality of the entries. On the other hand, prizes are awarded to a few winners only which would hamper collaboration at first glance.

3.4 User Behavior

Turning our focus now on the users' behavior during the challenge, we again find both collaborative and competitive elements. Two out of three users stated that they commented on other entries to either give feedback, provide suggestions for improvement or for their own inspiration. A content analysis of all comments left on entries (ca. 4000) confirmed this picture: We found people offering help, giving feedback and supporting others on a large scale. Regarding the initial submission (=disclosure) of entries, the situation is a bit different: one out of three users released her work in an early stage of the contest. Another third submitted rather late within the last 2 weeks before submission closing leaving the final third to upload at the very end of the submission phase.

It is very interesting to see that people collaborate even though only a few users can win one of the prizes. Even more strikingly, users lower their own chance of winning by helping others to improve their submission. It seems that social interaction within the community weighs more than the contest results.

3.5 Critical Issues

With more than 400 entries to choose from, the challenge was a tremendous success for both *Local Motors* and *Airbus*. Most of the users were also satisfied with the process (80% would get involved in other activities on the platform). However, some minor issues occurred that participants didn't like. Some claimed that the evaluation process was not transparent enough and that some of the initial requirements were not taken into account. Others did not trust the community management and felt exploited by *Airbus*. These are just a few individual opinions which one would find in any other competition as well. Still, we can learn that transparency and appreciation of users' efforts are very important. These issues may potentially harm the relationship to a community and are, thus, critical to the success of long-term value co-creation.

4 How to Get Started and What to Consider

We learned that a firm may improve its innovativeness by opening up and that tapping into the world of co-creation at different levels is possible. *Local Motors* represents an innovative tech firm where a community of tech enthusiasts is deeply integrated into idea generation and product development. The latest ideas that were collaboratively designed are a 3D printed car and a self-driving electric minibus. *Airbus*, on the other side, wanted to get in touch with co-creation and, thus, teamed up with *Local Motors* for the *Airbus Cargo Drone Challenge*. Within a very short time and with comparably low financial investment they received more than 400 design concepts of great heterogeneity to choose from and to integrate into its corporate R&D.

A time-bound contest setting with monetary incentives helps to gather many people in a short period of time and to spur innovation between users. The embeddedness in a collaborative community serves social needs of users like communication with like-minded peers and, thus, creates a positive environment with prospect of continuous engagement of users.

Our research results showed that users have very diverse personal backgrounds and experiences and subsequently a mixed set of motivations. While intrinsic factors like fun and problem solving play a significant role, we should not disregard extrinsic factors like money and job signaling. The users' behavior during the challenge supported this picture. While many users were heavily engaged in commenting and released their work early for feedback, others waited until submission closing to not disclose their ideas.

These insights tell us that we need to provide different incentives and functionalities. Prize money for the winning designs on the one hand, and feedback features and community functionalities on the other. This specific configuration, though, is not generalizable as every contest and community is different. Depending on the task, the firm's goal and the target audience a different set-up is required.

Firms that want to get in touch with co-creation should consider different approaches to start with, e.g. an idea contest within an existing community might be a good starting point as the risk of failure is comparably low. Still, it is important to take it seriously and regard the community as valuable resource. Professional feedback by and interaction with internal R&D staff during and after a contest is just as important as top management involvement and support. People are only willing to spend their time and share their knowledge if they feel welcomed and appreciated. They want to know what happens to their ideas afterwards and want to be treated as equal partners.

Building up a new community as an intense form of co-creation requires a lot of effort and a very open and collaborative mindset which very often challenges corporate culture. Thus, a cultural shift from "not invented here" to "proudly found elsewhere" (Huston & Sakkab, 2006) is necessary to fully exploit the potential of co-creation. As Joy's law says: "No matter who you are, most of the smartest people work for someone else" (Lakhani & Panetta, 2007). The focus shifts from finding the right employee to solve a R&D related task to managing and orchestrating

collaboration and innovative activities among different actors inside and outside a firm. Obviously, that calls for new management approaches and incentive regimes in R&D that contradict established approaches. Firms that already have supporters who gather e.g. in a brand community might consider hosting contests in that community in order to focus the effort of the users and to turn attention on a specific task.

Besides improving its innovativeness, opening up provides even more advantages for a firm: For example, users may become customers or at least positively influence a firm's reputation by word-of-mouth recommendation. Furthermore, engaging with users may help to identify potential employees with specific skills and experiences and improve the employer branding towards an innovative and modern firm. Finally, a compelling challenge can help to grab attention and result in broad media coverage.

We should also keep in mind that co-creation bears risks. First, firms need a compelling challenge that encourages many people to participate. Task specificity is important, too. It mustn't be too narrow to exclude new and unconventional approaches, but also not too broad which complicates evaluation and selection. If many people show up and submit ideas, the next step is to find the best solution(s). Handling people that a firm does not employ isn't easy either. If people feel exploited, they will leave and tell others about it. Especially, if they get the feeling that they are considered cheap workforce. This may harm the hosting firm's reputation. Trust building, hence, is crucial, especially at an early stage. People will only share their knowledge, if they get something in return (e.g. money, reputation, knowledge). Transparency of processes is another critical issue: if the evaluation process is not transparent and comprehensible, users might feel unfairly treated. We also need to take into account that not all users are perfect collaborators and innovators. Some users are loud and cause a lot of noise which requires careful community management. Managing communication with a large group of people is not easy and making anyone happy is not possible.

To sum up, getting right the mix of co-creation requires effort, resources and experience, but if a firm gets it right, the potential is huge and may help to improve its competitive advantage with new and better products.

5 Open Up or Close Down

We learned about the concept of co-creation and different approaches to apply it. While co-creating value with communities or by means of contests offers a good starting point, firms may also want to consider a new form of co-creation, namely contest communities.

The case study of *Local Motors*' contest community and the *Airbus Cargo Drone Challenge* has shown how web-based co-creation can be a powerful tool to enhance a firm's innovation portfolio. Hundreds of users from all over the world with diverse backgrounds and experiences from engineering and design joined in to submit their ideas and, with a bit of luck, see them come true. Within 6 weeks, more than 400 valid design concepts of great variety were submitted which would not have been possible by inhouse R&D. Interestingly, users not only competed, but also collaborated which

improved the overall quality of entries and contributed to a lively community. Hence, this configuration represents a promising way towards a long-term oriented and viable co-creation relationship.

It is very likely that new information and communication technologies and a growing number of people with internet access will spur virtual collaboration in the future. Open source software development in communities is a prominent example of virtual collaboration and has been demonstrating how online collaboration of volunteers can lead to superior products and, thus, put pressure on established IT firms based on proprietary approaches (Weber, 2004). The same is true for *Wikipedia* which lead to the erosion of traditional business models (Redlich et al., 2015). As "atoms are the new bits" (Anderson, 2010) the question is not "if", but rather "when" industrial value creation will be democratized as well. Firms that open up, share knowledge and learn how to effectively and efficiently manage collaborative value creation to the mutual benefit of users and the firm, thus, will very likely thrive in the long run.

References

Adamczyk, S., Bullinger, A. C., & Möslein, K. M. (2012). Innovation contests: A review, classification and outlook. *Creativity and Innovation Management, 21*(4), 335–360.

Anderson, C. (2010). In the next industrial revolution, atoms are the new bits. *Wired Magazine, 1*, 25.

Boudreau, K. J., & Lakhani, K. R. (2013). Using the crowd as an innovation partner. *Harvard Business Review, April*, 61–69.

Brabham, D. C. (2010). *Moving the crowd at threatless: Motivations for participation in a crowdsourcing application*. In Annual Meeting of the Association for Eduction in Journalism and Mass Communication, Boston.

Bullinger, A. C., Neyer, A. K., Rass, M., & Moeslein, K. M. (2010). Community-based innovation contests: Where competition meets cooperation. *Creativity and Innovation Management, 19*, 290–303.

Chesbrough, H. (2006). *Open innovation. The new imperative for creating and profiting from technology*. Boston: Harvard Business School Publishing.

Ebner, W., Leimeister, J. M., & Krcmar, H. (2009). Community engineering for innovations: The ideas competition as a method to nurture a virtual community for innovations. *R&D Management, 39*, 342–356.

Franke, N., & Shah, S. (2003). How communities support innovative activities: An exploration of assitance and sharing among end-users. *Research Policy, 32*, 157–178.

Füller, J. (2004). Refining virtual co-creation from a consumer perspective. *California Management Review, 52*(2), 98–122.

Füller, J. (2006). Why consumers engage in virtual new product development initiated by producers. In *Advances in Consumer Research* (Vol. 33, pp. 639–646).

Füller, J., Hutter, K., Hautz, J., & Matzler, K. (2014). User roles and contributions in innovation-contest communities. *Journal of Management Information Systems, 31*(1), 273–308.

Huston, L., & Sakkab, N. (2006). P&G's new innovation model. *Harvard Business Review* https://hbswk.hbs.edu/archive/pg-s-new-innovation-model.

Hutter, K., Hautz, J., Füller, J., Mueller, J., & Matzler, K. (2011). Communitition: The tension between competition and collaboration in communitybased design contests. *Creativity and Innovation Management, 20*, 13–21.

Howe, J. (2006). The rise of crowdsourcing. *Wired magazine, 14*(6), 1–4.

Jeppesen, L. B., & Frederiksen, L. (2006). Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments. *Organization Science, 17* (1), 45–63.

Lakhani, K. R. (2016). Managing communities and contests to innovate with crowds. In *Revolutionizing innovation: Users, communities, and open innovation* (p. 109).

Lakhani, K. R., & Panetta, J. A. (2007). The principles of distributed innovation. *Innovations, 2*(3), 97–112.

Lakhani, K. R., & Wolf, R. G. (2005). Why hackers do what they do: Understanding Motivation and Effort in Free/Open Source Software Projects. In J. Feller, B. FitzGerald, S. Hissam, & K. R. Lakhani (Eds.), *Perspectives on Free and Open Source Software*. Cambridge: MIT Press.

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practise in value creation. *Journal of Interactive Marketing, 18*(3), 5–14.

Redlich, T., & Moritz, M. (2016). Bottom-up economics: Foundations of a theory of distributed and open value creation. In J.-P. Ferdinand et al. (Eds.), *The decentralized and networked future of value creation*. Berlin: Springer.

Redlich, T., Moritz, M., Krenz, P., Buxbaum-Conradi, S., Basmer-Birkenfeld, S. V., & Wulfsberg, J. P. (2015). Survival through openness-how traditional industry could avoid the fate of print media. *Journal of Systemics, Cybernetics and Informatics, 13*(1), 17–24.

Rifkin, J. (2014). *The zero marginal cost society: The internet of things, the collaborative commons, and the eclipse of capitalism*. New York: St. Martin's.

Roser, T., Samson, A., Humphreys, P., & Cruz-Valdivieso, E. (2009). *Co-Creation: New pathways to value – An overview*. London: LSE Enterprise.

Tekic, A., Willoughby, K. (2016). *Co-Creation and open innovation: Related but distinct concepts in innovation management*. In Proceedings R&D Management Conference.

von Hippel, E. (2005). *Democratizing innovation*. Cambridge: MIT.

Weber, S. (2004). *The success of open source*. Cambridge: Harvard University Press.

Winsor, J. (2005). *SPARK: Be more innovative through co-creation*. New York: Kaplan Business.

Manuel Moritz is research assistant at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg and member of the working group *value creation systematics*. His research focus is value co-creation in online communities with or without organizations involved.

Tobias Redlich is senior staff engineer at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg and head of the working group *value creation systematics*. In his research, he studies bottom-up approaches to value creation such as open production and co-creation.

Using Open Production Sites for Supporting New Ways of Corporate Innovation

Jan-Hauke Branding, Sissy-Ve Basmer-Birkenfeld, and Tobias Redlich

1 Changing Realities? Openness, Innovation and Value Creation Practices

As of today, one can observe that the ongoing digitalization results in new patterns of production and value creation: there is a shift from traditional firm-centric, more or less top-down value creation practices towards more and more open, collaboration-based and often bottom-up practices. Based on this observation, there is an ongoing discussion about firm boundaries dissolving step-by-step (Anderson, 2012; Chesbrough, 2006; Moritz et al., 2016; Winsor, 2010). However, most companies still focus on traditional internal, closed and protected ways of innovating, which, considering their interests (e.g. profits and protection of their inventions), is reasonable.

But this undeniable and ongoing change is also going to influence the way companies are going to look at *producing, creating and making things or artefacts*. Redlich, for example, argues that the recent development will lead to what he calls *open production* (Redlich, 2011) and is going to challenge not only companies' views on production but is going to change society's view as well. More and more (local) actors participate in technology development, the creation of technologies and products in an independent, collaborative and bottom-up way. Within public discourse this development trades under various names, like co-creation, peer production, open innovation, commons-based economy or open source ecosystems[1] and these—sometimes just small-scale—innovative activities do not only cut across different sectors from agriculture to energy, health and education but its canon of

[1] Although they label different things, especially within scientific literature, they are used nearly interchangeably in public discourse.

J.-H. Branding (✉) · S.-V. Basmer-Birkenfeld · T. Redlich
Helmut Schmidt University, Hamburg, Germany
e-mail: brandinj@hsu-hh.de; basmers@hsu-hh.de; tobias.redlich@hsu-hh.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_3

values—openness,[2] a culture of sharing (of ideas and products) and a pinch of self-government—also differs very much from the common perspective on producing goods and creating value. Many researchers have described this very development in the last few years (e.g. Benkler, 2006; Chesbrough, 2006; Powell, 2012; Von Hippel, 2005) and also emphasized the benefits companies may get from the very different ways of opening up: customer integration generally leads to more feedback and, thus, to more sustainable and demand-oriented production resulting in reduced storage costs and better products. Open production and open innovation methods offer a wide range of opportunities for companies by not only giving external actors the possibility to be integrated into innovation and production, but by also providing employees with opportunities to try out ideas more independently (even together with externals).[3]

Within digitalized society and markets, future success of companies will be determined more and more by organizing (access to) knowledge and information, as both are the dominating factors for innovation practices. Interestingly, opening up and collaborating with others is one way of organizing such access. But whereas open innovation based for example on *crowdsourcing* represents a common tool of managers to improve innovation efforts nowadays (Redlich & Moritz, 2016), a widespread familiarity of open innovation *and* production based on the collaboration in and with *open production sites* (OPS) is still lacking. All in all, the impact of openness in the field of production is still very under-researched (Hamalainen & Karjalainen, 2017). OPS are one of the newer parts of this overall development and close collaboration with them to foster innovation *and* production practices represents a very special way of interactive value creation. Therefore, this article discusses the compatibility between traditional innovation practices and those new and more open ways of innovating and producing—using the examples of companies that have taken steps into exploring this exact compatibility.

2 Open Production Sites: Challenges Versus Opportunities

The concept of OPS is a fairly new one and is very likely going to play a key role in changing common ways not only of thinking and innovating, but also the way of *producing*, *creating* and *making*—by combining modern digital technologies (like 3D-printing) and the concept of openness (for example but not exclusively by reverting to open source software and open source hardware). OPS are places where production is an open process—therefore: *open production*—, producing physical goods on the basis of openness, collaboration and the possibilities

[2]The *principle of openness* is characterized by the idea of free and unrestricted access to knowledge and information, as well as transparent and collaborative/cooperative processes of decision-making (Peters, 2014).

[3]Even licensing of products that were dropped from a company's portfolio to another company to capture its value is, by some, seen as a part of open innovation (Gassmann & Enkel, 2006).

digitalized production offers (e.g. rapid manufacturing) (Redlich & Bruhns, 2008).[4] The open production community has, like many communities that are guided by the principles of openness, its roots in the open source software movement (OSSM) dating back to 1980s. Some of the movement's projects have made a name for themselves and are used by many people daily: e.g. Android, Linux, Mozilla or LaTex are all open source programs that shape at least parts of our everyday lives (and have developed into a billion-dollar market).

In the beginning, however, the OSSM was mostly about hacking[5] and establishing or fighting for digital liberties and rights, like improving software quality, keeping source codes open and being allowed to modify them and thereby fighting vendor lock-in. Although the idea to transfer those ideas to hardware might be guided by the same ideology, subjecting hardware to the principle of openness is a whole other story, as a physical artefact is not restricted to the digital realm and one needs more skills and knowledge to 'hack' such an artefact. Open source communities, however, both feature a *Do-it-Yourself* attitude and lifestyle and are mostly cultivated by tinkerers. Still, the open source hardware movement is comparatively young, but already fanning out into different sub communities and spaces, like maker and hacker spaces, FabLabs and other workshops offering unrestricted and sometimes even free access to (digital) *means of production*—so to some extend industry would be well advised to interact with the openness movement and, thereby, benefit from its expertise and services.

In all those attempts, the concept of openness, or better the degree of openness, is ever-present: the movement is basically split into initiatives really focussing on openness, meaning that everything from the first sketch to the prototype must be open for everyone's use and into others that (at least partially) want to restrict access and utilization. After all, what they have in common is that complete closeness or secrecy is not well-deemed in the whole movement. One must keep this in mind, if one wants to draw on the expertise and work ethic this movement has. Which is also why most of the challenges and opportunities revolve around (the degree of) openness. Given all that, we may now ask what OPS are and how they help improve common innovation practices.

2.1 Open Production Sites

Overall, the development described above is reflected by a worldwide emergence of interconnected OPS. The idea of such sites goes back to 2001 when a project of Neil Gershenfeld's team in the *Center for Bits and Atoms* at *Massachusetts Institute of Technology* (MIT) was seeking to analyze the connection between the contents of

[4]The term open in this article is used in the sense of free/unrestricted access (to the sites) not in the sense of cost-free.

[5]The term hacking is still connoted negatively, but we are referring to it as in the Jargon File (Raymond, 2015). There, hacking is part of an ethical code that fosters openness.

information and possible ways of its representation (Gershenfeld, 2005). The idea they called fabrication laboratory (FabLab) spread, resulting in a social and global movement with more than 2000 labs as of today. FabLabs are characterized as community-operated, self-organized and open manufacturing spaces that deliver easy access to robust and easy-to-handle means of production. They usually provide access to at least one 3D-Printer, a vinyl- and lasercutter as well as a CNC-mill (Gershenfeld, 2005; Walter-Hermann & Büching, 2014) and promote their use by holding regular workshops and advanced education in technical fields. They are unrestricted open spaces that provide a common place for encountering, learning, experimenting, joint creativity and value co-creation activities—*where anyone can learn* "how to make almost anything" (Gershenfeld, 2012).[6]

However, FabLabs mainly focus on tinkerers, students and individuals and their specific set of tools and machines—from a perspective of empowerment through education and joint creativity as well as promoting the idea worldwide. So, OPS are not necessarily part of the FabLab community (which is still one form of an OPS). There are *various levels of openness and autonomy* of workshops where people can access tools, means of (digital) production, knowledge/information and get in contact with other users and most FabLabs and other maker/hacker spaces lean towards full openness. Apart from that there are also OPS that are founded or funded by companies, are integrated into company infrastructures, in close collaboration with them or a part of industry or research clusters. Such integration or collaboration often results in a more profit and business-oriented approach as well as a focus on providing start-ups with technical infrastructure, promote B2B collaboration or grant company engineers and R&D access to means of digital production (for R&D purposes)—so tending more but not totally towards closeness (see also Fig. 1).

But one must keep in mind that the difference between OPS being integrated or being independent of companies is rather a gradual one and the asserted gap between openness or open innovation methods and business interests can be bridged. The interesting thing with OPS is that their focus *lies on (producing) hardware,* meaning on producing actual prototypes or even products; OPS are *open* places where *ideas are transformed into physical artefacts* (by individuals themselves or in collaboration with others, with business interest or without) (Baier et al., 2016). Recent studies (e.g. Osunyomi et al., 2016) also emphasize the fact that OPS do have a significant impact on the factors that promote innovation and inventiveness, e.g. by encouraging the development of vital small-scale activities and entrepreneurship.

The ongoing technological progress is not only going to influence existing markets and industries, but it will probably lead to an establishment of more and more OPS. However, this is not the only reason one should pay close attention: the number of people that are open and want to collaborate in OPS and be part of innovation practices is steadily growing. Suddenly, all fields dealing with physical

[6]Nevertheless, there are many FabLabs that do charge their users or take membership fees—so they are free regarding access but still not very costly. Also, to prevent misconception, they do not necessarily use open source technology.

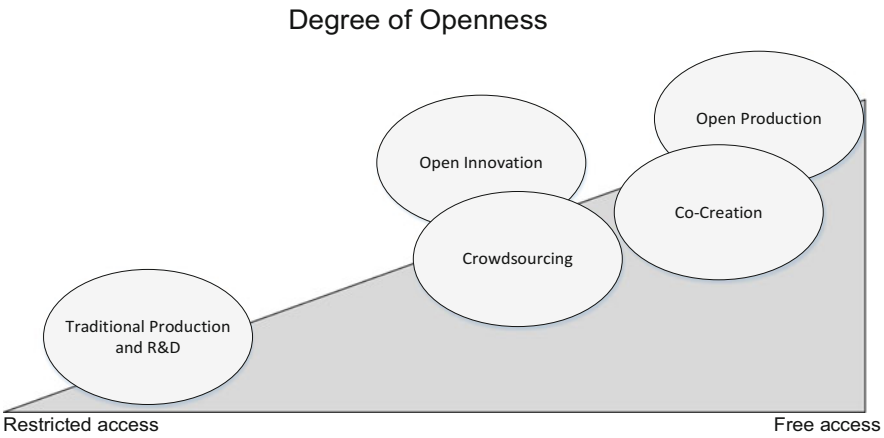


Fig. 1 Degree of openness of different management tools (authors' own illustration)

artefacts (e.g. product design, mechanical engineering, electronical engineering, sustainability studies, architecture, arts etc.) may have a huge number of people that they might draw to when it comes to using technology, designing new ones, figuring out needs, solving R&D problems etc.—just because OPS (potentially) provide a huge number of people with the means to acquire a certain technological literacy. This is also the main reason why companies (should) have an interest in such places—not necessarily for profit reasons only but also for reasons of diversification and small and fast production schemes.

Still, adopting the principle of openness inside the realm of the hegemonic traditional production and innovation practices is *no walk in the park*. From an organizational point of view a major contradiction has to be overcome: the need of keeping innovative knowledge and products to a company in order to adequately capture their value (usually done via copyrights and patents) and opening up to new ideas, designs, ways of thinking and producing: if a company wants to integrate the principle of openness—especially when done *via* an OPS—it has to collaborate with others, external third parties or even competitors. Sharing and transparency are usually seen as diametrically opposed to what is perceived as common innovating practices, but future innovations will be increasingly based on the give and take principle—meaning that profits may have to be shared *pro rata* as well. Chesbrough's famous quote: "Most innovations fail. And companies that don't innovate die" (Chesbrough, 2006, p. xvii) is emphasizing the necessity to be innovative, however, pros and cons, risks and benefits, challenges and opportunities still have to be weighed.

2.2 Challenges

The main challenge for most of the already existing OPS that are *not* integrated into company structures is creating viable business models. Competing on the market is not a reasonable business model but commercializing or licensing individual/individualized products just as taking membership or workshop fees could be one way of solving financial problems. However, the focus of smaller OPS, like FabLabs for example is not so much to produce artefacts for a market but rather to make means of production accessible for everyone. But what is true for all OPS is that at the contemporary stage of the respective technologies (additive and/or rapid prototyping/manufacturing, stereolithography) and machines (e.g. 3D-printers, CNC-mills, laser cutters, carbon printers) production cost per unit numbers are quite high and, thus, especially hard to stem for small initiatives with little capital. In addition to that the quality of the products or other issues with standardization and norms are also a big challenge (Buxbaum-Conradi et al., 2018).

One might argue that the concept of openness in general or open innovation and open production, in particular, might be in the way of overcoming those challenges and that it would take away the company's profits. But it is not openness that is a hindering factor, in fact it is rather a general scepticism in society in combination with a lack of funding (Buxbaum-Conradi et al., 2016; Grün, 2011). Companies integrating or collaborating with OPS are also dealing with questions of involvement and autonomy: the degree of openness is the key factor managers should keep in mind. For one thing, one wants the input to ignite new innovations and, eventually, new products and for another, one wants to keep company knowledge to the company. Furthermore, the image of being an innovative company is a promotional factor (both as brand awareness and employer branding) that should not be underestimated. Companies that want or must be seen as innovative and future oriented cannot afford an image change towards only being an integrator of innovative ideas as they might lose market influence. Too much openness may, thus, seem like a dangerous thing to do, but it is rather the way one organizes and integrates openness than openness for itself (see also the examples below).

2.3 Opportunities

One of the main reasons OPS bear such an enormous potential is they provide a *public domain technical infrastructure*. Granting access to technical equipment that transforms ideas into prototypes in a very short time gives people the possibility to experiment, learn and be creative or even innovative. Not only civil society but also the industry may profit from this development, for instance, by having an opportunity to use such spaces for small production or test runs as a part of their market research strategy lowering the risk of new products failing. So, if *potentially* everybody can not only use the most modern digital technology but also be trained at using it in a collaborative and free fashion, everybody may acquire a certain *technical literacy* transforming customers into *Prosumers* (Toffler, 1981)—describing a customer who

is not only consuming goods but also part of *creating* goods. There is a huge potential of bottom-up/grassroots innovations coming from tinkerers, individuals, engineers, students and craftsmen (Osunyomi et al., 2016; Grün, 2011; Smith et al., 2016; Walter-Hermann & Büching, 2014)—through such (customer) integration bottom-up innovations could be valorized and, in the best cases, may even outperform traditional (in-house) R&D (Redlich & Moritz, 2016; Chesbrough, 2006).[7] Moreover integrating the principle of openness widens market coverage and may also be used in marketing strategies.

This is fundamentally going to change the way one looks at innovation, production and consumption: being part of creating goods and services and the feeling of collaboration and appreciation that is part of customer's integration must be provided for by companies. It will create brand loyalty effects, customer sovereignty and demand-oriented and therefore more *sustainable production*. From the view of production, it is important to notice that with digital technology and rapid prototyping one can *design and produce* (more or less) *at the same time*. Technical drawings may be assisted by CAD-programs and be 3D printed right away while the designing phase is not over yet. So, one can directly see and 'feel' the product, accelerating the overall process of transforming ideas to (end-)products. Also, start-ups may get easier access to companies or managers through integrated OPS: in this case, managers, engineers and decision makers can easily get in contact with them and see them work on their actual projects, without the rather artificial scenery of pitching their projects in front of the whole management.

Furthermore, companies could use OPS as an incentive for employees by giving them the chance to try out new things and giving them a little bit of free space for their own innovativeness (see the example Berlin's open innovation space below). Adding to this, local actors that know about the *local* social, economic and environmental conditions may become part of value creation processes. They usually are more aware about communal needs and resources and, thereby, could help companies not only with innovation but also with sustainable and viable production, on point demand-oriented production (especially for highly individualized goods) and even regional development. Constant exchange with the local community of tinkerers, students, and the like may also turn them into future customers or even employees as well as shorten value chains (Buxbaum-Conradi et al., 2016, 2018; Hamalainen & Karjalainen, 2017).

All in all, the market moves more and more towards individualization and customization and more and more personalized goods and services are going to be *the* field every (innovation-oriented) company must play in (Reichwald & Piller, 2009). Opening up innovation *and* production processes need to be a part of companies' future politics, as they will have to incorporate the ideas, needs and designs of their target customers—and the openness movement may play a huge role in this development. Although the mind-set of its members revolves around sharing, non-hierarchical and decentralized production, commercialization of products or

[7] See for example the open online competition *Netflix Prize*.

specialization in a certain field is not uncommon to the movement, as examples like *Arduino* or RepRap-borrowings (3D-Printer replications) like *Ultimaker* and *LulzBot* show.

Furthermore, despite all the risks and scepticism, there are a couple of companies that have been engaged in integrating OPS into their own corporate structures. This is not only a way of reducing R&D costs and diversification by getting input from externals, but also a way for them to distinguish themselves from other business rivals. They must be seen as pioneers or even vanguards in the inevitable change of producing and consuming.

3 Integrating OPS: A Few Observations

Especially around technology clusters, (integrated) OPS can flourish, specialize in a certain (technological) field and cooperate within an existing infrastructure. Nevertheless, the degree of embeddedness in those structures and the willingness of companies to collaborate with or integrate the movement in general as well as with local workshops, makers and tinkerers in particular, into their structures is key to the success and viability of such undertakings. The degree of embeddedness and the overall objective of integrating or collaboration with OPS affects the degree of openness—who may use the facility when, what is to be worked on etc. pp.—as the examples below show. Although, the potential of OPS arises from widespread collaboration (which is admittedly very much still in the fledgling stage) and (mainly technological) local empowerment fostering innovative thinking and, subsequently, innovative practices, commercialization of products is still very much the realm of companies.

In the last years, many industries relying on innovation realized this potential: in Germany alone over 100 companies are already integrating or trying to integrate open innovation methods through spaces like OPS—however mostly focussing on apps and mobile software (Kreimeier, 2017). This development runs through all industries, be it the automotive industry, the financial industry or even the steel industry (e.g. *Daimler* and *Porsche* each have a digital Lab, *BMW* is sponsoring a FabLab in Munich, *Deutsche Bahn* has a digital lab and *Deutsche Bank* and *thyssenkrupp* each have a so called digital factory).[8] Of course, in most of those facilities technical apparatuses are not to the fore, many of them focus especially on mobile apps or software applications that alter their company's portfolio. As the following examples emphasize, there is a huge variety of ways to incorporate OPS or spaces that can turn into OPS throughout very different industries and branches that all have different market settings and boundary conditions for innovation resulting in different ways of collaboration (e.g. regarding the legal form of collaboration), in different approaches towards the (un-)restrictedness of access (e.g. open for

[8]Meanwhile, this development has even become part of the open innovation and open science vision of the European Commission (see European Commission 2016).

everyone or open just for business collaboration) and different overall objectives and target groups.

3.1 Aviation Industry

As profit margins are pressured by low-budget airlines and business trips decrease, new business models and innovations are desperately needed by many companies. The aviation industry is one of the most complex and knowledge-intense industries. Traditionally, its degree of openness is rather low, and start-ups or individuals are usually not granted access to the respective company infrastructure. Due to those (industry specific) boundary conditions, collaboration between smaller start-ups and tinkerers is rather cautious. Integration of openness (e.g. through OPS) into R&D and production strategies is in most cases restricted to either university teams, company engineers, combined teams or start-ups valuable to the respective company.

In 2015, the *Lufthansa Innovation Hub* (LIH) was founded in Berlin as a start-up unit of *Lufthansa* to coordinate possible partnerships with so-called TravelTech-Start-ups, but over time its focus shifted towards making and creating their own goods and services in collaboration with them. The facilities of the LIH are, amongst others, used for such collaboration. "If we are not building it [new goods and services] ourselves somebody else is going to build it—without any chance of influence from our side"[9] (Hofmann, 2017). It is obvious that it is very important to have a constant input of innovative and creative ideas, which is why in *Lufthansa*'s case the LIH identifies investors and scouts start-ups within the technology market (3 billion Euro of investments in 2016) in order to evaluate possible collaboration. Correspondingly, *Lufthansa* developed an open-API platform where tinkerers and developers may introduce ideas to existing Lufthansa technology. Until now *Lufthansa* has mainly focused on software (for mobile devices),[10] but they also scout in the field of Virtual Reality—a field that cannot cope without hardware. So LIH's infrastructure must adopt to the needs of rapid-prototyping.

Airbus' BizLabs (ABL), one in Toulouse, one in Hamburg and one in Bangalore, call themselves "global aerospace business accelerator(s)" (ABL, 2017a). Very similar to the LIH, they are part of *Airbus* and are split up into three spaces where aviation-oriented start-ups and *Airbus* engineers come together to turn innovative ideas regarding the aviation industry into businesses. The concept is to collaborate as closely as possible with small start-ups to help them understand the needs of the

[9]Translation by the authors. German original (by Sebastian Herzog, CEO of the LIH): "Wenn wir es nicht selbst machen, wird es da draußen von jemandem gebaut—und darauf haben wir dann keinerlei Einfluss" (Hofmann, 2017).

[10]For example, three major projects could be realized within the first 2 years of its existence: the App *AirlineCheckIns* (an App where you may check-in for every company), *Linea* (also an App where you may coordinate compensation in case something went wrong with a flight) and *Mission Control* (an App for business travellers where you may get hotel reservation, transportation etc. via messages) (Hofmann, 2017).

market and, eventually, integrate them into the working structures of major companies. The facilities offer co-working spaces, conference rooms and some shared equipment. The focus of ABL lies on sharing expertise and exchanging experiences and utilize its established openness network (e.g. there are collaborations with *Microsoft*, *I-Lab*, *Club Open Innovation* etc.)—this guarantees more exchange, contacts outside the aviation industry, and support from other experts (sometimes even on-demand). Moreover, the cooperation is not limited to start-ups from the aeronautical industry, the facilities are also open to projects from communication technology, robotics, AI, UAV or even data processing. So far 29 projects, from 3D-Printing to financial processes, have been or are conducted at the respective ABL (2017a, 2017b). Although, the ABL are not themselves (open) production sites, they are an intermediary for start-ups that use such facilities and depend on digital means of production. The overall objective for Airbus, admittedly, is to integrate innovative ideas and products from outside the company into their innovation strategy, however, through this they are also integrating (at least partly) open production methods: the start-ups work, create and design within the *Airbus* facilities and use their infrastructure—ABL may thus be called OPS in the very broadest sense of the word.

The *Hamburg Center for Applied Research in Aviation* (ZAL) is a public private partnership (PPP) (shareholders are the city of Hamburg, *Airbus Operations*, *Lufthansa Technik*, the *ZAL* association, the *German Aerospace Center* (DLR), the Technical University of Hamburg, the Helmut Schmidt University, the University of Hamburg and the Hamburg University of Applied Sciences) founded in 2009 which allows the *ZAL* to act on its own behalf as a SME. It has very strong ties to the *Hamburg Aviation* cluster and aims to pool Hamburg's technical expertise regarding aviation as well as integrating different actors into a bigger network of research and enterprise. *ZAL*'s *TechCenter* was opened up in 2016 and offers space for nearly 600 working stations, newest and most up-to-date research and testing infrastructure in order to foster R&D cooperation in six different technical domains. It also has to be regarded as an intermediary facilitating innovative ideas, prototypes and products from externals to the industry. Moreover, the *TechCenter*'s 50 experts provide expertise not only for the shareholders' B2B, but also for (external) start-ups and companies.

3.2 Medical Engineering

Founded in 2015 the *Open Innovation Space* (OIS) in Berlin is a cooperative of the medical engineering company *Ottobock* (global leader in technical orthopaedics and prosthetics) and a FabLab. It considers itself an open platform, a space of encounters and creative exchange. It was initiated by and integrated into *Ottobock*, which is the initiator, top project partner, landlord of the site and main contractee who operates the OIS in cooperation with *Makea Industries GmbH*—a company founded in order to provide easy and open access for individual and independent product development. Under the umbrella of OIS, *Makea Industries* operates the FabLab Berlin, an

OPS providing individuals and start-ups with means of digital production as well as expertise on such means.

But the FabLab of the OIS is not a usual FabLab just providing access to 3D-Printers, laser cutters and CNC-Mills: the cooperation with *Ottobock* made it possible to also provide access to a professional electronics infrastructure, a textile studio as well as a carbon composite laboratory. The overall objective of the OIS is fostering interdisciplinary research as well as collaboration between universities, research institutes and innovative start-ups and individuals that aim at inventions and product development all in a single site. The physical space itself consists of two departments: one used exclusively by *Ottobock* and their R&D engineers and the other one, the FabLab Berlin, used by individuals, start-ups, entrepreneurs and the R&D engineers from *Ottobock* (OIS, 2017). Thus, this place is also utilized by *Ottobock* as a creative well for their R&D engineers not only by *getting in touch* with the latest and most innovative start-ups and individuals in the Berlin region, but also because they themselves have the opportunity to try out new things and turn even crazy ideas into prototypes in no time—which is, of course, promoting creativity. There are usual visits of *Ottobock*'s employees to the FabLab watching tinkerers and start-ups working on their respective projects—whenever there is a chance they are very willing to collaborate with start-ups as well as individuals and integrate their ideas, prototypes or even products into *Ottobock*'s innovation strategy or even their portfolio: so far three very considerable projects have been conducted in the OIS: all are a cooperation between *Ottobock* and external individuals. One is an open source do-it-yourself bionic hand, another a digital service concept helping amputees to learn to walk again and finally a 3D-printed cosmetic arm prosthesis (OIS, 2017). The *degree of openness is very high*; *Ottobock* has opened a whole facility focussing on exposing their own engineers to new people, new technology, new ways of producing, and new ways of thinking.

3.3 Regional Development

The *Werkstätte Wattens* was founded in 2016 and is a regional development as well as a founding, start-up and entrepreneur centre situated in a former factory building of *Swarovski* in Wattens, a small city 15 km east of Innsbruck, Austria. It is a public private partnership between the *D. Swarovski KG* and the city of Wattens (operated by the *Wattens Regionalentwicklung GmbH*).[11] The main goal of *Werkstätte Wattens* is providing young entrepreneurs with good overall conditions for innovation practices and fostering long-term innovation. In the overall area of 2900 m^2 there are co-working spaces, team offices, a FabLab (called *Center for Rapid Innovation*) as well as production and workshop sites. *Werkstätte* sees itself as a programmatic intermediary between science (e.g. universities and research institutes like *Fraunhofer* which is a direct neighbour) and entrepreneurship (e.g. investors and

[11]With *Swarovski* holding 60% of the share and the city of Wattens 40% (Biedermann, 2016).

start-ups) fostering interdisciplinary approaches and organizing workshop on topics critical to entrepreneurial success. It is independent and decides which individual or start-up gets a chance to use the infrastructure.

So far, there are 35 young entrepreneurs or start-ups (with a little over 70 employees) working at the *Werkstätte* also forming interdisciplinary teams. *Swarovski*, is offering help and the possibility to collaborate with their engineers and R&D department. Both, *Swarovski* and the city of Wattens are profiting from creating and integrating an open production into their existing infrastructure—*Swarovski* mostly through getting in contact with ideas, technologies and ways of using them from externals and the collaboration with other start-ups, tinkerers and engineers. Here, the degree of openness is also very high if one focusses just on the FabLab. But the fact that the Lab mostly focusses on individuals, tinkerers and pupils from the area makes the *Werkstätte Wattens* a rather exceptional case: start-ups and companies use the infrastructure of the *Werkstätte* only due to its vicinity—so one could say it is integrated in an indirect way. However, the whole concept of the *Werkstätte* is not to see each space as a space for itself but rather to provide a holistic environment for creativity and innovation—with a focus on hardware.

4 Conclusion: Tired of Thinking Outside the Box? Create a New One Without Boundaries

We wanted to show that innovativeness may be improved by integrating the principle of openness, not only via the already well-known ways of crowdsourcing or co-designing but also through the integration of actual workshops where start-ups, students, tinkerers etc. can—together with company engineers—work on ideas, be creative and set innovative agendas for the future. OPS do not just promote entrepreneurial empowerment and innovation in foremost local and very collaborative settings but, more importantly, may, given that they are integrated in product design and value creation chains, also provide *cost-effective R&D*[12] as well as effective means to turn useful and innovative grassroots bottom-up innovations into physical artefacts—provided that companies are open to integrate alternative models of creating. Fully opening up is probably not the *conditio sine qua non* for new and successful innovation and production processes, but given the examples it should have become obvious that many industries may profit from opening up a little—of course, in respect to the different (market) conditions they find themselves in.

There is an enormous diversity of approaches to collaborate with or integrate OPS into company structures and processes, so there is no royal road but manifold ways. The examples above must be seen as possible and encouraging ways to do so and have to be regarded to as generic examples for innovative managers and companies

[12]Cost effective not only in regard to actual production but also in regard to personnel costs, as in the creation process of ideas within collaborative innovative practices existing open source files and models are often used.

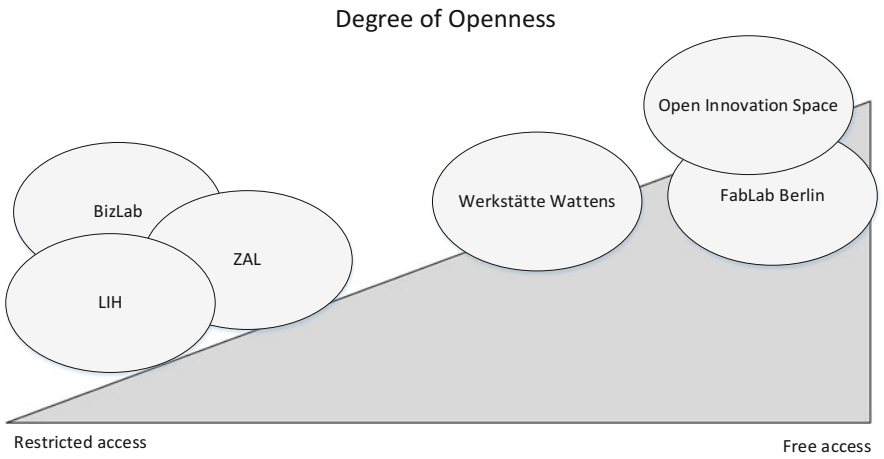


Fig. 2 Degree of openness of the examples (authors' own illustration)

that are open to open up. Moreover, the given examples should not be understood as exclusively advertising the integration of aspects of open production into the aviation industry or in the field of medical engineering, but rather that also high-tech industries are investing in integrating open production into their R&D *and* production (see Fig. 2).

Furthermore, they show that embeddedness and the degree of openness are potential switches or rather critical factors that can be used as managerial tools to improve the innovation capacities of a company. Be it as a spin-off, a subsidiary (LIH and OIS), a PPP (*Werkstätte Wattens* and *ZAL*) or inside the company (ABL), integrating principles of openness, mostly in the form of (at least partly) OPS or close collaboration with them, may, if done in the right way, be a lucrative diversification of existing processes. One can easily see that openness in the examples given is for the most part understood as *complementary* to existing processes and structures of inventing and innovating. Some researchers, however, even argue for supplementing many rather traditional innovation processes by (aspects of) open production, as internal and centralized R&D is becoming more and more obsolete and knowledge and information is widely spread. Introducing methods of openness—also in the realm of production—embraces this development and paves the way for new value (co-)creation possibilities (Chesbrough, 2006; Redlich & Moritz, 2016). One must acknowledge that opening up could, under the right circumstances be a very powerful engine of success or, depending on the business competition, even a necessity.

References

ABL–Airbus BizLab. (2017a). Retrieved April 12, 2018, from https://www.airbus-bizlab.com

ABL–Airbus BizLab. (2017b). *The global aerospace accelerator, Airbus BizLab, has selected its new batch from worldwide startups*. Retrieved April 12, 2018, from https://www.airbus-bizlab.com/news/the-global-aerospace-accelerator-airbus-bizlab-has-selected-its-new-batch-fromworldwide-startups/view

Anderson, C. (2012). *Makers: The new industrial revolution*. New York City: Random House Business.

Baier, A., Hansing, T., Müller, C., & Werner, K. (Eds.). (2016). *Die Welt reparieren. Open source und selbermachen als postkapitalistische Praxis*. Bielefeld: Transcript.

Benkler, Y. (2006). *The wealth of networks: How social production transforms markets and freedom*. New Haven: Yale University Press.

Biedermann, E. (2016). Werkstätte Wattens: Ein Gründerzentrum als Kulturwandler bei Swarowski. Retrieved April 12, 2018, from https://factorynet.at/a/werkstaette-wattens-ein-gruenderzentrum-als-kulturwandler-bei-swarovski

Buxbaum-Conradi, S., Branding, J.-H., Basmer-Birkenfeld, S., Branding, J.-H., Osunyomi, B. D., Redlich, T., Langenfeld, M., & Wulfsberg, J. (2016). Local embedding and global collaboration of open innovation, production and maker spaces. The (uncovered) potential of knowledge transfer and collaboration at the grassroots level – Insights from the growing FabLab community. In J. Wulfsberg, T. Redlich, & M. Moritz (Eds.), *Iinterdisziplinäre Konferenz zur Zukunft der Wertschöpfung* (Vol. 1, pp. 37–52). Hamburg: HSU University Press.

Buxbaum-Conradi, S., Branding, J.-H., Basmer-Birkenfeld, S., Branding, J.-H., Osunyomi, B. D., Redlich, T., Langenfeld, M., & Wulfsberg, J. (2018). Lokale Einbettung und globale Kollaborationsprozesse offener Produktionswerkstätten: Ein Einblick in die deutsche und arabische Maker-Community. In T. Redlich, J. Wulfsberg, & M. Moritz (Eds.), *Interdisziplinäre Perspektiven zur Zukunft der Wertschöpfung* (pp. 79–92). Wiesbaden: Springer.

Chesbrough, H. W. (2006). *Open innovation. The new imperative for creating and profiting from technology*. Boston: Harvard Business Review Press.

European Commission. (2016). *Open innovation open science open to the world–A vision for Europe*. Retrieved April 12, 2018, from https://ec.europa.eu/digital-single-market/en/news/open-innovation-open-science-open-world-vision-europe

Gassmann, O., & Enkel, E. (2006). Open innovation: Externe Hebeleffekte in der Innovation erzielen. *Zeitschrift Führung + Organisation, 3*, 132–138.

Gershenfeld, N. (2005). *FAB. The coming revolution on your desktop: From personal computers to personal fabrication*. Cambridge: Basic Books.

Gershenfeld, N. (2012). How to make almost anything: The digital fabrication revolution. *Foreign Affairs, 91*(6), 43–57.

Grün, G-C. (2011). *Erfolgreich durch Offenheit*. Retrieved April 12, 2018, from http://www.zeit.de/digital/internet/2011-08/vergleich-open-source

Hamalainen, M., & Karjalainen, J. (2017). Social manufacturing: When the maker movement meets interfirm production networks. *Business Horizons, 60*(6), 795–805.

Hofmann, A. (2017). *Was hat der Lufthansa Innovation Hub in zwei Jahren erreicht?* Retrieved April 12, 2018, from https://www.wired.de/collection/gadgets/was-hat-der-lufthansa-innovation-hub-zwei-jahren-erreicht

Kreimeier, N. (2017). *Die besten Deutschen Digitallabore*. Retrieved April 12, 2018, from https://www.capital.de/wirtschaft-politik/studie-ranking-die-besten-deutschen-digital-labore-9101

Moritz, M., Redlich, T., Grames, P., & Wulfsberg, J.-P. (2016). Value creation in open-source hardware communities: Case study of open source ecology. In *Technology management for social innovation, Proceedings of the 25th Portland International Conference on Management of Engineering and Technology (PICMET)* (Vol. 2016, pp. 2368–2375).

OIS–Open Innovation Space (2017). Retrieved April 12, 2018, from https://www.openinnovationspace.com/de

Osunyomi, B. D., Redlich, T., Buxbaum-Conradi, S., Moritz, M., & Wulfsberg, J.-P. (2016). Impact of the fablab ecosystem in the sustainable value creation process. *OIDA International Journal of Sustainable Development, 9*(1), 21–36.

Peters, M. (2014). *The idea of openness: Open education and education for openness*. Retrieved April 12, 2018, from https://archive.li/JaBJt

Powell, A. (2012). Democratizing production through open source knowledge: From open software to open hardware. *Media Culture Society, 34*(6), 691–708.

Raymond, E. S. (2015). Jargon file. In *Hacker ethic*. Retrieved April 12, 2018, from http://catb.org/jargon/html/H/hacker-ethic.html

Redlich, T., & Bruhns, F.-L. (2008). Open production – a new broker-based approach to interactive value creation and user manufacturing. *Proceedings of the ASME International Mechanical Engineering Congress and Exposition (IMECE), 4*, 181–189.

Redlich, T., & Moritz, M. (2016). Bottom-up economics. Foundation of a theory of distributed and open value creation). In J.-P. Ferdinand, U. Petschow, & S. Dickel (Eds.), *The decentralized and networked future of value creation: 3D printing and its implications for society, industry, and sustainable development* (pp. 27–57). Berlin: Springer.

Redlich, T. (2011). *Wertschöpfung in der Bottom-up-Ökonomie*. Berlin: Springer.

Reichwald, R., & Piller, F. (2009). *Interaktive wertschöpfung: Open innovation, individualisierung und neue Formen der Arbeitsteilung*. Wiesbaden: Springer.

Smith, A., Fressoli, M., Abrol, D., Arond, E., & Ely, A. (Eds.). (2016). *Grassroots innovation movements: Pathways to sustainability*. London: Routledge.

Toffler, A. (1981). *The third wave*. New York City: Bantam.

Von Hippel, E. (2005). *Democratizing Innovation*. Cambridge: MIT.

Walter-Hermann, J., & Büching, C. (Eds.). (2014). *FabLab: Of machines, makers and inventors*. Bielefeld: Transcript.

Winsor, J. (2010). *Flipped. How bottom-up co-creation is replacing top-down innovation*. Chicago: Agate B2.

Jan-Hauke Branding is research assistant at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg. In his research, he focuses on changes in working, consumption and production conditions due to the spread of open production facilities and new ways of production.

Sissy-Ve Basmer-Birkenfeld is research assistant and a member of the working group *value creation systematics* at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg. Her main research interests are participation in politics and economics, sustainability research, value creation systems and knowledge management.

Tobias Redlich is senior staff engineer at the Institute of Production Engineering at Helmut-Schmidt University, Hamburg and head of the working group *value creation systematics*. In his research, he studies bottom-up approaches to value creation such as open production and co-creation.

Distributed Manufacturing: Make Things Where You Need Them

Anna Sera Lowe

1 Introduction

During the twentieth century, the dominant model of making things became to make them in large batches in one place and ship them to where they are needed. Before the age of computers and the internet, if you wanted to control a process or coordinate many different activities, by far the best way to do that was to directly oversee it happening in one place. Economies of scale drove manufacturing to centralize, and then cost differentials drove manufacturing to locations where labor is cheap.

An alternative model is starting to emerge—the idea of Distributed Manufacturing (DM), where things are made close to their point of use. This is conceptually similar to what used to happen before the mass production era, but it tends to involve a lot of modern information technologies. The internet has given us the incredible possibility to move data around the world cheaply and, for most practical purposes, instantly. Digital manufacturing allows you to create a design in one location and send that design electronically to machines located all around the world which can each produce a copy. It is becoming easier to move bits instead of atoms. Distributed ledgers, smart contracts, and new payment methods are combining to make it easier and cheaper for individuals and small companies to trade directly with each other, reducing some of the advantages of large firms that control an entire supply chain. It is starting to become possible to imagine a system of global manufacturing that is far more efficient than what we currently have.

This is not advocating an end to global trade—it is looking at more efficient ways to use trade. Ghana, for example, currently grows fruit, exports it to South Africa and Portugal where it is turned into fruit juice and put into cartons which are then shipped back to Ghana and sold to consumers. The process of turning fruit into juice adds

A. S. Lowe (✉)
MakerNet Alliance, Nairobi, Kenya
e-mail: anna@nnvnx.com

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_4

value to the product, but the shipping does not. For most manufacturing technologies—including the ability to extract juice from fruit—there is no inherent reason why they have to be efficient to operate only on a large scale. There are many reasons why it is difficult and, at the moment, more expensive to make fruit juice in Ghana (availability of people skilled in operating the right kind of machinery, and reliability of the power grid chief among them)—but those are current reality, not immutable facts.

Distributed Manufacturing (DM) has the potential to impact society, business, economic development, value distribution, and power dynamics (Rauch, Dallasega, & Matt, 2016; Wulfsberg, Redlich, & Bruhns, 2011). A world in which every country on the planet adds value to its raw materials before they are exported and produces a significant proportion of the finished products it consumes, looks very different in geopolitical terms to the world we have today. Centralized mass production is not about to disappear. But by learning about and exploring the alternative, we can start to design a system more designed for the needs of the twenty-first century—one which offers companies the chance to create new markets and to serve some existing markets better.

This chapter will discuss models of distributed manufacturing that are particularly relevant to open, collaborative, and bottom-up value creation. Distributed manufacturing both builds upon and enhances other aspects of collaborative value creation. For example, a collaborative open source hardware project can lead to the creation of a product that can be made in multiple different places, and then the geographically distributed manufacturers can collaborate to collectively solve problems and improve the design in a way that adds value for the community as a whole.

This chapter draws on the following two case studies throughout:

Case Study 1: International Development Enterprises India (IDEI) and the Treadle Pump (http://www.ide-india.org)

IDEI had considerable success popularizing the use of the treadle pump (a foot-operated irrigation pump). They created a set of functionally equivalent designs, each suited to a different situation. Parts of the frame can be made from metal, wood, or bamboo according to what is cheaply available in different regions. The pump block can be made of metal inland, and concrete in coastal areas where the salinity of the soil corrodes the metal faster. This flexibility enabled the suitability of the product to be maximized in different areas and the treadle pump to be manufactured by dozens of small manufacturers, each producing and selling only one design that was most suited to their local area.

Case Study 2: The *MakerNet* Project and Local Manufacturing of Simple Medical Devices (www.makernetalliance.org)
The *MakerNet* Project (in which the author participated) explored manufacturing of new products and spare parts in Kenya, using a range of different manufacturing technologies: 3D printing, vacuum forming, bench assembly work (for an electronics product), and wood forming using a lathe. The project used skills, equipment, and raw materials that were all already available in Nairobi. The items made were tested with clinics in low-income areas around Nairobi and the local manufacture were compared to the market price of the closest available imported alternative.

2 Basics of Distributed Manufacturing

2.1 What Is Distributed Manufacturing?

By 'manufacturing' we mean carrying out value-adding steps in the creation of physical products. Manufacturing is usually thought of as being done on a large scale. Here we are interested in situations where a category of products is made on a large scale, even if individual production runs or use of a design are small scale. A carpenter making a single bespoke table can be thought of as part of a large-scale system for making tables worldwide. Human beings are spread out across the earth, and wherever there are humans, we use products. So, if we think about the places where products are used, the demand for almost every category of product is spread out around the world. By DM, we mean moving manufacturing out from a centralized location closer to the place where the product will be used (Fig. 1).

DM tends to mean making things in smaller batches, because each production location is serving a smaller segment of the global market. DM is particularly well suited to digital manufacturing technologies (such as 3D printing and laser cutting), both because you can send the digital design file anywhere, and because it is easy to switch from one design to another, so you do not incur 'changeover costs' which penalize small production runs. However, there are also some good examples of DM using traditional analogue manufacturing technologies, including the IDEI example given as a case study. A global system of DM would include many different business models—a few examples are described in the box "What does a Distributed Manufacturer look like?". For a discussion on different types of Distributed Manufacturing, see Fox and Alptekin (2017).

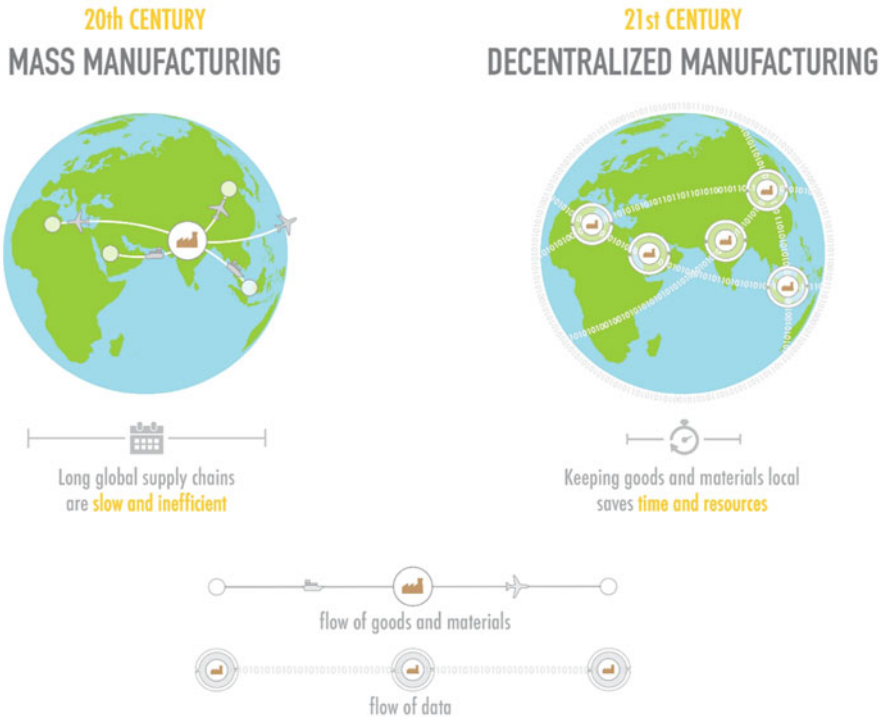


Fig. 1 Mass/centralized (left) versus decentralized/distributed manufacturing (right) (www.makernetalliance.org, CC-BY-SA)

What Does a Distributed Manufacturer Look Like?

Here are a few different examples of what distributed manufacturing can look like in practice. The details of these are fictional, but each is based on a concept that really exists.

The Personal Fabricator (e.g. See Wittbrodt et al., 2013)

Charlotte has her own 3D printer at home and uses it to make objects she needs for herself or her family. She enjoys making things and looks for opportunities to use her printer instead of buying new items. She usually looks online for an existing design and modifies it to suit her needs. Sometimes what she makes replaces a standard item she could have bought in a local store or online, and sometimes the item is more customized and may not have been available off the shelf. She has recently made a stand for her son's phone, a custom grip to make it easier for her elderly uncle with arthritis to hold his walking stick, a replacement shower curtain ring, and a soap dish.

(continued)

The Digital Blacksmith (e.g. See https://www.digitalblacksmiths.org/)

Paul and Sheelagh are co-owners of a small business in a mid-size town in Western Kenya. They went to university in Nairobi and afterwards wanted to do something that would let them move back home, where there were few jobs, and that would be useful to communities in the area where they grew up. They have four 3D printers and are hoping to branch out into other manufacturing technologies in the future. They have a range of standard products that they sell to businesses, schools, health clinics, and individuals. Some of these are their own designs (including some educational aids for schools), others are made from open source part libraries online—including for spare parts for items of medical equipment.

The Supply Chain Company (e.g. See www.ups.com and DHL, 2016)

Logistics Inc. is a multi-national company whose main business is shipping things around the world. Eight years ago, the board recognized that distributed fabrication had the potential to become far more widespread and set up a new division to experiment. The company now has five hubs where digital manufacturing can be done and hopes to roll the concept out more widely following an extended trial period. Several of their existing customers including a heavy plant manufacturer are now experimenting with shifting parts of their supply chains from a mass production and distribution model to a distributed manufacturing, make-on-demand model.

The Designer/Maker (e.g. See https://www.opendesk.cc/)

Sam loves designing and making things and is very happy that he can earn a living from it. He has a membership at his local makerspace which allows him to use all the tools they have, although most of his products are made on the laser cutter. He offers a range of standard items to his own designs, including coffee tables with a chess board engraved on top, and clocks with motivational quotes on them. He also accepts commissions and has done work ranging from making cases for electronics prototypes to creating stage furniture for a playhouse. As an extra strand to his business, he recently created a profile on an online platform that lets people select a furniture design and find a local craftsperson to produce it. His first contract was to make desks for a start-up company.

2.2 What Is 'Open' in the Context of Distributed Manufacturing?

DM does not have to be open, but here we are interested in the kinds that are. There is no single definition of what must be 'open' for a DM model to be relevant in the context of collaborative value creation. For our purposes there are two key ways in which openness is relevant to DM—firstly relating to access to the manufacturing assets, and secondly to the designs of the products made or the equipment used to make them. We will deal with each of these in turn.

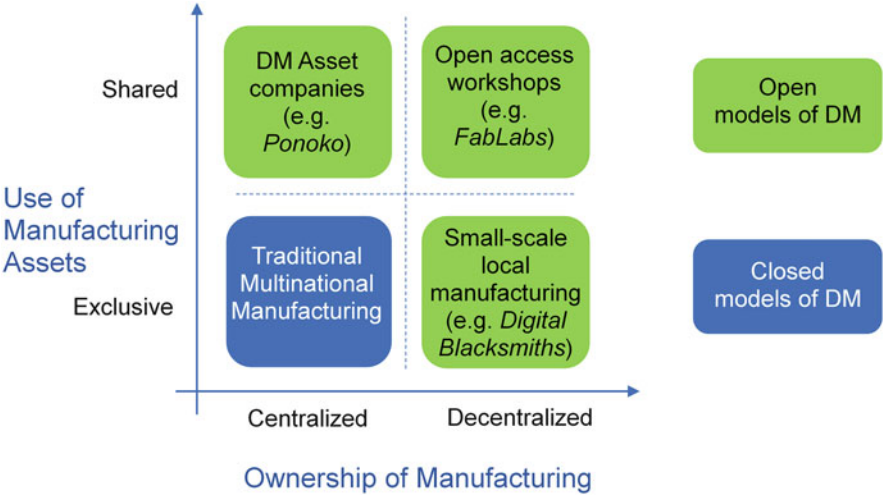


Fig. 2 Open and closed models of distributed manufacturing (author's own illustration)

Access to Manufacturing Assets

Some traditional multinational manufacturing can be said to be distributed, in that it takes place in multiple locations around the globe (for example, much car manufacturing is done regionally to be closer to market), but it is not open. Only the company that owns the factory can use it. There have been some interesting developments in this type of model about mass customization, but beyond the limited involvement of the customer in value creation by choosing from predefined options it has little relevance for collaborative economy models.

DM can be thought of as 'open' when a wide variety of people and organizations can access manufacturing assets (meaning the machines that are used to make things). For many people to have access, the type of machinery needs to either have decentralized ownership (many different organizations own similar machinery), or to be shared access (many different organizations can use machinery owned by one or few organizations), see also Fig. 2.

Ownership of machinery becomes decentralized when the equipment is relatively small and cheap—as 3D printers of plastic have become. Shared access manufacturing assets are those that can be used by anyone, whether or not they are affiliated with a particular organization, and for commercial or personal purposes. It does not necessarily mean free (and generally will not be free for a level of access appropriate for ongoing commercial operations). In both cases the key factor of interest is the ability of anyone (individual or organization) to access a manufacturing technology without (a) investing in purchasing those assets themselves, or (b) committing to ongoing high levels of use of particular assets, as in the case of contract manufacturing. It is this accessibility that really lowers the barriers to entry for manufacturing so that the creation of physical goods in society becomes a more collaborative exercise.

Open Source Hardware
'Open source' refers to something that can be freely modified and shared because its design is publicly accessible. In the case of hardware even more than software, the degree to which something really is publicly accessible is strongly determined by how well documented it is. Open hardware is very important to DM because it effectively allows companies in different places to share design costs. This ability to share the design function is one of the key things that distinguishes modern DM from craft production. In the *MakerNet* case study, most products were cost effective to manufacture locally because they were based on open source designs and thus required little design time to be included in the cost.

Open source hardware is relevant to distributed manufacturing both as end products and as manufacturing equipment:

- **Product Designs**—For example, there are many open source furniture designs on *Opendesk*, which buyers can request a local manufacturer to make for them.
- **Equipment Designs**—Open Source equipment such as *RepRap* 3D printers, *Precious Plastics* plastic recycling machinery, or the *Open Source Ecology* (OSE) project working on the *Global Village Construction Set*, open source designs needed as a blueprint for civilization. These are pieces of equipment that can themselves form the basis of a business—someone can start making products with a *RepRap* or bricks with the OSE brickmaker, whether or not they participated in the design of the equipment themselves.

2.3 Roles in the Open DM Value Chain

This section discusses the key roles in the open DM value chain (see Fig. 3). It is important to note that one person or entity can perform multiple roles, and one of the major areas of innovation in distributed manufacturing lies in combining these roles in new ways.

Designer
In centralized manufacturing, the manufacturer usually designs the product themselves and limits access to that design. In DM, when you have multiple organizations making essentially the same product for different geographical markets, it is far more common for these roles to be separated, and for designs instead to be shared by multiple manufacturers. This can of course be done in a closed fashion, where the designer charges for access to the design, but in many cases the designs are open source. Some designs are maintained by volunteer communities, such as the *e-Nable* network working on open source prosthetic hand designs. This can work well for products that are customized in most instances, but there are few examples of this producing high quality, repeatable, comprehensively documented hardware designs—possibly because, unlike with Open Source Software projects, real world testing cannot be done without incurring costs. See Buitenhuis, Zelenika, and Pearce

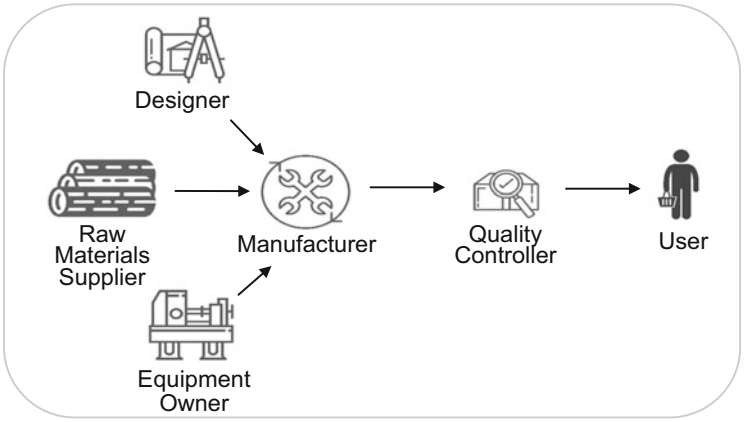


Fig. 3 Roles in the open distributed manufacturing value chain (author's own illustration)

(2010) for further discussion of business models for open source design relevant to DM value chains.

Raw Materials Supplier
This works just the same as with centralized manufacturing: the business model is to sell materials or components which are to be processed/combined in the manufacturing step. It is mentioned here because it can form part of a business model to support another role in a DM value chain. For example, some makerspaces have found that selling materials to the makers, both hobbyists and businesses, based from them is an important part of the business model that allows them to offer open access to manufacturing assets.

Equipment Owner
This may be the manufacturer, in which case the costs of the equipment are covered by selling the products made on them. Where the equipment owner is a separate entity (for example a makerspace that provides shared access to machines), the model is usually to instead charge for access to the equipment.

Manufacturer
Here we define the manufacturer as the person or organization that organizes the value adding work and arranges for the different inputs to be present. There is a simple business model for this role—unlike with open source software, no-one expects even open source hardware to be free, because the marginal cost of production of a physical product is not zero. So even where designs are open source, there are businesses based on manufacturing those designs and delivering them to the user—who is willing to pay in order not to make it themselves. The maker businesses that manufacture the furniture ordered through *OpenDesk.cc* fall into this category.

Quality Controller
Someone must take responsibility for ensuring the product is fit for purpose. In some value chains this role is taken by the customer (particularly common where they are also the designer, or the product is customized) or by the manufacturer, and there is no business model separate from selling the product. It is not yet common for this to be a distinct role in distributed manufacturing, but the *MakerNet* project is designing an experiment with distributed quality control via independent agents, to be rewarded by a percentage of the contract value and monitored via a reputation profile. This role becomes particularly key when we look at decentralized asset ownership forms of DM, as there is a need to ensure products produced in different ways are made to common quality standards.

Platforms
A discussion of the roles in a DM value chain would not be complete without a mention of information aggregator platforms. Whatever is distributed or open—the location of manufacturing assets, their ownership, or the designs to be used on them—there is a need to gather information and present it in a readily accessible format, and there are frequently commercial business models available for this, e.g. *3DHubs*.

3 Best Practices of Distributed Manufacturing

DM is very much an emerging field and best practices are not yet well established. There is considerable opportunity for firms to innovate and experiment with different approaches, and those that are successful on the factors most key for their market will be rewarded for that. In the mean time we can offer some guidelines to consider in designing a DM model. These are based on common features of successful examples and on the author's experience.

3.1 Appropriate Selection of Products

Not every product is equally suited to distributed manufacture. Whilst this mode of production is still in its infancy, organizations undertaking it are likely to incur costs associated with trialing different operating or business models, and they are more likely to be able to recoup those costs by operating in markets where DM offers value advantages over traditional, centralized manufacture. Put simply, trying to use DM to deliver the same products to the same customers that centralized manufacturing serves well is likely to fail. One product manufactured in Kenya in the *MakerNet* project—an umbilical cord clamp, which is readily available in the local market—cost eight times the price of a mass produced imported alternative and offered no advantages (in all other cases, the locally manufactured option cost was similar to or less than the imported alternative). The market expectations, demand

patterns, raw materials, and manufacturing technologies all play a role in defining whether or not a product is a good fit for DM.

Factors Suggesting a Product May Be a Good Fit for DM

- Demand is unpredictable and widely dispersed in either geography or time. A classic example here is spare parts for equipment that is used all over the world—you don't know when or where a part will fail. A higher unit production cost can be offset by a dramatic reduction in inventory holding cost and/or costs of downtime due to delayed availability.
- Different geographical locations have different needs from a functionally similar product—for example, an item of agricultural equipment may be specialized to different types of soil or landscape. The appropriate design can be made close to where it is needed.
- Cheap, small, robust, readily understood manufacturing technology can be used. If it can be made on a lathe, welded, 3D printed in plastic—it can be a suitable candidate for local manufacture.
- Raw materials are multi-purpose (i.e. used for a variety of end products) and/or widely available.

Factors Suggesting a Product Unlikely to Be a Good Fit for DM

- Large, expensive manufacturing equipment, particularly where that is specialized for the item being produced and/or requires highly specialist operators. The higher the cost of the equipment, the higher the quantity of product needed to amortize the cost, and the more specialized the equipment the more concentrated the production needs to be to achieve high enough levels of demand. Highly specialized operators will be harder to find in many different locations.
- The necessary raw materials are not available locally and are not used for anything else—because cost savings in distributing the finished product will be largely offset by the costs of distributing the raw materials.
- Either the raw materials or the manufacturing process is dangerous. The assumption is that centralization allows greater control and thus lowers risk. It would not be a good idea to distribute the manufacture of nuclear fuel for example.

We can see that microprocessors are a very poor candidate for DM whereas wooden chairs are a suitable candidate—and the real distribution of their respective manufacture reflects that.

3.2 Flexibility in Product Design

Another dimension on which models of DM differ is whether the products made in different places are actually done to the same (identical) design (as is the case where a 3D-printable spare part is produced in multiple locations where it is needed), or

merely similar. Many of the benefits of DM (ability to adapt to local needs and resources) occur when the product itself is different. The treadle pump example in the IDEI case study was so successful partly because the manufacturers in different locations were producing different versions of the product, adapted for local conditions or availability of materials.

3.3 Creative and Appropriate Role Configuration

As discussed above, there are many ways the roles in the DM value chain can be dispersed or combined between different actors. The way in which the roles are assigned can change the economics of the model or deliver competitive advantage in a particular market. For example, the cost of moving to a distributed manufacturing model for a large manufacturer can be cost prohibitive if they have to invest in all the manufacturing assets themselves, but attractive if they are able to pay for flexible access to shared assets. One decision of particular importance is how to involve the customer in the value chain—there are successful examples of getting customers to play different roles such as taking part of the manufacturer role (*Ikea*) or designer (*Custom Ink*).

3.4 Effective Quality Control Model

DM is a challenge for quality control. Best practice currently appears to be to centralize quality control. For example, *Jibu* franchises water purification companies but directly employs quality inspectors to test the water produced by franchisees. Innovation in distributed quality control is much needed and will likely offer a significant competitive advantage to those able to make it work effectively. Developments that bring down the price of equipment such as 3D scanners or material purity testing devices will have a big impact on the practicality of effective quality control for DM.

3.5 Operational Excellence

Finally, even more than in traditional centralized manufacture, the success or otherwise of DM will depend to a large degree on the consistency and quality level with which all aspects of the value chain process are executed. Ability to turn out high quality products in multiple locations, often with different types of equipment and/or differently skilled operators, is a difficult task that requires a relentless focus on process. This point is familiar to franchise owners such as *McDonalds*.

4 Implications for Management

4.1 Opportunities from Distributed Manufacturing

There are a range of opportunities from DM that present themselves to companies, including:

New Markets
There are commercial opportunities to satisfy customer needs that are not being met by centralized mass production. This may be because distribution costs are too high—as can be the case in frontier economies and other situations where weak supply chain infrastructure or high trade barriers make traditional supply chains expensive. In other situations, the needs of a customer base are too disparate to be well served by a mass manufactured product.

Better Service to Existing Markets
The proximity to the customer offers the ability to be more responsive to their needs, generate greater customer loyalty, or even to involve them in the value chain in some way. (See Kohtala (2015) for discussion of models where individuals play a role beyond that of just consumers).

Innovation
DM offers the opportunity for far more experimentation and thus innovation, not just in the product but also in the way it is produced (Johansson, Kisch, & Mirata, 2005). It is lower risk to try a different approach in just one manufacturing location among many. There are less resource intensive ways to try new products or new markets. By being able to tap into a network of shared production resources, companies can bring innovations to market faster and with lower investment and risk.

Sustainability
The reduction in transport and the potential to use more sustainable local materials (such as the bamboo used in some locations for the IDEI treadle pump) offer sustainability gains. When consumption happens close to the manufacturing facility, it is also cheaper to collect waste materials left after the product has been used so a closed-loop product life cycle can be more practical.

Resilience
Decentralized supply chains are less vulnerable to shocks. The disruption many car manufacturers experienced with parts availability following the earthquake and resulting tsunami in Japan in 2011 illustrated the risks of relying on a single location for key supplies.

4.2 Threats and Challenges from Distributed Manufacturing

DM is far from being a panacea, and the major difficulties stem from the reasons why centralized manufacturing has been so successful:

Coordination Costs
It is difficult and complicated to maintain centralized control over activities that happen further away from each other in time and space. It is harder to be sure that the same products made in 20 different factories all meet quality standards, than products made in one centralized factory. It is more complicated to manage inventory across 20 different locations than in one. All these things are possible, but they tend to add cost.

Transaction Costs
If the control function of the value chain is decentralized, which may be necessary in order not to incur high coordination costs, then the cost of all the transactions between different entities becomes an issue.

Both factors may be mitigated by clever or appropriate value chain configuration and use of technology. Algorithms based on big data and distributed ledgers are some of the technologies that currently look promising for reducing the impact of these costs. Separate to these issues inherent to the model, but no less important for established companies, are the difficulties and costs associated with changing both mindset and operating practices.

5 Conclusion

Human-centered design and co-creation approaches, where the people who will use a product get involved in designing it, throw up differences in what people want from a product. If you ask hospital staff in Kenya what they need from a suction machine trolley, it turns out that their needs differ from those of hospital staff in the USA or China where the products currently on the market were designed. If we start to design products that are more closely tailored for different purposes or environments, some of the rationale for making all those identical products in one place starts to fall apart.

It is not economic or sensible for all global mass production to shift to local, small-scale facilities. Nevertheless, there are significant benefits to be gained (from economic, human development, social, and sustainability perspectives) from far greater distribution of manufacturing than is currently the case. Some firms are staying away from engaging with this because they cannot yet see how to capture some of the value generated and make money from it. Those companies that actively engage, experiment with different business and operating models, and start to innovate in how they deliver physical products to the customer and what roles they play in the value chain are likely the ones that will be best placed to benefit from the opportunities that emerge.

DM tends to have higher per-unit manufacturing costs that mass manufacture in one location. The successful applications of DM are therefore those that are able to either generate greater value to the customer (for example, by delivering a product faster or customizing it) or by offsetting the manufacturing cost with savings elsewhere in the supply chain such as in distribution or inventory.

References

Buitenhuis, A. J., Zelenika, I., & Pearce, J. M. (2010). Open design-based strategies to enhance appropriate technology development. In *Proceedings of the 14th Annual National Collegiate Inventors and Innovators Alliance Conference: Open, March 25–27th 2010* (pp. 1–12).

DHL. (2016). *TrendReport: 3D printing and the future of supply chains – A DHL perspective on the state of 3D printing and implications for logistics*. Retrieved May 31, 2018, from http://www.dhl.com/en/about_us/logistics_insights/dhl_trend_research/3d_printing.html#.WxAAfIouCM8

Fox, S., & Alptekin, B. (2017). A taxonomy of manufacturing distributions and their comparative relations to sustainability. *Journal of Cleaner Production, 172*(2018), 1823–1834.

Johansson, A., Kisch, P., & Mirata, M. (2005). Distributed economies – A new engine for innovation. *Journal of Cleaner Production, 13*, 971–979.

Kohtala, C. (2015). Addressing sustainability in research on distributed production: An integrated literature review. *Journal of Cleaner Production, 106*, 654–668.

Rauch, E., Dallasega, P., & Matt, T. (2016). Sustainable production in emerging markets through distributed manufacturing systems (DMS). *Journal of Cleaner Production, 135*, 127–138.

Wittbrodt, B. T., Glover, A. G., Laureto, J., Anzalone, G. C., Oppliger, D., Irwin, J. L., et al. (September 2013). Life-cycle economic analysis of distributed manufacturing with open-source 3-D printers. *Mechatronics, 23*(6), 713–726.

Wulfsberg, J. P., Redlich, T., & Bruhns, F.-L. (April 2011). Open production: Scientific foundation for cocreative product realization. *Production Engineering, 5*(2), 127–139.

Anna Sera Lowe is the CEO of Manufacturing Change and one of the founders of the *MakerNet* Alliance, a group of people and organizations working on distributed manufacturing around the world. Her particular interest is business models for sustainable local manufacturing in developing countries.

Co-creation of Value Proposition: Stakeholders Co-creating Value Propositions of Goods and Services

Stefan Vorbach, Christiana Müller, and Elisabeth Poandl

1 Introduction

Currently, the co-creation of products and services is an important innovation activity performed by companies and a source of competitive advantage. Besides the value of co-creating activities for the company, the literature (especially in service-science research) highlights the value of co-creation to customers and other company stakeholders. Value is co-created by interactions among different actors in the ecosystem (e.g., suppliers, customers), which take active roles in shaping service offerings and experiences. As part of this process, companies can incorporate the customers' points of view and identify the customers' needs and desires. The customers co-create value by using the products and services through the integration and application of resources. Through this interactive process of value creation, customers and other stakeholders become co-creators of the firms' value propositions and the promised value that will be delivered to the customers (Payne & Frow, 2014). The value proposition is important when it comes to identifying opportunities for value co-creation. Beyond this, the value proposition can be regarded as a mechanism that creates greater stability within stakeholder relationships (Frow & Payne, 2011). So, by co-creating value propositions, customers and other stakeholders become co-producers of the value propositions that are offered to all stakeholders of the company.

Although the literature on value creation and value co-creation is filled with definitions and examples, a clear picture of value proposition co-creation or co-production is still lacking. Thus, the goal of this chapter is to provide an overview of the value proposition co-creation concept and illustrate it with examples.

S. Vorbach · C. Müller (✉) · E. Poandl
Graz University of Technology, Graz, Austria
e-mail: stefan.vorbach@tugraz.at; christiana.mueller@tugraz.at; elisabeth.poandl@tugraz.at

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_5

First, we delineate the concepts of value creation, value co-creation, value proposition and value proposition co-creation; second, provide practical examples of these concepts to delineate them still further; and, third, describe a process that can be used to co-create value propositions.

2 The Basic Concepts: Co-creation of Value and Value Proposition

The *co-creation of value* paradigm is broad, and scholars regard it from different points of view. The paradigm refers to how co-creation is applied in the company and is theoretically described as a conceptual framework that has characteristics of a toolkit. The *value proposition* concept, in contrast, is quite precise. This concept is defined as a promise of value made to customers to deliver a combination of values, such as price, quality, performance, selection and convenience (Payne & Frow, 2014). This paradigm and concept are described in detail in the following sections.

2.1 The Co-creation of Value Concept

The core idea of co-creation is that companies can produce goods, services and experiences of unique value by opening up and involving customers and other stakeholders in processes of continuous innovation and learning. Therefore, co-creation turned out to be a valuable means to increase a firm's competitiveness (Gouillart, 2011).

Instead of trying to encapsulate and defend their unique capabilities, firms compete by opening up their value chain, which consists of traditional functions and processes—from R&D to marketing and sales—offering docking points that attract a dynamic group of customers and other stakeholders. Co-creating products or services together allows both parties to detect market failures more quickly, find creative ways to address customers and gives co-creation applicants a competitive advantage.

But co-creation processes are dynamic and complex and, thus, more challenging than closed innovation processes. Firms which want to initiate and apply co-creation in their daily operations face difficulties due to their need to create a new mindset. Similar concepts, like co-production, open innovation, mass customization, user-generated content and so on, describe the significance of integrating firm-external sources into innovation and development processes. These concepts are aimed in the same direction, but do not address the issue of pointing out personalized customer experiences. This is, on the one hand, the pivot element of co-creation and, on the other hand, how they are mainly different from related concepts. In this regard, co-creation is about customers "*co-constructing their experiences*" (Prahalad & Ramaswamy, 2004, p. 11).

Although the co-creation paradigm is very broad, all definitions share the aspect that co-creation is a process which allows an active exchange with stakeholders

(e.g. customers) to take place, creates a new basis for innovation, is initiated by the firm, facilitates a win-win situation for both the stakeholder and the firm and establishes a sustainable and stronger relationship between the stakeholder and the firm.

2.2 The Value Proposition Concept

The development of the value proposition is both a strategic issue and the key to a successful business model. Payne and Frow (2014, p. 215) defined the value proposition "*as a promise of value to customers to deliver a particular combination of values—such as price, quality, performance, selection and convenience*". Osterwalder and Pigneur (2010) described distinct characteristics of value that are provided by the value proposition offered: In addition to the *newness* of the value proposition or the *performance* the value proposition provides, *customization* can also contribute to value proposition. Hereby, customers or customer segments participate in value creation through co-creation.

Value propositions include products, but also integrated value systems that solve the customers' problems. Overall, these propositions represent a bundle of benefits offered by the company to solve customer problems. An outstanding value proposition, thus, helps the company to achieve a competitive advantage. Besides the customer, Stähler (2002) described value creation partners as stakeholders of the value proposition, because the value proposition includes the value of participating in the business model and, hence, motivates the partners to participate. All companies implicitly or explicitly have some kind of value proposition, but they usually do not carry out specific activities that place a focus on the development of value propositions to support the company's success (Payne & Frow, 2014).

3 Combining Both Basic Concepts: Co-creation and Value Proposition

The concept of value proposition co-creation is mainly anchored in the service-science literature and constitutes an integral part of the service-dominant (S-D) logic. As little research on this topic has been conducted, a clear picture about how the co-creation of value propositions is conducted in practice is not yet available.

Because value proposition co-creation is anchored in the S-D logic, the roles of producer and consumer become blurred. This leads to a value that is co-created as part of the interaction that takes place between the producer and consumer by integrating resources and applying competences (Vargo, Maglio, & Akaka, 2008). In this system, the value proposition is described as the conveyor of potential value and is created as part of the exchange process that takes place between the suppliers, service provider and customer (Kohtamäki & Rajala, 2016). The customer, thus, becomes the co-producer of the value proposition, whereby we also refer to the co-production of value proposition (Cesarotti et al., 2014). The co-produced value proposition is the

outcome that is exchanged among all collaborating partners (Kohtamäki & Rajala, 2016). Whilst the service provider proposes the value proposition on the market, the customer accepts, rejects, or disregards the value proposition in need of resources (Vargo et al., 2008).

As the digital markets expand, the traditional supplier-consumer relationships take on an initiator-participant perspective, whereby suppliers and consumers adopt *"interchangeable and participating roles in value proposition development"* (Truong, Simmons, & Palmer, 2012, p. 197). Thus, the co-creation of the value proposition changes from only suppliers and consumers into network partners that mainly share knowledge (Truong et al., 2012). Frow and Payne (2011) argued that the value proposition takes on the role of a *value alignment mechanism* between the various stakeholders of a firm. The development of the value proposition within a network creates opportunities for value co-creation and strengthens the relationship with stakeholders. This emphasizes the importance of the value proposition regarding value co-creation among various stakeholders.

3.1 A Framework for Improving the Understanding of the Co-creation of Value Proposition Phenomenon

To effectively analyze and understand the phenomenon of co-creation of value proposition, we use a framework which divides the creation dimension from the dimension of value. In the first dimension, we differentiate between *creation* and *co-creation*. In the value dimension, we distinguish between *value* and *value proposition*. Consequently, a matrix with four quadrants is created (see Fig. 1).

Creation of Value (Quadrant I)
Historically, the definition of value creation has included a description of a process that takes place during the manufacturing process. Suppliers produce goods and services, and customers purchase goods and services. Therefore, this definition indicated that value was transferred from the producer to the customer via the product or the service.

The current meaning has changed in that customers govern their own consumption context (Grönroos, 2008). A product or service, thereby, incorporates value through its actual usage (value-in-use) rather than through its sales price (value-in-exchange) (Vargo & Lusch, 2008), and, hence, only the final beneficiary determines such value. For example, *Rio Tinto*'s copper and coal division offers its customers in the mature commodity market a supply of thermal coal to power stations that convert coal into electricity (Payne, Frow, & Eggert, 2017).

Co-Creation of Value (Quadrant II)
Prahalad and Ramaswamy were among the first scholars to point out the emergence of a new logic for value creation, whereby value is embedded in personalized experiences. They noted, "*early experimenters are moving away from the old*

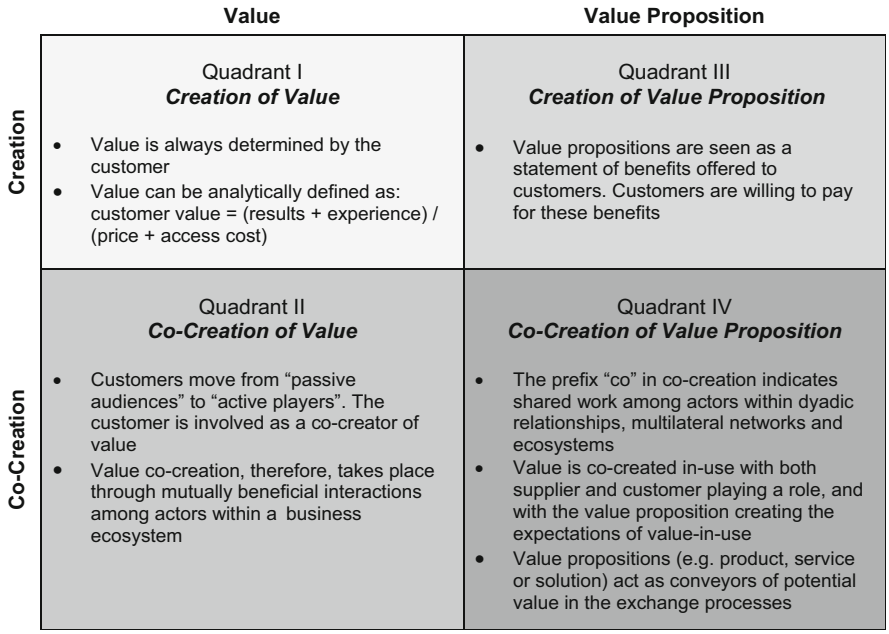


Fig. 1 Framework of the co-creation of value proposition phenomenon (authors' own illustration)

industry model that sees value as created from goods and services to a new model where value is created by experiences" (Prahalad & Ramaswamy, 2004, p. 172).

The creation of value currently results from a production process that involves both the company and the customer. As part of this new approach, the suppliers apply their knowledge and capacities to the production and branding of a product or service, and the customers apply their knowledge and capacities to the daily usage of that product or service (Vargo et al., 2008). Hence, the customer takes on an active role in the creation of the value experience, and the ultimate perception of the value is based on the interaction. Accordingly, "*value is co-created by multiple actors, always including the beneficiary*" (Vargo & Lusch, 2016). Companies increasingly integrate their customers in the co-creation of value.

For example, *Volvo* developed the *XC90* in a customer involvement project with B2C co-creation based on dyadic and face-to-face customer involvement in the automotive industry. Conventional market research activities and product innovation were complemented by a deeper understanding of the target customer in a cost-effective way, validating design preferences and improving the market offer. Thus, a more attractive product was co-created with Californian housewives, the target customers (Roser, DeFillippi, & Samson, 2013).

Creation of Value Proposition (Quadrant III)

A value proposition is defined as a promise of value to customers to deliver a particular combination of values, such as performance and price. From this

perspective, value propositions are viewed as statements of the benefits offered to customers. Customers are willing to pay for these benefits. Their value is not consumed or destroyed, as would be assumed by applying the traditional industrial logic. Instead, the value proposition may be produced, and the value experience can be created by members of the ecosystem (Kohtamäki & Rajala, 2016). As the value proposition is essential to the business model of a company, examples of a deliberately created value proposition are manifold.

For example, *Uber* caused major changes in personal transportation with its two value propositions, both distinct to the rider and the driver. With a single mouse-click, *Uber* provides the rider with suggestions of a private driver that can help them get anywhere, whereas the driver is offered a flexible earning opportunity and has the option to choose when and for how long they will drive (Payne et al., 2017).

Co-Creation of Value Proposition (Quadrant IV)
The literature on value co-creation has expanded significantly, and researchers have utilized a variety of concepts, e.g. co-design and co-development of value propositions as well as co-learning including joint organizational learning, relationship learning and co-innovation. The prefix "co" indicates that shared work among actors takes place within dyadic relationships, multilateral networks and ecosystems.

These concepts are relevant in traditional B2B relationships where suppliers and customers operate in close collaboration, bundling products and services. For instance, in *knowledge intensive business services* (KIBS), collaborative practices support the co-production of service offerings, and the practices of co-creating value in use are important (Kohtamäki & Partanen, 2016) Thus, the co-creation of value propositions can be understood as "*a gradual, inherently relational process during which the alignment between actors, or the value proposition, evolves and adapts to the contexts in which the actors integrate resources*" (Siltaloppi & Vargo, 2014, p. 1281). *Quirky* can be named here as an example. They mixed open innovation with crowdsourcing and customer co-creation. They involved an inventive crowd of members in new product development and commercialization, from the conception of the idea to the development of the finished product (Roser et al., 2013). Supplier and customer interact on a B2C level and co-create not only value, but also value propositions as their expectations of value-in-use (Frow & Payne, 2011). *Quirky*'s members are used to search for and develop new product ideas, to buy these products and generate a buzz about them (Roser et al., 2013).

3.2 Best Practices for the Co-creation of Value Proposition

Two findings seem to be of particular interest when establishing co-creation in B2B and B2C environments (Roser et al., 2013):

- B2B co-creation ventures: To align multiple participants from all involved organizations, steering committees are useful to co-create rules and govern the cooperation.
- B2C co-creation activities: Market-like forms of governance are more suitable for B2C co-creation relationships, as the co-creation participants are in a one-to-many relationship and will ask for the price or market value for their participation.

4 A Process Model for Co-creating the Value Proposition

The results of research in the field of co-creation of value propositions have shown that a deficit in process approaches exists. Only consultants who picked up co-creation found a way to more practically access the co-creation paradigm. Due to the complexity of co-creation processes, this lack of step-by-step guidance is reasonable. We selected approaches which seemed to be the most useful in terms of actual implementation and describe them briefly (see Table 1).

We analyzed the process models described above in terms of their applicability to the task of co-creating value propositions. At least two models could be identified that specifically fit the task of co-creating value propositions. These two models were combined in a new approach (see Fig. 2). We took the process model *value co-creation framework* described by Frow and Payne as a macro-process, in which the five process steps start with the step *identifying stakeholders* and end with the *co-creation of a shareholder value proposition*. Although the macro-process is a linear process model, it needs to be repeated periodically. We also drew inspiration from Osterwalder's *Value Proposition Canvas* model. We adopted some of the cyclical process steps from this model, namely from the steps *analysing and understanding stakeholder jobs* to *describing gain creators*. This micro-cycle needs to be repeated until the proper value proposition has been defined.

To achieve a better understanding of the process model, we underpinned our explanations by referring to an example from the company *Owlet*. *Owlet* developed a monitoring device for infants in form of a sock, which tracks the heart rate and oxygen level of the baby. The data from these devices are sent to a base station that notifies parents in real-time if the heart rate and oxygen level seem abnormal. At the same time, the data can be monitored via a smartphone app (Owlet Baby Care, 2017). When describing and explaining the particular steps of the model, it is important to point out that *Owlet* followed this process intuitively without being aware of the process model and using it as a guideline. Therefore, the *Owlet* example acts as an inspiration for the process model described above.

In the first step of the macro-cycle (Fig. 2) (*Identify Stakeholders*), *Owlet* analyzed their potential stakeholders. During their early activities, the company identified hospitals and health care personal as worthwhile stakeholders. But the value proposition defined at that time and for those stakeholders did not turn out to be profitable. Later, they identified the parents of newborns as a new stakeholder group. Parents are deeply interested in the wellbeing of their infants and, therefore, in monitoring the health data of their newborns. In the second step (*Define Core Values*), they defined

Table 1 Process models for co-creation and value propositions

DART framework (Prahalad & Ramaswamy, 2004) According to Prahalad and Ramaswamy, a co-creation process comprises four building blocks to start with: *D*ialogue, *A*ccessibility, *R*isk, *T*ransparency. In addition, the *four dimensions of choice* offer different options to individualize the co-creation experience of consumers or customers.
Managing the co-creation of value (Payne, Storbacka, & Frow, 2008) Payne, Storbacka and Frow developed a conceptual framework, which was progressively refined over the course of three workshops and interviews with senior managers. The outcome should meet the needs of a practical and robust process-based framework for value co-creation. Therefore, the conceptual framework has three main components: i) customer value creating processes, ii) supplier value creating processes and iii) encounter processes.
Six tips for running a co-creation project (Lam, 2013) According to Lam, six aspects should be considered when setting up a co-creation project: i) set clear (but not too restrictive) objectives, ii) prepare for "bad data" and outliers, iii) recruit the right mix of people, iv) offer appropriate incentives, v) get a buy-in from other stakeholders and vi) have a plan of action for what happens after the co-creation project.
Value co-creation framework (Frow & Payne, 2011) Frow and Payne proposed a five-step framework for getting co-creation right: i) identify stakeholders, ii) determine core values, iii) facilitate dialogue and knowledge sharing, iv) identify value co-creation opportunities and v) co-create stakeholders' value propositions. The process is iterative and recursive with each step, potentially impacting the other steps. The steps involve sensing, monitoring and feedback and integrating knowledge with other resources. The resulting co-created value propositions represent a tangible mechanism for mutually co-creating value shared among stakeholders.
Value Proposition Builder (Barnes, Blake, & Pinder, 2009) The Value Proposition Builder is a six-step iterative process: i) market analysis (the specific group of customers you are targeting), ii) value experience (benefits minus costs, as perceived by customers), iii) offerings (the product/service mix you are selling), iv) benefits (how your offering delivers clear customer value), v) alternatives and differentiation (how you are different from and better than others) and vi) proof (substantiated credibility and believability of your offering).
Value Proposition Canvas (Osterwalder et al., 2014) Based on Osterwalder's basic Business Model Canvas, the Value Proposition Canvas focuses on two elements of the BMC: Value proposition and customer segment. The goal is to address needs or problems in the customer segment by tying it to the value proposition.

the fear of sudden infant death syndrome (SIDS), of which the risk is highest during the baby's first year, as a core value of the parents. *Owlet* creates value by alleviating the parents' fear. *Owlet* developed their products through an interactive and iterative process with their customers (*Facilitate Dialogue and Knowledge Sharing between Stakeholders and Identify Value Co-Creation Opportunities*). For that reason, customers were interviewed to determine desired product functions and their willingness to pay. A landing page was developed to show how the product works and test how users provided information about their product usage habits. The feedback allowed the company to develop their product further and ensure that the product fulfils the following criteria: simple to use and inspiring comfort and trust (*Co-Create Stakeholder Value Propositions*). (Osterwalder et al., 2014)

By running the micro-cycle (job-pain-gain) several times, *Owlet* developed their offering and final products (Owlet Baby Care, 2017):

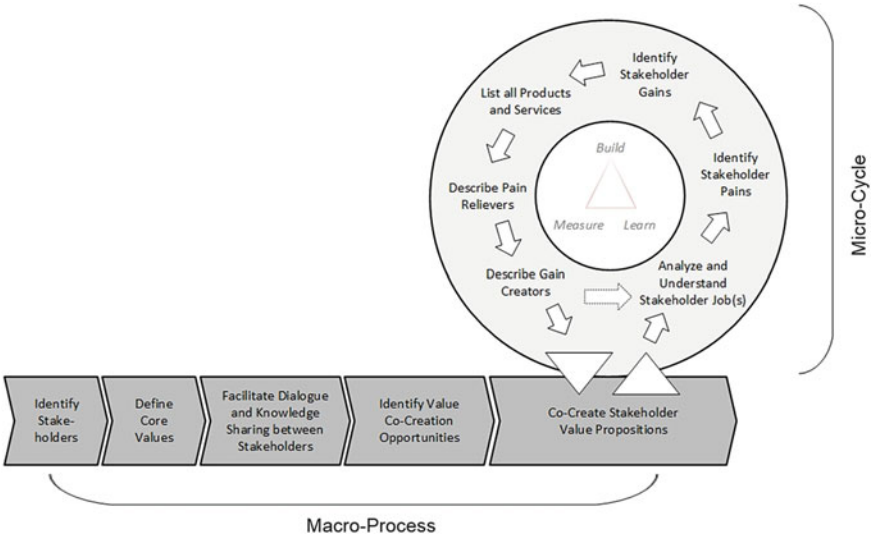


Fig. 2 A process model for value proposition co-creation (authors' own illustration)

- *Owlet* provides products that allows parents to monitor their babies heart rates and oxygen levels.
- *Owlet* provides products (Smart Sock™ sensor, Base Station and *Owlet* App) that give insights into the babies' health and wellbeing. They also educate parents on safe sleep practices as well as how to raise healthy babies.
- Sleep data are shared with health care professionals around the world.

Within the micro-cycle, the constant interaction with the customer helped the company further develop the value proposition. For example, the initial app made parents feel anxious, because they watched the numbers moving up or down. This was not the case with the latest version based on data from 300 testers who used the devices for over 20,000 hours. Parents became accustomed to seeing the numbers and stopped monitoring the app all the time. (Mobile Marketing Association, 2016).

In conclusion, *Owlet* has developed a product by closely working together with customers to create a value proposition that is simple to use and inspires comfort and trust (*Owlet Baby Care,* 2017).

5 Implications for Management

The co-creation of value proposition is a desirable goal, as it can help firms highlight the customers' or consumers' points of view and improve the front-end process of identifying customers' needs and requirements. The core idea of co-creation of value proposition is that companies can produce goods, services and experiences that have

unique value by involving customers, suppliers and other stakeholders in a process of continuous innovation. Instead of encapsulating and defending their unique capabilities, firms should compete by expanding their value chain beyond traditional functions and processes—from the R&D process to marketing and sales. Co-creating products or services together allows both parties to detect market failures quicker and find creative ways to address customers, giving co-creation applicants a competitive advantage.

Managers are well-advised to foster the potential benefits of co-creation. As our examples have shown (in agreement with Verleye, 2015), the benefits of the co-creation of value proposition encompasses hedonic benefits (having pleasurable experiences), cognitive benefits (acquiring new knowledge/skills), social benefits (being able to connect with other people), personal benefits (gaining a better status and recognition), pragmatic benefits (creating solutions to more effectively meet personal needs) and economic benefits (achieving compensation according to efforts made). To stimulating co-creation of value proposition from a managerial perspective, one needs to pursue certain activities: identify stakeholders, determine their core values, analyse value co-creating opportunities with stakeholders and start co-creating the value proposition. A deep understanding of the stakeholders' jobs, their pains and gains, potential pain relievers and gain creators is essential. Examples given in this chapter should help managers achieve success.

Although the chapter highlights the advantages of value proposition co-creation for the management, it needs to be stated that the presented framework and process are conceptual in nature. To develop measures for the management, an empirical study needs to be undertaken to provide more conclusive support for these ideas.

6 Conclusion

Co-creation of products and services has become a relatively powerful source of competitive advantage. By combining co-creation with the concept of value proposition, companies have the potential to take advantage of interactions beyond the classical interactions between stakeholders along the value chain. When value is co-created, companies can incorporate the customers' points of view and identify the customers' needs and requirements. The customers co-create value by using the products and services through the integration and application of resources. Through this interactive process of value creation, customers and other stakeholders become co-creators of the firms' value propositions, which represent the promised value to be delivered to the customers.

The goal of this chapter was to provide an overview of the value proposition co-creation concept and describe the concept using practical examples. For the hands-on application of the concept, we elaborated a process of value proposition co-creation. Taking both together, the process and the examples, we have provided practitioners with a set of options that they can use to improve their competitive advantage.

References

Barnes, C., Blake, H., & Pinder, D. (2009). *Creating and delivering your value proposition: Managing customer experience for profit*. London: Kogan Page Limited.

Cesarotti, V., Giuiusa, A., Kwan, S. K., Introna, V., & Spohrer, J. (2014). Designing multichannel value propositions to enhance value-cocreation phenomenon. *International Journal of Service Science, Management, Engineering, and Technology, 5*(1), 14–44. https://doi.org/10.4018/ijssmet.2014010102.

Frow, P., & Payne, A. (2011). A stakeholder perspective of the value proposition concept. *European Journal of Marketing, 45*(1–2), 223–240. https://doi.org/10.1108/03090561111095676

Gouillart, F. (April 2011). Experience co-creation. *Harvard Business Review*, 10–13. Retrieved April 12, 2018, from https://hbr.org/2011/04/experience-co-creation

Grönroos, C. (2008). Service logic revisited: Who creates value? And who cocreates? *European Business Review, 20*(4), 298–314. https://doi.org/10.1108/09555340810886585

Kohtamäki, M., & Partanen, J. (2016). Co-creating value from knowledge-intensive business services in manufacturing firms: The moderating role of relationship learning in supplier–customer interactions. *Journal of Business Research, 69*(7), 2498–2506. https://doi.org/10.1016/j.jbusres.2016.02.019

Kohtamäki, M., & Rajala, R. (2016). Theory and practice of value co-creation in B2B systems. *Industrial Marketing Management, 56*(2016), 4–13. https://doi.org/10.1016/j.indmarman.2016.05.027

Lam, L. (2013). *6 tips for running a co-creation project*. Retrieved April 12, 2018, from http://www.visioncritical.com

Mobile Marketing Association. (2016). Retrieved April 12, 2018, from http://www.mmaglobal.com/case-studyhub/case_studies/ view/36587

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers*. Hoboken: Wiley.

Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2014). *Value proposition design: How to create products and services customers want*. Hoboken, NJ: Wiley.

Owlet Baby Care. (2017). Retrieved April 12, 2018, from http://www.Owletcare.com/

Payne, A., & Frow, P. (2014). Developing superior value propositions: A strategic marketing imperative. *Journal of Service Management, 25*(2), 213–227. https://doi.org/10.1108/JOSM-01-2014-0036

Payne, A., Frow, P., & Eggert, A. (2017). The customer value proposition: Evolution, development, and application in marketing. *Journal of the Academy of Marketing Science, 45*(2017), 467–489. https://doi.org/10.1007/s11747-017-0523-z

Payne, A., Storbacka, K., & Frow, P. (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science, 36*(1), 83–96. https://doi.org/10.1007/s11747-007-0070-0

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing, 18*(3), 5–14. https://doi.org/10.1002/dir.20015

Roser, T., DeFillippi, R., & Samson, A. (2013). Managing your co-creation mix: Co-creation ventures in distinctive contexts. *European Business Review, 25*(1), 20–41. https://doi.org/10.1108/09555341311287727.

Stähler, P. (2002). *Geschäftsmodelle in der digitalen Ökonomie. Merkmale, Strategien und Auswirkungen*. Lohmar: Josef Eul Verlag.

Siltaloppi, J., & Vargo, S. L. (2014). Reconciling resource integration and value propositions – The dynamics of value co-creation. In *47th Hawaii International Conference on System Science, Big Island, Hawaii, 6-9 January 2014* (pp. 1278–1284). https://doi.org/10.1109/HICSS.2014.165.

Truong, Y., Simmons, G., & Palmer, M. (2012). Reciprocal value propositions in practice: Constraints in digital markets. *Industrial Marketing Management, 41*(2012), 197–206. https://doi.org/10.1016/j.indmarman.2011.11.007

Vargo, S. L., & Lusch, R. F. (2008). Service-dominant logic: Continuing the evolution. *Journal of the Academy of Marketing Science, 36*(1), 1–10. https://doi.org/10.1007/s11747-007-0069-6

Vargo, S. L., & Lusch, R. F. (2016). Institutions and axioms: an extension and update of service-dominant logic. *Journal of the Academy of Marketing Science, 44*(1), 5–23. https://doi.org/10.1007/s11747-015-0456-3

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European Management Journal, 26*(2008), 145–152. https://doi.org/10.1016/j.emj.2008.04.003

Verleye, K. (2015). The co-creation experience from the customer perspective: Its measurement and determinants. *Service Management, 26*(2), 321–342. https://doi.org/10.1108/JOSM-09-2014-0254

Stefan Vorbach is professor at the Institute of General Management and Organization at Graz University of Technology. His research concentrates on topics including: innovation and technology management, particularly business model innovation, strategic management, entrepreneurship and intrapreneurship.

Christiana Müller is assistant professor at the Institute of General Management and Organization at the Graz University of Technology. In her research she focuses on business model innovation and development under the aspect of increasing digitization.

Elisabeth Poandl is a research and teaching assistant at the Institute of General Management and Organization at Graz University of Technology. Within the research fields of the institute her major interests focus on entrepreneurship and business model innovation.

Blockchain-Enabled Open Business Models: New Means to Shared Value Capturing?

Robin P. G. Tech, Jonas Kahlert, and Jessica Schmeiss

1 Introduction

Open value creation, or open co-creation, have been discussed and implemented for nearly two decades (Chesbrough, 2003; Prahalad & Ramaswamy, 2004). The effect of openness on business models is said "to enable an organization to be more effective in creating as well as capturing value" (Chesbrough, 2007) and to be "the secret sauce to success" (Crandell, 2016). It seems as if opening one's business model can act as a cure for virtually any firm that struggles to innovate. General Electric for example partnered with the co-creation startup Local Motors to design next generation turbines. Lego is continuously crowdsourcing ideas for new models. DHL invites its customers to innovation centers so that they can help improve the logistics company's processes and co-create new products—such as the DHL delivery drone. To summarize: Open business models (OBMs) are on the upswing.

The problem is that it is mainly, if not exclusively, the value creation part that is open and collaborative. An open and shared value capturing—for example, the sharing of profits made from co-created projects—is long in coming. Various scholars have pointed this out (Frankenberger, Weiblen, & Gassmann, 2014; Soloviev et al., 2010; Tech, Neumann, & Send, 2017; Weiblen, 2014). But it seems that academia and practice see little feasibility in sharing captured value in a manner comparable to the value creation. Soloviev et al. (2010), for example, conclude that

R. P. G. Tech (✉)
Berlin Social Science Center, Berlin, Germany
e-mail: robin@atomleap.com

J. Kahlert
Google, Zurich, Switzerland

J. Schmeiss
University of Potsdam, Potsdam, Germany
e-mail: jessica.schmeiss@hiig.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_6

"the open business model gives too weak opportunities for collecting profits" (p. 693) and thus requires closed business model components for appropriation activities.

We want to use this chapter to start a discussion on new ways to enable open value capturing. The means we identified is called blockchain technology. Blockchain technologies, especially tokenized business models, greatly reduce market entry barriers for individuals to participate in value creation and capturing. Other blockchain technologies, such as smart contracts, reduce information asymmetries and transaction costs, and may therefore enable truly open business models. The disruptive potential of blockchain technology is considerable. In this chapter, we explore its impact from a theoretical perspective and give practical examples of today's implementations.

2 Background

2.1 Information Asymmetries Enable Monopolistic Business Models

Leland and Pyle (1977) concluded that "[n]umerous markets are characterized by informational differences between buyers and sellers" (p. 371). We have little reason to believe that this situation fundamentally changed in recent years. Quite the contrary, we assume that many business models today heavily rely on exploiting information and power asymmetries. Oftentimes, these business models are enabled by monopoly or oligopoly market situations. Thought leaders such as Peter Thiel—the co-founder of *PayPal* and first outside investor into *Facebook*—even advises startups to focus on creating business models that grant them a monopoly and to defend this monopoly by all means. In his view, the "[m]onopoly is the condition of every successful business" (Thiel, 2014, p. 34). Essentially, a monopoly's appeal stems from the fact that firms can reap so-called monopoly rents and larger profits.

But how do businesses establish monopolies through information asymmetries? To answer this question, we take up the new institutional economics (NIE) perspective. NIE assumes that human beings are bounded in their rationality and ability to retrieve and process information. It also assumes that intransparency and information asymmetries exist in most exchange relationships. Additionally, many business models are, willingly or unwillingly, complex. Complexity is regarded "a proxy for transaction costs" (Novak & Eppinger, 2001) and is a major influencer of transactional relationships and costs (Grover & Saeed, 2007).

Non-transparency and complexity lead to information asymmetries between buyers and sellers. Transaction costs are, among others, incurred by governance mechanisms that are put in place to exert control and establish trust between parties. These often-costly mechanisms also attempt to reduce monopoly and information rents. Compared to a theoretical optimum, this can be regarded as deadweight and thus economically inefficient. Generally speaking, transaction costs are thought to arise whenever institutions are created, maintained, and changed through contractual

agreements, which in turn are "unavoidable incomplete" (Williamson, 2000). Arrow (1969) even argued that transaction cost economics is "the theory of resource allocation in general" (p. 48).

2.2 What Is a Blockchain?

The Italian traders who founded Western capitalism started with books of lists, or ledgers, which tracked the cargo they sent out and the gold they brought in (Di Stefano, 2017). By becoming the primary infrastructure for keeping track of things, ledgers are a key foundation of modern capitalism (Weber, 1981). Today's digital ledger documents keep a record of account balances, land title registrations, copyrights, or votes—thus establishing a reliable record of ownership and asset flows and support for complex contractual agreements (Werbach, 2016).

A blockchain is a form of an electronic distributed ledger or database. Consequently, the list of facts the blockchain aims to keep track of (i.e., the ledger) is not stored in one central database. Rather, an instantiation of the same ledger is maintained by each node of the network (Wattenhofer, 2016). A blockchain is logically centralized; there is only one ledger. But organizationally speaking, the blockchain data is stored in a decentralized manner, as many entities in the network maintain a copy of the same ledger (Werbach, 2016).

The core value of blockchain technology stems from a decentral consensus mechanism which employs modern cryptographic technology. This mechanism allows all participants to be confident that what they see is accurate and consistent with the rest of the network without having to rely on a trusted third party or escrow. In contrast, in centralized systems, such as our modern banking system, central entities—banks for example—enable transactions by acting as the trusted third party, being, de facto and de jure, the single point of truth in case of disputes. By providing the technical foundation to transact value directly peer-to-peer, without a trusted third party, blockchain technology is expected to pave the way to enable a future decentral peer-to-peer economy, in which any kind of value can be transferred more cost-effective and more securely, than today. A more official definition of the key value of blockchain technology can be thought as:

> Blockchain technology allows parties who don't fully trust each other to come to a consensus about the existence and evolution of a set of shared facts without having to rely on a trusted third party. (Source: Adapted from MultiChain, 2016).

2.3 What Are Smart Contracts?

Traditional contracts define the rules and penalties around an agreement. Smart contracts, which can be implemented in newer blockchain variants such as *Ethereum* (Omohundro, 2014) do not only define the rules and penalties but also automatically

enforce those obligations, if they can be electronically enforced. In theory, any application or automated transaction that runs on a conventional computer can be executed on the distributed computer of its consensus network. In a blockchain, the collective power of the network ensures that the program code or the rules are executed in the exact same way as agreed beforehand by all parties, which makes the involvement of a third party to monitor and ensure the execution of the rules or the program logic redundant (Wright & De Filipi, 2015). Consequently, what smart contracts offer to do is reduce the ambiguity of contracts. Reduced ambiguity is important for parties who do not trust each other, as it reduces the possibility of the counterparty reinterpreting the contract clauses (Kaulartz & Heckmann, 2016).

2.4 What Are the Key Characteristics of Blockchain Technology and How Do They Work?

We will only describe very briefly the technical mechanisms behind blockchain technology. For a more detailed explanation, for technical-minded readers, please refer existing excellent sources, such as Kaulartz and Heckmann (2016) or Werbach (2016).

Public blockchains such as *Bitcoin* or *Ethereum* are immutable, incorruptible, non-permissioned, and transparent. These core attributes are central for blockchains' key value to provide a basis for transactions for parties that do not have to trust each other.

All data on transactions in a blockchain is *immutable* by design. The data is stored in a chain of blocks—that is why it is called blockchain—and each block contains a checksum of the previous block. The checksum of the next block is then calculated out of the checksum of the previous block, which is inherently linked to the checksum and the data of all previous blocks. Consequently, even a minor change somewhere in the data or the transactions is reflected in a different checksum. With the help of this inherently linked chain of blocks, blockchain technologies ensure that data has not been tampered with and do not allow any change in an existing chain of blocks.

How can one be sure that the blockchain stays intact and is never tampered with and is *incorruptible*? The obvious answer is a voting system among all nodes. If an inconsistency is detected, all nodes might be asked for their version of the truth, resolving the inconsistency. The consensus system protects against untrustworthy parties if the majority of the system is honest (Nakamoto, 2008).

Nevertheless, an attacker could potentially create enough nodes to dominate the network and impose its own false consensus. This challenge is well-known in cryptography and referred to as the Byzantine Generals Problem (Lamport, Shostak, & Pease, 1982). The architecture of the blockchain protocol solves this issue by making voting expensive. In a blockchain, nodes that wish to have their version of the truth considered by the network must engage in a process known as mining, through which they validate and establish consensus over chunks of transactions (Wright & De Filipi, 2015). In this process, nodes have to solve a cryptographic

puzzle as a proof of work, which requires expensive computing hardware and even more expensive electricity (Bonneau et al., 2015; Crosby et al., 2015; Hasse et al., 2016; The Economist, 2015). Even if an attacker decided to create enough nodes to impose a false consensus on the network, the mining costs for this attack would outweigh the potential benefits in most cases (Nakamoto, 2008; Wright & De Filipi, 2015). To incentivize nodes to engage in the mining processes, each successful miner is paid with the underlying digital currency or tokens (Peck, 2015). Hence, the blockchain protocol is designed in such a way that the benefits of cheating are far outweighed by the costs.

An immutable and incorruptible chain of transactions is important because repeated transactions are the core mechanism for creating reputation and, in turn, trust. Immutable in this context means not only that the content of the transactions is protected against manipulation, but also that the order of the transactions is fixed and cannot be modified, since they are stored in a chain of blocks. In a blockchain, all transactions are fully visible to all nodes, and there is only one consensus ledger mirrored across every machine on the network (Werbach, 2016). Hence all information in a blockchain is *transparent*.

In public blockchains, anyone with access to Internet and a device can participate. Access is unlimited. The *non-permissioned* nature of the process is important because it allows everyone to participate with no room for direct discrimination. Moreover, non-limited access to the blockchain is also important because there is consequently no need to trust a central authority that decides on permissions. Besides public blockchains, there are other deployment options, such as private blockchains or consortium blockchains. Private blockchains are like any internal system with permissions for participation and read/write access (Kaulartz & Heckmann, 2016). Consortiums are access and permissions controlled by pre-selected set of nodes (Kaulartz & Heckmann, 2016).

2.5 What Are Business Models?

The business model is still an emerging concept with various scholarly definitions and conceptualizations (Foss & Saebi, 2017; Wirtz et al., 2016). One of the most widely recognized definitions by Teece (2010) states that the "essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit" (Teece, 2010, p. 172). Essentially, it is the way a firm *communicates, creates, and captures value*.

In this context, business models are understood as a system of interrelated activities that expands beyond the firm's boundaries and allows firms to exploit business opportunities (Zott & Amit, 2010). Activity systems both within the firm and across its boundaries are complex, exploratory, and dynamic by definition because they are highly interrelated (Massa, Tucci, & Afuah, 2016; Osiyevskyy & Dewald, 2014; Tikkanen, Lamberg, & Parvinen, 2005). It is through its system of activities that a firm creates and captures value (Teece, 2010). *Value creation* refers to the way a firm creates value along its value chain (Achtenhagen, Melin, & Naldi,

2013; Amit & Zott, 2001) through its available resources and capabilities (Clauss, 2016; Spieth, Schneckenberg, & Matzler, 2016). *Value capture* describes the way a firm converts its value creating activities into profits and how it distributes these profits (Clauss, 2016; Teece, 2010; Zott & Amit, 2010).

2.6 What Are Open Business Models (OBM)?

Openness within a business model enables a firm to create and capture value more effectively through collaborations with external partners (Chesbrough, 2007; Holm, Günzel, & Ulhøi, 2013). As highlighted by Chesbrough (2007), open innovation and business models are closely intertwined. According to Chesbrough and Bogers (2014), open innovation refers to "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model" (p.17). Thus, firm boundaries become more permeable. The locus of innovation moves from an internal location to a location within a network of external partners (Chesbrough & Schwartz, 2007; Huizingh, 2011; West & Bogers, 2014). Innovation emerges because of knowledge flows within this network (Enkel, Gassmann, & Chesbrough, 2009).

Openness within a business model is defined, first, as the level of co-creation in the firm's business model, that is, the way external knowledge is identified. Second, the extent to which activities within the business model need to be relinked determines how knowledge flows and diffuses. Last, openness is facilitated by governance mechanisms that apply to both external and internal actors. These mechanisms allow for the integration of external knowledge to create and effectively capture value (Saebi & Foss, 2015). Frankenberger et al. (2014) and Tech et al. (2017) identify five idiosyncratic attributes of OBMs that support this high-level view on OBMs. First, OBMs facilitate joint value creation through circular collaboration. Second, OBMs require a carefully managed network of internal and external partners, resources, and activities. Third, this carefully managed network also opens up new possibilities for potential partners that would not be considered otherwise. Fourth, OBMs are currently focused on value creation, while value capture mechanisms are often not clearly defined and implemented. Last, in line with Saebi and Foss (2015), openness is described a continuum, in particular when it comes to value capture mechanisms. As Soloviev et al. (2010) state: "the open and proprietary business models cannot exist in the pure form [because] the proprietary business model gives very little space for innovation, while the open business model gives too weak opportunities for collecting profits." (p. 693).

A key success factor for OBMs is thus having strict governance mechanisms to execute value creation and value capture mechanisms. While governance mechanisms on the value creation side have been studied at length, little is known about how to manage and govern value capture mechanisms within OBMs due to a number of reasons (Frankenberger et al., 2014; Kohler & Nickel, 2017; Tech et al., 2017). First, *transaction costs* are high due to a complex and dynamic collaborative

network. Second, *entry barriers* for participating in OBMs are often high and regulated strictly by specific parameters. It may thus be hard to scale the network of participants enough to achieve a critical mass for capturing value. Third, it is often challenging to *incentivize and compensate* participants in a quick and transparent way, which may lead to a lack of motivation for both internal and external partners. The following case studies exemplify possible ways to cope with these problems.

3 Case Studies

3.1 Case 1 | *Ethereum*: An Open, Virtual, and Decentral Computer

The Technology
The first case we examine is *Ethereum*. Simply put, *Ethereum* is a virtual and decentralized computer that utilizes its own blockchain. It can be used to codify, decentralize, secure, and trade assets and dispositions. With Ethereum, one can codify representations of virtually any asset. More importantly, though, the computer-like properties make *Ethereum* a foundation for other (decentralized) software. This means that it can be used to build other blockchain products on top of Ethereum.

Example
AXA—an international insurance company—recently launched a product that uses the *Ethereum* blockchain. The product is a flight delay insurance that users can buy from *AXA*. Multiple properties of the contract are then stored on a publicly available and decentralized ledger for anyone to see. To reduce transaction costs for all parties, the insurer's product uses so-called smart contracts. These smart contracts—an inherent feature of the *Ethereum* technology—execute automatically whenever pre-specified criteria are met. In the case of *AXA*, this is a flight delay of more than two hours. If this mark is passed, the insurance automatically compensates the client.

Business Model Elements
Adding to the relative ease of setting up services and products on top of the *Ethereum* blockchain, it is also possible to create new digital tokens or crypto currencies that use *Ethereum* only as a basis for more sophisticated decentralized software. So far, we have seen projects focusing on decentralized cloud storage (*FileCoin*, *Storj*), digital advertising (*Basic Attention Token*, *adToken*), and even one specifically for dentists (*DentaCoin*). All projects that use *Ethereum* also require so-called *Ether*.

Ether is a digital token that has three key functions: (1) It is used to assign value to asset representations on the blockchain, (2) it is an exchange medium, and (3) it compensates participants of the virtual and decentralized computer who provide computational power and data storage. Transactions are verified by participants in this system and new *Ether* is minted to reward them for their work.

These participants—or nodes as they are also called—create value. They enable the *Ethereum* network and decentralize it. The barrier to entry and to participate is

comparatively low. In its simplest form, it requires an internet connection, a computer, and a special software that can be installed like any other software. Participation is thus non-permissioned. Contributing individuals or groups of people benefit from their work in two ways.

For one, they are directly compensated for every transaction they successfully verify. The *Ether* tokens they receive can be exchanged for national currencies, described as fiat. As we previously discussed, token transfer and exchange for fiat is very inexpensive when compared to traditional ways of exchanging currencies.

On top of this direct compensation, participants gain from the increasing value of *Ether*. With every increase in *Ethereum* usage, demand for *Ether* grows, thus driving prices up. While the amounts of newly minted *Ether* to pay nodes decrease over time—thus keeping transaction fees low—the price of a single token increases. Participants could hold on to their *Ether*, buy *Ether* it from exchanges, and use it as an investment asset that is easy to acquire.

3.2 Case 2 | Music Industry: New Digital Music Markets

The Technology

The second case we look at is the music industry. Many new blockchain startups have sought to disrupt this 130-billion-dollar industry. Smart contracts (mostly *Ethereum*-based) and *Bitcoin*-based platforms are being used to redefine how value is captured in the music industry. One of the biggest issues for artists in the music industry is that they have little to no information about how their royalty payments are calculated, and don't get access to valuable aggregate data about how and where people are listening to their music.

Examples

Bittunes is an independent digital music market with a special focus on independent bands, typically those who directly own the copyright and are not represented by a larger company or an agent. The platform provides music makers with the possibility of receiving royalties directly whenever a music sale takes place. Moreover, royalties are also shared to "music movers", an alternative distribution channel. They are paid in bitcoins relative to the percentage of digital data they contributed to the upload to the new purchaser of the music track. The artists are paid in bitcoins.

UjoMusic, another key blockchain player, is using smart contracts based on the *Ethereum* blockchain. It allows artists to manage their identities, music and licensing on their own terms. Smart contracts running on the *Ethereum* blockchain are then used to execute the contracts among artists and potential buyers. Buyers can pay with the *Ethereum* tokens to purchase the music according to the pre-defined terms.

SingularDTV develops an entertainment app ecosystem on top of *Ethereum* blockchain allowing artists to transform their intellectual property into financial assets.

Business Model Elements
New ways of value capturing enabled by blockchain technology are paving the way towards more sophisticated and transparent earning schemes in the music industry.

A blockchain can also be used to trigger micro-payments both to artists and any other contributing party. By providing a foundation for micro-payments, Blockchain technology opens up new revenue mechanism.

Smart contracts are used to trigger an agreement for everyone involved, for example, as soon as a song is played or downloaded. The recipient could be anyone involved, from a digital service provider (e.g., *Spotify* or *iTunes*), a radio station, to a film production crew. Digital identities, an integral part of each blockchain, can then ensure that the right licensing schemes are used for each party.

Based on platforms such as *Ethereum* artists can "tokenize" their intellectual property, turning it into a financial asset. Hence, the value of an artist's token reflects the economic value of her creative output. This allows anyone to buy "shares" in the creative output and the revenue streams of an artist.

3.3 Case 3 | Vehicle DAO: Vehicles that Own Themselves

The Technology
The last case we examine is from the mobility sector. This sector is highly dependent on physical assets and requires a myriad of firms to work together. With the advent of blockchain technology, in particular *Ethereum*-based blockchain projects, centralized organizations may be replaced by so-called decentralized autonomous organizations (DAOs). A DAO can be thought of as a higher form of the previously mentioned smart contracts (cf. DAO white paper n.d.). Bylaws of such organizations are embedded in complex sets of smart contracts. The DAO is governed by these smart contract sets and can therefore operate autonomously.

Example
A French startup called *Mobotiq* aims to create one of the first mobility DAOs. *Mobotiq*'s plan is to disintermediate multiple stakeholders of urban mobility value chains and to replace them with one decentral and autonomous organization. Ride-hailing and passenger matching, payment, identity management, and so forth are to be governed by the *Mobotiq* DAO. Aptly, the token that the company wants to use for all this is called *Mobotiq* Token. This token can be acquired by contributors and funds the creation of the DAO, and the development and expansion of its mobility service—including the acquisition of vehicles. The token is also intended to be used to pay for transactions on the blockchain, thus ensuring that the service is kept secure and logs become immutable.

Business Model Elements
With respect to a mobility DAO, value capturing can occur in multiple ways. The most direct implementation is a profit sharing scheme, i.e., *Mobotiq* token holders receive a predefined share of turnover or profit. With each trip, a percentage of the

payment is distributed among contributors corresponding to each token holder's share. There may also be a voting system to let token holders decide what the DAO should do with the funds it earned—buy new vehicles, expand into new areas, and so forth.

Another possible implementation is that of an earn out scheme. The DAO has a codified process to buy back tokens from contributors with the profits it has made; and continues to do so until all token holders are paid out. Ultimately the DAO would not only govern itself but also own itself.

4 Discussion and Conclusion

In this chapter, we gave a glimpse of the impact blockchain technologies already have on value capturing and distribution. *Ethereum*, insurance smart contracts, innovative music industry products, and the mobility startup *Mobotiq* are examples of open, codified, and decentralized value creation and capturing systems. Value creation occurs either indirectly and internally through token price increases, directly and internally within the system through mining, or directly and externally, that is outside of the system through revenue generation.

We showed that through blockchain technology—and smart contracts in particular—value capturing processes are made highly transparent. A lack of transparency in terms of value distribution—as identified by Kohler and Nickel (2017) and Tech et al. (2017)—are overcome as allocation formulas are codified and made more accessible. The notion that truly OBM are not feasible due to overly high transaction costs does not hold anymore. Monitoring and control mechanisms—traditionally deadweight loss centers—are being replaced with smart contracts. Decentrality and peer-to-peer networks facilitate trust and enable distributed, immutable, and incorruptible ledgers (cf. Table 1).

A key property of most blockchain-based projects is that they are non-permissioned. All three cases we discussed above display low entry barriers for new participants. Blockchain-based organizations thus allow contributors and investors to be included earlier and on a wider basis than in traditional firms. Token sales or so-called initial coin offerings (ICOs) oftentimes allow virtually anyone to take part (cf. Table 1). Token stakes in a DAO, for example, are equivalent to stock but with greatly reduced complexity and transaction costs to monitor and participate in the organization. This enables access for and openness to a much more diverse group of stakeholders with (potentially) democratizing effects on value capturing and distribution.

But entry barriers still exist—for example, online exchanges are necessary to acquire tokens—and highly volatile crypto-currency ecosystems increase rather than decrease information asymmetries at the moment. Search costs are thus very high. This is likely to remain true for the foreseeable future, as blockchain technologies do not eliminate all transaction costs. They may even increase search, information, and bargaining costs because the technology itself is so new and oftentimes difficult to understand. Additionally, other hurdles of value capturing remain. For a firm it is still necessary to identify and sort out the suitable external

Table 1 OBM problems and blockchain solutions

Problem open value capturing and distribution	Mechanism to solve problems	Why is blockchain of help
Many OBM not viable because of high transaction costs (esp. governance costs) of capturing and distribution processes	Peer-to-peer network, smart contracts	Distributed, immutable, incorruptible ledger decreases need for trusted third parties for policing and enforcement.
High entry barriers for participants (e.g., social networks and wealth required)	Non-permissioned token sales and ICOs	Non-permissioned
Difficult to incentivize participants, due to lack of transparency in compensation mechanisms	Decentrality, peer-to-peer network, smart contracts	Information is publicly available, transparency

stakeholders to collaborate with and to ensure absorptive capacities within the firm. Lastly, there are major technical issues to overcome. Due to erroneous code, the first DAO, for example, was swiftly hacked after raising more than 150 million dollars via a token sale.

Monopoly and information rents—major success factors for many firms—will likely continue to exist for the most part. But the level of transparency and the ease of information retrieval within blockchain systems is bound to change the status quo of how firms create and capture value. Traditional profit distribution processes are affected by information asymmetries that necessitate governance, monitoring, and control mechanisms leading to deadweight loss. Blockchain-based and codified distribution mechanisms, on the other hand, yield maximum transparency on who holds which share and when. The decentrality and immutability of the system further ensures trust and take away the need for control mechanisms.

Ten years after the first whitepaper on bitcoin, blockchain technologies, projects, and organizations are still in their infancy. Regulation remains a major uncertainty with respect to future blockchain developments. As governments and the public recognize the scale of systems such as *Ethereum*, regulation and creative input will most likely fuel and accelerate the future development of blockchain technologies.

References

Achtenhagen, L., Melin, L., & Naldi, L. (2013). Dynamics of business models-strategizing, critical capabilities and activities for sustained value creation. *Long Range Planning, 46*(6), 427–442.

Amit, R., & Zott, C. (2001). Value creation in e-business. *Strategic Management Journal, 22*(6–7), 493–520.

Arrow, K. J. (1969). Classificatory notes on the production and transmission of technological knowledge. *The American Economic Review, 59*(2), 29–35.

Bonneau, J., Miller, A., Clark, J., Narayanan, A., Kroll, J. A., & Felten, E. W. (2015, May). Sok: Research perspectives and challenges for bitcoin and cryptocurrencies. In *Security and Privacy (SP), 2015 IEEE Symposium* (pp. 104–121).

Leland, H. E., & Pyle, D. H. (1977). Informational asymmetries, financial structure, and financial intermediation. *Journal of Finance, 32*(2), 371–387.

Crandell, C. (June 2016). Customer co-creation is the secret sauce to success. *Forbes*. Retrieved April 12, 2018, from https://www.forbes.com/sites/christinecrandell/2016/06/10/customer_cocreation_secret_sauce/#26bf0b3e5b6d

Chesbrough, H. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.

Chesbrough, H. (2007). Business model innovation: It's not just about technology anymore. *Strategy and Leadership, 35*(6), 12–17.

Chesbrough, H., & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), *New frontiers in open innovation* (pp. 3–28). Oxford: Oxford University Press.

Chesbrough, H., & Schwartz, K. (2007). Innovating business models with co-development partnerships. *Research-Technology Management, 50*(1), 55–59.

Clauss, T. (2016). Measuring business model innovation: Conceptualization, scale development, and proof of performance. *R&D Management, 47*(3), 1–19.

Crosby, M., Nachiappan, N., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2015). *Blockchain Technology: Beyond Bitcoin*. Retrieved from: http://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf

DAO white paper. (n.d.). Retrieved April 12, 2018, from https://download.slock.it/public/DAO/WhitePaper.pdf

Di Stefano, J. N. (2017). *Blockchain: 'A novel solution to the problem of trust' beyond Bitcoin*. Phillynews.com. Retrieved January, 07, 2018, from http://www.philly.com/philly/blogs/inq-phillydeals/Blockchain-.html

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R and D and open innovation: Exploring the phenomenon. *R&D Management, 39*(4), 311–316.

Foss, N. J., & Saebi, T. (2017). Fifteen years of research on business model innovation. *Journal of Management, 43*(1), 200–227.

Frankenberger, K., Weiblen, T., & Gassmann, O. (2014). The antecedents of open business models: An exploratory study of incumbent firms. *R&D Management, 44*(2), 173–188.

Grover, V., & Saeed, K. A. (2007). The impact of product, market, and relationship characteristics on interorganizational system integration in manufacturer-supplier dyads. *Journal of Management Information Systems, 23*(4), 185–216.

Hasse F., von Perfall A., Hillebrand T., Smole E., Lay L., & Charlet M. (2016). *Blockchain: An opportunity for energy producers and consumers?* Retrieved from https://www.pwc.com/gx/en/industries/assets/pwcblockchainopportunity-for-energy-producers-and-consumers.pdf

Holm, A. B., Günzel, F., & Ulhøi, J. P. (2013). Openness in innovation and business models: Lessons from the newspaper industry. *International Journal of Technology Management, 61*(3/4), 324–348.

Huizingh, E. K. R. E. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*(1), 2–9.

Kaulartz, M., & Heckmann, J. (2016). Smart contracts – Anwendungen der Blockchain-Technologie. *Computer Und Recht, 32*(9), 618–624.

Kohler, T., & Nickel, M. (2017). Crowdsourcing business models that last. *The Journal of Business Strategy, 38*(2), 25–32.

Lamport, L., Shostak, R., & Pease, M. (1982). The byzantine generals problem. *ACM Transactions on Programming Languages and Systems, 4*(3), 382–401.

Massa, L., Tucci, C., & Afuah, A. (2016). A critical assessment of business model research. *The Academy of Management Annals, 11*(1), 73–104.

MultiChain. (2016). *How to spot a half-baked blockchain*. Retrieved January 07, 2018, from http://www.multichain.com/blog/2016/12/spot-half-baked-blockchain

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Retrieved January 07, 2018, from https://bitcoin.org/bitcoin.pdf

Novak, S., & Eppinger, S. D. (2001). Sourcing by design: Product complexity and the supply chain. *Management Science, 47*(1), 189–204.

Omohundro, S. (2014). Cryptocurrencies, smart contracts, and artificial intelligence. *AI Matters, 1*(2), 19–21.

Osiyevskyy, O., & Dewald, J. (2014). Explorative versus exploitative business model change: The cognitive antecedents of firm-level responses to disruptive innovation. *Strategic Entrepreneurship Journal, 9*(1), 58–78.

Peck, M. (2015). *The future of the web looks a lot like the Bitcoin blockchain*. Retrieved January 07, 2018, from http://spectrum.ieee.org/computing/networks/the-future-of-the-web-looks-a-lot-like-bitcoin

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creating unique value with customers. *Strategy and Leadership, 32*(3), 4–9.

Saebi, T., & Foss, N. J. (2015). Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions. *European Management Journal, 33*(3), 201–213.

Soloviev, V., Kurochkin, P., Rendiuk, A., & Zazuk, A. (2010). Innovative business models in the media industry. *Annales Universitatis Apulensis Series Oeconomica, 12*(2), 692–697.

Spieth, P., Schneckenberg, D., & Matzler, K. (2016). Exploring the linkage between business model (&) innovation and the strategy of the firm. *R&D Management, 46*(3), 403–413.

Tech, R. P. G., Neumann, E. K., & Send, H. (2017). Central components of open business models. In *What makes an open business model open?* Alexander: von Humboldt Institut für Internet und Gesellschaft.

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning, 43*(2), 172–194.

The Economist. (2015). *The promise of the blockchain: The trust machine*. Retrieved January 07, 2018, from http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine

Thiel, P. (2014). *Zero to one*. New York: Crown Business.

Tikkanen, H., Lamberg, J. A., & Parvinen, P. (2005). Managerial cognition, action and the business model of the firm. *Management Decision, 43*(6), 789–809.

Wattenhofer, R. (2016). *The science of the blockchain*. North Charleston, SC: Independent Publishing Platform.

Weber, M. (1981). *General Economic History*. New York: Routledge.

Weiblen, T. (2014). The open business model: Understanding an emerging concept. *Journal of Multi Business Model Innovation and Technology, 2*(1), 32.

Werbach, K. D. (2016). *Trustless trust*. Philadelphia PA: University of Pennsylvania, The Wharton School, Legal Studies & Business Ethics Department.

West, J., & Bogers, M. (2014). Leveraging external sources of innovation: A review of research on open innovation. *Journal of Product Innovation Management, 31*(4), 814–831.

Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature, 38*(3), 595–613.

Wirtz, B. W., Pistoia, A., Ullrich, S., & Göttel, V. (2016). Business models: Origin, development and future research perspectives. *Long Range Planning, 49*(1), 36–54.

Wright, A., & De Filipi, P. (2015). *Decentralized blockchain technology and the rise of Lex Cryptographia*. Retrieved January 07, 2018, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664

Zott, C., & Amit, R. (2010). Business model design: An activity system perspective. *Long Range Planning, 43*(2), 216–226.

Robin P. G. Tech is a senior researcher at the Society and Economic Dynamics group at the Berlin Social Science Center (WZB). His research focuses on the application of New Institutional and Behavioral economics to complex technical systems, high-tech entrepreneurship, and technology commercialization in general.

Jonas F. Kahlert pursued his PhD in Technology Management at Univerisity of St. Gallen, Switzerland and Standford University, U.S.A. His research focuses on distributed ledger technologies and its implications for strategic management as well as for the energy and the international development sector. He is currently working for Google as a Program Manager.

Jessica Schmeiss is a doctoral researcher at University of Potsdam, Germany and Stanford University, USA. Her research interests include business model design, design-driven innovation, and design thinking. Prior to pursing her PhD, she worked as a Product Marketing Manager at Google.

How to Take Advantage of Online Platforms Like the Sharing Economy Does

Anja Herrmann-Fankhaenel

1 Introduction

No matter how we name the activity around online platforms—sharing (Belk, 2014b; Benkler, 2004) access (Bardhi & Eckhardt, 2012) or collaboration (Botsman & Rogers, 2010)—and no matter from which perspective we try to understand it—business models (Kathan, Matzler, & Veider, 2016; Muñoz & Cohen, 2017), innovation (Pur, Huesig, Mann, & Schmidhammer, 2014) or social contribution (Jaeger-Erben, Rückert-John, & Schäfer, 2015)—one thing is evident: the phenomenon has entered many different communities—friends (Belk, 2014a), cities (Sharing Cities, 2016), markets (Zervas, Proserpio, & Byers, 2017) and the economy (Herrmann-Fankhaenel, 2016).

It is further noticeable that there is a lot of critique, a huge gap of evidence and that numerous topics should be taken into consideration when trying to understand the Sharing Economy, e.g. about 15% of all online platforms are related to different concepts like co-working (Spinuzzi, 2012) and crowdsourcing (Gassmann, 2012). To fully understand these forms of business, it is thus important to take on different perspectives. Still, it is obvious that these online platforms are developing rapidly in different fields and that they are increasingly used by a wide range of actors (e.g. startups, private users). Media coverage is broad und intense (Lorenzen, 2013; Ortmann, 2013), and only rarely academic expertise is involved. Moreover, focus and content are changing as the Sharing Economy itself is constantly evolving, e.g. AirBnB ban in New York (Röper, 2016).

Online platforms are rising and falling, some are succeeding, and some are failing, e.g. when this research started in 2013 more than 70 online platforms have been associated with this phenomenon in Germany. These days, about 15 of these online platforms shut down, 34 new platforms were created. This rapidly changing

A. Herrmann-Fankhaenel (✉)
Chemnitz University of Technology, Chemnitz, Germany
e-mail: anja.herrmann-fankhaenel@wirtschaft.tu-chemnitz.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_7

environment is also valid in an international context (e.g. Owyang, 2016). Hence, a systematic and comprehensive analysis might help to better understand the Sharing Economy and provide valuable insights for business.

This article is based on results from research on the Sharing Economy in Germany which focused on questions like: Which criteria can define the Sharing Economy? Are there distinct types of online platforms? What are similarities and differences with business as usual? Therefore, more than 70 online platforms associated with the Sharing Economy were explored inspired by the Grounded Theory research approach and focused on terms and conditions and imprints (Lueger, 2007; Strubing, 2008; Breuer, 2010; Mayring, 2007).

In Sect. 2, a qualitative picture of the Sharing Economy will be drawn. Furthermore, quantitative characteristics around business related issues of online platforms and the Sharing Economy are established. Section 3 covers basic types of online platforms and their business concept from a practical point of view. The goal is to outline practical guidance to make use of online platforms. In Sect. 4, managers will receive a broader perspective on online platforms and the Sharing Economy by considering private users, competitors and non-profit or value issues as impact factors. Finally, conclusions will be drawn from a macro perspective including business, social, individual and economy-wide matters.

2 Basics of the Concept: What Do We Know?

2.1 The Variety: Technology, Platforms, Marketplaces

'Sharing' defines the process of granting or getting access to infrequently-used resources, e.g. products or space (Bardhi & Eckhardt, 2012). The main driver of the Sharing Economy is the development of information and communication technologies (Müller, 2014). Web 2.0 approaches set the stage for online platforms with user-generated content and enabled sharing and collective behavior (Lackes & Siepermann, 2013). Hence, an online platform can be interpreted as an intermediate connecting supply and demand (Demary, 2015) and thus can be referred to as a marketplace (Hamari, Sjöklint, & Ukkonen, 2016), e.g. *Airbnb*, *eBay*, *Whyownit*, *Car2Go*, *NextBike* etc. This broad definition makes it hard to decide on what is part of the Sharing Economy, and what isn't. Based on the insights from the explorative research in Germany, a generalizable definition was derived to fully grasp the phenomenon (Herrmann-Fankhaenel & Huesig, 2016).

The major aspects are:

- Sharing Economy is made up of **online platforms** that are established **in any kind of legal forms**.
- Common feature of these platforms is an interaction called '**sharing**', which can be **(re-)selling**, **bartering**, **lending**, **renting**, and **donating**.
- 'Sharing' partners may be **private users**, **organizations** and **freelancers**.
- Items to be shared may be **products**, **services**, **knowledge**, **information**, and **money**.

At a glance: consumption for everyone, everywhere, of everything and at any time.

To get a clearer picture of the variety, let's look at some quantitative results on the Sharing Economy landscape in Germany based on 70 cases (Table 1).

What is new here compared to traditional businesses is that on most online platforms private users may become producers or suppliers at the online platform. Thus, consumers can turn into 'prosumers' (Heinrichs & Grunenberg, 2012) which makes it very appealing for private people to join and be part of the Sharing Economy in general (Müller, 2014). However, the online platforms that exclude professional users and allow private users only should be regarded as a special case (about 20% in Germany). The alternative to business as usual within such economic activity arises because it is neither based on power and control nor on exploitation of people and environment (Voss, 2010). Hence, the Sharing Economy and its online platforms are discussed as an alternative, sustainable or solidary form of consumption (Müller-Plantenberg, 2007).

This aspect is backed by a large number of online platforms where operators merely act as service providers or intermediaries (about 85% in Germany). Hence, the users are taking care of supply and demand. In addition, users themselves create content and design consumption how they like it (Fraiberger & Sundararajan, 2015). Moreover, sometimes the *operator* of an online platform is an organization that is running the online platform *besides other business segments* (about 20% in Germany).

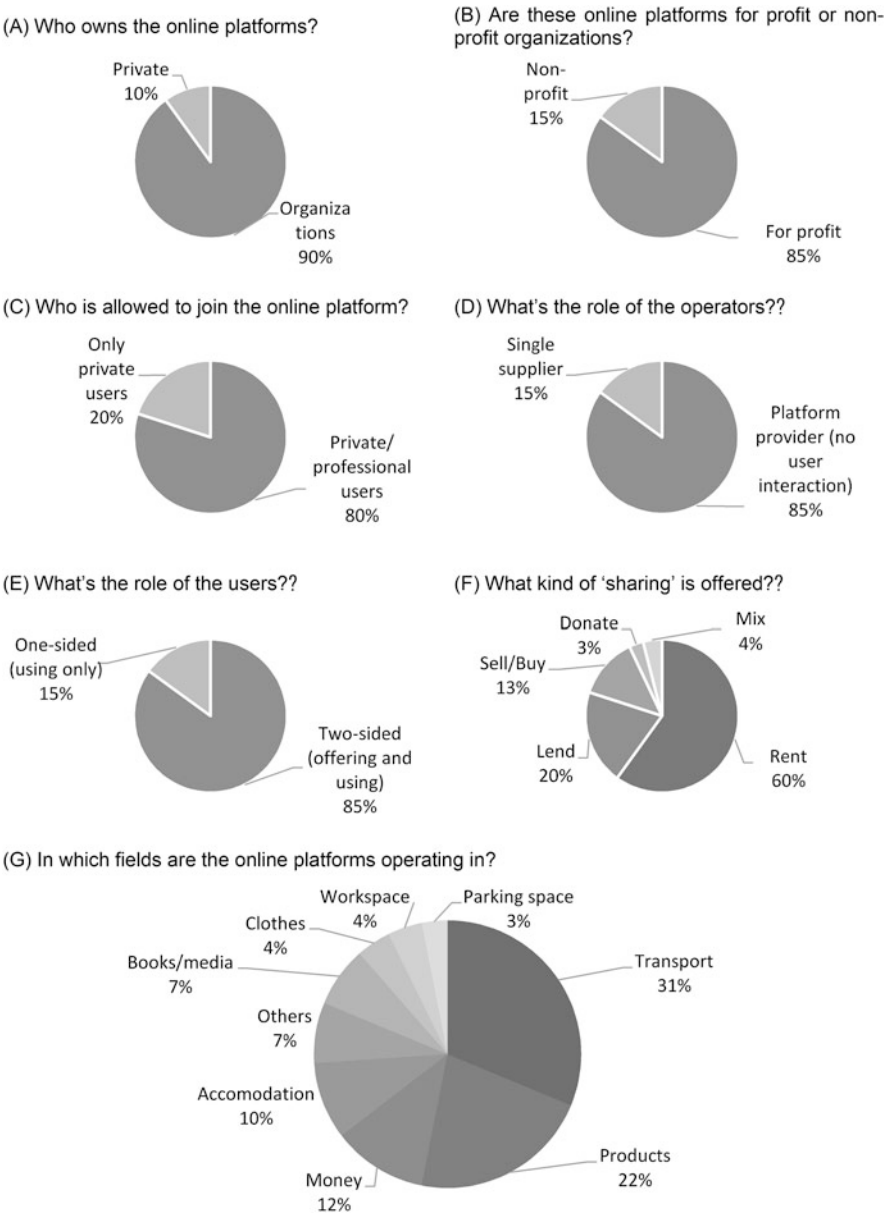
The great heterogeneity among the Sharing Economy makes it very interesting to be further explored. There are many approaches for organizations to choose from, e.g. *Deutsche Bahn AG* is offering own Bikes via *CallABike.de*, while *Spock* is an online platform that is inviting a third person to interact.

2.2 Types of Online Platforms

The Roles of the Operator

Operators of an online platform are holding two separate roles from an external perspective: being an operator or being the operator of and the single supplier on the platform. From this perspective, there are two kinds of online platforms within the Sharing Economy: *marketplace for others* (Hamari et al., 2016) and *online platform as medium* of distribution (see also Table 2). In the case of Germany, online platforms are mainly created for others as a platform for interaction (80%) referred to as exclusively user-supplied online platforms. Exclusively operator-supplied online platforms in contrast add up to 16% of all cases in Germany. Only in few cases (4%), the online platform operator allows users to act as suppliers besides himself. However, in most cases of this category users merely complement the offer of the operator.

Table 1 Insights on the Sharing Economy from Germany



A Business Perspective

Some online platforms follow very traditional business approaches. In these cases, the operator is the single supplier and hence users can only consume (and not tender own) products or services (Table 2). *Marketplaces for others* include two interesting

Table 2 Overview of types of online platforms (in Germany)

	OP as medium (exclusively operator-supplied Online Platform)		OP as medium (operator- and user-supplied Online Platform)		OP as marketplace for others (exclusively user-supplied Online Platform)		
Role of operator	16%		4%		80%		
User groups	Private	Private and profess.	Private	Private and profess.	Private	Private and profess.	Private and profess. With exceptions
Examples	*Drive now*	*Betahaus*	*Common Vintage*	*DeinBus.de*	*Nach-barschafts-auto*	*eBay*	*Mitfahr-gelegenheit*
Form of business	B2C, B2B		B2C, B2B		C2C	C2C, B2C, B2B	C2C with exceptions
Business as usual or market-places	Business as usual with private customers	Business as usual with all groups of customers	Mainly medium *(no further consideration)*		Marketplace for private consumption	Marketplace for everyone	Marketplace for nearly everyone
Share	20%				18%	58%	4%

types. There are online platforms where private people are acting without business intermediates (often called peer-to-peer concepts (Fraiberger & Sundararajan, 2015) or consumer collaboration (Botsman, 2013)); and there are hybrid marketplaces for all kinds of user groups where both private and professional users may be a supplier and consumer.

To this point, we find that the Sharing Economy is a very complex phenomenon and, hence, we can think of many ways of how to approach it. Moreover, it was shown that online platforms associated with Sharing Economy are following business as usual and alternative business strategies. Following the two basic types of online platforms (*marketplace* and *medium*), the next section derives business strategies for making use of online platforms.

3 Lesson Learned: What Is Important?

Based on the findings from Sect. 2, six approaches to online platforms can be outlined (Table 3). From a business perspective to guiding questions are:

- Who will be user of the online platform?
- What will be the level of integration: a new business, an additional business field or another business tool?

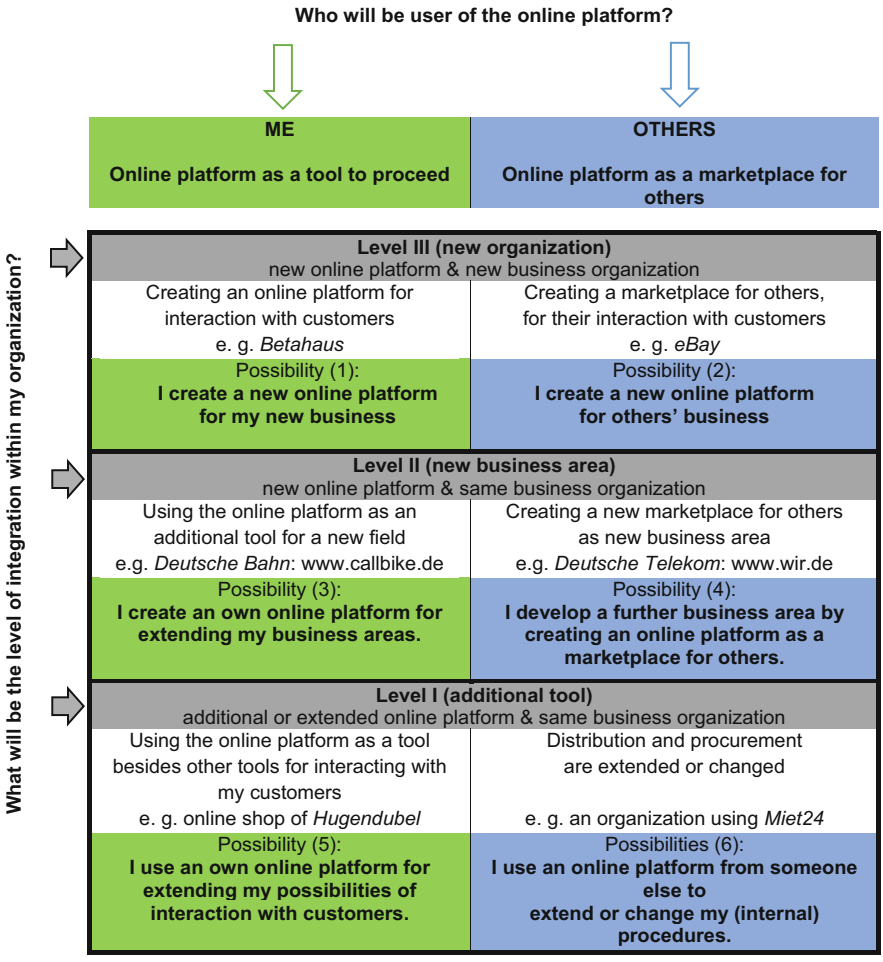
3.1 Online Platform as Marketplace for Others

The aim of this type of online platforms is to enable sharing for others in the sense of granting and getting access to products, services, and money by renting, loaning or resale between the users and without the operator as part of the consumption (Bardhi & Eckhardt, 2012; Belk, 2014b). Consequently, the aim and at the same time business model of an operator is to create and maintain a compelling marketplace for others to follow consumptive needs. The operator is responsible for the online platform. *eBay*, *Airbnb* and *Wimdu* are prominent examples for this kind of online platform (possibility (2) in Table 3). They created a marketplace for others and succeed without being an active part of the user's interaction (beyond hosting operations). Possibility (4) describes an operating organization that besides follows other business activities. A different approach is possibility (6): here, (professional) users use someone else's online platform. This is a very promising way for traditional businesses to operate in changing environment, e.g. offering product on *Amazon*. Thus, the Sharing Economy is offering new channels for distribution and/or procurement.

3.2 Online Platforms as Tool or Medium

In this setting, organizations use an online platform as a tool for engaging in customer interaction. Some incumbents like *Deutsche Bahn*, *Daimler* and *Citroen*

Table 3 Practical approaches to the Sharing Economy



offer additional services and products via own online platforms (possibility (3) in Table 3), e.g. *CallABike* run by *Deutsche Bahn* that complements their mobility service (trains) with bikes. Online platforms as a new and single business (possibility (1) in Table 3) are an interesting option mostly used by startups who connect online platforms to other innovative approaches, e.g. co-working. Possibility (5) describes approaches that are at an earlier stage of online business prior to Sharing Economy. Here, traditional businesses are seeking for digital solutions in an online platform environment.

3.3 Online Platforms for Competitors and Private Users

In the same way an organization can concentrate on one of these approaches to change their business activities (develop a new one or adopt to changes via online platform as additional or new tool), *competitors* may act in the same way. Thus, incumbents should consider new approaches when a startup is challenging traditional business. The integration of private users into the business environment should also be considered as they might turn into competitors or change consumption behavior.

4 Implications for Management

The previous section outlined various ways to use online platforms in a business context: Will I create a new online platform and design a marketplace for others? Do I want to use an online platform as a new channel for distribution? Or can I use existing online platforms to improve my procurement? The task and, hence, challenge of management is to find the right setting to deal with an ever-changing business environment and new business opportunities at the same time. Additionally, management should be aware of macro trends beyond business considerations that might influence markets and business performance, e.g. private users and startups. The following considerations provide information in this matter.

4.1 A (Private) User Perspective

On the individual level, it is obvious that online platforms create new opportunities for consumption, either in finding new private or business suppliers or becoming a supplier and maybe a 'prosumer' (Heinrichs & Grunenberg, 2012). Moreover, a study has shown that about 70% of all participants of the Sharing Economy are taking part for monetary reasons like saving money or gaining further income (Latitude, 2015). Earning money by offering personal goods and services is attainable within 80% of all online platforms in Germany.

Users are hence entering the market in which the online platform is operating in as suppliers, sellers, and providers in expectance of a monetary reward. In fact, the majority of the Sharing Economy enables private users to make money. Gaining further money for the participants means that they have more income for other usage, which is seen as an advantage for users of online platforms. The opposite is true at the same time: loaning products for free means economizing by preventing buying them or renting them from commercial business organizations. Due to the increase of sharing-related options it is possible that people change their habits: with the help of online platforms they access needed products, minimize required capital to finance bottom-line issues or enable more extravagance with the same amount of money (Botsman & Rogers, 2010). Based on this, sometimes the Sharing Economy is associated with users who are creating a new life style.

Likewise, in many cases it is hard to differentiate between professional and private sphere, especially in the areas of transportation and accommodation (Brühn et al., 2014). When offering e. g. accommodation permanently on online platforms, as it is typically on consumer-to-consumer renting online platforms, it is commercial behavior when getting money as a reward. Actually, private users become professional users incrementally.

To sum up what is happening is that private users turn from pure customers to producers/service providers with different implications: First, they can decide which platform to use and which supplier to choose from. Second, they become 'producers' as well as taking the "producer" side of consumption as private or business users. Third, they may start a new business by using an online platform.

4.2 The Micro Perspective

Users of an online platform follow personal interests. They consider online platforms as a "good place" to meet private objectives. They are free in deciding to end participation when their objectives are meet better in another organization. Thus, we see substitution effects and an negative impact on traditional industries (Pfeffer & Salancik, 2003). It was shown that joining online platforms and consuming in the offered way changes the scope of consumption on traditional businesses (Zervas et al., 2017). Especially evidence is generated for transportation and accommodation (Fraiberger & Sundararajan, 2015). In Germany, 35% of all online platforms are operating in these fields and hence can have effects on traditional car selling, renting and accommodation. If this is transferred to all rental and loaning online platforms, which are about 68% of the Sharing Economy in Germany, the assumption is that about two thirds are affecting traditional industries.

So, what to do about it? We have learned that understanding the Sharing Economy and this new kind of consumption offers a wide range of business opportunities, in particular for traditional organizations. Organizations could also try to react in the political and legal sphere to protect themselves (Tiberius, 2011), e.g. ban of *Uber* in Germany or restrictions for *Airbnb* in cities like New York or Hamburg. One has to keep in mind, however, that in the long run those strategies, businesses and individual actions will be viable that reach the legitimation of a majority (Pfeffer & Salancik, 2003).

4.3 The Social Perspective

Besides business-related opportunities, the Sharing Economy also bears a huge social potential. It may lead to changes in norms and values. The participation in online platforms influences peoples attitude towards ecology, sustainability, globalization, and the worthiness of social behavior. Even if monetary reasons have been drivers of joining an online platform, studies showed changes in consumers' attitude in general.

Studies in the U.S. found an increase of low-income people's welfare because peer-to-peer rental markets enable a higher standard of living through renting (Fraiberger & Sundararajan, 2015). Online platforms of the Sharing Economy are said to lead to social welfare (Heinrichs & Grunenberg, 2012). In Germany, however, only 3% of online platform can be found here these days (Herrmann-Fankhaenel & Huesig, 2016). Maybe social welfare will further develop as e.g. social innovations evolve with the help of online platforms. It is said to be a form of social innovation, when it solves unmet social needs successfully (Mulgan, 2006).

Summed up, social contribution can be fostered by online platforms. To this day, however, only few cases can be found. But to encourage all willing people to engage, it is possible to use online platforms for creating (social) welfare, like *foodsharing* and *betterplace* are doing (Notz, 2010; Voss, 2010).

5 Conclusion

The Sharing Economy is neither the solution for anything nor for anybody—rather it can be interpreted as new technology-driven and thus efficient approach to (collaborative) value creation via online platforms. Basically, there are two kinds of online platforms that enable new practical implications: online platforms as *marketplaces for others* and online platforms as a *medium* to create new businesses, additional business areas and additional tools for customer interaction. Organizations that want to tap into Sharing Economy should consider different approaches to start with depending on their specific context. Besides, organizations should closely monitor the changing market environment and watch out for new competitors that might influence its position.

References

Bardhi, F., & Eckhardt, G. M. (2012). Access-based consumption: The case of car sharing. *Journal of Consumer Research, 39*(4), 881–898.

Belk, R. (2014a). Sharing versus pseudo-sharing in Web 2.0. *The Anthropologist, 18*(1), 7–23.

Belk, R. (2014b). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research, 67*(8), 1595–1600. https://doi.org/10.1016/j.jbusres.2013.10.001

Benkler, Y. (2004). *Sharing nicely: On shareable goods and the emergence of sharing as a modality of economic production*. Retrieved April 12, 2018, from https://www.yalelawjournal.org/essay/sharing-nicely-on-shareable-goods-and-the-emergence-of-sharing-as-a-modality-of-economic-production

Botsman, R. (2013). *The sharing economy lacks a shared definition*. Retrieved April 12, 2018, from https://www.slideshare.net/slideshow/embed_code/28428767

Botsman, R., & Rogers, R. (2010). *What's mine is yours: The rise of collaborative consumption* (International ed.). New York: HarperBusiness.

Breuer, F. (2010). *Reflexive Grounded Theory – Eine Einführung für die Forschungspraxis*. Retrieved April 12, 2018, from http://www.springer.com/de/book/9783531925806

Brühn, T., Götz, G., Peitz, M., et al. (2014). Die Modelle Uber und Airbnb: Unlauterer Wettbewerb oder eine neue form der sharing economy? *Ifo Schnelldienst, 67*(21), 03–27.

Demary, V. (2015). *Competition in the sharing economy (IW policy paper No. 19/2015)*. Köln: Institut der deutschen Wirtschaft Köln. Retrieved April 12, 2018, from http://hdl.handle.net/10419/112778

Fraiberger, S. P., & Sundararajan, A. (2015). *Peer-to-peer rental markets in the sharing economy (working paper no. 15–19)*. NET Institute. Retrieved April 12, 2018, from https://econpapers.repec.org/paper/netwpaper/1519.htm

Gassmann, O. (2012). *Crowdsourcing – Innovationsmanagement mit Schwarmintelligenz – Interaktiv Ideen finden – Kollektives Wissen effektiv nutzen – Mit Fallbeispielen und Checklisten* (2nd ed.). München: Carl Hanser Verlag GmbH & KG.

Hamari, J., Sjöklint, M., & Ukkonen, A. (2016). The sharing economy: Why people participate in collaborative consumption. *Journal of the Association for Information Science & Technology, 67*(9), 2047–2059.

Heinrichs, H., & Grunenberg, H. (2012). *Sharing economy – Auf dem Weg in eine neue Konsumkultur?* Retrieved April 12, 2018, from http://fox.leuphana.de/portal/de/publications/publications(d6b3c3e7-cc53-4f93-88cf%20bca02b0d2f1f).html

Herrmann-Fankhaenel, A. (2016). Auswirkungen der Sharing Economy auf die Wertschöpfung des Wirtschaftsstandortes Deutschland: Eine Untersuchung der Innovationen und Veränderungsprozesse auf den Ebenen der Volkswirtschaft, der Unternehmungen und der Individuen. In: *1. interdisziplinäre Konferenz zur Zukunft der Wertschöpfung* (pp. 3–14). Hamburg.

Herrmann-Fankhaenel, A., & Huesig, S. (2016). How much social innovation is behind the online platforms of the sharing economy?: An exploratory investigation and educing of clusters in the German context. In *2016 Portland International Conference on Management of Engineering and Technology (PICMET)* (pp. 370–384). https://doi.org/10.1109/PICMET.2016.7806696

Jaeger-Erben, M., Rückert-John, J., & Schäfer, M. (2015). Sustainable consumption through social innovation: A typology of innovations for sustainable consumption practices. *Journal of Cleaner Production, 108*(Part A), 784–798. https://doi.org/10.1016/j.jclepro.2015.07.042

Kathan, W., Matzler, K., & Veider, V. (2016). The sharing economy: Your business model's friend or foe? *Business Horizons, 59*(6), 663–672. https://doi.org/10.1016/j.bushor.2016.06.006

Lackes, R., Siepermann, M. (2013). *Web 2.0*. Retrieved April 12, 2018, from http://wirtschaftslexikon.gabler.de/Definition/web-2-0.html

Latitude. (2015). *The new sharing economy study report.* Retrieved April 12, 2018, from https://www.scribd.com/document/38788695/The-New-Sharing-Economy-Study-Report-by-Latitude-and-Shareable-Magazine

Lorenzen, M. (2013). *Shareconomy: Besitzen ist out – Teilen ist in*. Retrieved April 12, 2018, from http://www.wiwo.de/technologie/cebit-spezial/shareconomy-besitzen-ist-out-teilen-ist-in/7849920.html

Lueger, M. (2007). Grounded theory. In *Qualitative Marktforschung. Konzepte – Methoden – Analysen* (pp. 189–205). Wiesbaden: Gabler Verlag.

Mayring, P. (2007). On generalization in qualitatively oriented research. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, 8(3). Retrieved April 12, 2018, from http://www.qualitative-research.net/index.php/fqs/article/view/291

Mulgan, G. (2006). The process of social innovation. *Innovations: Technology, Governance, Globalization, 1*(2), 145–162. https://doi.org/10.1162/itgg.2006.1.2.145

Müller, M. P. (2014). An economic analysis of online sharing systems' implications on social welfare. In *ECIS 2014 Proceedings – 22nd European Conference on Information Systems*.

Müller-Plantenberg, C. (2007). *Solidarische Ökonomie in Europa*. Kassel: Betriebe und Regionale Entwicklung. University Press.

Muñoz, P., & Cohen, B. (2017). Mapping out the sharing economy: A configurational approach to sharing business modeling. *Technological Forecasting and Social Change, 125*(Supplement C), 21–37. https://doi.org/10.1016/j.techfore.2017.03.035

Notz, G. (2010). *Theorien alternativen Wirtschaftens: Fenster in eine andere Welt* (1st ed.). Stuttgart: Schmetterling Stuttgart.

Ortmann, Y. (2013). *Sharing economy: Konzepte und Dienste auf einen Blick – deutsche-startups.de*. Retrieved April 12, 2018, from https://www.deutsche-startups.de/2013/07/02/sharing-economy-alle-konzepte

Owyang, J. (2016). *Honeycomb 3.0: The collaborative economy market expansion | Web strategy by Jeremiah Owyang | Digital business*. Retrieved April 12, 2018, from http://www.web-strategist.com/blog/2016/03/10/honeycomb-3-0-the-collaborative-economy-market-expansion-sxsw

Pfeffer, J., & Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective (parental adviso)*. Stanford, CA: Stanford Business Classics.

Pur, S., Huesig, S., Mann, H. G., & Schmidhammer, C. (2014). How to analyze the disruptive potential of business model innovation in two-sidedmarkets? The case of peer to peer lending marketplaces in Germany. In *Proceedings of PICMET '14 Conference: Portland International Center for Management of Engineering and Technology; Infrastructure and Service Integration* (pp. 693–709).

Röper, N. (October 2016, 27). *Neues Gesetz: Airbnb in New York vor dem Aus*. Retrieved April 12, 2018, from http://www.faz.net/1.4491695

Sharing Cities. (2016). Retrieved April 12, 2018, from http://www.sharingcities.eu/sharingcities/city-profiles

Spinuzzi, C. (2012). Working alone, together: Coworking as emergent collaborative activity. *Journalof Business and Technical Communication, 26*(4), 399–441. https://doi.org/10.1177/1050651912444070

Strubing, J. (2008). *Grounded Theory: Zur Sozialtheoretischen und Epistemologischen Fundierung des Verfahrens der Empirisch Begründeten Theoriebildung* (2nd ed.). Wiesbaden: VS Verlag für Sozialwissenschaften.

Tiberius, V. (2011). *Prozesse Und Dynamik Des Netzwerkwandels* (2008th ed.). Wiesbaden: Gabler Verlag.

Voss, E. (2010). *Wegweiser Solidarische Ökonomie: Anders Wirtschaften ist möglich!* (1st ed.). Neu-Ulm: Verein zur Förderung der sozialpolitischen Arbeit.

Zervas, G., Proserpio, D., & Byers, J. W. (2017). The rise of the sharing economy: Estimating the impact of Airbnb on the hotel industry. *Journal of Marketing Research*. https://doi.org/10.1509/jmr.15.0204

Anja Herrmann-Fankhaenel is research fellow, lecturer and PhD candidate at Chemnitz University of Technology at the professorship Innovation Research and Technology Management. Her research interests are diverse within the Sharing Economy and range from solidarity and business model innovation to the role of women and cross-country comparisons.

The F.A.I.R. Model of Cooperation: How Managers Can Co-create Value Within Innovation Networks

Jules Thoma

1 Creating Value Within Innovation Networks

How can firms create value efficiently and sustainably? Since future opportunities more and more supersede what has been reliable in the past, the most promising answer might be: by innovating. This inside rises two further questions for managers: What form of organization makes my firm innovative? and How do I create and maintain that structure? The first question is easy to answer. For three decades organizational and innovation theory has highlighted that networks are the most suitable structure for accomplishing innovation. In contrast, the answer to the second one is far less elaborated. Especially because products and services differ tremendously between industries—same is true for markets, legal conditions, customer habits or the culture of an organizational field in which innovations are embedded—it seems quite pointless to extract general principles for managerial behavior.

However, there is another reason why we still lack useful knowledge when it comes to the question of how to develop or engage in an innovation network. As the word *network* is used in diverse contexts and in different organizational settings, it remains either too broad or vague to deduce concrete management methods from it. With that in mind, we have to examine the fundamental characteristics that come along with this particular form of collaboration before we can start thinking about how to act and behave in an innovation network efficiently. When we take a closer look on innovation networks we do not just see that they provide a promising structure for innovation, but we realize that networks are an innovation by themselves: a social innovation. Unfortunately, the challenges managers face when they

J. Thoma (✉)
Technical University of Berlin, Berlin, Germany
e-mail: jules.thoma@tu-berlin.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_8

try to become a part of that particular social innovation are at least as demanding as in business or technological innovations.

2 The Challenges of Innovation

Traditional innovation theory alternates between the technological push and demand pull explanatory model. On one hand, innovations were considered as outcome of a linear process that starts with scientific discoveries which yield to new technologies and products. On the other hand, market-oriented explanation highlights the evolutionary processes dominated by the market. As a selection mechanism, markets rigorously favor only those innovations that tackle the customers' needs most efficiently. Today both unidirectional explanations are refined by models of interaction that highlight processes of recursive learning and adaption between producer and customers, e.g. co-creation (Prahalad & Ramaswamy, 2004) or open innovation (Chesbrough, 2003). In this context, we would emphasize four challenges innovative firms are facing in contemporary economy: *responsiveness*, *sharing know-how*, *value chain orientation* and *effective cooperation.*

2.1 Responsiveness

In today's dynamically changing economy, the traditional line between basic research and applied research is blurred. Same is true for production and consumption in the digital world. Thus, innovation is no longer a linear process that can be characterized by separated actors who successively contribute their part to a whole. In contrast, innovating partners should act in parallel and synchronically. This might even make it necessary to integrate new partners during an ongoing innovation process. In order to reduce ambiguous specifications or to react on changing requirements and latest research findings, close feedback loops have to be established. The rise of agile project management may be one compelling example. Eventually, responsiveness becomes a question of speed as well. Innovation requires not only to create a truly new quality but also to be faster than competitors or competing networks. The shrinking of time to market is crucial for innovating.

2.2 Sharing Know-How

In terms of innovation we have to thoroughly distinguish between information and know-how. Information is something you have or do not have, e.g. about the strategies of competitors, about the habits of customers, the market behavior or forthcoming political decisions. However, know-how is different to that. It is implicit. It is only present in the way people act or behave, how they approach problems and what kind of details they perceive when they find themselves in a complex situation. Know-how becomes visible only by the concrete handling of

things, materials or tools in interaction. Innovation is mostly a process of integrating diverse know-how. In this context, sharing know-how implies to understand, recognize and value each other stock of (tacit) knowledge. But there is another—quite paradoxical—aspect of sharing know-how for innovation. It is hard to foresee which knowledge will eventually become an element of the innovation respectively will become part of the value chain. Moreover, as you share your know-how during the innovation process others may learn from you and probably take over your 'share' of the value chain in the future.

2.3 Value Chain Orientation

Innovation is more than a good idea. It requires more than just creativity. And it is more than an invention manifested in a prototype. Innovations are new products or services that consumers literally spent money for or new processes implemented in a firm that increase efficiency and profit. That is why value creation lies at the bottom of the innovation concept. Since new products often prerequisite new supply chain constellation, innovation can only be successful if each partner can create his or her own profit along this new chain. Thus, for creating value, one firm depends on the performance of the total value creation system. From that perspective, co-creation not only applies for bilateral interaction, e.g. customer and producer, but for a multi-lateral relation between all partners of a totally new inter-organizational value chain.

2.4 Effective Cooperation

Learning, creativeness and the ability to adapt on changing environments dictated the firms' inside management agendas for the past decades (e.g. Senge, 2006). But to be innovative is not only a question of managers' mindsets or of the internal organizational structure. Rather it is the ability to establish new relationships outside the companies. It is simply easier to think outside the box when you interact with people who are 'out there'. However, to establish relationships of mutual understanding and trust especially among different professions, disciplines or industries ties up immense time and resources—while at the same time most innovation attempts fail. Against this backdrop effective cooperation becomes a key competency for innovating managers.

It is clear to see that all mentioned challenges are closely intertwined: Successful innovations presuppose new value chains among different people or firms which only evolve if members share know-how effectively, that is interact and communicate in a way which leads to fast understanding between partners. Nonetheless, each challenge highlights various aspects which all have to be taken into consideration as one significant pieces of the innovation puzzle.

3 Innovation Networks as F.A.I.R. Systems

These new insights from innovation research and practice are paralleled by the rise of the network concept in governance theory. The governance perspective searches for ways firms (or more general: organizations and states) can coordinate their work and interaction most efficiently. In this context networks are considered as a new (hybrid) form of cooperation between or among the traditional twofold logic of hierarchical firms and the open market (see Powell, 1990; Williamson, 2005). Network arrangements prove to be a promising alternative to overcome the disadvantages of the unchained market and the bureaucratic organization. As a result, they have quickly taken over the management agendas as the new one best way of organization (Snow, Miles, & Coleman, 1992).

In the seminal article about the new network forms of organizing, Walter W. Powell points out that networks most likely seem to evolve in business fields which demand fast flow of information and the sharing of tacit knowledge. Unsurprisingly, organizational and innovation theory easily converted into the concept of innovation networks (Powell & Grodal, 2005).

But what are the essential characteristics of innovation networks and how do they meet the challenges of innovation mentioned above? While in today's complex and sometimes fuzzy world ideal differentiations like the one between markets and hierarchies lose their plausibility, one has to be careful not to stress the concept of networks too much. Actually, the word *network* is applied to describe a variety of cooperation modes or structures (e.g. cluster, alliances, associations, clubs or societies) and by itself is subject to overarching typologies (e.g. deliberate networks, regional networks, strategic networks or social networks, to name only a few).

In contrast, we want to argue from a logical point of view. Since networks differ from the ideals of firms or markets, they are a new and unique form of cooperation—and by that a social innovation. Drawing on network and innovation theory as well as our own research we want to highlight four cultural features of innovation networks: ***f****lexibility,* ***a****uthenticity,* ***i****nterest* and ***r****eciprocity.* To say it simple: Innovation networks are **F.A.I.R**. systems.

3.1 Flexibility

Although most networks have an official name, a postal address, a network management and some kind of formal membership procedures (i.e. articles of association) they are no formal, bureaucratic, hierarchical organizations in the classical sense. In contrast to organizations (and projects as temporal organizations) networks have permeable borders. New members can join and leave the circle of cooperation quite easily while issues, topics, structures and activities might change as well. Networks are not manifested solely by formal agreements and restrictions or primarily by rule following but depend significantly on self-organization. Through that organizational flexibility, networks provide the building ground to explore new ideas and to investigate new opportunities.

3.2 Authenticity

The driving forces for innovation are human curiosity and the motivation to strive for improvement. At the same time, most innovations spring from incidental discoveries (think of radioactivity or post-it notes), trial and error or the new, unusual combination of things, methods and know-how. Innovation networks improve such affords by linking people that have most diverse organizational, professional and methodological backgrounds and ask what they can contribute to a possible innovation. As engineers, designers, natural scientists, social scientists, buyers, sellers and so forth encounter in a network they struggle to understand each other, are confronted by stereotypes, irritated by different perspectives, opinions and arguments. They ultimately need to leave their zones of comfort. However, to get involved with each other does not mean to adapt to a common group understanding but to identify and understand the unique value each member can bring into a cooperation. Authenticity is key for that process. Acting authentically—that is to speak clearly and openly about what you can (not) do, what you (do not) understand, what you think is (un) important and what kind of resources you (do not) want to contribute to a cooperation—is the best way to build a system of trust. As members understand and respect the inherent heterogeneity of the network system, innovative ideas and cooperation may emerge by dealing with and eventually by solving inconsistencies. In contrast to traditional groups, teams, projects or organizational norms conflict and contradiction are integral parts of innovation networks. This does not ease communication and make collaboration less complicated. Nevertheless, because of the inevitable incidental nature of innovation, this particular feature of networks paradoxically makes innovative cooperation more likely to succeed.

3.3 Interests

One common mistake when thinking about cooperation is that it implies altruistic behavior or the commitment to shared goals. But that is not necessarily true. Some philosophers might even argue that rational action always implies self-interested behavior. Besides, one has to keep in mind that a mutual goal (here: the specific innovation) unfolds its binding and motivating power only if it satisfies the fundamental needs of each cooperation partner. While particular collective goals might change through the process of co-creation and collaboration the needs and interests of each network member stay the same. However, networks do not work if members only seek their own interests without realizing that innovation can only be accomplished if every partner of a (new) value chain can add respectively gain enough value to sustain profitable. Although every network member pursues his or her own benefit each member at the same time has to regard the others as partners and has to respect their interests. Therefore, it is important to understand in principal the business models of each other and to consider how every partner can benefit from their particular share in the whole chain.

3.4 Reciprocity

Reciprocity is a norm that regulates human exchange relationships. It says, that what you give and what you take need to be of equivalent value. As such, it underlies every market transaction or labor contract. Unfortunately, during an innovation process the value of one's contribution (especially know-how, see above) cannot be easily converted into a certain amount of money. Moreover, each firm that joins a network preserves its independence, thus there is no central (hierarchical) position that has the legal power to control and balance inter-organizational transaction. As the 'neither market nor hierarchy'applies for innovation networks, *trust* becomes crucial (Powell, 1990). However, developing trust in a particular person as well as a entire network system goes hand in hand with a process of reciprocal cooperation which prerequisites the ability and readiness to (re-)negotiate what to contribute and what to take out continuously (see Lewicki, 2007). Such negotiations do not merely comprise co-creational efforts between single members but also apply for relationships between single members and the collective basis of the network as a whole.

These four characteristics of the F.A.I.R. system of cooperation directly address the challenges of innovation showed earlier in this article (see Fig. 1).

As we argue for a F.A.I.R. constitution of an innovation network we highlight the specific culture of cooperation that goes beyond formal and bureaucratic structures. It is essential to reflect that while the participants of an innovation network interact to solve technological issues they are at the same time unwittingly structuring the culture of cooperation in the network. Modern cultural studies stress such processes of social construction which are primarily depending on the mindset and literally on the corporal behavior and actions of human beings (Giddens, 1984). Thus, each member becomes a driving force of the constitution of an innovation network system. This in mind, we will now turn to the initial question of what management perspectives and actions effectively support the creation of value within innovation networks.

Challenges of innovation	Culture of innovation networks	Characterization
Responsiveness	Flexibility	• openness for new issues, themes and projects • fluctuation of members • opportunity driven
Sharing know-how	Authenticity	• individuality, habits and culture matters • different professions, methodologies, standards • cooperation "not at all costs"
Value chain orientation	Interests	• not primarily bases on shared values or common interests • co-creation • win-win orientation
Effective cooperation	Reciprocity	• no formal authority or jurisdiction • negotiation • trust

Fig. 1 How innovation networks apply to the challenges of innovation (author's own illustration)

4 Implications for a F.A.I.R. Management Mindset

There are three perspectives that managers should change, if they want to (co-)create value within innovation networks. Basically, this requires switching from egocentric network perspective to the network system perspective, from formal structure to collective culture (of trust), and from control and planning to creativity and entrepreneurial thinking.

4.1 The Network System Perspective

According to modern evolutionary thinking, one of the major tasks of management is to adapt the inner structure or even culture of a firm to the environment. As firms realized that they are embedded in a complex 'network' of suppliers and customers, 'network management' implies to analyze and (re-)shape their inter-organizational exchange relationships strategically (see Burt, 1992). However, this understanding of management leads automatically to an egocentric perspective on networks. If each (so called) member of an innovation network only perceives its own bilateral relation to another member there is nothing left to develop a reciprocal system. In order to establish collectivity, managers should take the idea of an innovation network seriously and evaluate the effects of their actions and those of others to the constitution of a network identity. Due to that, new perspective managers can start to think step by step about new tools, formats and methods and by that build up new competency and skills.

4.2 A Collective Culture (of Trust)

Traditional management thinking reaches its limits when it comes to innovation networks because it is inevitably connected with the formal, bureaucratic and hierarchical enterprise. Undoubtedly, that form of organizing and coordinating collaboration proved highly efficient because it assures commitment and reliability on a rational basis. In fact, as neo-institutional theory points out, bureaucracy procedures, contracts and law build the fundament of the western economic and democratic system. However, this efficiency is all too often paid for with a loss of innovation and creativity. Innovation networks refrain from such regulating and transcend from hierarchical and organizational boundaries and by that urge persons and groups to explore and innovate. Given the ubiquity and efficiency of formal procedures, it takes a lot of motivation, strength and skills to promote the particular culture of innovation networks and to participate in that social innovation process. As human interaction is always grounded in basic assumptions, bringing forward

cooperation and co-creation within innovation networks prerequisites the understanding and reflection of the new rules and premises that come along with a F.A.I.R. network culture.

4.3 Creativity and Entrepreneurial Thinking

The formal structures and processes of hierarchic organizations are strongly connected with mechanics and even mathematics. Following this mindset, complex structures need to be divided into smaller parts that can be handled and controlled. Such traditional assumption of rational behavior in management is complemented by contemporary concepts of leadership or entrepreneurship. It's plain to see that the latter management approaches fit the demand for innovativeness very well. Both management mindsets address different targets. While the hierarchical approach is strongly dedicated to an efficient and rational structure, leadership and entrepreneurship encompass emotion and the power to convince not only employees but also customers, stakeholders or investors and to build trust and commitment. When managers join an innovation network, this new facet is added to their job description. They become pivot players. On the one hand, they still represent their firm's logic and interests. But on the other hand, they join a loosely coupled group of 'entrepreneurs' and get in charge of developing that new innovation system.

5 Implications for F.A.I.R. Management Action

Finally, we switch to the pragmatic action and put some flesh on the general concept of culture in networks. For this purpose, we will apply a process perspective. We differentiate three steps network members usually undergo on their way to an innovation project: *entry, contact, negotiation* (Fig. 2).

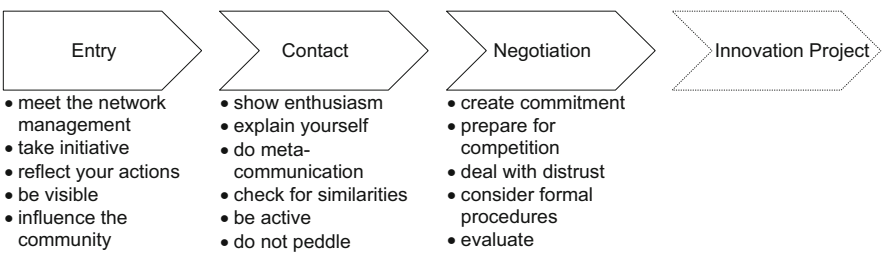


Fig. 2 Phases of cooperation in innovation networks (author's own illustration)

5.1 Entry

There are two ways you can become a member of an innovation network: you found a new one or you join an existing one. We will focus on the latter because it is the more likely scenario. In the following we will provide some guidelines about how to act when you join an innovation network:

Meet the Network Management
The first thing to do (even before you enter the network formally) is to arrange a face-to-face dialogue with the network management. It is the best way to establish a liable relationship which is a precursor for trust. The dialogue with a network manager is not the arena for false modesty. Clear communication will actually help the network manager to do his or her job. Besides, a good manager will disenchant your exaggerated expectations anyway.

This is what you want to talk about:

- Ask the management to inform you about ongoing projects, the network structure or groups and activities and interaction formats.
- Ask the management about success stories, issues and failures in the past, about the strategy for the future and how you can support concrete activities.
- Discuss the communication policy and how (maybe crucial) information is shared in the network and protected (from leaving the network) as well.
- Get a feeling for the network culture. Ask the manager about the mission statement of the network. In case there is none, ask why they do not need one. Ask for examples of good and bad practices and how in principle 'things usually are respectively should be handled'. It is by no means a sign of weakness or incompetence to ask the management for advices and consultation.
- In this very first meeting you should clarify what you expect from your membership, e.g. get new technological insights, get in touch with the central technological or business players, gain state funding for an innovation project.
- You should come up with your particular expectations from the network management as well. Name them directly, e.g. get contact to firm a, b, c; get information about ...; get the opportunity to present x, y, z ... on the website or events.
- Together, you should elaborate a clear scenario of what you want to accomplish within one year and put it on paper at the end of the meeting.

Take Initiative
As a new member, you should take the initiative and seek opportunities to get in touch with the network participants. Thereby you can demonstrate your motivation to cooperate and to innovate. This is also a good test to check how actively the members participate in the network. Only join the network if you have enough time for that.

Reflect Your Action
You should always be able to explain why you do things the way you do. Nothing can be more frustrating (for your partners and vice versa) in a co-creative situation

(e.g. idea workshop) if you cannot explain yourself—your answers, opinions, attitudes and perspectives.

Be Visible
Make sure that every member of the network gets to know you. The best way to be noticed is to invite the network (or a selected group of members) to your company and show what you do and how you do it. Communicate that the access to some areas is restricted. Even in a network it is legitimate to protect business secrets. Such behavior will actually increase your authenticity.

Influence the Community
Do not try to fit into an innovation network too much. As you step into a network the community will (and should) eventually change. You should rise themes by yourself and get actively involved in debates and discussions. Refrain from standard presentations of your firm and focus on why your firm joins the network, how the network fits into the firm's business strategy and propound how you wish to create value together with network members. An innovation network will not work (for you) if you are only out for inspiration.

5.2 Contact

There are diverse possibilities to get in contact with network members. The easiest one is to attend network events—especially those kinds of events that are restricted to network members. Typically, such events comprise workshops, working group meeting, dinner or fireside evenings, company tours, associate member meetings. However, you may also get in contact with network members on trade fairs, symposiums, fab labs or simply by chance.

Show Enthusiasm
Every beginning has its magic. Nothing will turn down a supportive and creative atmosphere as pessimism. This is especially true for co-creation and innovation. As you contact other network members you should be even more benevolent as usual.

Explain Yourself
The best way to act authentically is to explain yourself. Thus, as you will probably be confronted with stereotypes in an innovation network, you should be able to rebut them. As you are usually already aware of prejudices against your firm (e.g. big players may want to 'steal' ideas or employees from SME, scientists are only interested in publishing and state funding, startups act bigger than they are, to name but a few) it can be helpful to actively address them and explain how you want to handle them in the particular network cooperation.

Do Meta–Communication
As people from highly specialized disciplines, diverse professions and backgrounds—just imagine a designer, programmer, chemist, sociologist, engineer,

craftsmen, entrepreneur, manager—come together, the contact phase resembles a clash of mentalities, habits and methods. In a context of multiple perspectives people tend to behave politically correct. However, this can sometimes hinder communication as members do not want to become vulnerable because of their minor opinions or lack of particular knowledge. Paradoxically, while you try to act correctly you will hardly come to the root of a problem and waste your time with the network.

Check for Similarities
The process of knowledge sharing prerequisites a minimum of mutual understanding. Hence, you should try to find links, e.g. commonalities between your industries, business landscapes or even organizational and professional culture. But do not try too hard. It can be better to figure out that you are completely different. By all means you should avoid disregarding the value of a partner's profession.

Be Active
For most managers, the hint to be active is superfluous. Nevertheless, we want to stress that it is important to avoid showing restraint. Members will likely take that as an indicator for some kind of general distrust. As networks are nurtured by communication and participation there is no more inadequate behavior than simply 'watching'. Members should not be afraid to make a bad first impression because in networks they should become a chance to correct it.

Do Not Peddle
Remember, an innovation network is a place where new technological or marketing solutions are being co-created. Thus, you should avoid offering your standard products or services.

5.3 Negotiation

The negotiation phase generally starts after a group of members agrees to collectively devise an innovation project. It ends with a signed contract. Although the boundaries between contact, negotiation and project can sometimes be fluid, we want to stress that members cooperative action in innovation networks inevitably reaches a point where the elaborated fundament of trust is examined, and aspects of competition and distrust take over the agenda. Here are some strategies on how you can deal with that switch when it comes to negotiation in an innovation network context.

Create Commitment
As you build an inner-circle, you reach a new level of cooperation that demands a joint effort. Thus, to establish commitment the first thing to do is to come up with an agenda for the negotiating process that each member can agree with. The schedule should include milestones and issues to avoid frustrating, open-ended or even obsolete discussions (see logic of organization) as multi-lateral attempts to innovate already is time intensive and demanding for every group member.

Prepare for Competition
As cooperation gets serious due diligence requires to check out and test each other's competence, know-how and true intentions carefully. This process initially brings members—who before were driven by the sense of community and enthusiasm—back to 'real life' where firms struggle for survival on the market, may 'steal' know-how, take advantages of situations and leave partners behind. Since competition tends to undermine co-creational processes it is essential at this point for every member to envision the F.A.I.R. logic of innovation networks and, if necessary, explicitly refer to it during a discussion or workshop.

Deal with Distrust
Addressing critical issues or assessing proposals always can be perceived as an indicator for distrust. Although it might sound disturbing at first glance to bring forth the negotiation process managers should not refrain to admit and even communicate such distrust actively. However, it is most important to 'depersonalize' your argumentation, e.g. by referring to structural characteristics of the innovation network. As innovation networks are pervaded by heterogeneity and flexibility there are manifold sources for contradiction and conflict which makes the presence of distrust quite normal (Funken & Hörlin, 2012; Thoma & Funken, 2013). Besides, psychological research has argued for a long time that trust and distrust coexist in human relationships in a multifaceted manner. In fact, those relationships which consist of a high level of trust and a high level of distrust seem to be most effective (Lewicki, McAllister, & Bies, 1998).

Consider Formal Procedures
In most scenarios signing a cooperation contract goes beyond the jurisdiction of the particular persons that come together to innovate in the network. Besides, negotiation (typically about allocation of funding, performance specifications, division of labor, intellectual property and distribution rights) often comprises lawyers' expertise. Since most (bigger) organizations have standard procedures and contracts that have to be respected, every cooperation partner should be aware and able to make only those arrangements that will be approved by their company or organization.

Evaluate
Be aware that this phase marks a line of demarcation. If you accomplish to put together a co-creative innovation project, you will ultimately reach a new level of cooperation. If you cannot take that significant hurdle, you should consider leaving the network (and maybe join another one) as you—for whatever reason—are not able to create value within this one.

5.4 Innovation Project

As you managed to bring on an innovation project (e.g. strategic alliances, product development) the governance structure of your cooperation finally changes into a project organization and thus it becomes subject of (already well professionalized)

project management. However, you still stay a member of the network and you will turn back to the contact and negotiation phases as you try to find new ways for co-creating value with other network members.

6 Outlook: Should Firms Join an Innovation Network?

Most attempts to innovate fail for technical, organizational, legal or market reasons. Thus, creating value with technological or business innovation is highly unpredictable. Innovation networks can support such uncertain efforts and thus, sooner or later, firms and management will decide to use that new form of collaboration. However, as a social innovation networks are challenging as well since they lead to successful value creation only if managers revise their mindsets and think over their routines that have been proven to be efficient for so long.

It is true to argue that the ability to co-create value within innovation networks requires F.A.I.R. action. Nevertheless, one should not misjudge the F.A.I.R. model as moral or idealistic 'commandment', but rather think of it as an effective guideline for all managers and firms who want to create value by innovation.

References

Burt, R. S. (1992). The social structure of competition. In N. Nohria & R. G. Eccles (Eds.), *Networks and organizations: Structure, form and action* (pp. 57–91). Boston: Harvard Business School Press.

Chesbrough, H. W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.

Funken, C., & Hörlin, S. (2012). Misstrauen als ressource. Ein impuls für innovationsprozesse in KMU-netzwerken. *The Organ, 31*(1), 41–44.

Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Berkley: University of California Press.

Lewicki, R. J. (2007). Trust and distrust. In A. K. Schneider & C. Honeyman (Eds.), *The negotiator's fieldbook: The desk reference for the experienced negotiator* (pp. 191–202). Washington, DC: American Bar Association.

Lewicki, R. J., McAllister, D. J., & Bies, R. J. (1998). Trust and distrust: New relationships and realities. *The Academy of Management Review, 23*(3), 438–458.

Powell, W. W. (1990). Neither market nor hierarchy: Network forms of organization. *Research in Organizational Behavior, 12*, 295–336.

Powell, W. W., & Grodal, S. (2005). Networks of innovators. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 56–85). Oxford: Oxford University Press.

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creating unique value with customers. *Strategy and Leadership, 32*(3), 4–9.

Senge, P. M. (2006). *The fifth discipline. The art & practice of the learning organization*. New York: Currency Doubleday.

Snow, C. C., Miles, R. E., & Coleman, H. (1992). Managing the 21st century network organization. *Organizational Dynamics, 20*(3), 5–20.

Thoma, J., & Funken, C. (2013). Innovation durch funktionales Misstrauen – latentes und kommuniziertes Misstrauen in Innovationsprozessen in KMU-Netzwerken. In G. Becke,

C. Funken, S. Klinke, et al. (Eds.), *Innovationsfähigkeit durch Vertrauensgestaltung? Befunde und Instrumente zur nachhaltigen Organisations- und Netzwerkentwicklung* (pp. 179–192). Frankfurt a. M: Peter Lang.

Williamson, O. E. (2005). Networks – Organizational solutions to future challenges. In T. Theurl (Ed.), *Economics of interfirm networks* (pp. 3–27). Tübingen: Mohr Siebeck.

Jules Thoma, Dipl.-Soz. tech., has been researcher at the Department of Sociology at the Technische Universität Berlin. He conducted several empirical studies about the development of innovation networks and network management methods. Together with Prof. Dr. Christiane Funken he is co-founder of the TRUSTnet NETZWERKMANAGEMENT consulting agency (www.trust-net.org) which transfers research findings into network practice.

Part II

Open Source Ecosystems

Coordination, Loyalty and Competitive Advantage: What We Can Learn from Open Source

Benno Luthiger

1 Why Learning from Open Source?

Open source software is software whose source code is freely available. Such software is published under an open source license, allowing anyone to freely obtain, install, study, modify and redistribute it. Since the beginning of the 1990s, open source software has gained a considerable momentum. *Linux*, the open source operating system, is not only the dominant operating system for servers, but also of super computers. *Android*, an adoption of *Linux* for smartphones, is the predominant operating system in this area.

Open source is so successful that even *Microsoft* changed its attitude towards it. In 1976, *Microsoft* founder Bill Gates criticized in an "Open Letter to Hobbyists" the use and development of open source software. In 2001, Steve Ballmer, the *Microsoft* CEO at the time described open source as cancer. Since 2016, however, *Microsoft* has started to embrace open source. The company joined the *Linux Foundation* and releases more and more software under an open source license.

Open source software is produced by programmers who are paid for their work, as well as by programmers who work on open source projects in their spare time. This fact makes the open source phenomenon even more puzzling. Why do software developers spend their free time developing software freely given away? Why do companies invest in software projects whose results are accessible even to their competitors without charge?

Questions like these attracted the interest of the research community in economics. In the past years, research came to noteworthy findings concerning *cooperation* and *innovation*. In this contribution, I will recapitulate these findings. In the main

B. Luthiger (✉)
ETH Zurich, Zürich, Switzerland
e-mail: benno.luthiger@id.ethz.ch

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_9

part, however, I show what we can learn from open source to solve one of the most challenging management problems: the principal-agent problem.

1.1 Cooperation Among Competitors

According to market theory, competition generates economic efficiency. Therefore, antitrust policies seek to prohibit agreements and practices that restrict competition between businesses. In markets regulated this way, we expect competition between companies that are in the same field. In reality, however, we can see diverse forms of cooperation between competing firms, e.g. alliances, networks, joint ventures.

There are several reasons why companies enter cooperation with competing companies. Firms cooperate to seek complementary external resources, to mitigate risk and to learn from others. Through cooperation, two companies can gain access to each other's unique resources or share the cost of developing new unique resources.

Typically, cooperation does not take place in one of the involved companies' core competence. Thus, companies cooperating in a common project can simultaneously compete in other fields. One of the most famous cooperation projects in the open source area is the *Linux Foundation*. The main purpose of this foundation is the development of the *Linux* operating system. Prominent members of this cooperation project are *IBM*, *Oracle*, *Red Hat*, *Intel*, *HP* and *Samsung*. The software company that earned most from its operating system (and complementary applications), however, is not part of this cooperation. *Microsoft* became big with *Windows* and *Microsoft* had (until 2016) no interest on strengthening *Linux* nor building an alliance around the *Windows* operating system. We see the same pattern in the *OpenStack* project. This project aims at developing a cloud computing infrastructure. Prominent project members are *Rackspace*, *Red Hat*, *Intel*, *IBM*, *VMware* and *Citrix* as well as government agencies like *NASA* or *CERN*. Again, *Amazon*, the first and most important provider of cloud infrastructure, is not part of this cooperation project.

These examples show that cooperation is rather common, not only in software development. Open source, however, adds specific characteristic to such cooperation. To describe cooperation among competitors in the open source arena, the neologism "open coopetition" has been established (Teixeira, Mian, & Hytti, 2016). Open coopetition is characterized by maximizing the development transparency and the sense of community. At the same time, the managerial control and the enforcement of intellectual property rights are minimized. By its openness, such projects are as inclusive as they can be: Everybody can contribute. Users or other contributors do not need to sign a legal intellectual property arrangement to contribute (however, some open source foundations request the contributors to sign an agreement handing over the right to relicense the contributed software to the foundation). Moreover, they do not need to be a member of a particular company or affiliated with a particular association to be able to contribute.

We can explain cooperation also if we look at the individual level. Generally, most people like to cooperate. Most of the people behave prosocial. Especially in modern societies, they recognize in their counterpart not the enemy stranger, but a potential partner. In cooperation among competing firms, there is an additional aspect. People coming from different companies but working in the same area share a considerable amount of knowledge and professional background. Often, they share the same values and face similar problems. Under such preconditions, they would form a cooperation in a natural way. It is the competition regulations that makes them competitors. But on the individual level, they enjoy solving shared problems in a joint effort.

1.2 Innovate by Open Sourcing

Companies create innovations hoping that through such innovations they can gain a competitive advantage. For companies to innovate, there must be an efficient regime of intellectual property protection. Then, companies see research as a private investment because the property rights (e.g. patents, copyrights, trade secrets) assist the companies in getting private returns from their innovation-related investments. This model, known as "private investment" model, contrasts with the "collective action" model (von Hippel & von Krogh, 2004). If the intellectual property rights cannot be enforced, innovations become a public good. In such a model, everybody can profit from the innovator's work. This might be good for society's welfare if subsequent innovations can be realized based on former innovations. However, potential beneficiaries of an innovation have the option of waiting for others to contribute and then free riding on what they have done. Therefore, in a model where innovation is a public good, there is the risk of under provisioning. In research, this problem is solved by providing monetary incentives and reputation to researchers.

As von Hippel and von Krogh (2004) pointed out, open source software represents an interesting compound of the "private investment" and "collective action" models of innovation. They argue that most of the time, open source developers are users of the software they develop. Thus, they program to solve their own as well as shared technical problems, and freely reveal their innovations without appropriating private returns from selling the software. By solving their own problem, they make a private investment. Only by publishing this software under an open source license, they turn their private investment into a public good. Therefore, only the last step, the publication under an open source license, has to be rewarded to mitigate the free-rider problem. Since publishing and distributing software is cheap in the internet area, there is only a little reward needed to surpass the costs. In fact, we see reasonable rewards for open source developers, e.g. reputation or signaling effects. Therefore, innovation in the open source area happens because programmers contribute freely to the provision of a public good. They do so because they garner private benefits.

On the company level, open source plays particularly well in a strategy called "innovation happens elsewhere" (Gabriel & Goldman, 2002). This strategy is based

on the insight that most of innovations, even those concerning the company's core competence, happen outside of the company. Therefore, a company following this strategy tries to create ties to outside companies and customers of a kind that instigate outside innovation beneficial to the company. In a first step, the company identifies the company's proprietary values. Everything outside this inner circle of protected ideas and technology is available to be given away. By doing that, the company tries to create more products in the market that either are enablers for the products the company sells or form an aftermarket for them.

As shown before, open source is well suited to be given away in a controlled way. If a company gives away useful software tools or technologies (under an open source license), this spurs outside individuals to work on or with such software. Later, that developer might bring the tool into his company, which starts to use it for their own purposes. Because the tool was a gift and its source is available, individuals and their companies send bug fixes, extensions, modules, and ideas back to the company.

Next, an outside company using the opened software from the first company, recognizes that these tools or technologies can be combined with their own company's technology to produce products at lower cost, less risk, and of great value to their customers. Sometimes such a company will think of an application or variation of the original tool that will open it up to entirely and unexpected market. Even further, the original company, by creating, building, and maintaining a set of communities around the tools it provided, may engage in conversations with external actors and, thus, be able to lead and influence further directions.

These findings show how open source can instigate innovations on the individual level and how companies can utilize that to create competitive advantages.

2 Value Creation and Coordination

Looking back in the history of mankind, we recognize that prosperity per capita has steadily increased over the centuries. With its social organization, the human being has managed to create more and more value. To create welfare, the society has to coordinate the activities of the innumerable individuals in such a way that the individual activities do not interfere with each other and extinguish each other but complement one another. With what forms of organization and incentive structures could society achieve this?

The division of labor is the basis of productivity increases. In a society with division of labor, not all people have to do a bit of everything, but they can develop their specific abilities. However, the division of labor intensifies the problem of coordination. To effectively generate prosperity, the society must find efficient means to integrate the contributions of the individual. To achieve this, there are two basic possibilities. Either the individual contributions are integrated in an organic manner, e.g. by market mechanisms such as supply and demand, and price signals as means of control. Or the coordination is done in a mechanical way, through control exerted by a social structure integrating the individuals.

In modern societies, these two principles are mixed. Most people work in organizational structures that are integrated vertically or horizontally. Such structures may be private companies or administrations. Within such organizations, the individuals are mechanically integrated. These structures themselves are organically integrated, i.e. they are in competition with each other. Both history and practice show that market structures are extremely successful in coordinating largely autonomous structures. If the market is that successful in coordinating organizational structures like companies, would not it be possible that the market exerts the same strength of integration on the individual level? Are companies still necessary? With the advent of the digital society and the appearance of sharing platforms, this question is gaining in importance.

Obviously, coordination involves costs. Companies act as coordination arenas. With their organizational structures, they are more efficient to coordinate individuals than anonymous structures like the market. In an organizational structure, coordination is a key task of the management. Management has to organize the activities of the employees to achieve unanimity of individual efforts in the pursuit of group goals. The purpose of coordination is to make best possible use of the organization's resources. Coordination comprises tasks as planning, directing, organizing, controlling, staffing, leading, etc. Thus, coordination is the common thread that connects all the activities.

This brief explanation shows that coordination is a complex task. In addition, it makes clear that organizational structures like companies provide an elaborated toolset for coordination. However, there is a significant difference between market integration and company integration. If an individual and its contribution are integrated directly through market forces, everyone can be seen as its own little company. In this case, the corporate's objectives fall together with the individual's self-interest. In the latter case, the company's goals and the employee's self-interests are different things. Coordination within a company, therefore, has an additional dimension. In the end, coordinating the employees within a company means bringing their self-interest in line with the company's objectives. The problem each company has to solve here is well known as "principal-agent problem" (Coase, 1937).

In the industrial society, the method to solve this principal-agent problem was command and control. If the individual has no discretionary leeway, if every aspect of his work is specified upfront and controlled afterwards, the organization can be sure that the employee acts in the sense of the organization. The assembly line of the factories in the early twentieth century was the perfect implementation of this method. However, this option is viable only in a work environment characterized by deterministic procedures.

2.1 Knowledge Economy and Creativity

Since the advent of computers and digitalization, we live in a different world. The best term to describe the world of the twenty-first century is "Knowledge Economy". It was Peter F. Drucker (1969) who coined this term. He was the first who recognized

that since the middle of the twentieth century, something has fundamentally changed. While in the old days of the classic industrial society, it was the capital equipment driving the value creation, now the human capital took over.

The exploitation of capital equipment can be organized and measured using classical methods (product unit per time unit). Formal knowledge is decisive for its organization. This knowledge can easily be copied and reproduced. Thus, it forms the input of the robots, which have raised mass production to a new level in modern factories.

In the knowledge economy on the other hand, it is immaterial capital, human capital, that is utilized. The company's success depends no longer on formal, retrievable knowledge, but on living knowledge such as experience, discernment, self-organization. In the knowledge economy, knowledge is a resource, which is continually revised and constantly improved. Knowledge aims at generating and increasing knowledge. This is intended to create innovation and thus to secure and strengthen the company's competitiveness.

The well-trained individuals form the companies' human capital. Companies that have the most creative and imaginative employees are those who are successful in a knowledge economy. Especially in a competitive environment, the ability of employees to react to unplanned and unusual situations is crucial for the company's success.

In such an environment, control is no longer an option to make employees committed to the corporate objectives. In fact, it is the safest means to kill the employees' creativity. If companies want to be successful, they must offer an attractive work environment to attract and retain well-trained people as employees. Companies must try to win the loyalty of their employees. This is the only way to solve the principal-agent problem in the knowledge economy.

2.2 Loyalty

Loyal and committed employees are beneficial for the company for many reasons. They act to the benefit of the company, even if the working environment would allow them to follow their personal inclinations and their personal advantage. Studies show that loyal employees are ill less frequently; they have a positive image of their company and plan to make their professional career with their current employer. The relationship to their employer is characterized by a strong emotional bond. They are more productive, have fewer work accidents, perform better and cause less fluctuation costs than employees with a weak emotional bond (Gallup, 2016).

What are the factors responsible for the quality of this emotional bond? Decisive for the loyalty of the employees is the promise that they can develop in the company. In other words: Loyalty is exchanged for opportunities for development (Martensen & Grønholdt, 2006). As far as development opportunities at the work place are concerned, we must take two aspects into account. On one hand, it is about the long-term development possibilities. What chances does an employee have to make a

career within the company? On the other hand, development has a short-term aspect. This is about whether the employee enjoys his work. Can the employee take up his daily work with a good feeling, because he perceives it as meaningful and rewarding? Or said differently: is work fun?

2.3 Fun at Work

I have investigated this short-term aspect in a quantitative study of open source developers. Because of its openness, it is easy to get into contact with open source projects, which makes it easy to investigate the motivation of the people involved. One aspect particularly attracted my interest. Open source software is produced by programmers who are paid for their work, as well as by programmers who work on open source projects in their spare time. The formers are primarily extrinsically motivated, that is by monetary incentives. The latter are obviously intrinsically motivated, for no external pressure forces them to do what they do. Thus, the intrinsically motivated open source developers set the benchmark for what is possible if work is fun.

My research primarily focused on the question, how much of the developers' motivation to develop open source software can be explained by the fun motivation (Luthiger & Jungwirth, 2007). To achieve this, I used the flow concept by Csikszentmihalyi (1974) which I operationalized in a suitable questionnaire. I sent the link to this online questionnaire to well-known open source platforms where 1330 developers filled my questionnaire (during 54 days in summer 2004). With the collected data, I was able to demonstrate that fun is a relevant part of the commitment of open source developers. Almost one third (28%–33%) of the phenomenon can be explained by this. However, this result points out that there are still other motives for producing open source software (e.g. reputation (Watson, 2005), signal production (Lerner & Tirole, 2002), altruism (Haruvy, Prasad, & Sethi, 2003) etc.).

While studying the data, I recognized that both programmers that are paid for their work as well as hobbyists were present in my sample. 518 people in my dataset were involved in open source projects exclusively in their spare time. These correspond to the classic image of a hacker. In contrast to this, there were 153 people who participated exclusively in open source projects during their working hours. These are professionals who are paid (by their employer or the open source community) for their work. This situation gave me the opportunity to explore the following questions: do paid professionals, who engage during their working hours in open source projects, experience the same amount of fun as their counterparts, the hackers? If there is a difference: what is the reason why the same work, put in a different context, is less fun?

My analysis proved indeed that professionals enjoy significantly less fun while developing open source. I therefore looked for conditions causing this difference. I identified five features as potential causes.

Monetary Incentives
Monetary incentives are an obvious difference between professionals and hackers. Professionals are paid for their work in open source projects whereas hackers are not. The latter engage in their spare time, voluntarily and unpaid.

Formal Authority
A hacker can elude every formal authority. A professional, on the other hand, usually has a superior who can give him instructions to a certain extent. The developer as an employee must comply with them.

Deadlines
For hackers, deadlines play no role at all. A spare time hacker engages in open source projects only when it suits him. The professional environment however is tied to business processes, and deadlines are inevitable.

Project Vision
An open source project that wants to attract developers on a voluntary basis has to provide a project vision. When a developer decides to work in a project, the impression of being able to perform something meaningful in and through the project plays an important role. That is exactly the purpose of the project vision: it shows what problems (for the peer group, the company, the society etc.) will be solved by the project and, thus, embeds the project in a broader context (technical, social etc.). Professionals, on the other hand, are given the task to participate in a specific project by their superiors. A project vision is not a necessary condition for their commitment. This does not mean that such a project cannot have a vision. This vision is just not decisive for the professional's participation in this project.

Optimal Challenge
For a developer to enjoy his work, for he gets the feeling of flow, the challenges that the project offers must be optimally aligned with the developer's abilities. If the task is too demanding, he feels frustrated and anxious, if it is too easy, he feels under challenged and bored. A hacker can freely choose the project, and therefore the degree of the challenge. He can make the choice that best suits his needs. A professional usually does not have this choice. Again, it is possible that the professional finds optimal challenges. Since the project choice is determined (and paid) by its employer, this factor is not a prerequisite for his commitment.

How does the fun while programming change depending on these criteria? Using my dataset, I have been able to do an analysis in which I've correlated the developer's fun with these five criteria. This analysis gave an interesting result. I was able to prove a significant correlation between project vision, optimal challenge and deadlines on the one hand and the experience of fun on the other. The presence of formal authority had no effect on the enjoyment, as did the monetary incentives.

Particularly noteworthy is the result regarding the deadlines. My expectation was that the pressure of a deadline would have a negative impact on fun and flow. The

Table 1 Fun depending on criteria (column: does criteria exist?)

Criteria	Hacker	Professional	Correlation
Monetary incentives	No	Yes	
Formal authority	No	Yes	.115
Deadlines	Yes	Yes	.256**
Project vision	Yes	?	.358***
Optimal challenge	Yes	?	.270***

Remark: ***significant on 1% level, **5% level

data suggests an inverse relationship. Developers, who report from deadlines, do not feel less, but more fun. Obviously, deadlines are no fun killer.

This finding leads to an interesting conclusion. Looking at Table 1, we see that two of the criteria inevitable for the professionals' work situation (monetary incentives and formal authority) have no consequences of the developers' enjoyment. As we have seen, the third inevitable criterion (deadlines) correlates positive with the developers' fun. The two crucial criteria for the developers' fun (project vision and optimal challenge) are optional in the professional's work situation.

3 How to Win Loyalty

Coming back to our initial question. I've stated that the employer has to win the employee's loyalty to bring the employee's interest in line with the company's goals. To achieve this, the employer has to offer long-term as well as short-term development opportunities. Concerning the short-term development opportunities, that is the employee's enjoyment at work, I have proposed the hacker's commitment in open source projects as bench mark. For a productive work, there is no more fun imaginable than if a person makes it voluntarily and without external pressure.

If we compare the fun a hacker enjoys during his work in his free time with the same situation of a professional at his work place, we have come to a remarkable conclusion: there is no compelling reason why the professional work is less enjoyable than the work done in free time. It is obvious but not compelling. It is obvious, because the employer does not have to offer project visions and optimal challenges to his employees for the work to be done. However, if he is looking for the employees' loyalty, that is exactly what he should do. If he can offer meaningful project visions and if the work is neither frustrating nor boring, chances are good that he has employees who like their work and, thus, are loyal to their employer.

Peter F. Drucker, the discoverer of the knowledge economy, states: "The ability to make good decisions regarding people represents one of the last reliable sources of competitive advantage since very few organizations are good at it." According to this quote, decisions regarding people are the most important strategic and operative decisions a manager can make. Most managers nowadays agree with this statement. In the *Deloitte* report about Global Human Capital Trends (2014), managers state as the second most urgent issue to redefine the engagement strategy, i.e. "to move from

keeping people to attracting them and creating a passionate and compassionate place to work". These managers know the value of good employees for the company. They know from experience that human happiness boosts human productivity. Such experience gets strong support from the study in personnel economics (e.g. Oswald, Proto, & Sgroi, 2002). But how can we convert a paid clerk to a happy and therefore loyal and productive employee? Learning from the study of open source developers, we see that the project vision and the optimal challenge are the decisive factors in achieving this goal.

4 Learning from Open Source

The open source development model provides a stable framework for cooperation. It allows companies to find complementary external resources, to mitigate risk and to learn from others. Open source maximizes the development transparency and the sense of community of the cooperation and, at the same time, minimizes managerial control and the enforcement of intellectual property rights. Such cooperation, therefore, allows to freely move information between the cooperation partners and foster the creation of joint findings.

Open source stimulates innovation in diverse ways. Software developers innovate by solving their own as well as shared technical problems, and freely reveal their innovations without appropriating private returns from selling the software. IT companies donate code, applications and technologies to build up a community or an ecosystem around these tools. Such an ecosystem can open up new markets and provide precious user feedback to the donator, helping him to improve its products, designs and directions.

Companies adopting elements of the open source development model are typically IT companies. If it comes to the principal-agent problem, however, we see some implications relevant not only for IT companies, but for every company in the knowledge economy. If you cannot control smart people, what are your options to bind high potentials to the company and leverage their creativity? You have to win their loyalty, and open source shows how to achieve this. Employees are loyal when their employer offers long-term development possibilities and enjoyable work. Work makes fun if the work is backed by a vision and offers optimal challenge.

References

Coase, R. H. (1937). The nature of the firm. *Economica. New Series, 4*(16), 386–405.

Csikszentmihalyi, M. (1974). *Beyond boredom and anxiety*. San Francisco: Jossey-Bass.

Deloitte. (2014). *Global human capital trends*. Retrieved October 17, 2017, from https://www2.deloitte.com/insights/us/en/focus/human-capital-trends/2014.html

Drucker, P. (1969). *The age of discontinuity*. Amsterdam: Elsevier.

Gabriel, R. P., & Goldman, R. (2002). *Open source: Beyond the fairytales*. Retrieved October 4, 2003, from http://csis.pace.edu/~grossman/dcs/gabriel_open_source/beyond_the_fairytales.pdf

Gallup. (2016). *Präsentation zum engagement index 2015*. Retrieved June 5, 2016, from http://www.gallup.de/file/190028/Praesentation%20zum%20Gallup%20Engagement%20Index%202015.pdf

Haruvy, E., Prasad, A., & Sethi, S. P. (2003). Harvesting altruism in open-source software development. *Journal of Optimization Theory and Applications, 118*(2), 381–416.

Lerner, J., & Tirole, J. (2002). Some simple economics of open source. *Journal of Industrial Economics, 52*(6), 197–234.

Luthiger, B., & Jungwirth, C. (2007). *Pervasive fun*. Retrieved February 5, 2007, from http://firstmonday.org/ojs/index.php/fm/article/view/1422/1340

Martensen, A., & Grønholdt, L. (2006). Internal marketing: A study of employee loyalty, its determinants and consequences. *Innovative Marketing, 2*(4), 92–115.

Oswald, A. J., Proto, E., & Sgroi, D. (2002). *Happiness and productivity*. Retrieved October 17, 2017, from http://www.andrewoswald.com/docs/6MayOsProtoSgroi2012.pdf

Teixeira, J. A., Mian, S. Q., & Hytti, U. (2016). *Cooperation among competitors in the open-source arena: The case of OpenStack*. Retrieved October 1, 2017, from https://arxiv.org/abs/1612.09462

von Hippel, E., & von Krogh, G. (2004). *Open source software and the "private-collective" innovation model*. Retrieved December 5, 2017, from https://evhippel.files.wordpress.com/2013/08/private-collective-model-os.pdf

Watson, A. (2005). *Reputation in open source software*. Retrieved November 21, 2005. https://pdfs.semanticscholar.org/10b4/374ade427bf9be0287c3faf21adf5fbd249c.pdf

Benno Luthiger is software developer at the IT Services department of the ETH Zurich. He has a degree in Physics, Cultural Anthropology and Economics. In his research, he is interested in Open Source, Machine Learning and Blockchain Technology.

Understanding Open Source Software Communities

Jan-Felix Schrape

1 Introduction

The term *open* has become part of the standard vocabulary in the digital era. An important starting point for the popularity of the openness paradigm is the increasing relevance of open source projects in software development since the turn of the millennium. Not long thereafter, the concept of *commons-based peer production* gained traction: Hailed as a technically effective "collaboration among large groups of individuals [...] without relying on either market pricing or managerial hierarchies" (Benkler & Nissenbaum, 2006, p. 381), commons-based peer production was to be accompanied with "systematic advantages [...] in identifying and allocating human capital" (Benkler, 2002, p. 381). More recently (see, e.g., Rifkin, 2014; Sundararajan, 2016), the concept has been applied in adjacent fields, such as the service sector (*Sharing economy*) or material production (*Maker economy*).

Today, open source architectures are predominating in the area of basic IT infrastructures (e.g., web servers) and in many segments of the enterprise software market (Table 1). However, studies of recent open source software (OSS) projects have also shown that their growth and increase in market relevance goes hand in hand with the formation of hierarchical decision-making routines and that the established projects of today are not run by volunteers but are based on the contributions of employed developers. For example, in the *Linux* kernel project, 85% of the changes were made by programmers who "are being paid for their work." (Corbet & Kroah-Hartman, 2016, p. 12).

Against this backdrop, this chapter provides an overview of open source communities and their socio-economic contexts. I begin with a brief history of OSS projects, followed by the identification of four ideal-type variants of current

J.-F. Schrape (✉)
University of Stuttgart, Stuttgart, Germany
e-mail: jan-felix.schrape@sowi.uni-stuttgart.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_10

Table 1 Estimated global market share of OSS architectures (in %)

	2017	2010
Mobile Operating System	Android: 67%	Android: 11%
Browser (Desktop)	Mozilla Firefox: 13%	Mozilla Firefox: 31%
Server Operating System	Linux: 67%	Linux: 69%
Webserver (active)	Apache: 48% Nginx: 36%	Apache: 72% Nginx: 4%
Database Management	OSS (div.): 55%	OSS (div.): 35%
Web Content Management System	WordPress: 60%	WordPress: 51%

Data Sources: NetApplications, StatCounter, W3techs (status: 7/2017, see Schrape, 2018, p. 82)

project communities that differ significantly in their economic orientations and modes of coordination. The chapter ends with the conclusion, that by now all major IT organizations leverage open source technology as OSS projects have become important incubators for branch-defining infrastructures, and offers managerial implications to this effect.

2 A Brief History of Open Source Software

The development of the free software movement can be seen as a response to the previously initiated commodification of software: In the 1950s and 1960s, computer programs were not yet perceived as an independent product but rather as a research and business tool to be refined by all users. By the 1980s, however, most software products were sold as binary files without accessible source code. Furthermore, amendments to copyright law had increased the protection of software. As an ethical statement about this turn of events, Richard Stallman (1983) announced his plan to develop an independent operating system (GNU for "GNU's not Unix"). Stallman's project proved to be the breeding ground for free software development: In 1985, he established the *Free Software Foundation* (FSF), which swiftly enlisted large-scale sponsors such as the IT manufacturers *Sony* and *Hewlett-Packard*. The most relevant innovation, however, was the introduction of new licensing models, like the General Public License (GPL), which ensure that any forks of free software remain free: "Each time you redistribute the Program [. . .], the recipient *automatically* receives a license from the original licensor to copy, distribute or modify the Program." (FSF, 1989).

However, the spread of the GNU project itself remained restricted because of its focus on workstations as well as its sociopolitical connotations. The *Linux* kernel project, which was introduced in 1991 by then-student Linus Torvalds, offered a solution to these problems: As a free operating system kernel for the more affordable micro-computers, it was attractive for a larger number of developers, and beyond that, Torvalds (2002) was characterized by a more liberal attitude than Stallman: "This world would be a much better place if people had less ideology and a whole lot more 'I do this because it's fun [. . .].'" That said, the *Linux* project, too, was initially

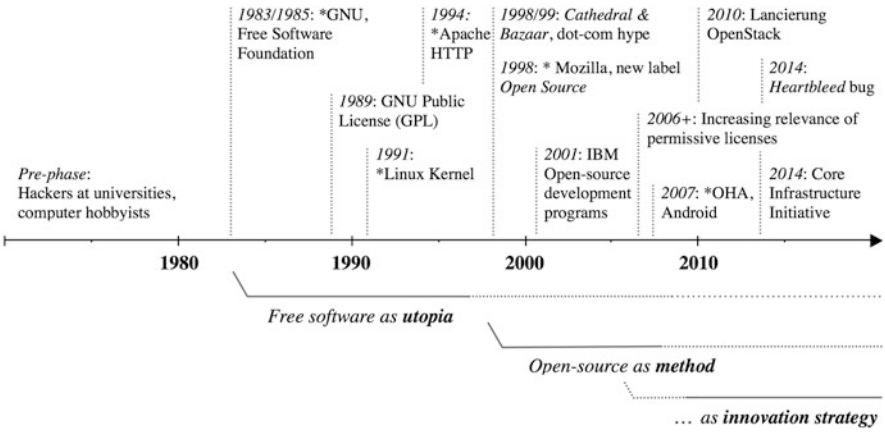


Fig. 1 OSS as utopia, method and innovation strategy (Schrape, 2017)

known only by specialists and enthusiasts. It was not until the book *The Cathedral and the Bazaar*, published by software developer Eric S. Raymond in 1999, that the Linux kernel became more widely known. The main thesis of the book was: Whereas in traditional software development models the source code is at best published for the final version of the program and the respective developer groups are hierarchically organized—corresponding to a *cathedral*—the source code in projects such as the *Linux* Kernel is visible during the whole development process, and their groups are maintained by self-organization without managerial hierarchies—corresponding to a *bazaar*. Yet, critics observed early on that while many suggestions came from the community, final changes were released by only one person—the project leader (Bezroukov, 1999).

In the next decade, then, OSS development became an increasingly recognized working method within the industry for three main reasons (Fig. 1):

- First, a growing number of IT companies began outsourcing the development of software to the open source field (e.g., *Netscape Communications*).
- Second, in 1998, a group of developers concluded that the term "free software" could impede the spread of OSS in commercial contexts and therefore introduced the new label "open source", which they considered to emphasize the superiority of this software development model while deflecting from any political aspects.
- The third factor that contributed to the recognition of OSS was the spectacular stock market success of some open source companies in 1999 (e.g., *Red Hat*).

These interrelated trends, combined with the continued expansion of the IT market, led to the rapid proliferation of OSS projects. Indeed, their number grew from several hundred in 1999 to the several million projects which can today be found on platforms such as *GitHub*. Given this increase, open source licensing has been subject to strong diversification (Table 2): Alongside original "copyleft" licenses such as the GPL (*strongly protective*), additional licenses have been issued

Table 2 The most used OSS licenses worldwide (Black Duck Knowledgebase; status: 1/2018)

	e.g., used by	2017 (%)	2010 (%)	Orientation
MIT License	*jQuery*	32	6	permissive
GPL 2.0	*Linux* kernel	18	47	strongly protective
Apache License 2.0	*Android*, *Apache*	14	4	permissive
GPL 3.0	GNU	7	6	strongly protective
BSD License 2.0 (3c)	*Chromium*, *WebKit*	6	6	permissive
Lesser GPL 2.1 / 3.0	*VLC Media Player*	6	9	weakly protective
ISC License	*OpenBSD*, *nhttpd*	5	n/a	permissive

that permit the inclusion of free software in proprietary products as long as these elements remain open (*weakly protective*) or even permit the publication of derivations under downright restrictive conditions (*permissive*). This diversity expands the strategic options for commercial stakeholders: *Google*, for instance, decided from the outset to put project-own code of Android under the permissive Apache License 2.0.

In that sense, a corporatization of open source software projects can be observed in two ways. On the one hand, branch-essential infrastructure projects like the *Apache* HTTP Server, the cloud computing platform *OpenStack* or the *Linux* kernel, are by now in large part funded by grants from technology corporations or operate like the mobile operating system *Android* under the general management and control of commercial providers (in this case: Google). On the other hand, the developer base of larger and prominent projects is increasingly financed by companies, too: In the *Linux* kernel and 5000 other market-relevant projects, more than 50% of all contributions between 2000 and 2011 were made during western standard 9-to-5 working hours (Kolassa, Riehle, Riemer, & Schmidt, 2014). And the *Linux* Foundation recently pointed out that the percentage of independent developers in the *Linux* kernel development (2009: 18%, 2014: 12%, 2016: 8%) is declining in contrast to the contributions of contributors paid by established companies, e.g. *Samsung*, *Google, or IBM* (Corbet & Kroah-Hartman, 2016).

It is in this way that open source development increasingly became enmeshed with the software industry. In the enterprise software markets, which account for more than 80% of global software sales, "a widespread use of open source technology" can be observed (Driver, 2014). Thus, it is not surprising that by now all key IT companies are involved in OSS projects:

- *Microsoft* launched its subsidiary MS Open Technologies in 2012. Since then, it has put many other components under an OSS license, namely in order "to achieve a strategic objective, such as promoting industry standards, advancing interoperability [. . .]." (Microsoft, 2017, p. 20) In June 2018, it additionally acquired the open source software hosting platform GitHub for 7.5 billion US-Dollar.
- *Apple*'s operating system packages *macOS*, *iOS*, *tvOS*, and *watchOS* are at its core based on the *Unix*-like operating system *Darwin* and contain hundreds of

other OSS components (e.g., *WebKit*). Likewise, many consumer electronics products from *Samsung* and other leading companies are enabled by OSS.
- *IBM* had already invested several hundred million US dollars in the development of *Linux* at the millennium turn to counteract *Microsoft*'s dominance in the enterprise sector. Today, *IBM* is involved in hundreds of OSS projects, among them the cloud platform *OpenStack*, in which *Intel* and *HP* also participate.
- A special variant of corporate open source exposures is the development of the Android operating system by the *Open Handset Alliance*, initiated by *Google*. Advertised as a pure OSS project, its development is de facto steered by *Google* alone. With the launch of *Android*, *Google* apparently succeeded above all in facilitating the seamless access to its services for as many devices as possible.

In that sense, many popular open source communities by now have close financial ties with leading IT companies, which are investing in open source projects as part of their overarching innovation strategies, thereby securing a considerable influence on relevant communities while at the same time allowing for greater predictability in planning for these projects as regards both their human and financial resources.

3 Varieties of OSS Projects

Over the last 20 years, OSS has thus become an integral part of the IT industry and as a result, the spectrum of OSS projects has become steadily broader: At one end, there are still some communities which are committed to Stallman's sociopolitical ideals and which are aligned with egalitarian organizational principles. At the other end of the spectrum, we find an increasing number of projects that are under the control of leading IT companies and that follow hierarchical development models (Table 3).

3.1 Cooperate-Led Collaboration Projects

These projects are defined by clear hierarchies and a strong corporate influence. Its products usually have a high visibility and impact in markets. The communities majorly comprise coders and developers that are employees of the involved corporations. Examples are *Android*, *WebKit* (HTML engine) and *Fedora* (*Linux* distribution), where the strategic control lies with the major corporate actor; in these cases: *Google*, *Apple*, and *Red Hat*. *Android*-own code, for instance, is run under permissive licenses, which, in combination with further legal frameworks, give *Google* comprehensive control. In the cloud computing project *OpenStack*, big sponsors likewise have considerable influence. This type of corporate collaboration under the terms of open licenses allows to overcome two knowledge-sharing dilemmas: One, OSS licenses prevent the direct proprietarization of collectively developed code by any individual entity. Secondly, they prevent abuse from free riders given the traceability of which firms use which elements and if they participated

Table 3 Manifestations of open source projects

	Corporate-led collaboration projects e.g., *Android*, *OpenStack*	Heterarchical infrastructure projects e.g., *Apache* HTTP, *Eclipse*	Elite-centered project communities e.g., *Linux* kernel, *Firefox*	Peer production communities e.g., GNU CC, *Arch Linux*
Work organization	Mainly hierarchical	Horizontal–meritocratic	Mainly hierarchical	Horizontal – egalitarian
Strategic management	Leading company or consortium	Board or steering group	Project founder or Management team	Committee or core team
Funding	Participating firms	Primarily corporate contributions	Corporate and private donations	Private donations
Participant pool	Mainly staff from the involved firms	Employed developers, firm representatives	Employed and (few) voluntary developers	Primarily voluntary developers

in the development. In addition, in this day and age, it is often more feasible to create new software products by building on already existing open source architectures than by developing the software from scratch (see, for details, Schrape, 2017).

3.2 Heterarchical Infrastructure Projects

Heterarchical infrastructure projects, whose products are ever-present beneath the visible surface of our IT systems, are also closely intertwined with corporate contexts. Some were initially based on architectures that were formerly proprietary (e.g., the software development environment *Eclipse*). Others (like the *Apache* HTTP Server) were characterized by rapid organic growth, since they offered solutions to previously unaddressed problems, making them interesting to companies early on. Today, most infrastructure projects are supported by IT companies that seek to adjust the respective code to their business needs. However, these communities operate, as a rule, under the umbrella of nonprofit organizations and are not steered by corporate core circles. Management positions are assigned on a meritocratic basis ("the more you contribute, the more responsibility you will earn"), but in these projects, too, employed developers, explicitly assigned by their companies to work in the community, are more likely than amateurs to advance to central positions in strategic project management.

An infrastructure project that points to risks of the OSS model for the IT industry as a whole is the encryption software framework *OpenSSL*, that is used in nearly all market-relevant IT systems: Since the late 1990s, *OpenSSL* was developed by one full-time programmer assisted by a very small team of volunteers and received little or no financial support from the corporations using the framework in their products. As a result of their increasing requests, ever new features were integrated into *OpenSSL*—yet without bolstering the level of maintenance work accordingly. In

2012, then, this culminated in an oversight that led to the major "Heartbleed" vulnerability, which was not discovered until 2014. It was later described as the "worst vulnerability found [...] since commercial traffic began to flow on the Internet." (Steinberg, 2014).

3.3 Elite-Centric Project Communities

Elite-centric project communities are also based largely on the contributions of developers who are affiliated with companies, but these contributors are not under the direct control of a commercial actor. Rather, coordination happens in a "lieutenant system built around a chain of trust" (Kernel.Org, 2016). It is either led by a project manager, by a team or by the founder. Linus Torvalds "is the final arbiter of all changes accepted into the Linux kernel" (Kernel.Org, 2016); Mark Shuttleworth sees himself as "self-appointed belevolent dictator for life" and "plays a happily undemocratic role" in the Ubuntu project (Ubuntu, 2017). However, to ensure long-term community involvement they shouldn't override many of the boards' decisions. *Mozilla*, for example, installed a clear hierarchy for the *Firefox* project: From *super-reviewers* and *stewards* to two *ultimate decision makers*. One of these positions has been held by former *Netscape* manager Mitchell Baker since 1998.

While such a top-down management curtails the scope of the participants in these projects, it also counteracts fragmentation. However, while in projects such as *Debian* or *Mozilla*, the overall rules and guidelines are formally fixed, in the *Linux* kernel project, Torvald's informal leadership led to "opaque governing norms": "Without the law or a clear mechanism of accountability those injured by or excluded from peer production processes have very limited recourse." (Kreiss, Finn, & Turner, 2011, p. 252).

3.4 Peer Production Communities

In contrast, egalitarian-oriented peer production communities are, based on their self-understanding, about market-independent, intrinsic and equitable collaboration among volunteers. However, cases such as *KDE*, *GNU* or *LibreOffice* demonstrate that more traditional leadership structures are required when a community matures and reaches a critical size. *KDE*, for example, does not have a single project manager but instead the "KDE Core Team", with several dozen contributors, that decides on the strategic direction of the platform (KDE, 2017). The *GNU Compiler Collection* is administrated by the "GCC steering committee [...] with the intent of preventing any particular individual, group or organization from getting control over the project" (GNU, 2017). And the community of *LibreOffice* is maintained by self-organization alongside working groups but operates under the strategical guidance of The Document Foundation, including a board of directors and an advisory board, Red Hat being a member in both entities and the most active code contributor (Corbet, 2015).

By contrast, intrinsically motivated communities such as *Arch* (*Linux* distribution) or *jEdit* (text editor) are addressing specific user groups, are rather irrelevant to the general software market and run by small teams, due to which they have so far been able to do without pronounced social structures. These smaller communities are characterized by barriers as well, "including steep learning curve, lack of community support, and difficulties finding out how to start" (Steinmacher, Conte, Gerosa, & Redmiles, 2015, p. 1380). When they grow, however, they also tend to take on rather 'cathedral-like' organizational modes, regardless of the level of technical efficiency they may have attained.

4 OSS Projects as Incubators of Innovation

The outlined empirical studies on current OSS projects debunk two assumptions: One, that the technical infrastructures of the web can, on their own, resist an "ossification of power" (Benkler, 2013, p. 225) in such communities. And two, that there is a radical new information economy in which corporate actors are losing ground in the face of "nonproprietary, voluntaristic, self-assisted practices" (ibid., p. 213).

Two arguments stand against these assumptions: First, even though online infrastructures used in open source projects are the basis for coordinating work flows, they in no way lead to a loss of relevance of social structuring patterns. In OSS communites, too, collectively accepted guidelines and managerial hierarchies emerge. Vice versa, these institutionalization dynamics are a fundamental prerequisite for an OSS project to be perceived as an entity (by internal as well as by external stakeholders) and to be capable of strategic action on the long run. Second, beyond that, corporate players usually are able to act more systematically than individual actors, because they have the discretion to utilize their resources regardless of their members' preferences and they have formalized decision-making routines. They therefore contribute significantly to a reliable planning environment, in turn garnering them considerable clout and influence over the developer community.

In that context, open source software projects have been subject not only to corporatization but also to a steadily intensifying embracement by leading technology corporations. From the point of view of innovation research, such a development does not seem unusual: Like other niche innovations, free software projects were initially "carried and developed by small networks of dedicated actors", often fringe actors or enthusiasts, yet became subject to professionalization as soon as they caught the attention of the mainstream markets (Geels & Schot, 2007, p. 400). In fact, history has seen many episodes of "collective invention" (e.g., in the development of flat panel displays) during which corporate or individual actors shared their knowledge openly, thereby benefiting from "cumulative advance" (Allen, 1983, p. 23).

However, in contrast to former cases of collective invention, OSS projects remain viable beyond the emergence of predominant solutions and their commercialization. This may be attributed to the following interacting factors:

- Already in the 1980s and 1990s, the free software scene gave rise to *robust licensing models* that were designed to avoid a commodification and proprietarization of collective work results. To this day, these licenses ensure a reliable project-specific exchange of knowledge between developers and companies that may be competitors otherwise (e.g., *Apple* and *Samsung*).
- Concurrently, a *rapid advancement of information and communication technologies* has facilitated the access to projects and the spread of their products as well as it has allowed for more transparency in the verification of compliance with their licensing conditions.
- And most importantly, in an industry that is characterized by very short innovation cycles and that has been expanding for the last 30 years, OSS projects have proven to be important *incubators for industry-fundamental standards and infrastructures* (such as the *Linux* kernel, *OpenStack*, *Android* or the *Apache* HTTP server).

Thus, at the turn of the millennium, a novel form of collaborative development that initially took place in niches decoupled from the general market was increasingly adopted by the industry and is today a key element of the innovation strategies of all major IT providers. OSS projects have contributed to more flexibility in the collaboration between individual developers as well as in the cooperation between commercial and non-commercial market actors—through which they evolved into essential breeding grounds for new products and infrastructures. At the same time, however, open source code alone does not result in transparent coordination patterns or a disintermediation of established resource distributions.

Therefore, the prospect that the original concept of commons-based peer production, which was rarely applied as such even in early OSS communities, could readily be adapted to neighboring socio-economic fields such as 3D printing or socio-political phenomena like social movements remains at best misleading. Worse, these types of narratives deflect from the fact that some trends engendered by the digital transformation are not necessarily compatible with the ideal of a more open and democratic economy. We think only of the potential gradual erosion of labor regulation or the hegemony of a few multinational companies over the key infrastructures of communication and information to a degree unprecedented in media history.

5 Entrepreneurial Implications

Against this backdrop, the ongoing success of open source development in the digital economy leads to serious entrepreneurial potentials as well as challenges, especially for small and middle-sized companies.

Beyond popular catchwords such as “open innovation” that draw strong dichotomies (e.g. between “closed” and “open”) which do “not really exist in industry” (Trott & Hartmann, 2009, p. 728), OSS communities on the one hand facilitate the project-related collaboration between market participants as their licensing models comprise a proven legal and structural basis for collective research and development activities. For smaller software providers the involvement in OSS projects can additionally serve as an important vehicle to increase brand recognition. Moreover, the

adaptability, low cost and "inherent trialability" (Spinellis & Giannikas, 2012, p. 667) of OSS architectures contribute to operational flexibility in IT development. "[Developers] are basically saying: Hey, we're trying all the open source alternatives first, because it's so painful dealing with our procurement department, that we'll only go commercial if we can prove that the open source stuff can't work." (Hammond, 2014, 21. min.)

Furthermore, already existing and well tested OSS architectures such as cloud platforms, operating environments, core infrastructures and developer tools (e.g., for the upcoming 'Internet of Things', augmented reality or artificial intelligence) are able to accelerate corporate product development, especially as open infrastructures do not carry any impetus for application code or hardware to be open itself (Weinberg, 2015). In that sense, the *Open Source Automation Development Lab* (OSADL), a community of more than 65 middle-sized and large companies (status: 1/2018), coordinates and promotes the development of open source software infrastructures for the German machine and automation industry.

As many established OSS projects are de facto controlled by one or a few leading companies, a recourse on existing frameworks such as *Android* or *OpenStack* on the other hand harbors the danger for smaller firms to become dependent on the market decisions and innovation strategies of bigger market players. On this account, it remains crucial for IT providers to maintain unique service features and to find a proper equilibrium between the embracement of open source software and the development of proprietary product components, as well as to consciously organize the complex interplay between the individual commitment of their developers in OSS projects and the working and managerial structures within the own company. Moreover, to reduce operational risks, the well-considered choice of viable and competently coordinated OSS projects is becoming increasingly important as not regularly maintained software code may result in hardly to overcome technological lock-in-situations.

Acknowledgement The research for this chapter was funded by the *Hans-Böckler-Stiftung*.

References

Allen, R. (1983). Collective invention. *Journal of Economic Behavior & Organization, 4*(1), 1–24.

Benkler, Y. (2002). Coase's penguin, or, Linux and 'the nature of the firm'. *Yale Law Journal, 112*, 369–446.

Benkler, Y. (2013). Practical anarchism, peer mutualism, market power, and the fallible state. *Politics and Society, 41*(2), 213–251.

Benkler, Y., & Nissenbaum, H. (2006). Commons-based peer production and virtue. *Journal of Political Philosophy, 14*(4), 394–419.

Bezroukov, N. (1999). A second look at the cathedral and the bazaar. *First Monday*, *4*(12). Retrieved August 19, 2017, from http://firstmonday.org/article/view/708/618

Corbet, J. (2015). Development activity in LibreOffice and OpenOffice. *LWN.net*. Retrieved August 21, 2017, from https://lwn.net/Articles/637735

Corbet, J., & Kroah-Hartman, G. (2016). *Linux kernel development report*. San Francisco: The Linux Foundation.

Driver, M. (2014). *Within the enterprise, open source must coexist in a hybrid IT portfolio*. Research Report. Stamford: Gartner Inc.

Free Software Foundation. (1989). *GNU General Public License (GPL) Version 1.0*. Retrieved August 9, 2017, from http://www.gnu.org/licenses/old-licenses/gpl-1.0.en.html
Geels, F. W., & Schot, J. W. (2007). Typology of sociotechnical transition pathways. *Research Policy, 36*(3), 399–417.
GNU Project. (2017). *GCC Steering Committee*. Retrieved August 23, 2017, from https://gcc.gnu.org/steering.html
Hammond, J. (2014). Open source by the numbers. Presentation, All Things Open Conference 2014. Retrieved August 23, 2017, from https://www.youtube.com/watch?v=GTFM39h5m5g
KDE Project. (2017). *Project management*. Retrieved January 21, 2018, from https://www.kde.org/community/whatiskde/management.php
Kernel.Org. (2016). *How to get your change into the Linux kernel*. Retrieved August 14, 2017, from https://www.kernel.org/doc/Documentation/SubmittingPatches
Kolassa, C., Riehle, D., Riemer, P. & Schmidt, M. (2014). Paid vs. volunteer work in open source. *Proceedings 47th Hawaii Conference on System Sciences*, 3286–3295.
Kreiss, D., Finn, M., & Turner, F. (2011). The limits of peer production: Some reminders from Max Weber for the network society. *New Media & Society, 13*(2), 243–259.
Microsoft Inc. (2017). 2016 Annual Report. Retrieved August 6, 2017, from http://www.microsoft.com/investor/reports
Raymond, E. S. (1999). *The Cathedral and the Bazaar*. Sebastopol: O'Reilly.
Rifkin, J. (2014). *The zero marginal cost society*. New York: Palgrave Macmillan.
Schrape, J. F. (2017). Open-source projects as incubators of innovation: From niche phenomenon to integral part of the industry. *Convergence: The International Journal of Research into New Media Technologies*. Online first. https://doi.org/10.1177/1354856517735795
Schrape, J. F. (2018). Open-Source-Communities: Die soziotechnische Verstetigung kollektiver Invention. In U. Dolata & J. F. Schrape (Eds.), *Kollektivität und Macht im Internet*. Wiesbaden: Springer.
Spinellis, D., & Giannikas, V. (2012). Organizational adoption of open source software. *Journal of Systems and Software, 85*(3), 666–682.
Stallman, R. (1983). *New UNIX implementation*. Retrieved August 9, 2017, from http://bit.ly/1DSDoXW
Steinberg, J. (2014). Massive internet security vulnerability. *Forbes*, 10 Apr 2014. Retrieved August 9, 2017, from http://bit.ly/2vHXvqT
Steinmacher, I., Conte, T., Gerosa, M. A. & Redmiles, D. (2015). Social barriers faced by newcomers placing their first contribution in open source software projects. *Proceedings of the 18th ACM Conference on Comp. Supported Cooperative Work & Social Computing*, 1379–1392.
Sundararajan, A. (2016). *The sharing economy*. Cambridge: MIT Press.
Torvalds, L. (2002). Re: Remove bitkeeper documentation from Linux tree. Linux Kernel Mailinglist. Retrieved August 12, 2017, from http://lwn.net/2002/0425/a/ideology-sucks.php3
Trott, P., & Hartmann, D. (2009). Why 'open innovation' is old wine in new bottles. *International Journal of Innovation Management, 13*(4), 715–736.
Ubuntu Project. (2017). *Governance*. Retrieved January 21, 2018, from https://www.ubuntu.com/about/about-ubuntu/governance
Weinberg, B. (2015). *Open source and the internet of things: A reality check*. Retrieved August 14, 2017, from http://blog.blackducksoftware.com/open-source-and-the-internet-of-things-a-reality-check

Jan-Felix Schrape is Senior Researcher in the Department of Organizational Sociology and Innovation Studies at University of Stuttgart, Germany. He has published on changes in media structures and the actors of innovation processes.

Harnessing the Synergy Potential of Open Source Hardware Communities

Robert Mies, Jérémy Bonvoisin, and Roland Jochem

1 Introduction

Open source hardware (OSH) is defined by the *Open Source Hardware Association* (OSHWA) as: "hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design". In other words, an OSH product is an artefact which is provided with sufficient public documentation to allow any interested person to study and develop it further, and which is released under a license granting any interested person with the right to produce and distribute it. In the logic of the open source movement,[1] sharing documentation is the starting point for making the product development process fully permeable for outside participation. This collides with the dominant business logic based on IP protection and closed organizations and therefore requires explanation.

The phenomenon of OSH can nowadays mainly be observed in grassroots initiatives but also in emerging businesses such as start-ups and small enterprises. Some medium-size enterprises have built their operations on OSH, especially in the supply market for makers. Two examples of them are the companies *Ultimaker* and *Aleph Objects*, both developing, manufacturing and distributing 3D-printers. Another example is the company *OpenBeam*, producing extruded aluminum framing

[1] See Carillo and Okoli (2008) for an overview.

R. Mies (✉) · R. Jochem
Technische Universität Berlin, Institute for Machine Tools and Factory Management, Chair of Quality Science, Berlin, Germany
e-mail: robert.mies@tu-berlin.de; roland.jochem@tu-berlin.de

J. Bonvoisin
University of Bath, Bath, UK
e-mail: j.bonvoisin@bath.ac.uk

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_11

systems for rapid prototyping of machinery building. Nonetheless, OSH also raised interest of larger industrial players as exemplified by the automotive industry. *Tesla*, one of the newcomers and challengers in this field, engaged in this way by declaring they would "*not initiate patent lawsuits against anyone who, in good faith, wants to use our technology*.[2]" The more established French automobile company *Renault* announced in 2016 a partnership with the *OSVehicle* project to open up the electric car *Twizy*. Although the realization of these strategies has not issued concrete open source content so far, they indicate that OSH gained attention out of the sphere of grassroots initiatives and individual making.

From an economic perspective, OSH ecosystems can be viewed as incubators for start-ups and for newcomers. Companies can draw a multitude of advantages from engaging in open source environments regarding the three aspects: technology, people, and process development (Aksulu & Wade, 2010):

- The most obvious commercial advantages are provided by the former. OSH communities' core competencies lie upstream within ideation and product design and development. This creates a downstream potential for commercial activities of OSH-related businesses or company initiatives to act as manufacturers and distributors of OSH products. Nowadays, pioneering OSH-related businesses are already supplying sophisticated open source products to customer segments such as makers and scientists. Commercial OSH downstream supply encompasses full products, assembly kits, high-value components and complementary parts (i.e. optional extras). The advantages are not just greatly reduced R&D, patenting, and licensing costs; cutting out the middlemen through direct sourcing and crowdfunding are significant components of OSH-related business models. As a by-product, the label "open source" enjoys an excellent reputation amongst its many supporters worldwide and can contribute to a brand's image gain.
- In terms of people development, advantages are either created by company employees being exposed and widening their network within OSH environments, or by opportunities for talent recruiting, as contributing in OSH requires a hands-on attitude and intrinsic motivation to engage in technical problem-solving. The former can offer more broadly attractive opportunities for companies to build new capabilities within OSH communities. Moreover, for company employees, engaging in OSH projects will also provide them satisfaction through self-fulfillment, which is generated by means of contributing in the afore-mentioned problem-solving.
- Companies have also been showing interest to benefit from process methodologies of open source environments. Full-scale economic potential is created through the advancement of OSH community processes to span entire value chains. As a result, lively innovation platforms are formed with multiple product spin-offs around which various players are combining a diverse set of valuable and dynamic resources. These resources encompass Q&A-based help

[2] https://www.tesla.com/blog/all-our-patent-are-belong-you

and troubleshooting forums, tutorials for makers, extensive design libraries, marketplaces for direct sourcing of products and parts, customization services for application-specific designs, offerings of independent aftermarket services, consultancy, assembly workshops, training, and many more. This creates network advantages for all involved parties—above all the end user.[3]

However, to fully realize the potential of hardware development in open source projects, companies need to first learn what it means to participate in OSH communities. The aim of this article is to explain to managers how they can navigate their companies to participate within OSH communities. The article first gives a brief overview in Sect. 2 on the concept of OSH. In Sect. 3, comparisons between the proprietary and open source logics are drawn along seven themes, which lead to practical recommendations. Section 4 provides a discussion of implications for companies and gives an outlook.

2 Basics of Open Source Hardware

2.1 Emergence of the Phenomenon

In software engineering, open source products have been developed for around 30 years and generate nowadays billion-dollar businesses. So, what first looks surprising from a business perspective is merely the extension of already working intellectual property (IP) management models from the software branch to the realms of physical products. A hugely successful project and allied firm in this field is the example of the operating system Linux and the multinational company *Red Hat*. *Red Hat* participates in the development and offers distributions and related services to its clients. Building on the experience gathered in software, the open source IP model first started to extend to physical products through electronics. The flagship of this evolution and today one of the most successful companies building on open source electronical hardware is *Arduino*. More recently, the extension of the open source IP model has also reached other types of physical products such as mechanical products, mechatronic products, construction, and textile products. Two projects which raised large attention from the public are *Local Motors* and *Open Source Ecology*.

2.2 Context

The emergence of OSH is one of converging trends towards transferring product development and production activities from industrial practices to the public. These

[3]For further reading on revenue streams, please refer to Li, Seering, Ramos, Yang, and Wallace (2017) and Fjelsted, Adalsteinsdottir, Howard, and McAloone (2012).

trends are enabled by the growing accessibility of affordable manufacturing and prototyping technology, the ubiquity of networked information capture and sharing capabilities through online social media and platforms, as well as the increasing digitalization of product development and production. They crystallize in the figure of the so-called "maker", who builds his/her own products in a makerspace, shares his/her designs publicly on digital platforms and participates in peer-to-peer projects. This character incorporates the post-modern ideal of a humanistic, progressive autodidact. This ideal refuse the alienating organization of society based on status and consumption, preferring "doing" to "having" as a principle of social distinction. It also prefers information sharing to exclusive rights on IP and stands for democratic access to self-determination capabilities.

2.3 What Is the Source of Hardware?

A product is open source when its technical documentation is published under a license guaranteeing the four freedoms of open source: freedom to study, to make, to modify and to distribute. This technical documentation may take different forms depending on the objective pursued by the product originator. There are generally three options:

- The originator intends to build transparency for his/her customers. In this case, relevant documentation may be computer aided design (CAD) files and drawings.
- The originator wants the product to be widely produced and adopted beyond its own sphere of influence. In this case, relevant documentation may be bills of materials and assembly instructions.
- The originator intends to create a community-based product development process allowing the participation of any interested developer. In this case, it is not only relevant to share the CAD files, but also information about the development process: what are the expected requirements for the product, what has been already achieved and what are the pending tasks, how can a contributor join in the project, etc.

For a more detailed description of those three cases and of the corresponding relevant documentation, see "Best Practices of Open Source Mechanical Hardware—A guide with practical advice for sharing product-related documentation—Version 1.0" by Bonvoisin and Schmidt (2017).

2.4 Magnitude of the Phenomenon

Two types of hardware products can be considered depending on their complexity. On one side of the complexity range, the design and publication of simple products performed by individual "home engineers" has boomed in the last years. This is mostly a result of the great dissemination of affordable 3D-printers as well as the

availability of online sharing places for CAD models such as *Thingiverse*, which counts around 900,000 uploaded objects. These objects are generally designed as one-person-projects. Though, collaborative development may also occur in the form of sequential series of remakes: one maker develops one version which is taken over and developed further by someone else, and so on. On the other side of the complexity range, one can find examples of OSH products combining different technologies, made of several parts, designed to satisfy demanding needs. The complexity of these products generally requires collaborative development processes involving several contributors in parallel. More than 200 products or development projects of this type have been identified, covering product categories such as machine tools, vehicles, power supply as well as robotics, agricultural, medical, and laboratory equipment. A curated list of complex OSH products is maintained by the Observatory of Open Hardware at http://opensourcedesign.cc/observatory.

2.5 Open Source Hardware Lifecycle

There are basically two approaches to the development of OSH products (Bonvoisin, Mies, Boujut, & Stark, 2017). These are reflected in the OSH lifecycle depicted in Fig. 1. The first approach is to reveal the result of a *product development project performed in a private setting*—this is also called public innovation, as the end of this process is marked by the publication/revelation of the product documentation which has been kept private so far. The second approach is to develop the product in a community-based setting—this we call *open source product development* (OSPD). The end of this process is marked by the release of already public documents in a stable version. In both cases, the resulting OSH product can be redesigned either in a private or in a community-based setting. Also, a product can be simultaneously in different states of the lifecycle, that is, be a stable OSH product which is produced, be the object of a community-based improvement process and be further developed by other actors in a private setting.

At this time of the development of the phenomenon of OSH, it seems public innovation largely outweighs open source innovation (Bonvoisin et al., 2017). Whereas the concept of open source is generally understood as a product development model (see for example Gacek & Arief, 2004; Raasch, Herstatt, & Balka,

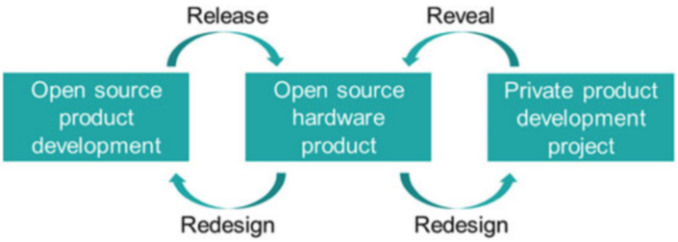


Fig. 1 The open source hardware lifecycle (adapted from Bonvoisin et al., 2017)

2009), there are only few examples of projects using open source approaches in the product development and being successful in gathering community-based product development processes. The large majority of OSH products remains the results of public innovation processes—hence contradicting the common misperception of open source being automatically collaborative. This is the result of challenges in the building of OSH communities around OSPD processes which are addressed in the following paragraphs.

2.6 Open Source Hardware Communities

Rooted in the Open Source Movement, OSH communities embody the communalization of technology from private institutions to the public. OSH communities are socially formed groups of heterogeneous agents and actors who co-create OSH products. Within them, geographically dispersed contributors are coordinated in online platforms by a core team. Because developers, users and followers gravitate around the core team (Ye & Kishida, 2003), the social model of open source communities is also commonly referred to as *onion model*. Due to their loosely coupled structures and fluid boundaries, participation levels vary over time in terms of quantity as well as content. Hence, considering a person as a community member can be justified by diverse levels of participation. Participants may engage as followers, replicators, developers, or community managers, among other roles. They proactively self-organize and choose their own roles as well as the period of their involvement. Within open source environments, actors are not connected through organizational affiliation (Aksulu & Wade, 2010) but rather contribute as individuals. Firms as well as any other types of organizations may choose to engage within OSH communities or initiate them themselves, although they participate and are recognized based on individuals' merit.

2.7 Open Source Product Development Process

As mentioned above, the transfer of the open source paradigm to physical objects is generally associated with OSPD processes. OSPD projects aim to create the momentum for distributed work in OSH communities as the primary source of value creation. This organization of work is relevant for the development of complex physical products which are dependent on the provision of inputs from several people in a collaborative setting. OSPD thus fosters collaboration towards needs-based problem solving within self-organized processes that span all design phases from conception to manufacturing. OSPD processes are internet-based and require the use of groupware as well as social media to support data management and communication, which are in turn required for effective collaboration, continuity of work, and acquisition of new members. A critical element to the structuration of OSPD operations is the use of a data management versioning systems to facilitate contributions.

2.8 Open Source Product Development Process Model

One of the most often used product data management systems used in OSPD processes is *Git* (or derivatives), which has originally been developed to support the development of the *Linux* Kernel. Such systems enable OSPD projects to evolve task-by-task, without a predetermined agenda, as a collection of contributions in which each contribution immediately furthers the course of action of the project. Progress is achieved through an iterative and ideally self-organized process involving the following four sets of activities: (i) task definition and assignment, (ii) task contribution and validation (feedback and review), (iii) integration of stable versions, and alongside (iv) continuous product-related documentation (see Fig. 2).

Tasks are defined and logged in modular issue lists, where they can be *self-selected* (jargon for claiming) or suggested to project contributors. It is, however, common-place that core teams shoulder the lion's share of the work effort. As well tasks can be proactively initiated and performed by the same contributor. Contributed tasks are either validated or related changes get directly integrated on the product system level by core team members, which occurs syn- or asynchronously. Reviewing is usually performed by core team members, who either accept or reject them. They then publicly give feedback on further improvement needs. Several iterations can be made until acceptance is given. As an integral part of all these activities, appropriate technical documentation needs to be carried out continuously. Even after merging, tasks are never closed, only their priority changes. It is a characteristic of OSPD processes that they are not completed when a stable product version is reached, rather, they remain subject to perpetual improvement (Bonvoisin & Boujut, 2015).

Whilst this development mode is highly adaptive, integrative and effective, it runs a risk of lacking efficiency and convergence towards a mature product; and may never reach the stage of fulfilling acknowledged consumer product standards. Since

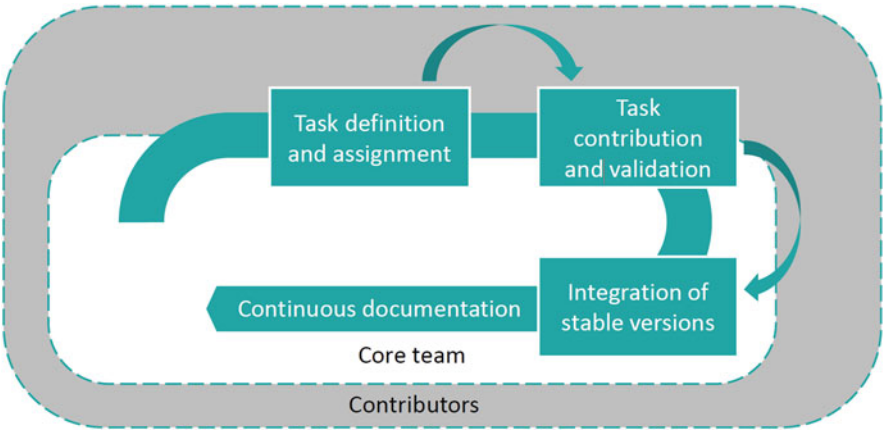


Fig. 2 Open source product development process model (authors' own illustration)

anyone can take the results and has the right to produce derivatives, it means that efforts are not wasted, on the contrary, they create opportunities for entrepreneurship.

3 Practical Recommendations for Managers

Business managers may feel no reason to approach product development in open source projects any differently to other forms of business partnerships and cooperation. Following conventional wisdom in organizational management, practice and theory will most certainly result in norms and values of OSH communities being violated, and company participation being stalled. The aim of the following section is therefore to highlight major differences between the world of business and the field of OSH around seven themes.

3.1 Co-designing vs. Open Source Product Development

The topic of co-designing has generated great interest and wide adoption by many companies. It generally falls within the open innovation paradigm as an outside-in process (Enkel, Gassmann, & Chesbrough, 2009). Piller, Schubert, Koch, and Möslein (2005) propose methods for the integration of online communities of customers and users in innovation activities of companies. This is facilitated within closely regulated environments, e.g. by means of idea tournaments and challenge platforms (see Piller, Vossen, & Ihl, 2012). Similarly to OSPD, co-designing is also internet-based and heavily relies on computer-mediated technologies for communication and collaborative work (Abhari, Davidson, & Xiao, 2016). Design research has recognized the great potential of co-designing in early design phases (Sanders & Stappers, 2008), although, generally the concept and practices of co-designing do not span beyond idea generation and evaluation of designs.

OSPD is on the other hand distinct from co-design in several aspects. As mentioned above, it is based on the OSH paradigm and thus sets the primary objective of distributed development and collaboration for needs-based problem solving instead of company innovation success. Finally, OSPD defines OSH communities as the primary source of value creation. The most crucial distinction therefore lies within its emphasis on openness. Balka, Raasch, and Herstatt (2010) have defined the following three aspects of openness: (1) *transparency* of design documentation (open outputs), (2) *accessibility* of the design process (open process), and (3) *replicability* of the product (i.e. by means of distributed manufacturing). In co-designing, openness is required in terms of needed accessibility of the design process for customers to provide creative input for commercial exploitation. Cova and Dalli (2009) stress that customers are far from being partners in this relationship and observe how the widely heralded harmony is often short-lived due to the other side of the coin of double exploitation of customers. These socio-economic

dynamics are caused by restrictions of the underlying role concept (customers and manufacturers) and objectives (company innovation).

Openness in OSPD is achieved through best practices of OSH (Bonvoisin & Schmidt, 2017) which are aimed at all three aspects of openness. While transparency is a prerequisite for products to be labelled open source, it facilitates accessibility and replicability. The former according to empirical findings of Bonvoisin et al. (2017) is characteristic for OSPD and the latter for public innovation. In accordance with Boisseau, Omhover, and Bouchard (2018), full openness cannot be realized in practice and must be understood as a "direction to pursue". Nevertheless, OSH communities extend the inclusive nature of participative design towards all design phases, and thereby beyond the focus of online communities of users and customers on ideation and evaluation. For company initiatives to harness the full potential of OSH communities, R&D managers and strategists first and foremost need to define appropriate business models and activities which reflect the OSPD approach.

3.2 Global vs. Local Sourcing

Since the *End of History* was pronounced by Fukuyama (1989) in his famous essay, the process of economic globalization of value chains of goods and services has been dominated by production offshoring. Subsequently, multinational corporations have been enjoying superior returns. More recently in the US, the reverse phenomenon of reshoring can be witnessed where numerous multinationals are setting out to relocate some of their production back into their home market (Brandon-Jones, Dutordoir, Neto, & Squire, 2017). OSH may participate in this trend to relocate activities as it is based on values opposing citizen participation in product design and production to blind outsourcing. Rather it supports designing and production for local needs. OSH calls for a locally rooted focus concentrating on generating and exchanging information on design configurations, prototypes, or incremental improvements, for example. At the same time, it gathers its strength from the fact that it is an internet-related phenomenon. As such it is about global sharing of information to involve people around the globe to jointly open up technologies and products for the public domain. OSH proponents feel strongly about their obligation to share knowledge. They do not agree with knowledge being locked up and wasted—something they are uncompromising about as it relates to OSH community activities. Several projects have managed to reach out to an extensive global network of developers (e.g. *FarmHack* or the *E-Nable* community). This is an invaluable pool of knowledge.

To formulate realistic and reasonable aims for company participation in OSH projects, business managers need to understand and internalize the OSH paradigm and its collective value system on unconditional knowledge sharing and local connectedness. This needs to be communicated clearly but can be further consolidated by dedicated supply chain managers' and strategists' action to promote strong local setups.

3.3 Exclusivity vs. Reciprocity

In the logic of capitalist market environments value is generated and exploited through the means of the firm whose activities serve as the engine for the common societal good. Sustaining the competitive advantage of a firm requires its resources to be valuable, rare, non-substitutable, and imperfectly imitable (Barney, 1991). For example, imitation by other market players would cause a firm to suffer a complete setback on its competitive edge and for any associated rents to be lost. Opposed to this, the OSH paradigm proposes that value is constantly being created and shared freely and indiscriminately for distributed exploitation—including for commercial interests.[4] Knowledge is not held as an advantage over others but serves as a shared resource in the quest for continuous technological diversification and advancement. In fact, the commitment of OSH communities to share results publicly eliminates hidden agendas which often end up busting strategic alliances between enterprises.

It should be noted however, that companies are forbidden from divulging market intelligence to competitors and giving away IP for free as this would be a huge problem for them. Giving away such information of IP is not necessary for companies to engage in OSH activities. What companies need to consider, however, is that beyond avoiding any loss of intellectual capital participating in OSH projects comes with a collaborative advantage through the creation of synergies. Within OSH communities contributors define a common cause, which companies can also influence on an equal footing. They just simply must get into action and become a part of an OSH project or initiate one. Mutual trust and respect will evolve with every contribution. Whilst the project grows and diversifies, joint action will allow for joint aims to be served and company efforts to be paid off. R&D managers and strategists alike need to take a clear stance in their companies on the modalities of engagement how to seek collaborative advantages through the creation of synergies.

3.4 Mass vs. Niche Focus

Within the field of OSH, the absence of competition influences market segmentation. During industry evolution competition animates market segments and commodifies them. The critical event in the evolution of industry structures is the convergence around a *dominant design*[5] of an accepted product architecture and production methods (Grant, 2010). At that point competitive dynamics are more and more driven by commercialization success and economies of scales. Competitors advance their position according to capacity and capabilities and market entry barriers are

[4]OSH licensing includes the commercial use of OSH products. A non-commercial license (e.g. Creative Commons' non-commercial license) would in fact not be in line with the definition of OSH (see above).

[5]The term dates back to Utterback and Abernathy (1975).

erected. In contrast, OSH projects blend in with their environment through their communities.

As OSH products become public resource domains, they are freely available for any desirable designation on highly personalized products. Through continued development and derived works purpose-specific niche designs establish a completely demand-driven diversification of open source ecosystems. This creates a close interaction between users, developers, as well as makers and producers of OSH products. In fact, these groups of actors closely blend in with each other to the degree of considerable overlap, whereby for example a user may decide to also engage as a developer. As mentioned above, it was the demand of makers and scientists for 3D desktop printers which has created various niches of 3D desktop printers which are being supplied today by some of the liveliest OSH communities to date. The widely disseminated 3D desktop printers such as the makes of *Lulzbot Taz*, *RepRap*, or *Ultimaker* are an impressive proof of how niche designs created highly diversified and complementary OSH activities.

In general, the fragmented structure of OSH ecosystems connects participating companies with many niches of small customer segments. This can only be matched by businesses through a *focus strategy* characterized by Porter (1985: 15) as narrow targeting of small market segments to meet distinct customer needs or particular challenges of production and delivery systems. Appropriate business cases need to be examined that define aligned activity sets, such as promoting launch management capabilities for small-scale production within highly flexible and lean workshops that integrate multiple fabrication and mounting processes. Beyond this, companies may indeed set technological trends for the future through being immersed in OSH ecosystems and thereby create new dominant designs and spur future industries.

3.5 Hierarchical vs. Self-Governed Workflows

Within new product development the cultivation of a conducive project climate is considered good practice (Kahn, Barczak, Nicholas, Ledwith, & Perks, 2012). Companies can benefit from several widely diffused project management standards (see Ahlemann, Teuteberg, & Vogelsang, 2009) which can be considered useful for product development (Pons, 2008). From the setting up of project teams to the monitoring of milestones to project close-outs, companies have to ensure that their project teams are efficiently managed, and deliverables are on time. It is the job of managers to ensure coherence towards clear objectives. Here lies the greatest challenge for company participation in OSH projects. First, traditional project management practices are not applicable in the world of open source (Aksulu & Wade, 2010), which may come as a bit of a shock to outsiders. Product specifications are only derived progressively and are largely undetermined from the start. Any attempts to install an upfront stage of requirements setting or any agenda for that matter would just be futile as no hierarchical chain of commands exists to enforce action.

Yet OSH practitioners from the experience of the authors are surprisingly confident and relaxed about the progress of their projects, even though no accountability or ownership of tasks exists. Instead of telling contributors what to do, they promote self-governed workflows (see subsection "Open source product development process model"). By doing this they have to spread documentation awareness to ensure transparency and accessibility or insist on the practice of "early release", whereby contributors are encouraged to publicly share ideas and design sketches immediately instead of waiting for a document to be perfect before it is published. Meaningful company participation in OSH projects in practice has to be aligned with this and deploy resources by means of a swarm organization approach: At this stage, providing technical design and problem-solving tasks by engineers and technical specialists are at the forefront, but also R&D managers can provide great value added on communication and task organization by switching from managing to coaching.

3.6 Control vs. Self-Propelled Learning

Coordination in companies requires appropriate control mechanisms. Being employed in a company involves the contractual transferring of power to leadership teams who have the say on how decision rights are allocated. Control can also be exercised through performance measurement and reward systems. These are the main control mechanisms within the capitalist firm according to Jensen and Meckling (1992), who refer to them as the "internal rules of the game". They have been shown empirically to be highly effective. The disadvantage is, however, that they are strongly based on extrinsic incentivization.

In contrast, contributing in an OSH community is governed by self-organization, which would not work without intrinsic drive. Project initiators and core teams appreciate it when others take charge of literally any matter. It would be absurd to ask contributors to contractually transfer decision rights or measure their performance. When people put themselves forward to fulfil a task, it is of their own accord and they are their own leaders. By approaching technical design challenges contributors make best use of their personal skill set and where necessary try to extend it. Advanced open source projects amplify this by constant review and feedback loops during task fulfilment which provide critical suggestions for improvement until approval is given for a suitable solution. Here, failure is an integral part of the process.[6] In this way, contributors are socialized in an environment of self-propelled learning. Personal learning and development is a key success factor of OSH projects and it also reflects how well projects can leverage the drive of their contributors. Because learning progress naturally tends to be non-linear, the ability to "let go" is crucial for OSH practitioners.

This requires the ability for core teams and initiators to accept the direction of the project, even if it is not moving in the envisaged direction. They must leave the

[6] See Lee and Cole (2003) for how learning through criticism is an inherent part of the culture within the Linux kernel development project.

needed room in projects for progress and convergence to organically occur. Businesses should therefore avoid becoming dependent on OSH project activities and refrain from unrealistic plans of rapid scaling. Nor should superiors put undue pressure on their employees to exert unrealistic influence. Company participation in OSH projects should instead be geared towards a medium- to long-term strategy which complements their own activities.

3.7 Company vs. Community IT Infrastructure

Frictionless information flows in project teams require interoperability of information systems. This applies not only to conventional industrial contexts but also prevails in community-based product development. The main difficulty in OSPD is that the capacity and the willingness of the community to adapt to costly proprietary systems is limited. Not every individual contributor can afford a costly license, for example for a CAD software your company prescribes. And why would they, if there are open source alternatives to these software tools? In line with the ethical imperative of unrestricted availability of information, there is a general normative pressure in the open source movement towards the ideal of a complete open source tool chain. By authoring your designs with costly proprietary software and saving them in proprietary formats as well, you implicitly require from others to possess a license of this same software. This excludes a certain category of people, which is against the clause of non-discrimination against persons or groups in the Open Source Definition.

Additionally, saving information in a format which is only readable with a very specific software can be viewed as deliberate obfuscation, which is explicitly excluded by the Open Source Hardware Definition. Switching to an open source toolchain contributes to frictionless information flows and therewith to the emergence of a lively community of contributors. Alternative sharing of closed format design files by means of converting them into open formats is only a makeshift solution, which is not free of drawbacks. Indeed, every format conversion implies information losses and new barriers in the further edition of the converted file, as the conversion process cuts valuable information such as parameters and constraints. Sharing the original design files remains the best solution to support others in editing them further. OSH communities rely heavily on groupware solutions to support their workflows. To date there is an abundance of open source software solutions available for OSH needs which are however often not integrated very well, something that is compensated astoundingly well by the versatile contributors within this domain. Since company IT infrastructures have to be secured, IT admins should be involved early in a company's decision to participate in an OSH project to find suitable solutions for employees to be able to safely use open source tools and not compromise the companies' IT infrastructure.

A solution of great importance for community-based product development is the use of distributed version control systems (DVCS) such as *Git* as they support the distributed workflows mentioned above (see subsection "Open source product development process"). On the contrary to centralized version control systems

(CVCS) generally used in industry—which are based on a client-server approach where the reference version is kept in a central vault—decentral systems adopt a peer-to-peer approach where every peer possesses a copy of the complete information repository. Synchronization is not done through a check-in check-out system but through the dissemination of patches or update among all the copies of the database. The advantage of these systems lies in their resilience and relative independence of each of the peers. Setting up a DVCS simplifies the access of community members to the project data and sets a clear statement of willingness to collaborate on an equal basis. If your company does intend to form an OSH community, setting up DVCSs is highly recommended also from a strategical point of view, as it is a clear statement towards pluralistic governance and compliance with the four freedoms of open source.

The resulting practical recommendations from the comparison between the proprietary and open source logic for the seven different themes are summarized in Table 1. They are formulated as good practices and contrasted with opposed poor practices.

4 Discussion and Outlook

A recent survey on complex, non-electronic OSH projects carried out by the authors shows that more than one quarter of them were company-founded. More than one third of the OSH projects had companies participating in their development activities. Since OSH is a young phenomenon these numbers will likely increase as it has been the case within the open source software domain. Proactive companies need to begin to think beyond the limited scope of open innovation and towards the opportunities that are emerging in the field of OSH.

West and O'Mahony (2008) observe higher levels of transparency and accessibility in open innovation communities founded by individuals than those founded by companies. This may be due to different development approaches and agendas. However, a deeper understanding of values promoted by the OSH paradigm will enable companies to leave the needed room for OSH communities to progress effectively and harness the full synergy potentials of OSH participation. Following of the good practices outlined in this article will help company initiatives to participate in OSH communities to create a long-term win-win situation for both sides. The first departure point for any worthy company participation or initiation of OSH communities is to think from a community-based view instead of a firm-based perspective. Participation within the OSH field requires companies to depart from their entire *modus operandi* on community activities. Lack of coherence and what they may perceive as lofty goals may stop managers to give authority to any company engagement in OSH initiatives. Strategists and R&D managers need to recognize that the benefits of OSH participation are much broader than in traditional B2B cooperation. Screening and analyzing of appropriate collaboration scenarios is essential to get a full picture on potential synergy advantages.

Table 1 Practical recommendations for company participation in OSH communities

Poor practices	Good practices
Co-designing vs. open source product development	
• Trying to turn OSH activities into company innovation activities • Compete for space within OSH communities	• Identify synergies that reflect OSH communities' sovereignty to remain the primary source of value creation • Engage with community collaboratively
Global vs. local sourcing	
• Consider citizen participation in product design and production as outsourcing • Waste knowledge by locking it up	• Internalize the collective value system of unconditional knowledge sharing and local connectedness • Reach out to a global community of contributors as an invaluable pool of diverse knowledge • Enable product customization and development by sharing product-related information
Exclusivity vs. reciprocity	
• Hold knowledge as an advantage over others • Close OSH products up • Giving away company IP or divulging competitive intelligence to competitors	• Treat knowledge as a shared resource • Seek collaborative advantage through the creation of synergies • Influence OSH project aims on an equal footing within OSH communities
Mass vs. niche focus	
• Unrealistic expectations of rapid scaling	• Engage in a focus strategy that defines aligned business activity sets • Reach out to customers through highly personalized products
Hierarchical vs. self-governed workflows	
• Unilateral agenda setting • Hierarchical chain of commands • Traditional project management practices	• Resource deployment by means of a swarm organization • Early release of designs, ideas, documents • Switch from managing to coaching
Control vs. self-propelled learning	
• Extrinsic incentivization (such as monetary rewarding) • Try to get control over others	• Treat failure as an integral part of the process • Leave the needed room in projects for progress to organically occur
Company vs. community IT infrastructure	
• Share proprietary file formats • Retain a centralized approach to information management	• Create and share design files in open formats (without conversion) • Use open source software • Use decentral versioning management systems

In practice, additional implications of company participation in OSH communities exist which have not been discussed in this article. These include issues such as licensing or governance issues which can prevent any serious involvement in OSH communities. Furthermore, the concept of open source itself can be subject to misinterpretation which may lead to confusion with common crowdsourcing approaches or challenge platforms. The certification program of the Open Source Hardware Certificate by the *OSHWA* is a first step towards distinction

and signaling of compliance with open source principles. However, further standardization efforts are required to strengthen the concept of OSH and define more precise compliance criteria. Finally, companies are only beginning to explore advantages of the open source IP model in terms of physical products. The future will tell how different OSH approaches are interpreted by companies.

This article has been written in the frame of the French-German interdisciplinary research project "Open!—Methods and tools for community-based product development". It is jointly funded by the French and German national science agencies ANR (Agence Nationale de la Recherche, grant ANR-15-CE26-0012) and DFG (Deutsche Forschungsgemeinschaft, grants JO 827/8-1 and STA 1112/13-1).

References

Abhari, K., Davidson, E., & Xiao, B. S. (2016). *Taking open innovation to the next level: A conceptual model of social product development (SPD)*. In: AMCIS 2016 Proceedings.

Ahlemann, F., Teuteberg, F., & Vogelsang, K. (2009). Project management standards–diffusion and application in Germany and Switzerland. *International Journal of Project Management, 27* (3), 292–303.

Aksulu, A., & Wade, M. (2010). A comprehensive review and synthesis of open source research. *Journal of the Association for Information Systems, 11*(11), 576–656.

Balka, K., Raasch, C., & Herstatt, C. (2010). How open is open source? – Software and beyond. *Creativity and Innovation Management, 19*(3), 248–256.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management, 17* (1), 99–120.

Boisseau, É., Omhover, J. F., & Bouchard, C. (2018). Open design: A state of the art review. *Design Science, 4*.

Bonvoisin, J., & Boujut, J. F. (2015, July). *Open design platforms for open source product development: Current state and requirements*. In: Proceedings of the 20th international conference on engineering design (ICED 15), 8—Innovation and Creativity, pp. 11–22. Milan, Italy.

Bonvoisin, J., & Schmidt, K. C. (2017). *Best practices of open source mechanical hardware – A guide with practical advice for sharing product-related documentation – Version 1.0*.

Bonvoisin, J., Mies, R., Boujut, J.-F., & Stark, R. (2017). What is the source of open source hardware? *Journal of Open Hardware, 1*(1), 5.

Brandon-Jones, E., Dutordoir, M., Neto, J. Q. F., & Squire, B. (2017). The impact of reshoring decisions on shareholder wealth. *Journal of Operations Management, 49*, 31–36.

Carillo, K., & Okoli, C. (2008). The open source movement: A revolution in software development. *Journal of Computer Information Systems, 49*(2), 1–9.

Cova, B., & Dalli, D. (2009). Working consumers: The next step in marketing theory? *Marketing theory, 9*(3), 315–339.

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: Exploring the phenomenon. *R&D Management, 39*(4), 311–316.

Fjelsted, A. S., Adalsteinsdottir, G., Howard, T. J., & McAloone, T. C. (2012). *Open design consulting: How to capitalise on and adapt to open source practices for tangible products*. Open Design Consulting. M.Sc. Thesis in Management Engineering Department of Management Engineering, Technical University of Denmark.

Fukuyama, F. (1989). The end of history? *The National Interest, 16*, 3–18.

Gacek, C., & Arief, B. (2004). The many meanings of open source. *IEEE Software, 21*(1), 34–40.

Grant, R. M. (2010). *Contemporary strategy analysis* (p. 272). Chichester: Wiley.

Jensen, M. C., & Meckling, W. H. (1992). Specific and general knowledge and organizational structure. In L. Werin & H. Wijkander (Eds.), *Contract economics*. Oxford: Blackwell Publishers.

Kahn, K. B., Barczak, G., Nicholas, J., Ledwith, A., & Perks, H. (2012). An examination of new product development best practice. *Journal of Product Innovation Management, 29*(2), 180–192.

Lee, G. K., & Cole, R. (2003). From a firm-based to a community-based model of knowledge creation: The case of the Linux kernel development. *Organization Science, 14*(6), 633–649.

Li, Z., Seering, W., Ramos, J. D., Yang, M., & Wallace, D. R. (2017). *Why open source?: Exploring the motivations of using an open model for hardware development*. In: ASME 2017 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. American Society of Mechanical Engineers.

Piller, F. T., Schubert, P., Koch, M., & Möslein, K. (2005, July 1). Overcoming mass confusion: Collaborative customer co-design in online communities. *Journal of Computer-Mediated Communication, 10*(4), JCMC1042. https://doi.org/10.1111/j.1083-6101.2005.tb00271.x

Piller, F. T., Vossen, A., & Ihl, C. (2012). From social media to social product development: The impact of social media on co-creation of innovation. *Die Unternehmung, 65*(1), 7–27.

Pons, D. (2008). Project management for new product development. *Project Management Journal, 39*(2), 82–97.

Porter, M. (1985). *Competitive advantage: Creating and sustaining superior performance* (1st ed.). New York: Free Press.

Raasch, C., Herstatt, C., & Balka, K. (2009). On the open design of tangible goods. *R&D Management, 39*(4), 382–393.

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-design, 4*(1), 5–18.

Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of product and process innovation. *Omega, 3*(6), 639–656.

West, J., & O'Mahony, S. (2008). The role of participation architecture in growing sponsored open source communities. *Industry & Innovation, 15*(2), 145–168.

Ye, Y., & Kishida, K. (2003). Toward an understanding of the motivation Open Source Software developers. In *Proceedings of the 25th international conference on software engineering* (pp. 419–429). Portland: IEEE Computer Society.

Robert Mies is a research assistant at the Chair of Quality Science, Institute for Machine Tools and Factory Management, Technische Universität Berlin. His research focusses on distributed processes of open source hardware projects. Herein, he is investigating methods and tools for community-based product development and the topic of company-community collaboration.

Jérémy Bonvoisin is assistant professor at the Department of Mechanical Engineering, University of Bath, England. His research focusses on both environmental and social aspects of product development. He works towards setting standards for open source hardware and investigates citizen participation in product development.

Roland Jochem is the Director of the Chair of Quality Science and the Managing Director of the Institute for Machine Tools and Factory Management, Technische Universität Berlin. His long-standing research in the field of quality management focusses on improving the efficiency and effectiveness of business processes and organizational structures, e.g. by addressing the issue of cost of quality (CoQ) and the reliability management by applying data science methods.

Open Source Medical Devices for Innovation, Education and Global Health: Case Study of Open Source Magnetic Resonance Imaging

Lukas Winter, Ruben Pellicer-Guridi, Lionel Broche, Simone A. Winkler, Henning M. Reimann, Haopeng Han, Felix Arndt, Russ Hodge, Süleyman Günyar, Manuel Moritz, Kate Michi Ettinger, Olivier de Fresnoye, Thoralf Niendorf, and Mehdi Benchoufi

L. Winter (✉)
Physikalisch Technische Bundesanstalt, Berlin, Germany
e-mail: lukas.winter@ptb.de

R. Pellicer-Guridi
Centre for Advanced Imaging, The University of Queensland, Brisbane, QLD, Australia

L. Broche
Aberdeen Biomedical Imaging Centre, University of Aberdeen, Aberdeen, UK
e-mail: l.broche@abdn.ac.uk

S. A. Winkler
Department of Radiology, Stanford University, Stanford, CA, USA
e-mail: simone.winkler@stanford.edu

H. M. Reimann · H. Han · R. Hodge
Max-Delbrück Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany
e-mail: henning.reimann@mdc-berlin.de; haopeng.han@mdc-berlin.de; hodge@mdc-berlin.de

F. Arndt
Facility for Antiproton and Ion Research in Europe (FAIR GmbH), Darmstadt, Germany
e-mail: info@anwaltarndt.com

S. Günyar · M. Moritz
Institute of Production Engineering, Helmut Schmidt University, Hamburg, Germany
e-mail: manuel.moritz@hsu-hh.de

K. M. Ettinger
Mural Institute, San Francisco, CA, USA
e-mail: kate@muralinstitute.com

O. de Fresnoye
Centre d'Épidémiologie Clinique, Hôpital Hôtel Dieu, Assistance Publique des Hôpitaux de Paris, Paris, France

Epidemium, Cancer Epidemiology Open Science Program, Paris, France
e-mail: olivier@echopen.org

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_12

1 Introduction

Modern industrial societies would be much different if their citizens didn't have continuous access to a broad palette of medical technology (medTech). Modern devices help prevent, diagnose, treat and manage medical conditions, ranging from diseases to injuries and disabilities, thus saving lives and improving the health not only of individual patients, but of all those around them. But for a considerable proportion of people around the world, healthcare is far from *available*, *accessible*, *appropriate* and *affordable* (4 As). Differences divide not only the global north and south, but also rural areas versus cities with university hospitals, in terms of the 4 As of medical devices. Existing challenges are becoming aggravated and new ones are arising through the aging of society. Healthcare expenditure has increased over the last 20 years to the point that the current global average represents 10% of GDP. And in sharp contrast to most other industries, the specific structure of the healthcare industry makes an optimization of the 4 As difficult (WHO, 2010, 2011, n.d.).

The function of stakeholders in the traditional medical industry are uniquely entangled. In a public healthcare system, the person ordering the service does not receive the service; the person receiving the service does not pay for the service; providers of the service do not determine what they are paid for the service; the payers for the service determine the price but do not directly receive the service. In contrast to products of other industries, medTech needs to comply with regulations that go above and beyond classical safety standards, leading to substantially higher investment costs and severe delays for the market entry of new products. The result is the monopolization in the healthcare industry that we are currently witnessing. Under this scenario, even if an innovation is bound to reduce costs over the long term, there is no guarantee that it will lower market prices or the cost of ownership—if it becomes available at all (European Commission, n.d.).

Overcoming these obstacles that impede the 4 As will require feasible strategies that can arise from the current, complex system and yet simultaneously challenge it. A model for doing so can be found in "open source" strategies that have been pursued in other economic sectors. From open source software, we have learned that global and voluntary collaboration of people in online communities can result in superior products compared to proprietary firm-based approaches. In fact, open source software increasingly influences the corporate environment. Major players

T. Niendorf
Max-Delbrück Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany

MRI.TOOLS GmbH, Berlin, Germany

Experimental and Clinical Research Center (ECRC), a Joint Cooperation Between the Charité Medical Faculty and the Max-Delbrück Center for Molecular Medicine, Berlin, Germany
e-mail: thoralf.niendorf@mdc-berlin.de

M. Benchoufi
Faculté de Médicine, Paris Descartes University, Paris, France

Epidemium, Cancer Epidemiology Open Science Program, Paris, France

in the IT sector make use of open source software these days. With the advancement of easy-to-use and affordable product development and production technologies as well as access to these means, the open source spirit spilled over into the world of physical objects (open source hardware). We find online communities where people jointly develop products and share the designs. Lately, companies have been evolving in this ecosystem that work with or around open source hardware. Thus, corporate entities should be aware of these developments and consider more open approaches in their value creation systems and processes (Moritz, Redlich, Grames, & Wulfsberg, 2016; Thomson & Jakubowski, 2012).

In medTech first steps have been pursued successfully in recent years for the development of lab equipment, medical prostheses, electroencephalograms, stethoscopes and even more complex medical imaging devices such as ultrasound (US), computed tomography (CT) or magnetic resonance imaging (MRI). The time is ripe for an open sourcing of medTech (echOpen, n.d.; Jansen, n.d.; Open Source Imaging, n.d.).

Here we present a pragmatic vision of the way collaboration in open source research and development of medTech can promote sustainable growth in innovation, education and global health. We discuss our current efforts to develop an open source magnetic resonance imaging scanner as a case study through which we can estimate the global savings such a system would bring in terms of medical costs. We conclude the chapter by generalizing this case to a longer view of the milestones that open source medTech would have to achieve on the way to a type of healthcare that could improve the 4 As and boost an open source medTech economy.

2 Benefits of Open Source MedTech

Open source in this context means that all constituent parts of the entire medTech including hardware and software are made publicly available such that anyone can study, modify, distribute, make, and sell the design/code or hardware/software based on that design/code. This implies that the know-how that underlies the technology must be transparent and free for anyone to use as the basis for further developments or commercialization. It is important to add that open source medical devices and their modifications can only be placed on the market after its safe use has been approved e.g. by clearance of a regulatory body (OSHWA, 2012).

2.1 Growth in Innovation

In magnetic resonance imaging and many other fields, innovation stems predominantly from the scientific community rather than from industry. But how successfully are such innovations being translated into products that ultimately help patients? A recent survey conducted by the journal *Nature* revealed that over 70% of 1500 researchers have attempted and failed to reproduce a peer scientist's experiments. A major reason is a lack of access: to data, details of a hardware setup, source code of the software used for data processing, and other stages of the research pipeline. With

research and development expenditures currently standing at 2–3% of the GDP, low replication rates indicate a rather low return of resources, and suggests that much is wasted as scientists attempt to put scientific results to use in (a) creating innovations or (b) translating them into clinical applications (Baker, 2016).

Accelerating the progress of science would be well served by open source strategies, which would make reproducibility faster and more efficient and resources to be devoted to innovation instead of being spent on the reproduction of the status quo. Only two and a half years after the *RepRap* project launched its first open source 3D printer in 2007, about 4500 machines have been reproduced leading eventually to the 3D printer revolution with a plethora of applications. This viral effect led to the competitive and blossoming 3D printer market we are witnessing today, with drastically reduced costs and widespread innovations including 3D-printed prosthetic limbs, 3D printed stethoscopes for US$5 or 3D printed implants (Jones et al., 2011; Porup, n.d.; VITAPRINT, n.d.).

Innovation in medical research and development has yet to experience such a growth spurt. Positive trends are observable in the software domain such as *OpenEMR*, an open source medical practice management software, or *3DSlicer*, an open source software for medical image analysis. Other positive signs include the open access movement towards free access to scientific publications. But this is barely enough and does not truly address the development of instruments. Collaboration and reproducibility need an open source directive, that allows a much broader access to data, source code and hardware specifications. Open source initiatives benefit the authors by a fast and more widespread dissemination and translation of their work, which increases its impact while maintaining their authorship through open source licenses. At the same time open source software and hardware benefits from high quality documentation by means of scientific publications that undergo a rigorous peer review process. Such efforts permit a substantial reduction if not minimization of redundancy and encourage a wide community to engage in demanding projects by sharing resources, ideas and outcomes ("Open Innovation Open Science Open to the World—a vision for Europe," 2016).

Full and free access to information is beneficial far beyond science. Businesses can use this information to validate newest research results for faster innovation cycles in product development and quicker time to market. A notable example can be seen in the *OpenPOWER* foundation, an initiative by *IBM* with other founding members such as *Google*, *Nvidia* and *Mellanox*. Facing the inevitable frontier of physical limitations in current chip design, *IBM* opened up its processor specifications, firmware, and software towards the goal of engaging in open collaboration. The not-for-profit open ecosystem has to date numerous members in the form of businesses, universities, and research institutions. The innovative outcome of this initiative was demonstrated by a record set in high performance computing in 2017, which broke the previous record from the same year—but did so using one-tenth the power and 1/100th the computer space. These are just two examples of the way open collaboration initiatives spur innovation and businesses, and the quality of healthcare would benefit tremendously from similar approaches as the field pursues the 4 As for medTech (IBM, 2017; OpenPOWER Foundation, n.d.).

2.2 Market Impact

Open source medTech unlocks new business opportunities and lowers the hurdle for market entries by outsourcing research and development, local manufacturing and local maintenance. Competitive regional markets can be created that would potentially stabilize low prices for healthcare products as well as related services, such as maintenance. In addition, this will encourage the creation of a broader range of customized products. This is particularly important when adjusting a medical device to the local environment and underserved needs. For example, a university hospital where technology is often developed has different requirements than a solar powered rural hospital.

Here, 3D printing provides a role model to follow, not only of innovation but also of the market impact of open source technology coupled with patent expiry. Giving access to knowledge regarding the manufacturing of a 3D printer with the ability to freely commercialize it has generated ample business opportunities, leading to competition and lower prices, consequently widening the range of applications and leading to a disruptive technology for manufacturing. A similar development is emerging on the horizon for many medical devices if the know-how behind the technology is made openly available.

Open source encourages the participation of patients, patient organizations and practitioners in the development process. Their input is key to improve the quality, ease of use, safety, function, patient comfort, costs and customization to local infrastructure of the devices. Eventually, diffusing the technology worldwide will permit its applications to niche but clinically relevant issues such as the diagnosis and treatment of rare diseases.

The basic underlying technology of the most used diagnostic imaging modalities, x-ray, ultrasound, computed tomography and magnetic resonance imaging—have been established for several decades in the clinic. Through the expiration of many technological patents, the road is free to open source the reproduction of these devices and adapt them to state-of-the art technology. This process requires strong business partners to distribute healthcare products. At the same time product development is not dependent on a few entities because most of the knowledge created in the process is free. This is not merely a vision; it has already started, with the development of an open source EEG or an open source handheld ultrasound device as highlighted in Fig. 1. Apart from the aforementioned lower R&D costs of open source medTech, faster innovation cycles, lower legal fees, quicker time to market, better product quality, enhanced safety and compliance, lower costs for marketing, and an ethical bonus for the brand are other convincing arguments for businesses to engage in this exciting new domain (echOpen, n.d.; Gibb, 2014; OpenBCI, n.d.).

The yearly performed survey from Black Duck Software amongst over 1300 corporate open source software users provide a glimpse into the potentials for an

Fig. 1 Comparison of a console style ultrasound device (left) with the recently developed portable open source ultrasound imaging device *EchOpen* that can be operated together with a smartphone (right). (illustration by courtesy of *EchOpen*)

open source medTech industry. Initially lower costs were the number one reason for businesses to use open source software. Today, only a few years later, the foremost reasons are quality, competitive advantages and customization. Over 90% of respondents said that open source software improves efficiency, interoperability and innovation of their business (Black Duck Software, n.d.).

2.3 MedTech Manufacturing Laboratories

Along with public institutions, there is an ongoing movement to open multi-secular institutions to civil society. Small scale workshops like fabrication laboratories (FabLab) or open-innovation ecosystems like living labs are shaping new interactions between public stakeholders, engaged citizens and businesses. Hackathons on various subjects from food-delivery in hospitals to orientation signaling inside hospitals or data-mining are becoming more frequent. Worldwide challenges like *Kaggle* or *HeroX* give a glimpse into the vast possibilities and advantages that could be extracted from multi-scale collaborations with citizens, open communities and private businesses. One instructive example is the living lab *la fabrique de l'hospitalité* in Strasbourg which is a place where hospital agents and healthcare system users design thoughtful approaches together to help build solutions for patients.

Following this trend, the implementation of dedicated open innovation hubs or medTech labs can be an important vehicle to crystallize approaches to health

promotion as an interface between healthcare providers, healthcare payers, businesses, scientists, engineers and individuals. These entities could be an intrinsic part of universities, research centers or hospitals, where lab space and equipment are typically available. Implanting an open source mindset into these infrastructures allows to connect such innovation hubs worldwide. These spaces have an immense potential for open source value creation for innovation, education and global health and are an economic motor for a supportive private sector. Although medTech labs do not necessarily imply open source, the latter is generally strongly bound to these experiences. There is no magic in considering the open source movement. It is ruled out by Mauss' "sociology" theorem "to any gift, counter-gift". Hence, like *Wikipedia*, open source proceeds from the same idea that "I" am interested on developing this part of the "edifice" because I can benefit from usage either of the tool itself or what it enables me to do elsewhere. So, global high scale open source collaboration is feasible given the universal interest of anyone (practitioner and patient) into being a user and developer of a quality health system.

2.4 Improved Decision Making for Healthcare Providers and Payers

The open source development of medical devices would have a direct impact on hospital management, not only by creating competitive markets that reduce the price of medical devices, but also by streamlining the services around it. Currently many medical devices require maintenance and service contracts. These costs typically lie around 10–14% of the equipment cost per year with original equipment manufacturers (OEM). Assuming the cost of an MRI scanner to be US$1.5 million, 6% service costs per year, and a usage over 10 years, the service costs sum up to US$0.9 million for a single system (without taking into account the cost of maintenance of accessories with around 7–8% service costs). These costs could be reduced significantly through third-party services, insurance coverage or in-house maintenance. While currently in-house maintenance solutions are only beneficial for larger departments and/or multiple sites, this might change for open source ecosystems. (Sferrella, n.d.)

Open source medTech is accompanied by increased transparency of the product, which enables improved decision making regarding the purchase of medTech to ensure an appropriate use during medical procedures and best price-performance ratio. This transparency should increase making informed decisions of diagnosis/treatment cost for medical devices and procedures to payers (e.g. health insurances), funding organizations and governments. Additionally, healthcare providers such as hospitals or practitioners would enjoy further benefits from a "value" bonus of an open source medTech brand. The practitioner or patient becomes part of the open community. By using this technology, she or he helps to make it accessible worldwide in a sustainable way, because the knowledge generated, and its clinical application is free for everyone, everywhere and forever. This is an appealing

business model and would attract healthcare users in a manner similar to the way *BIO* or *Fairtrade* certifications are attracting consumers (Gibb, 2014).

2.5 Paradigm Shift in Patient Safety and Regulations

An open source development of medTech has the potential to change or extend the medTech regulatory model. Currently, medical devices are regulated at the regional or at the nation-state level. These schemes are not globally harmonized creating a gap between countries, regions and between established and emerging markets (Ettinger, Pharaoh, Buckman, Conradie, & Karlen, 2016).

In markets where medTech is regulated, access to standards may require payments and the use of proprietary technologies that can significantly raise the cost of new product development. Open source medTech would make standards readily available through documentation and would promote innovation around existing proprietary technologies creating an open source supply chain for product development.

Developing robust open source medTech that meet open standards and demonstrates its effectiveness openly presents an opportunity to harmonize the global regulatory system. With an open source approach to device development and monitoring, technologies would be accountable for quality, reliability and safety consistently across markets, thus closing current gaps in the global scheme (Ettinger, 2015).

Troubleshooting errors that might harm or kill patients after the product has been marketed is difficult, particularly for the closed and proprietary software and hardware currently used in the vast majority of approved medical devices. In the case of drug infusion pumps for example, several fatal errors in the US led to the FDA establishing collaboration with researchers to generate open generic drug infusion pump models. These generic models allow manufacturers to assess the safety of their infusion pump software without revealing its proprietary details. Although this was a reasonable approach in this particular example of closed software, it is only a workaround. While drug infusion pumps may use around 170,000 lines of code, the complexity of other medTech software, such as that for MRI, increases its number drastically (The Economist, 2012).

Furthermore, these software considerations do not even consider the potential for hardware errors. This complexity renders the generation of generic MRI models for safety testing unrealistic, like for many other medical devices, and rather requires open source medTech solutions for placing patient safety into the spotlight. Additionally, open data monitoring capabilities can be integrated into open medTech designs. This approach promotes the development of open source sensor and internet of things (IoT) technologies to monitor quality, reliability and safety (QRS) data. An open source solution that integrates tools to assure QRS from the outset of the design

and throughout the lifecycle of a product promises valuable information for product makers, regulators, clinicians, and patients.

While the opportunities of transparent medTech are intriguing, open source medTech raises reasonable concerns regarding quality when in principle anyone can rebuild medTech based on openly available construction plans. In regulated markets, this technology cannot be distributed legally without approval of a certified body which requires that safe use be demonstrated by the manufacturer within the scope of the regulations. In unregulated markets however, medTech products could enter the market without such quality assurance. Here general safety guidelines and quality control processes such as hardware and software testing procedures of the device are required, which need to be developed by the community. To implement these guidelines an independent international organization could provide a seal certifying quality assurance like the model of *Fairtrade International* which provides fair trade standards for goods, along with a seal of approval.

2.6 Open and Free Education

Even if a medical device can be purchased, there is no guarantee that it will be properly used, because this may require many skills that are unavailable in a given region of the globe. Crucial for the development of medTech is an adequate training of medical physicists and physicians, technicians, engineers, and other hardware or software specialists. This is now possible in the internet-era, where global access to up-to-date educational content is available outside of universities or specialized training centers.

A popular example of an open source educational approach is *Wikipedia*, whose concept for providing open information is based on a platform that is accessible worldwide and can be used by anyone to learn from, correct existing, or contribute new material. With to date around 70,000 editors the content quality of *Wikipedia* is continuously increasing. A similar initiative centered on the development and use of open source medTech would support a global and multidirectional approach to teaching and transitions in healthcare. In practice, providing open access to documentation, manuals, data, university lectures, exercises, lab courses, public health statistics, market intelligence and source code facilitates learning and the training of users, developers, technicians, students, business professionals, healthcare experts and researchers, while continually stimulating creativity. Open standards allow simplified sharing of code, hardware construction plans and anonymized data for training, research and development purposes. An open source platform around magnetic resonance imaging and related medTech has been created at www.opensourceimaging.org, to interconnect open source research, development and educational material. More such initiatives are needed to liberate knowledge centered on healthcare.

3 Case Study of an Open Source Magnetic Resonance Imaging (MRI) Scanner

Magnetic resonance imaging is an essential medical diagnostic tool. Routine applications range from the accurate diagnostic lesion detection of ligaments in the knee, through quantification of myocardial perfusion in cardiac imaging, the accurate detection of brain tumors, breast cancer screening or temperature mapping for interventional ablation, to name a few. In a growing range of clinical applications, MRI has become a gold standard for diagnosis. It's a non-invasive technique and does not rely on ionizing radiation (in contrast to computed tomography or x-ray) that is harmful to the patient. The success of MRI is only countered by costs that have limited the range of its uses in research and the clinics and is the only factor that has put the technology beyond the reach of many patients throughout the world. This can be changed. An open source approach accompanying innovations will address the total cost of ownership (TCO) of an MRI system at several levels, as elaborated in chapter "Using Open Production Sites for Supporting New Ways of Corporate Innovation" and illustrated in Fig. 2.

Scanner hardware and software acquisition cost can be reduced through competitive local or regional markets generated by open source products. Open source research and development also allows to develop more MR systems for customized clinical applications and customized local resources (such as space constraints, unstable power supplies etc.), rather than universal devices that can be used but are not designed for a specific application. While these universal systems stem from revenue-based business strategies of vendors supplying the global market, in a more distributed market, customization of multiple small entities will bring the clinical application into focus. The competitive local markets will be extended to the service market as well, allowing to reduce maintenance costs of a device either by in-house maintenance or third-party contractors. Training of staff is facilitated by open source documentation, education and training while an inclusive development process that engages practitioners, technicians etc. in the development process will create simpler and safer systems (Fig. 2).

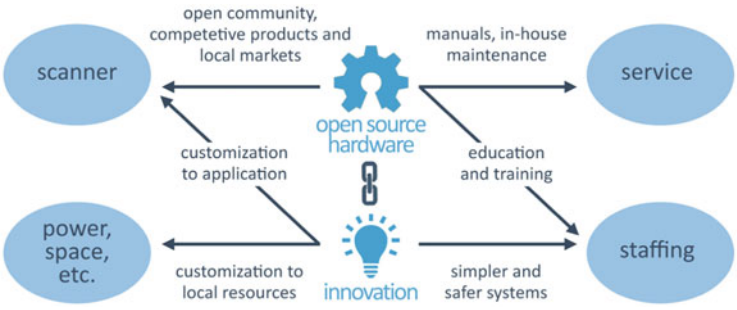


Fig. 2 Reducing the total cost of ownership (TCO) of MRI using open source (authors' own illustration)

Fig. 3 Concept of the open source imaging initiative (OSI^2) (authors' own illustration)

In general, the technological complexity of MRI and the fact that development is predominantly carried out by the research community is another justification of an open source approach. These considerations motivated the establishment of the *Open Source Imaging Initiative* (OSI^2), advocating research and development of Open Source MR technology, with one of its aims to collaboratively develop an MR scanner, that would be open source in terms of both software and hardware as shown in Fig. 3 (Arndt et al., 2017; Winter et al., 2016b). In this concept, software and hardware developments follow a modular approach to stimulate independent developments and exchangeable components by a wider community. Compared to the already established Open Source Software (OSS) economy, Open Source Hardware (OSH) is a relatively new and unexplored area making it challenging to determine its added value compared to commercial products (Huang, 2015). Nonetheless, a realistic machine like the *Cost-effective Open Source Imaging* (COSI) MR scanner currently developed in Berlin, Germany (Blücher et al., 2017; Winter, Barghoorn, Blümler, & Niendorf, 2016a), provides an excellent basis for estimates of healthcare cost savings.

3.1 Appropriate Technology for Each Clinical Application

State of the art clinical MRI scanners operate at high magnetic fields of 1.5 T and 3.0 T. Ultra-high field MR scanners operating at 7.0 T will enter the clinical practice soon. Such high fields offer intrinsically increased signal-to-noise ratio, which translates into improved image quality by e.g. improving the spatial resolution, by enhancing diagnostic contrast and by shortening examination times. To generate these strong magnetic fields, windings of superconducting materials are cooled with liquid helium to maintain cryogenic temperatures. The technological implementation is complex and costly in particular for large magnets (human MRI) and high fields due to the intrinsic Lorentzian forces. While other components of an MR system like electronics do not change substantially with increasing field strengths, the magnet costs are the major contributor to the purchasing costs of an MRI.

While high-end high field MRI is an important clinical workhorse and ultra-high field MRI is leading to novel scientific knowledge and technological breakthroughs, from the healthcare perspective the question remains: What image quality is sufficient for a cost-efficient diagnosis of the patient? Like in other areas of human needs a diverse range of options provides most suitable solutions, such as choosing between a bicycle or a car in transportation, or a telephone or smartphone in communication. Even an MRI scanner of extremely limited capability is superior to having no imaging capability at all. Indeed, multiple studies showed that there are several clinical applications where the diagnostic value gathered from low field MRI (0.2 T) is equivalent to higher field systems (1.0 T) (Ejbjerg, Narvestad, Jacobsen, Thomsen, & Østergaard, 2005; Kersting-Sommerhoff, Hof, Lenz, & Gerhardt, 1996; Pääkkö, Reinikainen, Lindholm, & Rissanen, 2005; Parizel et al., 1995; Wu, Chen, & Nayak, 2016).

To achieve such field strengths permanent magnets, present a viable alternative to liquid helium cooled superconductors while avoiding the need for a constant power supply and a magnet supervision system. While permanent magnets using an iron return

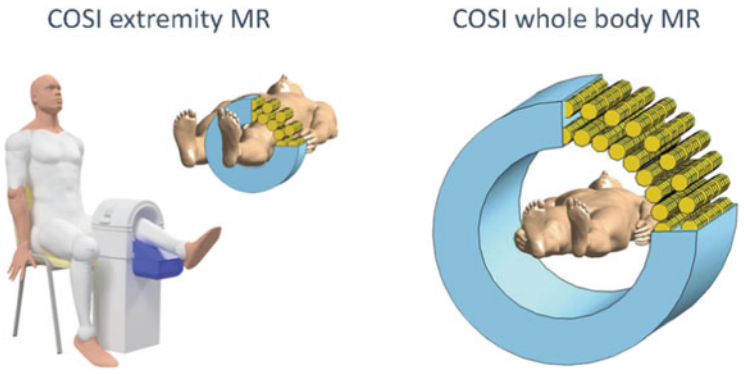


Fig. 4 Concepts of cost effective open source imaging (COSI). "Mobile" extremity MR scanner at 0.3 T (left) and whole body MR scanner at 0.2 T (right) using permanent magnets (authors' own illustration)

yoke are bulky and increase costs, small permanent magnets in Halbach arrangements afford lightweight configurations (Fig. 4). Halbach magnet configurations can even be designed such that gradients in the magnetic field can be deliberately used for spatial encoding, which makes the need for high power gradient amplifiers obsolete (Cooley et al., 2015; Halbach, 1980; Winter et al., 2016a).

3.2 Cost Savings of COSI Extremity MR

The COSI extremity MR system under development applies this technology at a magnetic field strength of $B_0 = 0.3$ T (Fig. 4). The MR magnet consists of multiple small octagonal shaped NdFeB permanent magnets with a remanence of $B_r = 1.43$ T. As a transmitter and receiver, a software defined radio is used together with an open source software framework, which enables hardware independent development of MR imaging techniques. To generate sufficient power for the transmitted radio frequency (RF) pulses, a 1 kW RF power amplifier was build. The estimated material cost (not cost optimized) of the final system is around US$10,000.

Once the COSI extremity MR system is constructed its clinical application could include musculoskeletal imaging of the extremities such as the knee, foot, wrist and elbow. The COSI system is smaller and lighter (<100 kg) than a commercial MRI device and can be used for mobile applications. The value of this system has been estimated by following the Pearce approach (Pearce, 2015). The results represent potential cost savings calculated by four different methods. The Downloaded Substitution Valuation (DSV) method was used to calculate the economic savings through substitution of a comparable commercially available extremity MRI (Esaote O-Scan 0.31 T) with a COSI Extremity MR. The saved replication value for companies, radiological practices or hospitals can be determined with the Avoided Reproduction Valuation (ARV) method. The Market Savings Valuation (MSV) method was used to identify market savings for the year 2022, as time is still needed to introduce the market-ready version of the product into the medical sector. In addition to the three methods, the Secondary Streams of Value (SSV) method has been used to determine additional cost savings through lower medical examination costs.

The total cost of ownership (TCO) of a new Esaote O-Scan 0.31 T for 10 years excluding staffing cost is US$511,333. The TCO of the COSI Extremity MR is only US$26,550 (assuming US$15,000 for the scanner) for the same period. For the German market the DSV method has identified savings up to 87.6 million per year. Based on the ARV method, the saved replication value of all companies was identified to range up to US$2.6 million for one year. The MSV method was used to calculate the market savings for the year 2022, which equals US$8.4 million per year. The SSV method has shown savings potential of US$77.8 million per year for health insurance companies due to the reduction of medical examination costs with the COSI extremity MRI by 20% (Günyar, 2017).

To provide a long-term view and a future trend analysis, the calculated savings of each method for the next 20 years were summarized and illustrated in Fig. 5. The figures survey the lowest and highest saving value of all methods including the savings attributed to lower medical examination costs. In the worst-case scenario, nearly US$1.6 billion can be saved after 20 years and more than US$3.3 billion can

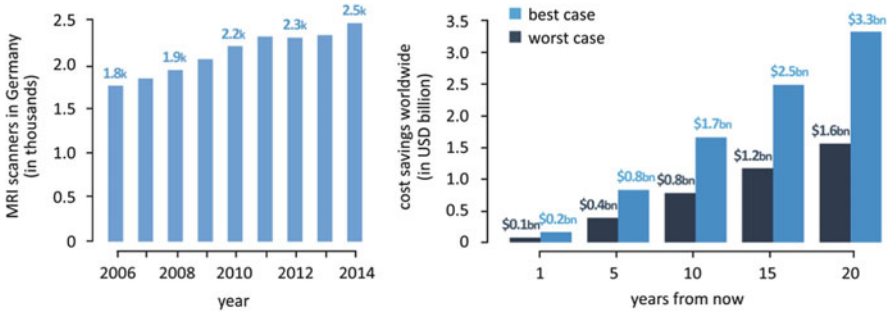


Fig. 5 Left: number of MRI scanners in Germany from 2006–2014; right: estimated cost savings for the public healthcare system in Germany based on purchasing an open source COSI Extremity MR. Up to US$3.3 billion can be saved after 20 years (authors' own illustration)

be saved based on the best-case scenario. These calculations are based on the assumption that every third of all MR examination is an extremity scan (30% market share as observed in Germany). By analyzing the entire global MR market, even higher potential cost savings are expected.

The presented case study was performed for a low field system based on permanent magnets. In general, open source development is not limited to a particular technology. So, it might be also envisioned that e.g. the design and construction of superconducting MR magnets at higher fields and corresponding hardware is made available in an open source way.

4 Conclusion

We have proposed applying the open source framework to the medTech economy in a way that would make essential instruments more available, accessible, appropriate and affordable to healthcare facilities and patients all over the world while ensuring the quality that such devices must attain.

We describe key potential benefits of such an approach, which would incorporate the following values: (i) It would open innovation and development of medTech to collaborations in which entire communities can participate, instead of only a few competing vendors; (ii) it would stimulate business opportunities for small companies by creating competitive markets that would likely stabilize the prices for products and services at a level appropriate to any given region; (iii) it would draw practitioners and patients into the open community, encouraging specific customizations of the technology that would make it much more patient-centric; (iv) it would promote the development of community guidelines by which certification procedures and patient safety are ensured and globally harmonized by the transparency of technologies and codes; (v) it would maximize return on public investment for the healthcare system, through lower hardware costs, lower service cost, improved cost assessment for health insurance companies and improved decision making on medTech purchasing by healthcare providers through

transparency; (vi) it would transfer technology and knowledge from resource rich to resource poor settings globally and (vii) open and free education will raise the level of training of medical physicists and physicians, technicians, engineers, and other hardware and software specialists worldwide.

We also presented the case study of a prospective open source MR scanner whose development represents an attractive business opportunity that would substantially reduce MR-related costs in healthcare systems. We show that this can be done in a way that improves efficiency and decreases costs without fundamentally changing current healthcare systems or business models. MR is an excellent example of a crucial high-end technology to which access is primarily limited by cost. This issue can be solved and extended to a vast range of diagnostic, therapeutic, and preventive medical technologies. The only prerequisite is our willingness to adopt a mindset of openness and collaboration in the development of an open source infrastructure. In particular, investments are needed from the public and private sector to boost open source medTech, which does not follow the classical economic model based on IP protection and does not fall under basic but rather applied research, for which early stage public funding opportunities are scarce. With such kick-starter open source medTech and its socio-economic impact is likely to follow the success and sustainable growth of the open source software movement. The potential gains—a real democratization of the quality of global health—are surely worth taking this step.

References

Arndt, F., Aussenhofer, S., Behrens, E., Blücher, C., Blümler, P., Brand, J., et al. (2017). Open source imaging initiative (OSI2) – Update and roadmap. *Proceedings of the International Society for Magnetic Resonance in Medicine*.

Baker, M. (2016). 1,500 scientists lift the lid on reproducibility. *Nature News, 533*(7604), 452 https://doi.org/10.1038/533452a.

Black Duck Software. (n.d.). *The tenth annual future of open source survey*. Retrieved December 18, 2017, from https://www.blackducksoftware.com/2016-future-of-open-source

Blücher, C., Han, H., Hoffmann, W., Seemann, R., Seifert, F., Niendorf, T., et al. (2017). COSI transmit: Open source soft- and hardware transmission system for traditional and rotating MR. *Proceedings of the International Society for Magnetic Resonance in Medicine, 184*.

Cooley, C. Z., Stockmann, J. P., Armstrong, B. D., Sarracanie, M., Lev, M. H., Rosen, M. S., et al. (2015). Two-dimensional imaging in a lightweight portable MRI scanner without gradient coils. *Magnetic Resonance in Medicine, 73*(2), 872–883.

echOpen. (n.d.). *echOpen project – Designing an open source and low-cost echo-stethoscope*. Retrieved October 11, 2017, from http://echopen.org

Ejbjerg, B. J., Narvestad, E., Jacobsen, S., Thomsen, H. S., & Østergaard, M. (2005). Optimised, low cost, low field dedicated extremity MRI is highly specific and sensitive for synovitis and bone erosions in rheumatoid arthritis wrist and finger joints: Comparison with conventional high field MRI and radiography. *Annals of the Rheumatic Diseases, 64*(9), 1280–1287.

Ettinger, K. M. (2015). Open issues and a proposal for open-source data monitoring to assure quality, reliability, and safety in health care devices targeting low-and middle-income countries. In *Technologies for Development* (pp. 81–90). Cham: Springer.

Ettinger, K. M., Pharaoh, H., Buckman, R. Y., Conradie, H., & Karlen, W. (2016). Building quality mHealth for low resource settings. *Journal of Medical Engineering & Technology, 40*(7–8), 431–443.

European Commission. (n.d.). *Guidance – Growth – European Commission*. Retrieved October 11, 2017, from http://ec.europa.eu/growth/sectors/medical-devices/guidance_en

Gibb, A. (2014). *Building open source hardware: DIY manufacturing for hackers and makers*. London: Pearson Education.

Günyar, S. (2017, July 24). *Wirtschaftliche Bewertung von Open Source Hardware am Beispiel eines Magnetresonanztomographen*. Hamburg: HWI Hamburg.

Halbach, K. (1980). Design of permanent multipole magnets with oriented rare earth cobalt material. *Nuclear Instruments and Methods, 169*(1), 1–10.

Huang, A. b. (2015, March 31). *The death of Moore's law will spur innovation*. Retrieved November 17, 2017, from https://spectrum.ieee.org/semiconductors/design/the-death-of-moores-law-will-spur-innovation

IBM. (2017, April 25). *HPC in oil & gas record set today! [CTB10]*. Retrieved October 11, 2017, from https://www-03.ibm.com/press/us/en/pressrelease/52164.wss

Jansen, P. (n.d.). *openct|the Tricorder project*. Retrieved December 18, 2017, from http://www.tricorderproject.org/blog/tag/openct

Jones, R., Haufe, P., Sells, E., Iravani, P., Olliver, V., Palmer, C., et al. (2011). RepRap – The replicating rapid prototyper. *Robotica, 29*(1), 177–191 https://doi.org/10.1017/S026357471000069X.

Kersting-Sommerhoff, B., Hof, N., Lenz, M., & Gerhardt, P. (1996). MRI of peripheral joints with a low-field dedicated system: A reliable and cost-effective alternative to high-field units? *European Radiology, 6*(4), 561–565.

Moritz, M., Redlich, T., Grames, P. P., Wulfsberg, J. P. (2016). *Value creation in open-source hardware communities: Case study of Open Source Ecology*. In: Management of Engineering and Technology (PICMET), 2016 Portland International Conference on. IEEE, pp. 2368–2375

OpenBCI. (n.d.). *OpenBCI – Open Source Biosensing Tools (EEG, EMG, EKG, and more)*. Retrieved December 18, 2017, from http://openbci.com

OpenPOWER Foundation. (n.d.). *OpenPOWER Foundation*. Retrieved October 11, 2017, from https://openpowerfoundation.org

Open Innovation Open Science Open to the World – a vision for Europe. (2016). Publications Office European Union.

Open Source Imaging. (n.d.). *Open Source Imaging – Open source soft- and hardware research and development of magnetic resonance imaging (MRI) and other related medical devices*. Retrieved October 11, 2017, from http://www.opensourceimaging.org

OSHWA. (2012, May 26). *Open Source Hardware Association*. Retrieved November 21, 2017, from https://www.oshwa.org/definition

Pääkkö, E., Reinikainen, H., Lindholm, E.-L., & Rissanen, T. (2005). Low-field versus high-field MRI in diagnosing breast disorders. *European Radiology, 15*(7), 1361–1368.

Parizel, P. M., Dijkstra, H. A., Geenen, G. J., Kint, P. A., Versteylen, R. J., van Wiechen, P. J., et al. (1995). Low-field versus high-field MR imaging of the knee: A comparison of signal behaviour and diagnostic performance. *European Journal of Radiology, 19*(2), 132–138.

Pearce, J. (2015). Quantifying the value of open source hardware development. *Modern Economy, 6*, 1–11.

Porup, J. M. (n.d.). *This 3D-printed stethoscope costs $5, outperforms $200 competitors – Motherboard*. Retrieved October 11, 2017, from https://motherboard.vice.com/en_us/article/539xkn/this-3d-printed-stethoscope-head-costs-5-outperforms-200-competitors

Sferrella, S. (n.d.). *Equipment service: Total cost of ownership*. Retrieved November 20, 2017, from http://www.radiologybusiness.com/topics/business/equipment-service-total-cost-ownership

The Economist. (2012, June 2). When code can kill or cure. *The Economist*. Retrieved November 21, 2017, from http://www.economist.com/node/21556098#print

Thomson, C. C., & Jakubowski, M. (2012). Toward an open source civilization: (Innovations case narrative: Open source ecology). *Innovations, 7*(3), 53–70.

VITAPRINT. (n.d.). VITAPRINT: Vitaprint. Retrieved October 11, 2017, from http://irnas.eu/vitaprint

WHO. (2010). *Medical devices: Managing the mismatch: An outcome of the priority medical devices project*. Geneva: World Health Organization.
WHO. (2011). First WHO Global Forum on Medical Devices: Context, outcomes, and future actions
WHO. (n.d.). *Baseline country survey on medical devices, 2014 update: Medical Equipment – Total density per million population*. Retrieved October 11, 2017, from http://gamapserver.who.int/gho/interactive_charts/health_technologies/medical_equipment/atlas.html
Winter, L., Barghoorn, A., Blümler, P., & Niendorf, T. (2016a). COSI magnet: Halbach magnet and Halbach gradient designs for open source low cost MRI. *Proceedings of the International Society for Magnetic Resonance in Medicine, 3568*.
Winter, L., Haopeng, H., Barghoorn, A., Hoffmann, W., Hetzer, S., Winkler, S., et al. (2016b). Open source imaging initiative. *Proceedings of the International Society for Magnetic Resonance in Medicine, 3638*.
Wu, Z., Chen, W., & Nayak, K. S. (2016). Minimum field strength simulator for proton density weighted MRI. *PLoS One, 11*(5), e0154711.

Lukas Winter is staff scientist at the Physikalisch Technische Bundesanstalt (PTB) in Berlin, Germany and founder of the Open Source Imaging Initiative (OSI^2, www.opensourceimaging.org). His research focusses on ultrahigh field magnetic resonance imaging (MRI), MR safety and the construction of an affordable open source low-field MRI.

Part III

Legal Challenges of Co-creation

Patent Law in the Era of 3D Printing: The Practitioner's Perspective

Constantin Blanke-Roeser

1 Introduction

3D printing is a technology which may change the traditional structure of production and distribution chains in the future (Bechtold, 2016). But as the costs not only for the printers but also for the materials to be used have been fallen drastically in the recent past, it can be expected that an increasing number of private users will be able to use 3D printing technologies (Benkard, 2015). This may be relevant regarding patented products, as well as Intellectual Property law including patent law in general (Schulze & Staudenmeier, 2015), since a growing number of private users will be able to produce patent protected products at home or order them at local printing services or shops in their neighborhood (Nordemann, Rüberg, & Schaefer, 2015). On the other hand, 3D printing is a useful device for *FabLabs*, allowing to produce prototypes or end products, as the result of creative collaborations.

This paper focuses on patent law as the IP law most particularly affected by 3D printing. The first section of this paper introduces the basics of the technical background as well as of the current patent legal framework in Germany. It also gives an overview on how and where patents can be received and on the requirements for patentability. The second section concretely examines possible infringements of existing patents in the context of 3D printing, which should be avoided. As this article addresses practitioners, it provides examples in order to demonstrate the practical relevance.

C. Blanke-Roeser (✉)
Bucerius Law School: Center for Transnational IP, Media and Technology Law and Policy, Hamburg, Germany
e-mail: constantin.blanke-roeser@law-school.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_13

2 Basics

2.1 3D Printing

The term 3D printing summarizes several technologies which produce three-dimensional objects. 3D printers use various materials, which are, after a melting process, applied to a platform, with a solid end object consisting of multiple layers (Zukas & Zukas, 2015). The technology is described more precisely by the term *additive manufacturing* (Nordemann et al., 2015).

The printing process functions on the ground of a template comprising the necessary information, the so-called *Computer-aided design* (CAD) file. These files may be produced in different ways. First, they may be newly designed by means of specific software or a 3D scanner which scans existing objects (Nordemann et al., 2015). Second, CAD files can be downloaded online, mainly from specialized online platforms (Schmoll, Ballestrem, Hellenbrand, & Soppe, 2015). The 3D printers which are used in private households are still comparably simple. However, in the near future, more versatile and even cheaper machines will be developed (Bechtold, 2016). Another option for consumers is to have the products printed by professional 3D printing services that can afford more complex technologies.

2.2 Patent Law and Legal Framework in Germany

General Principles of Patent Law

Patents are exclusive rights which protect technical inventions. They are granted by national authorities and provide their owners with legal monopolies, allowing them to use the invention exclusively—themselves or by e.g. granting a license—, as well as to exclude others from using it within the territorial scope of the patent (Kraßer & Ann, 2016) for a limited period of time (20 years for German and European patents). This is essential because inventions, as immaterial ideas, are intangible goods which—in contrast to tangible goods—are ubiquitous and non-rival, meaning that multiple users could use them simultaneously at different places without reducing their amount. The legal monopoly artificially makes the invention scarce, transforming it into a marketable good (Haedicke, 2013). Patent law aims at fostering innovation, as the legal monopoly is an incentive for inventors, as it allows them to amortize the time and money invested in the research.

Legal Framework in Germany

Currently, the legal framework in Germany provides two types of patents: the *national patent* on the basis of the German Patent Act (Patentgesetz, PatG) and the *European patent* on the ground of the European Patent Convention (EPC). Counterintuitively, European patents grant protection only for several particular states to be chosen by the applicants (therefore, they are often called *bundle* of national patents) (Fitzner, Lutz, & Bodewig, 2012, PatG, Einl.).

The German patent is granted by the German Patent and Trademark Office (Deutsches Patent- und Markenamt, DPMA), based in Munich. First, the DPMA examines whether the requirements for patentability are given: Patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application. After a patent has been granted, a declaration is entered in the German register for patents, as well as published in the Patent Gazette. At that very moment, it comes into force, with all its legal effects.

The European patent is granted by the European Patent Office (EPO), also based in Munich, with the procedures and requirements for patentability being equivalent to those for German patents for most steps.

Soon, inventors will be able to opt for a further type of patent, the so-called European patent with Unitary effect (*Unitary patent*), see also Table 1. These patents will cover the entire territory of the participating EU Member States (so far, not all member states are willing to join the new system). Unitary patents will also be granted by the EPO, with the procedure being equivalent to that for European patents for the most part. For Unitary patents, a specific legal framework has been designed: the *patent package*. It comprises two EU regulations[1] and the international Agreement on a Unified Patent Court (UPCA). The UPCA still lacks ratification by more Member States, before the whole package will be set into force (Grabinski, 2013).

Despite the ongoing "Brexit" preparations, the United Kingdom will probably participate in the system, which will require some minor legal exceptions allowing for a (future) non-EU member state to remain in it (see Haberl & Schallmoser, 2017). Germany has not yet ratified the UPCA because the national laws designed to implement it into national law are currently object of a constitutional complaint before the German Federal Constitutional Court. If the Court rejects the complaint—which is likely—, Germany is probably going to ratify the UPCA in the course of 2018, as the last mandatory ratifying participating Member state. This would be the starting point for the entry into force of the whole patent package. The UPCA will then, as national law, apply to classic European patents as well.

Table 1 Three types of patents in Europe (future)

National patent	European patent	Unitary patent
• Legal basis: national law (e.g. PatG in Germany) • Granted by the DPMA	• Legal basis: EPC, national law ("bundle of national patents") • Granted by the EPO	• Legal basis: Patent package, EPC • Granted by the EPO

[1] "Regulation (EU) No 1257/2012 of 17 December 2012 implementing enhanced cooperation in the area of the creation of Unitary patent protection" (EPUE-Reg) and "Regulation (EU) No 1260/2012 of 17 December 2012 implementing enhanced cooperation in the area of the creation of Unitary patent protection with regard to the applicable translation agreements" (EPUET-Reg).

2.3 Interim Result

Technical inventions can be protected by patents if they fulfill the requirements for patentability. In that case, an application for a patent should be submitted with the help of a patent attorney at the patent office (e.g. the DPMA for German patents) or the EPO (for European and Unitary patents). Patent infringements can be pursued in the relevant national courts, respectively in the upcoming *Unified Patent Court* (UPC) in case of European and Unitary patents.

3 Possible Infringements in the Context of 3D Printing

This section focuses on possible infringements of *existing* patents of other rights owners. Therefore, it examines the infringing potential of the most relevant actions in the context of 3D printing. For that purpose, the three types of patents (German patent, European patent and Unitary patent) are differentiated.

As a basic recommendation, in a first step, a research in the relevant registers, which are accessible online on the websites of DPMA[2] and EPO[3], on whether a specific technical invention is patented, is recommendable. However, this offers only insufficient security, given how many patents exist, even cumulatively in many (complex) products.

3.1 German Patents

The PatG differentiates between patents on objects and procedures, with objects being more relevant in the given context. According to sec. 9 s. 2 no. 1 PatG, third parties are not allowed to manufacture, offer, or use a product that falls under the subject-matter of a patent, nor to place it onto the market, nor to import or possess such a product for one of these purposes (so-called *direct* infringement). Moreover, there is *indirect* infringement (sec. 10 PatG, see III.1.b) for details). In the context of 3D printing, there are numerous actions happening which are possibly relevant for patent law (see Fig. 1). The most important ones are going to be discussed in the following sections.

Manufacturing and Distribution of Objects
Reproducing objects which fall into the subject-matter of patents by producing them via a 3D printer would constitute manufacturing in the sense of direct use of the patent (sec. 9 s. 2 no. 1 PatG), unless the technological features of the end product significantly differ from those of the original one (Nordemann et al., 2015). Without the rights owner's permission, this would constitute direct patent infringement.

[2] See https://register.dpma.de/DPMAregister/Uebersicht?lang=en

[3] See https://register.epo.org/regviewer?lng=en

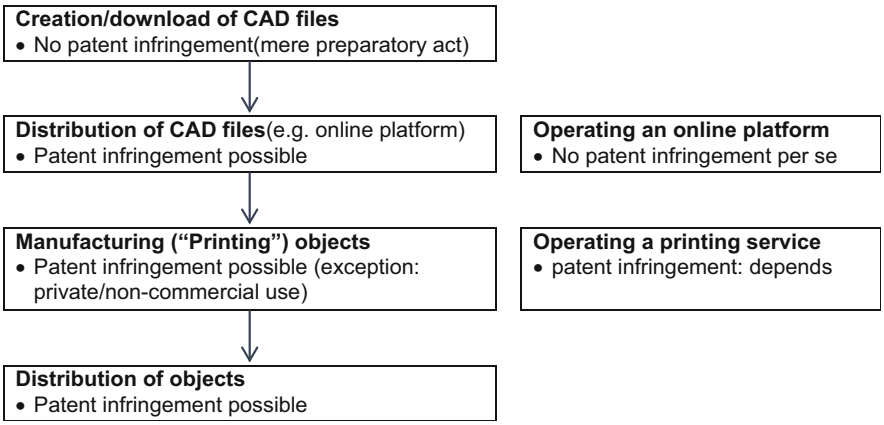


Fig. 1 Actions and potential infringements related to 3D printing (German law) (author's own illustration)

Example

A Berlin-based start-up produces a patented small engine that had originally been invented for model railways, after they had downloaded the CAD file for it from an online platform. They reproduce it several times (manufacturing) and integrate it into an enthusiast app-controlled model car whose design can be shaped individually by customers online. Afterwards, they have the cars shipped to the latter (putting into the market).

Exceptionally, the use is legal (no patent infringement), if it occurs in private environment and for non-commercial use (sec. 11 no. 1 PatG). This exception is not limited quantitatively (Schmoll et al., 2015), which is relevant especially for wear parts. Furthermore, this also applies to the production by third parties (e.g. print services), if this serves the private user in the end (Schmoll et al., 2015). However, the two prerequisites constitute a relevant obstacle (Benkard, 2015, § 10). First, the *private area* is restricted to the personal environment and needs of the persons acting or at least to those related to them (Haedicke & Zech, 2014), e.g. for home settings or leisure activities (Schmoll et al., 2015). Second, the term *non-commercial use* means that nothing can be earned in return (Schmoll et al., 2015).

By contrast, handing a product to somebody else without any consideration after having the product used privately for a certain amount of time would still be non-commercial. A controverted question is whether selling a product to a third person after a period of private use is still non-commercial use. Some scholars deny that. However, as the product becomes a used one after the period of private use, the transfer should be classified as non-commercial in the absence of additional circumstances in the individual case (for all, cf. also Blanke-Roeser, 2017), e.g. if such actions do not happen repeatedly by the same person in a similar manner (for the whole section, see Benkard, 2015, § 10).

Example

Two members of a social project reproduce a patented water filter repeatedly with the best intention and send the new filters gratuitously to people in need. This does not fall under the exception of sec. 11 no. 1 PatG because it leaves the private area.

In contrast, *professional printing services* which manufacture products for private customers ("manufacturing on demand") do not fall under sec. 11 no. 1 PatG (direct infringement, cf. Düsseldorf Higher Regional Court, InstGE 7, 258—Loom-Möbel), as from their perspective the invention is neither used privately nor non-commercially.

Actions Related to CAD Files

The first relevant action in the context of CAD files is creating and distributing them. The second main action is downloading CAD files which already exist.

Distributing a CAD—e.g. uploading it to a relevant online platform or re-sending it to individual persons by email—is no direct infringement, as patent law generally aims at fostering innovation, not at hampering the spread of information (Haedicke & Zech, 2014). However, the distribution of CAD files may *indirectly* infringe patents in the sense of sec. 10(1) PatG (Schmoll et al., 2015). According to the latter, patents shall further have the effect that any third party shall be prohibited, in the absence of the consent of the proprietor of the patent, from supplying or offering to supply, within the territorial scope of the PatG, persons other than those entitled to exploit the patented invention with means relating to an essential element of the invention for use within the territorial scope of the PatG if the third party knows or if it is obvious from the circumstances that those means are suitable and intended for using that invention. The upload of a CAD file constitutes *offering to supply* (Nordemann et al., 2015). Directly forwarding it to certain recipients constitutes more than merely offering, it constitutes *supplying*. Although traditionally, the term "means" was understood merely in a material way, covering e.g. hard copies of construction plans (Schmoll et al., 2015), it should cover immaterial (CAD) files in a contemporary interpretation (Mes, 2015, § 10).

A teleological view urges a broad interpretation which generally covers digital files. In most business and private contexts today, documents are likely to be forwarded digitally. Furthermore, forwarding digital files is more dangerous to rights owners, as it allows multiple patent infringements at the same time (Haedicke & Zech, 2014). Moreover, the other prerequisites of sec. 10(1) PatG are satisfied when CAD files are uploaded or forwarded. A CAD file *relates to an essential element of the invention*. In a modern understanding of "means", it is not required that the means is bodily integrated into the new product itself nor that it has or could have a technical function (Haedicke & Zech, 2014). It should be sufficient that a CAD file not only contains information on every parameter of the particular product, technically forming the basis and necessary condition for its production (Schmoll et al., 2015). Lastly, the third party also *knows* in the sense of Art. 10(1) PatG that the

particular CAD file is suitable and intended for using that invention if he displays that in an advertisement (Schmoll et al., 2015), e.g. by naming the file accordingly. At least, the file's suitability for such a use is *obvious from the circumstances*. To sum it up, uploading or forwarding CAD files that contain the information ready to print a patented product indirectly infringes that patent.

However, forwarding a CAD file gratuitously and only to related persons may be allowed under the above-mentioned exception of sec. 11 no. 1 PatG, too (Nordemann et al., 2015). By contrast, uploading files to online platforms always exceeds the private area, and is therefore always illegal (Haedicke & Zech, 2014).

On the other hand, *creating* a CAD file is a mere preparation for a possible later infringing use, and is irrelevant under patent law (Mengden, 2014). The same applies to *downloading* an existing CAD file. However, further spreading the CAD file would be an indirect infringement—equivalent to spreading self-made CAD-files (see above) [disagreeing Mengden, 2014].

Example

It is legal to design a CAD file that contains the exact sketch of a patented water pump and all information for its production by means of 3D printing. However, uploading this file to the website or blog of a co-creation project without the rights owner's permission is illegal, even if it happens in the course of a social project.

Providing an online platform where CAD files can be downloaded does not even fall under sec. 10(1) PatG [disagreeing Mengden, 2014]. Platforms cannot be subsumed under the term "means", even given the above-mentioned contemporary interpretation. Furthermore, platforms do not relate to an essential element of the *invention* [disagreeing Mengden, 2014]. Third, the subjective side (knowledge or obviousness from the circumstances) could only be assumed if the relevant platform is limited to CAD files on products covered by the subject matter of patents. This will probably remain an exception.

3.2 European Patents

The EPC contains only few substantive rules. For most substantive questions, it refers to the specific national laws of those Member states of the European Patent Organization (EPO) which were selected in the application for the particular patent (Art. 2(2) EPC) (Fitzner et al., 2012, EPÜ, Art. 2). Therefore, in case of the German part of a European patent, the same German national rules apply. Thus, the above-mentioned results for German patents can be transferred to European Patents. Consistently, however, for the other national parts of the European patent bundle, the other particular national laws apply, resulting in differences in some aspects.

For example, some national patent laws lack exclusions comparable to the German sec. 11 no. 1 PatG (for details, see Bechtold, 2016) which can lead to different results to German law so far. However, in the near future, the UPCA will

apply to European patents as well, becoming part of national laws after its implementation by the Member states participating in the Unitary patent system (see Art. 84(2) UPCA) (Haedicke, 2013). The UPCA contains rules very similar to those under German law, including an exception for private and non-commercial use (see next section) which is comparable to sec. 11 no. 1 PatG. Therefore, the mandatory implementation of the UPCA into the national laws of the participating member states will lead to a further harmonization, making the differences in crucial questions marginal.

3.3 European Patents with Unitary Effect (Unitary Patents)

Art. 5(3) EPUE-Reg (to be read in accordance with Art. 7 EPUE-Reg) defines the law applicable for the scope of protection of Unitary patents and their exceptions. The reference includes Art. 25 et seq. UPCA (Haedicke, 2013). Art. 25 UPCA contains regulations on direct use, Art. 26 on indirect use of patented inventions. Art. 27 UPCA determines exceptions for the protection. Art. 25 to 27 UPCA correspond to their German counterparts in sec. 9–11 PatG (Romandini, Hilty, & Lamping, 2016). E.g., Art. 27 lit. a UPCA has almost the same wording as sec. 11 no. 1 PatG. At first sight, the results for German national patents would also apply to Unitary patents.

However, the UPCA will be interpreted by the UPC, a court common to the Contracting Member States (Art. 1 UPCA). This court will comprise multinational instances (cf. Art. 8 et seq. UPCA), aiming to elaborate autonomous interpretations independent from particular national legal traditions. In addition, the material law of UPCA must be interpreted according to EU law although, in a strict sense, it is a mere international treaty. This is because Art. 5(3) EPUE-Reg constitutes an incorporating referral (Haedicke, 2013). Therefore, the past and future jurisdiction of the European Court of Justice (CJEU) must be respected, the UPC will even be allowed to start preliminary rulings with the CJEU (see Haedicke, 2013, for the whole section). Thus, it is not clear whether Art. 25 et seq. UPCA will be interpreted in the way elaborated above for German law or whether the UPC's interpretation will differ in specific questions (cf. Romandini et al., 2016).

4 Limits of the Current Legal Framework

The distribution of 3D printing technologies, especially in private households, challenges patent law and displays its limits (similar Bechtold, 2016). Firstly, as many inventions are not protected under patent law, the legal framework is limited, either because the inventions fail to fulfil the prerequisites for patentability or because the term of the patent has already expired. This is no specific problem of 3D printing. But as examined above, even the use of a patented invention does not infringe the relevant patent in many cases. The underlying cause is that the possibly

infringing acts are split up into partial acts which do not constitute a use of the patent and thus not an infringement (Haedicke & Zech, 2014).

The 3D printing "society" is complex and comprises many participants, such as creators of CAD files, providers of online platforms, or private households. But even enforcing existing legal claims (cf. § 139 PatG, resp. Art. 63(1) and Art. 68 (1) UPCA) is difficult due to *practical* factors (Bechtold, 2016): Firstly, tracing direct infringers is difficult and expensive in the digital environment where CAD files are rapidly distributed (Doherty, 2012). Secondly, many actions happen in private households which are not observable (Haedicke & Zech, 2014). Thirdly, lawsuits are risky, especially for European patents, where various parallel lawsuits in different participating states may be necessary (Bechtold, 2016).

To improve the rights owners' position, various approaches to tighten the patent law framework have been discussed. However, at least in near future, concrete changes are improbable and not recommendable under German or European law, as the current legal framework balances the conflicting interests appropriately.

5 Summary

3D printing is an important technology which will impose relevant changes to traditional production and distribution chains in future. It constitutes a great opportunity for new value creation strategies, especially in a setting of co-creation, as it allows for bridging the digital to the material world. However, creators should be aware that they have to respect existing patents, as patent infringements may lead to significantly detrimental legal consequences. While the design of CAD files or the 3D scan of an existing object are irrelevant preparatory acts, spreading or uploading such files may constitute indirect infringements. 3D printing objects even constitutes a direct infringement. On the other hand, new technical inventions can be protected by own patents. In the future, three types of patents will available: national patents, classical European patents and Unitary patents.

This paper is based on a more recent and longer contribution published in the Journal Gewerblicher Rechtsschutz und Urheberrecht (GRUR), 2017, pp. 467–475 (for details, see list of references). It is introductory and reflects personal legal opinions which can vary from those of future jurisdiction. Reading the paper does not replace individual legal advice by a specialized lawyer in every single case.

References

Bechtold, S. (2016). 3D printing, intellectual property and innovation policy. *International Review of Intellectual Property and Competition Law, 47*(5), 517–536.

Benkard, G. (2015). Patentgesetz: PatG, Gebrauchsmustergesetz, Patentkostengesetz (11). Munich: C.H. Beck.

Blanke-Roeser, C. (2017). 3D-Druck und das Patentrecht in Europa. Die Grenzen des geltenden Rechts und des zukünftigen Einheitspatents sowie alternative Lösungsansätze. *Gewerblicher Rechtsschutz und Urheberrecht, 119*(5), 467–475.

Doherty, D. (2012). Downloading infringement: Patent law as a roadblock to the 3D printing revolution. *Harvard Journal of Law and Technology, 26*, 353–373.

Fitzner, U., Lutz, R., & Bodewig, T. (2012). *Patentrechtskommentar. PatG, GebrMG, IntPatÜG, PCT und EPÜ mit Nebenvorschriften* (4th ed.). Munich: C.H. Beck.

Grabinski, K. (2013). Der Entwurf der Verfahrensordnung für das Einheitliche Patentgericht im Überblick. *Gewerblicher Rechtsschutz und Urheberrecht Internationaler Teil, 62*(4), 310–321.

Haberl, A., & Schallmoser, K. (2017). Einheitliches Patentgericht startet im Dezember 2017 – Vorläufige Anwendung ab Mai 2017 geplant. *Gewerblicher Rechtsschutz und Urheberrecht Praxis im Immaterialgüter- und Wettbewerbsrecht, 9*, 70–71.

Haedicke, M. (2013). Rechtsfindung, Rechtsfortbildung und Rechtskontrolle im Einheitlichen Patentsystem. *Gewerblicher Rechtsschutz und Urheberrecht Internationaler Teil, 62*(7), 609–617.

Haedicke, M., & Zech, H. (2014). Technische Erfindungen in einer vernetzten Welt. Das Internet als Herausforderung für das Patentrecht. *Gewerblicher Rechtsschutz und Urheberrecht-Beilage, 116*(1), 52–57.

Kraßer, R., & Ann, C. (2016). *Patentrecht. Lehrbuch zum deutschen und europäischen Patentrecht und Gebrauchsmusterrecht* (7th ed.). Munich: C.H. Beck.

Mengden, M. (2014). 3D-Druck – Droht eine "Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand. *MultiMedia und Recht, 17*(2), 79–85.

Mes, P. (2015). *Patentgesetz, Gebrauchsmustergesetz: PatG, GebrMG. Kommentar* (4th ed.). Munich: C.H. Beck.

Nordemann, J. B., Rüberg, M., & Schaefer, M. (2015). 3D-Druck als Herausforderung für die Immaterialgüterrechte. *Neue Juristische Wochenschrift, 68*(18), 1265–1271.

Romandini, R., Hilty, R., & Lamping, M. (2016). Stellungnahme zum Referentenentwurf eines Gesetzes zur Anpassung patentrechtlicher Vorschriften auf Grund der europäischen Patentreform. *Gewerblicher Rechtsschutz und Urheberrecht Internationaler Teil, 65*(6), 554–560.

Schmoll, A., Ballestrem, J., Hellenbrand, J., & Soppe, M. (2015). Dreidimensionales Drucken und die vier Dimensionen des Immaterialgüterrechts. Ein Überblick über Fragestellungen des Urheber-, Design-, Patent- und Markenrechts beim 3D-Druck. *Gewerblicher Rechtsschutz und Urheberrecht, 117*(11), 1041–1050.

Schulze, R., & Staudenmeier, D. (2015). Digital revolution: Challenges for contract law in practice. *Journal of European Consumer and Market Law, 4*(6), 215–216.

Zukas, V., & Zukas, J. A. (2015). *An introduction to 3D printing*. Sarasota, FL: First Edition Design Publishing.

Constantin Blanke-Roeser is a trainee lawyer at the Hanseatic Higher Regional Court in Hamburg. He studied law at Bucerius Law School, Hamburg (Germany), and Stellenbosch University, South Africa, as well as medicine at the University of Hamburg and the Universidade Federal do Ceará (Fortaleza, Brazil). His research is focused on IP law, and on medical law.

Navigating Patents in an Open Hardware Environment

Dana Beldiman and Fabian Fluechter

1 Introduction

The past few decades have seen a substantial increase in the number of patents issued. Some have been amassed by non-practicing entities (NPE's) in an effort to extract royalties (Chien, 2014, p. 461), others have been accumulated by operating entities for defensive purposes (Arthur, 2011; Hardy, 2011). Often, multiple patents are granted for a single technology, causing them to overlap into thickets (Shapiro, 2001). All of these conditions give rise to an opaque and uncertain patent environment (Lemley & Shapiro, 2005, p. 75), which brings with it the real risk that new inventions infringe on existing patents. A source of anxiety for entrepreneurs and investors, the current patent environment has the potential of hindering product innovation and commercialization.

In response to these conditions, industries, private actors and advocacy groups have developed legal instruments meant to neutralize the risk of patent infringement. Their aim is to operate as a shield against the risk of infringement suits by establishing "patent-free" zones, which give actors the "freedom to operate" in their technological field (Chien, 2015). This chapter will discuss the operation of some of these instruments, specifically from the perspective of small entrepreneurs and companies which have adopted the open access collaborative model.

D. Beldiman
Bucerius Law School, Hamburg, Germany

UC Hastings, San Francisco, CA, USA
e-mail: dana.beldiman@law-school.de

F. Fluechter (✉)
Bucerius Law School, Hamburg, Germany
e-mail: fabian.fluechter@law-school.de

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_14

2 Open Software and Open Hardware

Possibly the best known "open" movement is open source software (OSS). Though met with skepticism in its beginnings in 1991, the *Linux* environment, which is the poster child of the open access movement, currently runs on more than 82% of the world's smart phones and 92% of the world's supercomputers (Pearce, 2017).

OSS differs from traditional innovation in that information is shared within the entire community of contributing software developers. Members make available their source code through "open licenses" (Ackerman, 2009; Li, Ramos, Seering, & Wallace, 2017). The strength of this approach lies in the vast number of contributors, who create collaboratively, having unrestricted access to the entire body of innovation previously developed within the community (Benkler, 2017, p. 231, 235; Vetter, 2009, p. 2087). Members make their contributions for free, motivated primarily for personal enjoyment, enhancement of their reputation and other idealistic reasons. Economic motivations, if any, are secondary (see Motives for Writing Free Software).

Open hardware (OH) parallels the creative process of OSS in the tangible world, in that its developers provide design specifications for physical products, rather than for software. Like OSS, it is based on collaborative contributions from numerous geographically distributed actors, who, within a community, license information and specifications so that they can be used, accessed, studied, modified, improved, and distributed by anyone (http://wiki.ohanda.org/; Ackerman, 2009; Greenbaum, 2013; Katz, 2012; Li et al., 2017; Pearce, 2017). Because of the obvious benefits of "open" innovation models, entrepreneurs and investors are increasingly adopting this mode of value creation.

An unclear and threatening patent environment increases the likelihood that a new product may unwittingly infringe an existing patent. Such an environment can significantly impact a new entrepreneur's innovative endeavors. Open network communities, such as OH, are particularly vulnerable, not only to actual threats of infringement, but also to the mere perception of such a threat. One reason is that, in general, acquiring patents is not part of their ethos. Therefore, they often lack the interest, knowledge and economic means to secure patents and to engage in defensive strategies (Chien, 2014). A second reason is that the innovative activity of such communities is more easily deterred, because they innovate primarily for non-economic reasons. Mostly, they are not bound by a formalized hierarchy or entity structure (Li et al., 2017) and can cease their contribution at any time. The perception of a threatening patent environment could place a chill on innovation in open networks and cause them to cease their innovative activity altogether.

3 The Risk of Patent Infringement

The legal basis for a patent infringement suit is as follows. Anyone who makes, uses, sells, offers for sale or imports a product or process that infringes a patented invention in the territory, generally the country in which the patent has been granted,

may be liable for infringement and subject to an infringement suit by the patent's owner in a court of applicable jurisdiction (§ 9 German Patent Act; 35 USC § 271). A patent may be infringed directly, when every limitation of a particular claim of the patent is present in the allegedly infringing device, or by equivalence, if the accused device performs substantially the same function, in the same way with the same result. Not knowing that a technology infringes, or infringing by accident or mistake, is not a defense to an infringement action (Global-Tech Appliances, Inc. v. SEB S. A.). Despite these clear-sounding norms, whether a given patent infringes, can only be predicted as a matter of probability, given the uncertainty of (1) the scope of most patents and (2) whether a particular invention falls within the scope of the patent claimed to be infringed. This uncertainty is exploited by third parties to extract royalties from users of the technology (Lemley & Shapiro, 2005).

If an infringement action is successful, the court may issue an order enjoining the infringer from further use of the patent, and possibly grant other remedies, including an award of damages (§ 139 German Patent Act; 35 USC § 284). Given the costs involved in defending against such legal action are high and the consequences of a potential loss, an infringement suit constitutes a serious threat to the defendant. Small companies are particularly vulnerable to this threat, because they would have to front legal fees, and in case of an adverse outcome, they would be precluded from using their technology. The possibility that they might be put out of business is quite real.

4 Defensive Mechanisms

In the face of this risk, legal constructs have begun to emerge that are intended to mitigate it. These instruments are based on an interplay between contract laws and IP laws, and create non-proprietary "safe zones", which allow inventors to conduct R&D, testing, manufacturing and commercialization of their products (Contreras, 2015; Schultz & Urban, 2012). They combine different tools, including voluntary public commitments to limit exploitation or enforcement of patents, defensive publications, non-aggression promises, cross-licenses or defense pools and pledges by patent owners (Contreras, 2015; Schultz & Urban, 2012). The concept of such non-proprietary zones is relatively new. Accordingly, they tend to exist in the form of safe-zone "patches", rather than as a full grant of immunity. Still, with proper strategy, entrepreneurs can benefit from these constructs.

The following will provide an overview of some of the patent defense instruments that are relevant to companies which seek to take advantage of the collaborative strengths of the "open" creation models. We have selected these particular instruments for two reasons: start-up enterprises often lack the economic resources to secure patents and members of open innovation communities tend to reject the notion of appropriating knowledge in the form of patents. Accordingly, the mechanisms discussed are purely defensive in nature and do not require users to actually own patents (for a brief summary of all defensive mechanism described here, see Table 1).

Table 1 Defensive mechanisms in an Open Hardware environment

	Defensive publishing	Patent pledges	Open patent agreements
Basis	Doctrine of novelty	Unilateral promise	License (bilateral agreem.)
Effects	Destroys novelty	Patent owner will not enforce patent	• Immunity to infringement suits • Cross-license of patents
Advantages	Freedom to operate, no royalties	Freedom to operate, no royalties	Freedom to operate, no royalties
Disadvantages	Costs for strategic planning of publication	Uncertainties regarding scope, enforceability and reliability	• Administration costs • Effects limited to community
Strategic considerations	• Sufficient & broad disclosure • Give access to patent examiners	• Learn about pledge • Determine scope of Pledge	Observe conditions and limitations of relevant license
Examples	• Defensivepublications.org • kdab.com/defensive-patent-publication-qt-type-erased-iteration/	• Tesla's patent pledge • PIJIP database	• Apache license • TAPR license • GNU license • Defensive Patent License (DPL) • Open Invention Network (OIN)

4.1 Defensive Publishing

Description

Defensive publishing is a well-known technique intended to pre-empt a third party's effort to patent in a certain technological space. By defensive publishing, a company may choose to make an invention public in order to place it into the public domain (Marrali, 2014, p. 81; Schultz & Urban, 2012). The benefits are twofold: the company gains freedom to operate in its technological space and the public at large benefits from a patent-free zone (Baio, 2012). It is based on the legal doctrine of novelty, namely that an invention, once published, becomes "prior art" and destroys the novelty of subsequent inventions in the respective technology (35 USC 102 lit a); EPC Art. 54). Prior art may also serve to support findings of obviousness (lack of an inventive step) (35 U.S.C. § 103; EPC Art. 56).

Strategic Considerations

An effective publication must meet certain legal requirements. First, the "publisher" must ensure that the publication is enabling, i.e. a disclosure must be made sufficient to allow a person skilled in the art to practice the invention (35 USC §112; EPC Art. 83; EPO Guidelines, Part F, Chapter III, Sufficiency of Disclosure). Second, the information must be published accessibly enough to come to the attention of patent examiners. Essentially the same amount of information must be gathered for defensive publishing as for a patent application. This may be a complex task, especially in a setting in which

data about how the invention is made and how it functions are distributed within a community and communicated in short-hand. While the publication need not be in the same format as a patent application, it must describe the idea of the invention, how it functions, the flow of data, etc., including drawings or figures, sufficient for a person skilled in the art to practice it (Id.).

In terms of scope, a defensive publication should cover as broad an area as possible, in order to prevent third parties from obtaining patents on variants or alternatives. The publication method used must be sufficiently widespread, so that a patent examiner pressed for time can easily find and understand it. Blogging can be an effective means of defensive publication (Steveire, 2014). In terms of costs, defensive publishing may appear to be a low-cost mechanism. That is not necessarily true. A defensive publication must be well planned and executed in order to be effective. It should preferably be undertaken by someone with knowledge of patent law. Guidance on defensive publishing can be found on the websites of organizations that support open access to knowledge. For *Linux* users, for instance, the OIN's Defensive Publications website contains FAQs and provides access to its database with useful samples for interested publishers (Contreras, 2017).

4.2 Patent Pledges

Description

Patent pledges are unilateral promises by a patentee to limit or forgo enforcement of a patent. They are intended, among other things, to spread the use of specific technologies. One of the most prominent examples is Tesla's patent pledge (Musk, 2014). They are a relatively new instrument, and consequently, the legal issues surrounding patent pledges have not yet been tested in court (Maracke & Metzger, 2016, p. 483). Whether the pledge is enforceable, i.e. whether it constitutes a defense against a patentee's enforcement action relating to the pledged patent, is a fundamental question which remains open (Contreras, 2017, p. 543, 545).

Under US law, for instance, a pledge might be enforceable as a license, either express or implied (*Hewlett-Packard Co.* v. *Repeat-O-Type Stencil Mfg. Corp.*, Inc.). An implied license requires no formal grant, and can arise in a variety of ways, including through acquiescence, conduct, equitable estoppel and legal estoppel. The doctrines are generally based on the assumption that the patentee has forfeited its right to enforce the patent after having made a promise to the contrary, upon which the user has relied to its detriment (Integrated Global Concepts, Inc. v. J2 Global, Inc.). A user would have to show an affirmative grant of consent by the patentee, reliance by the user and material prejudice to the user (Global Concepts, Inc. v. J2 Global; Wang Labs. v. Mitsubishi Elecs. Am).

Strategic Considerations

Pledges are appealing because they create freedom to operate, on a royalty-free basis. In terms of ease of use, accessibility and cost, patent pledges are hard to beat. However, certain hurdles must be taken into consideration in deciding to act upon a pledge.

Initially, a potential patent pledge user faces the challenge of learning about a specific pledge in the first place, given the lack of reliable and exhaustive sources. Often a pledge is simply announced in a corporate release. Unless the pledger is a significant player, such as *Tesla* (Musk, 2014), the pledge may receive little attention. To locate a pledge, a user would have to rely on publicly available information, online communities, or word of mouth. A useful resource, for US patents at least, is the patent pledge database compiled by the Program for Information Justice and Intellectual Property of the American University, Washington College of Law (PIJIP), which features a list of patent pledges, along with their terms, where available (PIJIP database).

Further, pledges are often phrased in very general terms and thus open to interpretation. For instance, numerous pledges promise not to assert software patents against companies with less than 25 "people" (PIJIP database). Would an OH community qualify as a pledgee? A community of more than 25 contributors would appear to be disqualified under the express language of the pledge. It may well be, however, that in a decentralized setting, the individual who accepts and initially uses the pledge would be deemed to be the sole pledgee. Absent express restrictions on sublicenses or other transfers, a pledgee's license to members of the community may fall within the stated scope of the pledge and not disqualify the community.

Another question to consider is whether the patent pledged will cover the pledgee's intended product. To that end, an entrepreneur who plans to act on the pledge, must obtain the patent and examine its claims. Some pledges identify patents by patent number, others simply refer to a company's patents or technology (Musk, 2014). The text of a patent can be found at the office of its registration, such as the US Patent and Trademark Office[1] or the European Patent Office.[2] A Google patent search is a valuable initial resource as well. Patents generally become publicly available 18 months after filing of the patent application (USPTO MPEP 1120). Will the patent provide the pledgee with all the necessary information? All patents are required to include an enabling disclosure, sufficient to allow a person skilled in the art to practice the invention (35 USC §112; 35 U.S.C. §282). A pledge cannot be assumed to cover continuations or divisions of the pledged patent, or any kind of patented improvements of the technology owned by the pledger.

A user must further be aware of the precise scope of the pledge's limitations, such as field of use, category of users, duration, etc. Non-compliance would likely void the promise and make the user vulnerable to infringement actions. Users must also keep in mind that the pledger does not necessarily own all the patents to a respective technology. Despite using a patent under a pledge, a user may still infringe patents on the same technology owned by third parties.

Finally, the risk of an enforcement action cannot be ignored. The patentee or its successors in interest could sue the user if circumstances change, due to events such as revocation, acquisition of the company, merger or insolvency (Schultz & Urban, 2012, p. 14). The user's defense will be helped by evidence of its reliance on the

[1] www.uspto.gov

[2] www.epo.org

patentee's promise, showing investment of resources, such as time, skill, effort or financial commitments, as well as substantial prejudice from withdrawal of the pledge. In any event, a user must seek to preserve evidence of the pledge in its original terms. This may be useful in case the pledge is modified by its maker or the website listing it is taken down, since, at a later date, the original status of the pledge may be virtually impossible to confirm (Contreras, 2017, p. 579).

Ultimately, the decision whether to accept a pledge and invest effort, time and resources must be made on an individual basis, as a function of whether the pledged patents cover the inventors' product, and of their risk tolerance. For a user cognizant of the uncertainties involved, pledges remain a viable, easy and attractive source for acquiring technologies and minimizing the risk of infringement.

4.3 Open Patent Agreements

Open Patent Agreements (OPAs) are defensive constructs, which in their terms generally adhere to a free and open access philosophy. They can be based on a promise of immunity to infringement suits made by the members of a particular network, or on a (cross) license in which the licensee agrees not to file an infringement suit against any member. These constructs are generally royalty-free, but may involve administration costs (Callahan & Schultz, 2015, p. 151, 152). The following will discuss different types of OPAs: the patent peace provision, the Defensive Public License and the Open Invention Network.

"Patent Peace" Provisions and Licensing within the OH Community

Description

Patent peace provisions are clauses commonly found in open licenses, such as Apache (Apache License). They serve to shield members of the community from patent suits by other members and thus enable a free flow of information among inventors. Patent peace provisions may take the form of an express patent license, in the nature of a condition subsequent (Id.). Alternatively, patent peace provisions can be a commitment not to enforce a patent, whether as a permission to practice a patent (TAPR License, section 0), as a covenant not to institute offensive patent litigation against a member of the community (GNU License, section 11), or as a hybrid provision to a similar effect (Apache License). A patent peace obligation extends to all licensees/recipients of the contribution and is passed on to downstream licensees.

Strategic Considerations

In using a patent peace provision, it is important to keep in mind that it will only shield against infringement claims by other members of the community but will not insulate from claims coming from *outside* the community.[3] Therefore, even if a

[3]For more information, see www.defensive publications.org/defensive-pubs-faqs

patent peace provision is in effect among members, both individual members and possibly the entire community remain vulnerable to patent infringement claims from third parties. Some of the tools meant to protect against suits from outside the community will be discussed below.

Even within the community, users must comply with the provision's specific limitations. Failure to do so will terminate the effect of the license and leave the user open to infringement liability. Most licenses terminate upon initiation of an infringement suit alleging that a work or contribution infringes (Apache License, section 3). Similarly, if a licensee is unable to grant immunity because of a conflicting agreement or a court order, its rights under the license will cease, along with the effect of patent peace provision (TAPR License, section 0).

The Defense Patent License DPL

Description

The Defense Patent License[4] (DPL) is a standardized defensive license with a copyleft feature that requires any modifications to be distributed under the same license terms, thus making the sharing requirements "viral" (Schultz & Urban, 2012, p. 20). It is based on an automatic cross license, combined with a patent peace provision which creates bilateral obligations not to enforce patents offensively against others who make the same commitment.

Under the terms of the license, DPL users are required not to initiate patent litigation against other DPL users, to offer the entire patent portfolio under the DPL and to bind successors in interest in the patent portfolio to the same conditions. Users may terminate the license upon 6 months advance notice (Defensive Patent License; Schultz & Urban, 2012, p. 39, 50, 52). A terminating user's licenses granted up to the time of termination remain in effect after discontinuation, as they are irrevocable. However, patents granted to that user after discontinuation will not become part of the DPL. Other DPL users may revoke their licenses granted to a terminating user upon discontinuation. Users joining the DPL after discontinuation by a licensor, will not be able to secure licenses to that terminating licensor's portfolio under the DPL (Defensive Patent License, section 0).

Certain maintenance costs arise related to recordkeeping of the membership, dates of accession and termination, the patents licensed, etc. Given the network's decentralized character, the costs will likely be fairly low.

Strategic Considerations

Participation in the network does not require ownership of patents (Defensive Patent License, preface). Consequently, the benefits the DPL brings are potentially substantial. In return for joining the network, an entity would receive royalty-free access to the entire portfolio of all other DPL users, regardless whether or how many patents it contributes. This construct favors small entities which own no or few patents

[4] www.defensivepatentlicense.org

(Hayes & Schulman, 2013). The benefit must, of course, be placed into context: the DPL being in an incipient stage, only has 23 patents under license as of the date of this writing (https://defensivepatentlicense.org/users-and-patents/).

A small entity might nonetheless be interested in joining for several reasons. First, if technologies licensed under it match the entity's needs, the DPL is an easy and inexpensive way to gain freedom to operate. Second, the DPL has growth potential and is likely to accumulate high quality patents in its portfolio because it requires users to license their entire portfolio under the DPL (Hayes & Schulman, 2013). Its irrevocability feature tends to make the license stable and permanent (Schultz & Urban, 2012, p. 50, 52). Finally, companies might be motivated to join simply to enable a further step towards establishing a broader open patent ecosystem. The DPL's costs must be measured against the value conferred by the network: if there is a match between the potential user's project and the type of technology currently licensed under the DPL, this may be a small price to pay for relative patent peace.

The Open Invention Network

Description

The Open Invention Network[5] (OIN) is a consortium focused on creating non-proprietary space around the Linux ecosystem in order to avert patent litigation (OIN mission statement). It combines elements of a proprietary defensive patent aggregation entity with an openness ethos. The OIN has been described as an example of "open and thoughtful vision of a patent pool" (Schultz & Urban, 2012, p. 34). The OIN was founded by a number of large companies, and currently includes such large players[6] as IBM, Google, RedHat, Toyota, Daimler. Some of them have provided the initial funding and the consortium still remains dependent on them.

The OIN owns an extensive patent portfolio and over two thousand licenses. It uses a combination of patent protection strategies,[7] including acquisition of patents, cross licensing them subject to patent peace provisions (OIN License, section 3.4), and defensive publications.[8]

The OIN's strength lies in the fact that it concentrates on a widely-used, single technology. Being well-funded it can acquire Linux-related patents and new licenses on an ongoing basis.[9] As a result, the OIN covers so wide an area of the *Linux*

[5] www.openinventionnetwork.com

[6] see also: http://www.openinventionnetwork.com/community-of-licensees/

[7] OIN FAQ "Patent troll" activities continue to be a hot topic. What is Open Invention Network doing about that?" (http://www.openinventionnetwork.com/press-room/faqs/)

[8] see also http://www.linuxdefenders.org/ and www.defensivepublications.org providing guidance on defensive patent strategies

[9] OIN FAQ "What is Open Invention Network" (http://www.openinventionnetwork.com/press-room/faqs/)

ecosystem, that it has been able to avert suits by NPE's against its members for years (Parloff, 2015).

Strategic Considerations

For users of *Linux*, the OIN is an extraordinarily valuable tool. It provides access and royalty-free licenses to a large and growing number of patents which relate to the functionality of the Linux environment. In other words, it gives users patent-worry free development in the Linux environment. The network is open to developers, big and small, regardless whether they own patents or not. Joining is easy: a user must simply sign a single license agreement.

On the downside, the OIN depends on outside resources such as money and patent transfers. As an independent entity, it might change management, philosophy, business priorities, it might go out of business, or sell its patents to third parties who could pursue non-OIN Linux users. Absent the backing of significant players and its heavy reliance on trust and reputation (Parloff, 2015), a potential user might be concerned about its impermanence. Overall, for Linux users it provides as strong a protection from infringement suits as is available.

5 Conclusion

As demonstrated by OSS, innovation that relies on collaboration and knowledge sharing can be highly effective and can contribute significantly to the creation of knowledge, to progress and welfare. Yet, the opaqueness and uncertainty of the patent environment place such innovation at risk. Start-up entrepreneurs and small companies may be easily deterred from inventive endeavors by the threat of patent infringement, because they lack the resources to take defensive action, and in some cases, are disinclined to patent their inventions.

Recent years have seen the emergence of legal constructs intended to mitigate infringement risks through the combined use of contract and IP law. In the foregoing discussion, we have attempted to illustrate some the most important defensive patent strategies available to emerging entities. At this stage, none of these instruments is comprehensive enough to offer a one-stop solution, and even their combined use will not provide full protection. However, the field is in its infancy and further such instruments will develop. As important as containing the actual infringement risk, is reducing the *perception* of such risk. The above discussion is meant to help readers find pathways towards freedom to operate, as well as to the peace of mind to continue their inventive endeavors. Ultimately, it is up to the individual entrepreneur or investor to adopt appropriate strategies that can navigate among the patent dangers that may lurk.

References

35 United States Code 2016 (US).
Ackerman, J. R. (2009). Toward open source hardware. *University of Dayton Law Review, 34*(2), 183.
American University Washington College of Law, Program for Information Justice and Intellectual Property (PIJIP). *Non-SDO Patent Statements and Commitments*. Retrieved April 12, 2018, from http://www.pijip.org/non-sdo-patent-commitments/
Apache License version 2.0. (2004). Retrieved April 12, 2018, from www.apache.org/licenses/LICENSE-2.0
Arthur, C. (2011). *Nortel patents sold for $4.5bn*. Retrieved April 12, 2018, from www.theguardian.com/technology/2011/jul/01/nortel-patents-sold-apple-sony-microsoft
Baio, A. (2012). A patent lie – How Yahoo weaponized my work. *Wired Magazine*. Retrieved April 12, 2018, from www.wired.com/business/2012/03/opinion-baio-yahoo-patent-lie
Benkler, Y. (2017). Law, innovation, and collaboration in networked economy and society. *Annual Review of Law and Social Science, 13*, 231–250.
Callahan, M. W., & Schultz, J. M. (2015). Is patent reform via private ordering anticompetitive? In J. L. Contreras & M. Jacob (Eds.), *Patent pledges: Global perspective on patent law's private ordering frontier* (pp. 151–152). New York: Edward Elgar. Retrieved April 12, 2018, from http://www.pijip.org/wp-content/uploads/2015/03/Jason-Schultz-Matthew-Callahan-Patent-Reform-Private-Ordering-Anticompetitive.-Patent-Pledges-2015.pdf
Chien, C. (2014). *Startups and Patent Trolls*. 17 Stan. Tech. L.R. 461.
Chien, C. (2015). *Exclusionary and diffusionary levers in patent law*. Santa Clara Law, Faculty Publications. Retrieved April 12, 2018, from digitalcommons.law.scu.edu/facpubs/882
Contreras, J. L. (2015). Patent Pledges. *Arizona State Law Journal, 47*, 543–557.
Contreras, J. L. (2017). A patent pledge taxonomy. In J. L. Contreras & M. Jacob (Eds.), *Patent pledges: Global perspective on patent law's private ordering frontier*. Cheltenham: Edward Elgar.
Defensive Patent License, version 1.1. Retrieved April 12, 2018, from https://defensivepatentlicense.org/license
European Patent Convention 2016 (EU).
Global-Tech Appliances Inc. v. SEB S.A. 563 U.S. 754 (2011).
GNU General Public License, Version 3. (2007). Retrieved April 12, 2018, from https://www.gnu.org/licenses/gpl.html
Greenbaum, E. (2013). Three dimensional printing and open source hardware. *NYU Journal of IP and Entertainment Law, 2*, 257.
Guidelines for Examination in the European Patent Office 2017 (EU). Retrieved April 12, 2018, from http://www.epo.org/law-practice/legal-texts/guidelines.html
Hardy, Q. (2011). *Google buys Motorola for patent parts*. Retrieved April 12, 2018, from http://www.forbes.com/sites/quentinhardy/2011/08/15/google-buys-motorola-for-patent-parts/#72db85422fff
Hayes, D. L., & Schulman, C. E. (2013). *A response to a proposal for a defensive patent license (DPL)*. Last revised 27 July 2013. Retrieved April 12, 2018, from https://papers.ssrn.com/sol3/papers.cfm?abstract-id=2054314
Hewlett-Packard Co. v. Repeat-O-Type Stencil Mfg. Corp. Inc. 123 F.3d 1445, 1451 (Fed. Cir. 1997).
Integrated Global Concepts Inc. v. J2 Global Inc. No. C-12-03434-RMW (N.D. Cal. June 28, 2013). Retrieved April 12, 2018, from https://docs.justia.com/cases/federal/district-courts/california/candce/5:2012cv03434/256710/52
Katz, A. (2012). Towards a functional licence for open hardware. *International Free and Open Source Software Law Review*. Retrieved April 12, 2018, from http://www.ifosslr.org/ifosslr/article/view/69/131
Lemley, M. A., & Shapiro C. (2005). Probabilistic patents. *Journal of Economic Perspectives, 19*, 75. Retrieved April 12, 2018, from https://law.stanford.edu/publications/probabilistic-patents/
Li, Z., Ramos, J. D., Seering, W., & Wallace D. R. (2017). *Why open source, exploring the motivations of using an open model for hardware*. Conference paper DETC 2017. Retrieved April 12, 2018, from www.researchgate.net/publication/316884384

Maracke, C., & Metzger, A. (2016). Playing nice with patents: Do voluntary non-aggression pledges provide a sound basis for innovation? *North Carolina Journal of Law and Technology, 17*(3), 483.

Marrali, M. (2014). *Filling the gap: Evaluating which legal mechanisms effectively protect freedom and openness in hardware*. University of Groningen Digital Archive, p. 81. Retrieved April 12, 2018, from http://arno.uvt.nl/show.cgi?fid=134977

Motives for Writing Free Software. GNU Operating Sys. Retrieved April 12, 2018, from https://www.gnu.org/philosophy/fs-motives.en.html

Musk, E. (2014). *All our patents belong to you*. Retrieved April 12, 2018, from https://www.tesla.com/blog/all-our-patent-are-belong-you

OIN License Agreement. Retrieved April 12, 2018, from http://www.openinventionnetwork.com/joining-oin/oin-license-agreement/

OIN Mission Statement. Retrieved April 12, 2018, from http://www.openinventionnetwork.com/about-us/

Parloff, R. (2015). Amid the patent wars, an oasis of calm collaboration. *Fortune*. Retrieved April 12, 2018, from http://fortune.com/2015/10/06/open-invention-network-anniversary/

Patent Act 1980 (GE).

Pearce, J. M. (2017). *Emerging business models for open source hardware*. Michigan Technological University. Retrieved April 12, 2018, from http://digitalcommons.mtu.edu/materials_fp/67/

Schultz, J., & Urban, J. (2012). Protecting open innovation: The defensive patent license as a new approach to patent threats, transaction costs, and tactical disarmament. *Harvard Journal of Law and Technology, 26*(1), 24.

Shapiro, C. (2001). Navigating the patent thicket: Cross licenses, patent pools, and standard setting. In A. B. Jaffe, J. Lerner, & S. Stern (Eds.), *Innovation policy and the economy*. MIT Press, Cambridge. Retrieved April 12, 2018, from www.nber.org/chapters/c10778

Steveire. (2014). Defensive Patent Publication for Qt. Retrieved April 12, 2018, from http://www.kdab.com/defensive-patent-publication-qt-type-erased-iteration/

TAPR Open Hardware License. Retrieved April 12, 2018, from www.tapr.org/ohl.html

USPTO Manual of Patent Examining Procedures (MPEP) 2015 (US). Retrieved April 12, 2018, from https://www.uspto.gov/web/offices/pac/mpep/index.html

Vetter, G. R. (2009). Commercial free and open source software: Knowledge production, hybrid appropriability, and patents. *Fordham Law Review, 77*, 2087. Retrieved April 12, 2018, from http://ir.lawnet.fordham.edu/cgi/viewcontent.cgi?article=4435&context=flr

Wang Labs. v. Mitsubishi Elecs. Am. 103 F.3d 1571, 1580 (Fed. Cir. 1997).

What is Copyleft? GNU Operating Sys. Retrieved April 12, 2018, from http://www.gnu.org/copyleft/copyleft.html

What is Open Invention Network. OIN FAQ. Retrieved April 12, 2018, from http://www.openinventionnetwork.com/press-room/faqs/

What is Open Invention Network doing about that? OIN FAQ. Retrieved April 12, 2018, from http://www.openinventionnetwork.com/press-room/faqs/

Dana Beldiman is a professor of law at Bucerius Law School, Hamburg and UC Hastings, San Francisco. She heads the Bucerius Intellectual Property Center. Her research is focused on aspects of international and comparative intellectual property, primarily as related to knowledge and innovation.

Fabian Flüchter is PhD student and research assistant at the Center for Transnational IP, Media and Technology Law and Policy, Bucerius Law School, Hamburg. His research focuses on joint innovation, especially jointly owned trade secrets, from a legal perspective.

Managing Content in a Platform Economy: Copyright-Based Approaches to User-Generated-Content

Clemens Appl and Philipp Homar

1 User-Generated-Content: Setting the Scene

As the widespread phenomenon of UGC is highly diverse and appears in different manifestations, no generally accepted definition exists for this type of media content (Li, 2017, p. 5). However, scholars agree that UGC can be classified according to the "creativeness" that prosumers express when they generate and share "their" content via digital platforms: For example, Gervais differentiates between "user-authored", "user-derived" and "user-copied content" (Gervais, 2009, p. 858 et seq.), whereas Lev-Aretz distinguishes "pure-UGC", "derivative content" and "pure reproductions" (Lev-Aretz, 2012, p. 142 et seq.). With the first category ("user authored content" and "pure UGC" respectively), both scholars refer to content originally created by prosumers that involves no works (or part of works) created by third parties. For example, blog posts or photos taken by prosumers themselves may typically fall in this category.

As this type of UGC does not build upon creative efforts of others, they pose no challenges for rightholders and therefore remain outside the scope of this article. On the contrary, the other categories of UGC describe practices in which prosumers share content that was, at least partially, created by others. For example, prosumers can use pre-existing works and enrich them with their own creativity, so that the result reflects both their own creative effort and the intellectual creation of others ("user-derived" or "derivative content"), see Fig. 1.

This type of UGC is a commonplace phenomenon and appears in all media categories, e.g. music (remixes, cover-versions or mashups), photography (memes), video (parody videos) and text (fanfiction) (Homar & Lee, 2016, p. 154). Another way of prosumers' appropriation of intellectual creations created by third parties is

C. Appl (✉) · P. Homar
Danube-University Krems, Krems an der Donau, Austria
e-mail: clemens.appl@donau-uni.ac.at; philipp.homar@donau-uni.ac.at

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_15

Fig. 1 A "meme" as an example of UGC (authors' own illustration)

what Gervais and Lev-Aretz refer to as "user-copied content" or "pure reproductions", respectively. In these cases, users just share third parties' content and do not express their own creativity (e.g. when they upload music or films on file sharing platforms or other content sharing websites). The latter categories of UGC have in common that they may collide with the economic and moral interests of the parties whose intellectual creations were used. Against this background, the question arises about the possibilities that copyright law provides for rightholders to control subsequent uses of their content.

2 Appropriation of Pre-existing Creative Content Under the European Copyright Framework

2.1 Protectability of Pre-existing Content

The basic requirement for copyright law to provide an author (e.g. writer, composer, filmmaker) or intermediary (e.g. a publisher, record company or film producer) with legal options is that their content constitutes a copyright protected work. Thus, two conditions have to be met: First, content has to be regarded as a literary or artistic work (Art. 1 Berne Convention). As this includes every production in the literary, scientific and artistic domain, whatever the mode or form of its expression may be (e.g. text, pictures, music, videos, cf. Art. 2 para. 1 Berne Convention), and computer programs and compilations of data (Art. 10 TRIPS, Art. 4 and 5 WCT) are protected as well, almost every media content is eligible for copyright protection.

The second requirement is that content "*is original in the sense that it is its author's own intellectual creation*" (CJEU C-5/08—Infopaq para. 37). This means that a work must meet a minimum standard of "originality", so that it reflects the

personality of the author (CJEU C-145/10—Painer para. 94). According to case-law of the European courts, the threshold of originality is usually set at a low level: For example, copyright protection was granted to the broadcast of a football match (Austrian Supreme Court [OGH] 4 Ob 208/15i; OGH 4 Ob 184/13g) and it is even eligible for the mass of amateur photographers who capture everyday scenes in landscape, portrait or vacation photos (OGH RIS-Justiz RS0115740; for portrait photos also CJEU C-145/10—Painer para. 99).

Furthermore, even if photographs or videos should not meet the required originality and therefore not qualify as copyright protected works, they will nevertheless be protected by neighbouring rights (according to Sec. 72 and 95 German Copyright Act, Sec. 73 et seq. Austrian Copyright Act). The same applies for music samples, which are regularly protected as sound recordings (Sec. 85 German Copyright Act, Sec. 76 Austrian Copyright Act), even if they are too short for constituting an original intellectual creation.

Therefore, most of the media content that internet users can take as a basis for their own (user-generated) creations constitutes a protected subject matter, so that the owners of the copyright in the pre-existing works can control subsequent uses according to the scope of their copyright.

2.2 Scope of Copyright Protection for Governing Uses in UGC

Exclusive (Economic) Rights

Copyright grants authors and holders of neighbouring rights (e.g. performers, phonogram producers, film producers, broadcasting organizations) a bundle of exclusive rights that allow them to authorize others to use their protected subject matter and to exclude any third party from using it without their permission (Schulze in Dreier/Schulze, 2015, § 15 para. 5). However, in practice, authors and performers often grant exclusive usage rights to publishers, film producers or record companies, so that their exclusive rights are exerted by these intermediaries.

Regarding uses of works in UGC, the following exclusive rights are at the center of interest:

- The **right of reproduction** (Art. 9 Berne Convention, Art. 2 InfoSoc-Dir; see also Sec. 16 German Copyright Act and Sec. 15 Austrian Copyright Act), which covers any *direct or indirect, temporary or permanent* reproductions *by any means and in any form, in whole or in part* (Art. 2 InfoSoc-Dir). Due to the broad scope, a series of acts carried out in the process of creating and sharing UGC can be subject to the rightholders' exclusive reproduction right: For example, it applies when prosumers download works on their devices or upload them on servers (Loewenheim in Schricker/Loewenheim, 2017a, § 16 para. 21).
- The **making available right**, which covers any acts of making works available by wire or wireless means so that members of the public can access them from a place and at a time individually chosen by them (Art. 8 WCT, Art. 3 InfoSoc-Dir; see also Sec. 19a German Copyright Act and Sec. 18a Austrian Copyright Act).

Accordingly, this right applies to prosumers who incorporate a protected work in UGC and upload it on (publicly accessible) digital platforms, so that other internet users can access it by downloading or streaming (Bauer, 2011, p. 146). However, the question arises if also content platforms (e.g. *YouTube*, *Facebook*, *Instagram*) infringe the making available right. Their business models are characterized by providing the technical infrastructure for prosumers to upload and share UGC, by structuring the uploaded content and by presenting it in a unified user experience.

Currently, it is debated if these content platforms make works available to the public in the light of Art. 3 InfoSoc-Dir: The fact that they do not select the content that is uploaded by their users speaks against the assumption that they carry out an act of making works available to the public (Conrad, 2017, p. 293). Accordingly, various German courts have so far denied the direct liability of content platforms for infringements of the making available right (OLG Hamburg 5 U 87/12, MMR 2016, 269; OLG München 29 U 2798/15, GRUR 2016, 612); at present, a clarifying decision of the German Supreme Court (e.g. BGH I ZR 140/15) remains to be seen. However, a recent decision by the CJEU suggests that platforms make works available to the public under Art. 3 InfoSoc-Dir if they index and classify the uploaded content so that it may be easily located by users, provide a search engine and actively filter some content (CJEU C-610/15—The Pirate Bay). Hence, typical UGC platforms that structure UGC to a unified user experience, and therefore provide more than just mere infrastructure (as storage providers or webhosts do), will typically interfere with the making available right (Appl, 2017, p. 172 et seq.).

- The **right of adaptation**, which covers the exploitation of works in adapted or transformed versions (Art. 12 Berne Convention see also Sec. 23 German Copyright Act and Sec. 14 para. 2 Austrian Copyright Act). If works are adapted or transformed when they are incorporated into UGC, e.g. if pictures are combined with text ("memes") or music is remixed or covered, the adaptation right applies in addition to the reproduction right and the making available right.

As copyright protection extends to works as a whole and to its parts (Sec. 1 para. 2 Austrian Copyright Act; CJEU C-5/08—Infopaq para. 38; CJEU C-403/08 and C-429/08—FAPL/Murphy para. 156), the exclusive rights also apply if prosumers only use parts of works in UGC. This requires that the part itself constitutes an expression of the author's intellectual creation. However, as courts set a low threshold of originality and neighbouring rights subsist below the threshold of originality (see above), taking sequences or pictures of films or samples from musical works will regularly be covered.

However, specific uses of works are excluded by **statutory exceptions**. In this case, rightholders cannot assert their exclusive rights, as the law itself grants users a permission to use protected works. For example, users are allowed to make single reproductions of works for private, non-commercial use ("**private copying exception**", Art. 5 para. 2 lit. b InfoSoc-Dir; Sec. 53 para. 1 German Copyright Act; Sec. 42 para. 4 Austrian Copyright Act). Therefore, this exception merely allows prosumers to download works (provided that they are not downloaded from

obviously unlawful sources, see CJEU C-435/12—ACI Adam; Sec. 53 para. 1 German Copyright Act; Sec. 42 para. 5 Austrian Copyright Act), to use them for their own (private) purposes and to share them within their family or with close friends (Loewenheim in Schricker/Loewenheim, 2017b, § 53 para. 23). However, the private copying exception does not allow prosumers to download works in order to share them with other internet users (Sec. 42 para 5 Austrian Copyright Act) or to use private copies for making a work available to the public (Sec. 53 para. 6 German Copyright Act, Sec. 42 para. 5 Austrian Copyright Act).

Besides the private copying exception, further statutory limitations and exceptions may apply to certain forms of UGC: As nowadays social media platforms are flooded with prosumer-made "tutorials" or "online-courses", which more or less include pre-existing materials for illustration, the question arises whether such tutorials can be considered as "teaching" according to the **teaching exception** (Art 10 para. 2 Berne Convention; Art. 5 para. 3 lit a InfoSoc-Dir). However, the notion of "teaching" seems quite narrow (cf. von Lewinski, 2008, para. 5.171 et seq.), as, for instance, the Committee Reports of the Berne Convention provides a strict approach ("*teaching at all levels—in educational institutions and universities, municipal and State schools, and private schools*"; but "*Education outside these institutions [...] should be excluded*"). Thus, typical forms of prosumer-made content—even if it can be considered "educational"—go far beyond the traditional understanding of "teaching". Even if Recital 42 of the InfoSoc-Dir suggests a broader approach by expressly including "distance learning", it is still unclear to what extend the publication of educational UGC can rely on the teaching exception (see also Treitl, 2016, p. 162).

Another privilege that can apply to UGC is the exception for **quotations** (Art 10 para. 1 Berne Convention; Art 5 para 3 lit d InfoSoc-Dir). A prosumer may base a use of pre-existing material on this exception if the acquired works or parts thereof are included for a specific reason (criticism, review, illustration of a thought, support or defeat one's arguments, scientific analysis, commentation etc. [cf. von Lewinski, 2008, para. 5.166]) and in a specific way (appropriate extent of the quote, lawfully made available work and indication of the source). Thus, UGC (like mash-ups, memes or fan fiction) is not privileged, if (a) the purpose of including third-party content is just an end in itself, (b) the use is excessive and/or (c) the prosumer unjustifiably fails to indicate the source.

Whilst quotations are based on a deliberate usage of pre-existing works, some prosumer-made content consists of more or less **randomly included third-party content**. Paradigmatic examples of such UGC are touristic snapshots including copyrighted motives in the background (e.g. billboards, cars, clothes, artwork etc.) or the famous 'dancing baby home videos', in which babies are dancing to music from a TV or radio broadcast. Art 5 para. 3 lit. i InfoSoc-Dir privileges an "incidental inclusion", but—for instance—German courts apply high standards that have to be met by prosumers (e.g. BGH I ZR 177/13, GRUR 2015, 667). Prosumers fail to meet these standards, if—even randomly—included material has a significant and formative influence on the UGC. For example, in the dancing baby cases, the included third-party music typically has a relevant effect on the viewer's impression of the

video. Thus, only in cases where the incidentally included third-party content plays only a tangential role, the exception for incidental inclusion (as provided by national copyright law) may apply (see also Treitl, 2016, p. 163). Finally, the exploitation of prosumer-made content that includes third-party material for the purpose of **caricature, parody or pastiche** can be privileged by Art 5 para. 3 lit. k InfoSoc-Dir. However, many cases of UGC go beyond the limits of a parody, at least in its traditional understanding (Homar, 2016, p. 168).

In summary, it can be held that most forms of UGC are not covered by privileges granted by international, European or national copyright law. Prosumers therefore face several legal uncertainties if they disseminate UGC that includes third-party material.

Moral Rights

Apart from protecting economic interests, copyright also acknowledges that authors are personally invested in their works and therefore provides them with a bundle of moral rights. For example, under Art 6*bis* Berne Convention (Sec. 13 German Copyright Act, Sec. 19 et seq. Austrian Copyright Act), authors enjoy a **right of attribution**, which allows them to have their authorship recognized in clear and unambiguous fashion (Ricketson & Ginsburg, 2010, p. 600). Therefore, if UGC creators share UGC that contains pre-existing works (or part of such works) without citing the original authors, they regularly infringe the right of attribution (Homar, 2016, p. 166). Additionally, under Art 6bis Berne Convention (Sec. 14 German Copyright Act, Sec 21 Austrian Copyright Act), authors enjoy a **right of integrity**, which allows them to object to distortions, mutilations or other modifications of the work that prejudice their honour or reputation. Thus, even if original authors expressly allow modifications (e.g. under the "CC BY 4.0" license), they can still object to gross distortions (Homar, 2016, 168). This applies, for example, to adaptations of works that associate its author with discriminatory statements (cf. CJEU C-201/13—Deckmyn).

3 Copyright-Based Approaches for Governing Uses of Works in UGC from a Rightholders' Perspective

Against this background, using existing works in UGC remains widely within the rightholders' discretion and copyright law basically offers them three different approaches.

3.1 Restrictive Approach

A way how rightholders can deal with the phenomenon of UGC is to follow a restrictive approach and prevent the incorporation of their protected subject matter into user generated works. This may be an option if UGC is considered as conflicting with economic and/or moral interests. In order to follow a restrictive approach, rightholders can **rigorously enforce their rights** by legal means based

on a strict monitoring of social media platforms. European Copyright Law provides a bundle of measures, procedures and remedies to ensure the enforcement of copyright. This includes provisional and precautionary measures (interlocutory injunctions, cf. Art. 9 Enforcement-Dir), corrective measures (recall, removal, destruction; cf. Art. 10 Enforcement-Dir), injunctions (cf. Art. 11 Enforcement-Dir), damages (Art 13 et seq. Enforcement-Dir) and publicity measures (publication of judicial decisions; cf. Art. 15 Enforcement-Dir).

To ensure an efficient enforcement, these legal instruments are complemented by the right of information (Art. 8 Enforcement-Dir), which enables rightholders to gain information about the identity of an infringer and/or the extent of infringement from a person who "*was found to be providing on a commercial scale services used in infringing activities*" (Art. 8 para. 1 lit. c Enforcement-Dir). Thus, internet service providers have to disclose the identity of their customers, if they are suspected infringers. But in many cases the right of information—which is of paramount importance for enforcing copyright in the digital world—collides with internet users' fundamental rights to privacy and data protection (cf. CJEU C-275/06—Promusicae; CJEU C-461/10—Bonnier Audio). Thus, if prosumers act anonymously or not under their real name, it is nearly impossible to combat copyright infringement at source. However, rightholders can exercise their rights against intermediaries like internet service providers or social media platforms, according to a notice and takedown procedure (Art. 8 para. 3 InfoSoc-Dir; Art. 12 et seq. E-Commerce-Dir).

Furthermore, we argue that digital platforms are directly liable for infringing content if they utilize and appropriate prosumer-uploaded UGC in order to provide a unified service experience to their costumers (Appl & Homar, 2018, p. 147 passim.).

Even if—more or less efficient—means of legal enforcement exist, rightholders can also take technological protection measures (e.g. Digital Rights Management, copy protection, encryption etc.) into consideration. By applying these measures, rightholders can aim at de facto preventing prosumers from using works in UGC. Given that such measures are "effective", they also enjoy legal protection against circumvention (Art. 6 InfoSoc-Dir).

All in all, authors and/or rightholders can rely on several legal instruments to enforce their intellectual property, with intermediaries being the main targets. However, practical circumstances (e.g. the mass of UCG content uploaded and litigation costs) can hinder a restrictive approach. Furthermore, rightholders have to decide whether a restrictive approach is an appropriate way to deal with UGC, particularly as it has become a socially accepted form of social expression. If they decide so and force digital platforms to take their works down, they have to reckon with antagonizing platform users, as numerous examples in the past have shown.

3.2 Liberal Approach

However, rightholders can also follow a **liberal approach** and foster UGC practices. For example, several bands launch remix competitions and allow users to create and share remixes of their songs. In terms of copyright, this can be achieved by **granting prosumers a non-exclusive license** that allows them to use and adapt an original work, which necessarily contains the reproduction right, adaptation right and the right of making the work available to the public. In this case, prosumers who observe the license terms do not infringe the exclusive economic rights and therefore cannot be prevented. If the adaptation right is covered by the license, modifications inherent to common practices of prosumers' creativity will also not infringe the moral right of integrity, so that only uses that seriously affect authors' moral interests can be objected.

It becomes evident that a liberal approach seriously impairs the possibility of controlling subsequent uses. This is further strengthened by the fact that open content licenses (e.g. the creative commons licenses) are often irrevocable. Therefore, rightholders should carefully choose licensing schemes that suit their interests (e.g. the "CC-BY-NC" if they want to restrict UGC practices to non-commercial practices) and establish clear licensing terms. In practice, choosing this liberal approach may be an option if rightholders want to use prosumers' creativity to increase the visibility of their works and do not seek (direct) financial compensation for UGC practices. This approach may, however, result in non-monetary (e.g. social recognition) or even indirect financial remuneration if the increased visibility can be used to bolster other sources of income (e.g. through merchandising revenues) or future career perspectives, for example by gaining new audiences. However, any reward requires the visibility of the works that are incorporated into UGC. Therefore, we recommend licensing terms that require attribution of the author and/or rightholder and the source where the work was originally made available.

It should be noted that a liberal stance can also be facilitated by **merely tolerating UGC practices** without granting licenses ("tolerated use", cf. Lev-Aretz, 2012, p. 149 et seq.). In this case, however, several uncertainties occur for both rightholders and prosumers. As the legal meaning of tolerating uses is construed in accordance with national law, rightholders risk to give their tacit consent on usage practices and thereby potentially forfeit their rights granted by copyright.

3.3 Monetization Approach

If rightholders want to increase the dissemination of their works and directly participate in revenues generated by UGC practices, they can follow the approach of **monetizing** creative reuses of their works. This can be achieved by using the exclusive rights not to prevent subsequent uses, but to obtain a compensation from UGC creators. In practice, two possibilities of monetizing UGC practices can be distinguished.

One option is to pursue an '**individual licensing model**' in which rightholders charge a license fee for granting prosumers the rights they need for creating UGC. This model allows to define the license terms and license fee; however, as it requires the agreement of licenses with each UGC creator, rightholders have to establish an effective system for rights clearance, payment and tracking unlicensed uses of their works. Therefore, an 'individual licensing model' involves high transaction costs and will currently only be an option for major rightholders (e.g. international record companies), as individual authors will regularly not have the required resources.

Another possibility of monetization is participating in **revenue sharing programs offered by UGC platforms**. For example, *YouTube*'s 'Content-ID' program offers the possibility of monetizing videos uploaded by other users if they contain copyright protected works. In order to participate, rightholders have to submit their works to a database that serves as reference for the 'Content-ID' system. Based on this database, videos uploaded by other users are scanned and if they match the submitted content, one option *YouTube* offers is to 'monetize'. In this case, the uploaded video remains available on the platform, advertisement is displayed with it and the rightholders receive a share of the advertising revenues. In contrast to an 'individual licensing model', copyright owners do not enter into license agreements with UGC creators but conclude agreements with UGC platforms, which qualify as pre-emptive licenses for the mass usage of copyright protected content by the users of the platforms (Lev-Aretz, 2012, p. 152). Thereby, transaction costs are reduced so that revenue sharing programs provide an option of monetization if rightholders do not have the resources for establishing individual licensing schemes.

Furthermore, as content platforms often have technologies for tracking mass uses, they offer the possibility of monitoring and monetizing uses that otherwise would remain undetected and uncompensated (Lev-Aretz, 2012, p. 167). Given that Art. 13 of the Directive-Proposal on Copyright in the Digital Single Market obliges content platforms to implement "*measures to ensure the functioning of agreements concluded with rightholders*", such as "*effective content recognition technologies*", it can be expected that revenue sharing programs will further gain in importance. However, by participating in revenue sharing programs, the conditions under which works can be used and the compensation depend on the usage terms of the platforms. If there is a misbalance between rightholders and platform operators in terms of bargaining power, achieving a reasonable compensation for UGC uses based on mere participation in advertisement revenues will not be an easy task.

Given these difficulties, a monetization approach may be fostered by **collective management** of exclusive rights. If rightholders have their rights managed by a collective management organization ("CMO", e.g. a collecting society), they lose the possibility of negotiating the modalities of remuneration with platform operators individually; however, authors and rightholders can benefit from the CMOs' expertise and resources to monitor uses and grant licenses for mass uses of copyright protected subject matter. Therefore, collective management lowers transaction costs and, due to the comprehensive repertoire of CMOs, increases the bargaining power vis-à-vis digital platforms.

4 Conclusion

As copyright law provides both exclusive rights that cover most uses of existing works in UGC and legal remedies to enforce these rights, authors, performing artists and other rightholders (publishers, record companies, film producers etc.) have several options to address these usage practices. However, whether a 'restrictive', 'liberal' or 'monetizing' approach provides the appropriate solution for their (economic and moral) interests depends on the **individual circumstances**. These circumstances are determined by the following—by no means exhaustive—factors: Different interests will occur according to the **protected subject matter**, as money-intensive works (e.g. blockbusters, sound recordings) may more easily be prejudiced by UGC practices than works that were not created for commercial purposes (e.g. blog-entries, personal videos, vacation photos etc.). Furthermore, the interests may depend on the **person of the rightholder**. For instance, authors and performing artists may more easily be satisfied with an increased visibility, whereas intermediaries (e.g. publishers, record companies, film producers) will, of course, long for financial remuneration. Another factor is the **stage of exploitation**, as UGC practices may more easily collide with the rightholders' interests if content is still in the early stages of the of the exploitation chain. Accordingly, there is no one-size-fits all solution to addressing the usage of copyright protected subject matter in UGC practices.

References

Appl, C. (2017). Urheberrecht im digitalen Binnenmarkt: Evolution statt Revolution. *ÖBl 2017/47*, 169.

Appl, C., & Homar, P. (2018). Mind the value gap: Wertschöpfung in der prosuming culture und wirtschaftliche partizipation Kreativschaffender. In T. Redlich, M. Moritz, & J. Wulfsberg (Eds.), *Interdisziplinäre Perspektiven zur Zukunft der Wertschöpfung* (pp. 147–160). Wiesbaden: Springer Gabler.

Bauer, C. (2011). *User generated content*. Berlin: Springer.

Conrad, A. (2017). Zum Modell der Rechteklärung und Rechteverwaltung auf Hosting-Plattformen. *ZUM*, 289.

Gervais, D. (2009). The tangled web of UGC: Making copyright sense of user-generated content. *Vanderbilt Journal of Entertainment and Technology law, 11*, 841.

Homar, Ph. (2016). Prosumerism and moral rights. *MR-Int*, 164.

Homar, Ph., & Lee, S. (2016). The rise of the prosumer. *MR-Int*, 152.

Lev-Aretz, Y. (2012). Second level agreements. *Arkon Law Review, 45*, 142.

Li, Y. (2017). User-generated content from international and Chinese law perspectives. *MR-Int*, 5.

Loewenheim, U. (2017a). § 16. In G. Schricker & U. Loewenheim (Eds.), *Urheberrecht 5*. Beck: Auflage, München.

Loewenheim, U. (2017b). § 53. In G. Schricker & U. Loewenheim (Eds.), *Urheberrecht 5*. Beck: Auflage, München.

Ricketson, S., & Ginsburg, J. C. (2010). *International copyright and neighbouring rights* (Vol. I). Oxford: Oxford University Press.

Schulze, G. (2015). § 15. In T. Dreier & G. Schulze (Eds.), *Urheberrecht 5*. Beck: Auflage, München.

Treitl, V. (2016). UGC: Is there room for the "Dancing Baby" under the InfoSoc Directive? *MR-Int*, 160.
Von Lewinski, S. (2008). *International copyright law and policy*. Oxford: Oxford University Press.

Clemens Appl is head of the Department of Legal Studies and International Relations at the Danube-University Krems. He is a full professor for International, European and Austrian Copyright Law and heads the Intellectual Property and Privacy Group. His research is focused on copyright, design protection and patent law, especially with regard to standardization, software and open innovation.

Philipp Homar is a Research Associate at the Department for Legal Studies and International Relations at the Danube-University Krems. His main field of research is IP Law with an emphasis on Copyright Law and the challenges posed by digital media.

Overcoming Concerns in Collaborative Transactions

Rosalie Koolhoven

1 Introduction

Collaborative platforms enable the creation of a sustainable, inclusive future with a circular and shared use of goods and resources, by giving transparency to supply and demand and easy access to that information. Some of them, focussed on peer2peer transactions, encourage social and local experiences that a linear business market cannot offer (Pluess, Kim, Lee, & Pelaez, 2016). The contracts that are the legal basis for the intermediary services and the "sharing experience" are often multiple bilateral contracts. Despite the positive sides, lawyers and policy makers fear the loss of consumer protection in these triangular relations. For the law, it is difficult to identify who is the "professional" or "trader" that should offer consumer protection. Is it the intermediary platform, being the professional, or is it the "prosumer" who is the factual supplier? Can consumer law apply in that relation, and should it? Alternatively, should consumers be able to choose lower prices, taking the loss of consumer protection for granted?

This contribution cannot give the answer to all those questions. The platforms that are engaged in matching activities within the sharing economy vary considerably (VVA, Milieu, & GFK, 2017). At this point in time governments and researchers are still gathering data from market analyses about consumer experience in the platform economy to decide how to regulate platform activities. This contribution, therefore, explains which concerns are found in literature of governmental and academic reports, to translate them to policy measures, which could inspire platforms to create a positive platform landscape, which might make taking active measures by a legislator superfluous.

R. Koolhoven (✉)
Transboundary Legal Studies, University of Groningen, Groningen, The Netherlands
e-mail: r.koolhoven@rug.nl

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1_16

2 Development of the Platform Landscape

European legislation protecting consumers was designed in former days, when distant contracts involved mostly the inquiry for and sale of goods via web shops of existing, physical stores. Soon, web shops emerged that offered only online contracting, such as Amazon. Still then, the relationship between seller and buyer was a B2C relationship as the web shop was a business. The online sharing economy, characterized by exchange between two consumers, changed this, because the suppliers are not businesses anymore but rather consumers engaging with other consumers. Even though the online sharing economy emerged already in the 1970s with initiatives such as the Project Gutenberg (Lessig, 2008) only recently it grew famous, because of Uber and Airbnb disrupting the existing transport and accommodation markets. In essence, the technology these platforms offer enables a more efficient use of "resources". The business models that coincide disrupt the existing landscape.

Notwithstanding the debate about whether Uber and Airbnb should be called "sharing platforms", or whether the term "sharing" should only apply to idealistic consumers offering the use of their goods for free, I will leave the terminology discussion aside. Laws apply based on the facts describing a certain activity, not based on the name the parties give their activity. A person that uses another's asset for free, is involved in a borrowing/lending contract, not a "sharing contract". This contribution looks at the sharing landscape and the role of platforms based on the activity of platforms and their participants, the way the E-Commerce Directive (2000/31/EC) does.

3 Chances and Concerns

Governments on both national and European levels consider the sharing economy as a chance for sustainable development and inclusivity. Consumers may consume local or receive an "insider experience" or more social experience through Couchsurfing and Airbnb than when staying at a hotel. Environmental benefits play a role as well: we can borrow something we do not need every day to prevent a new item from being produced and "waste" resources (The Economist, 2013). Some elements of the sharing economy, such as promoting access over ownership and enabling connections amongst people have the potential to foster inclusivity (Pluess et al., 2016). The platforms offer a clear, transparent comparison of supply, demand and prices; they push competition and therefore show lower prices than professional hotels, transportation companies and other business suppliers do (Min. Economic Affairs, 2015).

On the "supply side", platforms offer a low threshold for almost anyone to engage in some activity and earn money, be it as nonprofessional carpenter, nonprofessional bed & breakfast, nonprofessional cook or delivery service (European Commission, 2016a).

Anyone with a kitchen and a cookbook could potentially sell meals to others (Meyer, 2016). The transaction (search) costs to engage in a gig helping someone with household activities, babysitting and walking the dog are very low in the platform landscape, which is a positive, powerful characteristic of platform engagement. When starting a business one can use Liquid Space that makes office space rent-by-the-hour possible, instead of traditional contracts, which are 1, 2 or 5 year-based (Pluess et al., 2016).

Governments and scholars note that some of these developments put consumer rights under considerable pressure. Consumers have gained many rights based on European regulation by the directive on Consumer Rights (2011/83/EU), Directive 1999/44/EC on sale of consumer goods and Directive 93/13/EEC on unfair terms in consumer contracts. The question is whether they can fully enjoy these rights when they engage via platforms, because platforms are not the suppliers of goods and services that these rules are directed to. There are other consumers—their peers—instead. One could summarise the problem stating that regulation suffers from the division of tasks in the sharing economy; the professional platform is not providing the underlying service, whereas the service provider might not be a professional or is a professional "hiding" behind the platform pretending to be a prosumer.

As a result, negative experiences accumulate in the sharing economy and lead to a necessity for the legislator to take active measures. Peer consumers report frequent problems with transactions on P2P platforms. A recent study shows more than half of the consumers of a peer2peer platform (55%) have experienced at least one problem over the past year. "The most frequent problems relate to the poor quality of goods or services, or to the goods and services not being as described. Problems with the quality of products/services appear to be almost twice as frequent in P2P markets (29%) as in online purchases in general (15%). [. . .] Problems on accommodation platforms were less likely to get resolved than problems on other collaborative platforms. Peer providers report fewer problems (14%) than peer consumers; most relate to cancellations (over 40%) and various payment issues (47.5%)" (VVA, 2017, p. 12). There might be a way to act ahead of a "bad reputation" of the contribution of platforms to the sharing economy. Platforms could provide more clarity themselves and take some positive measures in answer to the concerns, to enhance faith and belief in a more sustainable consumptive future.

4 The Major Concerns

I will focus on five fundamental concerns governing the essentials of contracting. These five major concerns cover (1) the nature of the service offered by a platform; (2) the price; (3) uncertainty about the content of the sharing contract; (4) the identity of the contracting parties; (5) the quality of the parties as professional or "prosumer" which influences the existing rights and obligations.

4.1 The Nature of the Service Offered by a Platform

Whereas a traditional contract as governed by many Civil Codes is the bilateral contract between two parties, the platform landscape is characterised by multiple bilateral contracts or three-party contracts. An often-heard statement is that the platform only facilitates the conclusion of a contract between others and therefore has no relation with the contracting parties. If we take the facts to the legal analyses, we find that platforms do have a contractual relationship with their users. Their services, however, differ from platform to platform. That causes a debate on the degree of liability that platforms have for passing on information and when engaging in activities beyond passing information (ECJ C-236/08 to C-238/08, 2010).

First, a consumer searches for a platform that will help him find something that he needs. In the case of *Airbnb*, a consumer wishing to go on a holiday and someone offering a place to stay will each become a member of *Airbnb*. Taking into account what *Airbnb* offers, *Airbnb* should be seen as intermediary, Vermittler, Makler, *bemiddelaar*, or "broker": the middle man that facilitates the conclusion of a contract between others without becoming a party himself (Busch, Schulte-Nölke, Wiewiorowska-Domagalska, & Zoll, 2016; Ebenroth et al., 2014; Sørensen, 2016). Only later, the two members will use the search service, booking and messaging service to conclude a bilateral "sharing" contract.

After the conclusion of that sharing contract between the two members, an obligation to pay arises on the side of the lessee or 'user' vis-a-vis the lessor or the one who performs the gig. The payment in some cases, such as in *Airbnb*, *Croqqer* or *Uber* is due to the platform, which then acts as a "limited payment collection agent". This is a specific assignment by which the agent (the platform) is obliged to collect the payment from the debtor and to pay it to the creditor. This payment collection usually is done in the name of the collection agent, on the account of the creditor.

A "simple" rental contract, as in the case of *Airbnb*, invoked other contracts: mediation to facilitate the conclusion of the rental contract and payment collection agency (Sénéchal, 2016). In most cases, the platform service is extended to advertising, marketing, searching and ranking or listing up search results, administration of reviews, rating, messaging, conflict resolution, guarantees, insurances, customer service, extra certification, for example verifying accounts or addresses against payment to offer trust mechanisms (OECD, 2016). The "product" or "service" that the supplier offers on the other hand is what gives the name to the "economic activity", distracting the consumer from the additional platform services and obligations (Mozina, 2016).

The legal implications of these schemes are unclear (Wendehorst, 2016). Platforms offer a large variety of services in different sectors, which makes it hard to obtain certainty about the legal consequences (Sénéchal, 2016). Some platforms offer an online "notice board", whereas others only facilitate users to meet in a virtual space. Mere notice board platforms are to be treated differently from a platform such as Uber that is involved in the contract making, governance and performance of the sharing contract. Only in some cases, one will conclude that a platform is actually the service provider itself. When assessing the extent of control

that platforms have and how they influence the consumers through "algorithmic management", one should conclude that some platforms play an active role. The additional or ancillary services nowadays reach beyond the scope of passing on information that traditional platforms did. According to the opinion of Advocate-General of the ECJ, Szpunar, *Uber*'s matching activity and the sharing (transportation) contract are economically dependent in such a way that *Uber* basically offers one "composite service" of which both the contract making by electronic means and the factual transport are part (ECJ C-434/15). Yet, not every commercially driven platform offers a composite service.

In short: the platforms facilitate contracting, but at the same time forget to shed light on the legal implications. If we contract via a platform with someone else, we do not understand how and whether these contracts are intertwined (Busch, Schulte-Nölke, et al., 2016). Whom do we turn to in case of a problem, in case of non-performance or damage?

4.2 The Price

There is the assumption that the use of digital platforms to match supply and demand leads to a more transparent market with better prices and higher quality (Tripathi, 2015). This goes hand in hand with existing rating systems and, intertwined, the lack of licences of which the function might be replaced by review systems, although we are not sure whether that is a feasible future in terms of competition law and in terms of consumer safety and protection of public safety. If we do not need to buy or obtain licences through education, we have less investment costs to charge on to the customer. The lower prices do not only come from fact that services and goods are often offered without licences but are also the result of the fierce competition in a negative sense (Pluess et al., 2016). Malhotra and Van Alstyne (2014) draw our attention to the fact that the earning possibilities within the platform economy are very small. At the bottom of the pyramid, there is the broadest layer, which is one of poverty: "Going freelance is hollow freedom is the wage for labor is free".

Secondly, there is the tax issue. If gig workers in the end of the year will contribute to the income taxes, there will be only little left of what they "earned". That shows that very cheap services do not exist outside a "black market" (Pluess et al., 2016).

The OECD spreads out that the "low price" might be misleading in the sense that there might occur many other costs later on. The OECD mentions costs for non-conformity, repair, replacement, administration, and travel costs to solve a problem, decrease in value of property though damaging goods or mistreatment of a good by the other party, costs for legal advice and lost time and income due to injury. They also mention that immaterial damages are likely to occur: for a low price there is limited choice, psychological stress in case something goes wrong and one does not know about his rights because the contract is atypical, anger, embarrassment, a breach of privacy and integrity from receiving someone at home, discomfort and an impact to health due to these problems (OECD, 2016). A recent

consumer behaviour analyses shows that 55% of consumers feel they would not have concluded a sharing contract if they would have known more about the product but fail to search a remedy because it is so complex (VVA, Milieu, and GfK, 2017).

4.3 The Content of the Sharing Contract

Another concern which comes with low pricing and "modern friendly contracts" that are created, is the question whether a supplier of a good or service can be expected to offer "more" than only the core product or service. May we expect a guarantee or a liability arrangement, a safety net, from the prosumer that agrees to such a low price? Study shows that even though both parties to the C2C contract are consumers, their relationship is not necessarily "balanced" by the platforms that set out the rules of engagement. In unforeseen circumstances, a judge has the discretion to create a balance between the contracting parties' obligations, but we want clarity in advance and prevent unforeseen circumstances and court proceedings. What we see now is a very scarce enforcement (VVA, Milieu, & GfK, 2017).

4.4 The Identity of the Contracting Parties

Imagine going to "Bonnie" to pick up a meal. The E-Commerce and Consumer Directive impose information duties about identity and location of the product or service provider. Using a nickname is not enough. The consumer should to be able to know whether the service provider is insolvent or engaged in illegal activities and where it is located for after sales services, the enforcement and execution of rights. Only when a buyer arrives at Bonnie's, he might experience her identity. She might be someone else using a nickname, covering up she used to exploit a restaurant, which was closed due to food safety problems. Platforms are an attractive way of offering services without getting a bad reputation, escaping legislation. When we go over to sleep somewhere or receive people at our home to pick something up, we are in a vulnerable position. Knowing whom we are dealing with is a matter of safety.

According to the European Commission, these information duties should be met by sharing platforms as well as professional suppliers or service providers offering the underlying services. The Commissions' *Guidance*-document to the Consumer Directive (European Commission, 2014, p. 31) states: *"When a trader uses an online platform to market his products and conclude contracts with consumers, the provider of that platform shares, in so far he is acting in the name of or on behalf of that trader, the responsibility for ensuring compliance with the Directive"*. In literature, we find that it is unclear whose responsibility it is, to provide this information. However, the platform's responsibility increases with its involvement in the sharing contract (Hatzopoulos & Roma, 2017; Mozina, 2016). In peer2peer contracts, it remains unclarified whether the prosumer is bound by these rules (European Commission, 2016a). The OECD states that the questions whether all information duties should be imposed on both professionals and prosumers, is the most important yet

difficult question pending. Yes, it is a relatively easy way to provide clarity, but one should also take into account the differences in expertise, experience and skill online between private parties and professionals (OECD, 2016).

4.5 The Quality of the Contracting Parties

Most concerns are related to the question whether the suppliers or service providers in the sharing contract are consumers or professionals. European directives distinguish between consumers and professionals or traders. To some extent, there is no uniform definition, because each situation is different and asks for an interpretation in the light and wording of the applicable directive (Cauffman, 2016). On a national level, there are different definitions as well for tax (VAT or income) purposes (Mol-Verver, 2017; Renkers, 2017). Uncertainty is an impediment to participate both on the supply and demand side. The European Commission identifies a few factors that will help qualify the parties, based on the regularity of the provision of goods or services, profit and revenue (European Commission, 2016a). The OECD furthermore mentions "whether a transaction is planned or not, the way it is organised, the number of transactions, their value, the duration of the activity, the impression to the outside world, the way the activity is perceived by consumers, and commercial intentions" (OECD, 2016). At the same time, it can be important for a consumer who offers goods or services on a non-professional basis, to uphold his own status as a consumer to benefit from consumer protection vis-à-vis the platform.

5 How to Resolve the Problems

5.1 The Platform's Stricter Liability

Taking the lack of clarity in the service division, there is a need to divide the contractual triangle into the matching (platform-consumer) relation and the sharing (prosumer-consumer) relation. Only then, one can analyze what contracts exist and how the existing rights and obligations are divided. The obligation to be clear about this, touches upon the large amount of information duties that exists for professional parties (platforms) based on the mentioned Consumer and E-Commerce Directives. To make sure that the consumer who enters a professional looking platform is aware that he might be dealing with a nonprofessional, it could be helpful to visually emphasize the fact that two contracts are being concluded. For example, by changing the interface's colour as soon as one leaves the realm of the platform. Also, the division of tasks—in other words: being clear on the service or product that platforms actually offer—should be considered key information. Platforms should offer short lists accompanying the—overall—very extensive General Terms.

The starting point for platform obligations is the mentioned E-Commerce Directive. Its objective is the proper functioning of the internal market by ensuring the free movement of information society services between Member States. The obligations

are directed to those offering an information society service, which is "any service normally provided *for remuneration*, at a distance, by electronic means and at the individual request of the recipient of services" (Directive 98/34/EC, art. 1(2)). Platforms try to escape any responsibilities by arguing that they operate "for free", but in fact, they gather and sell data and are offering remunerated services. Clarification about the gathering and use of data is one of the main topics being addressed by the European Commission's at this moment (European Commission, 2016a; VVA, Milieu, & GfK, 2017).

Information society service providers, such as platforms, profit from an exemption of liability for passively passing on false information according to article 14 of the E-Commerce Directive. Based on that, the prosumer is liable for non-fulfilment of the sharing contract or other occurred damages and the platform cannot be involved in a claim (Mozina, 2016). Guarantees that are given by a platform are seen as voluntary. Recently however, it was mentioned that they might not be "passive" enough to rely on the liability exemption. European Court of Justice ruled in the case of Google France/Louis Vuitton that the exemption only applies "(. . .) when [the] service provider has not played an active role of such a kind as to give it knowledge of, or control over, the data stored" (ECJ C-236/08 to C-238/08, 2010; European Commission, 2016a).

The current debate heads into another direction. The European Commission and Court are reconsidering this liberal regime for platforms that offer ancillary services. The level of control that platforms such as *Airbnb* and *Uber* have is important. According to the Commission, key criteria or guidelines to assess the level of activity are (i) whether the platform sets the final price to be paid; (ii) whether the platform sets key contractual terms; and (iii) whether the platform owns the assets used to provide the underlying service (European Commission, 2016a). In the most recent case, dated 20 December 2017, before the ECJ, *Uber*'s service—connecting nonprofessional drivers with persons who wish to make journeys by means of a smartphone application—was regarded as being inherently linked to a transport service and, accordingly, must be classified as "a service in the field of transport" within the meaning of EU law. *Uber* exercises decisive influence over the conditions under which the drivers may provide the service. The intermediation service must be regarded as an integral part of an overall transport service and not an information society service for which the exemption of liability exists. The *Uber* judgement is therefore a step towards increased liability.

When assessing the extent of control that platforms have and how they influence the users through "algorithmic management", one might conclude that some platforms play an active role. That changes their responsibilities. Marie Jull Sørensen describes that *Uber* could be liable for the damages of a passenger, if it does not remove a driver who is a sex offender from its app (Sørensen, 2016). The reason for that is that *Uber* has a "considerable degree of control" over the driver by setting all standards for both drivers and cars and because it has the vital power to exclude misbehaving drivers. The ancillary services reach beyond the scope of passing on

information. Liability based on additional or ancillary services is to be assessed separately (European Commission, 2016a). When assessing that liability, the E-Commerce Directive in considerations 54 and 55 prioritises the application of the better national legal protection: "the Directive cannot have the result of depriving the consumer of the protection afforded to him by the mandatory rules relating to contractual obligations of the law of the Member State in which he has his habitual residence".

Beneficial for the fair development of the platform-user relationship would be, to anticipate to the national contract rules that may apply and the consumer protection they aim for (Busch, 2017; Busch, Dannemann & Schulte-Nölke, 2016; Oberlandesgericht Hamburg, 1985). We find in the European Commissions' Communication (2016b), that the European Commission encourages platforms to take responsibility to create a platform market in which consumers are well protected.

It would be good to take responsibility to give information about the contracting parties, not to allow nick names or not accept people without insurances, check the safety and behavioural background in all "sharing contracts" that involve a certain amount of private sphere such as accommodation or rides. With respect to the role of the platform in the prosumer-consumer relation, it is important to note that platforms encourage behaviour that might lead to unsafe situations, such as in the case of *Airbnb* accommodations that are not safe enough to fulfil an accommodation function instead of a living function (Min. Economic Affairs, 2015). Let alone the vulnerable position people are in when they receive strangers inside their house or when they are staying at someone's place, as is the case with *Couchsurfing*, *Airbnb* and alike. A broker is responsible to provide the information to both parties to the fundamental contract about each other to facilitate the conclusion and fulfilment of that contract.

Secondly, it should be made clear what services are paid for when contracting via a platform *in advance*. Some platforms only offer all the information about their own service or the costs of that service *after* having signed up. That means consumers are paying with data before knowing the service or the price. This is not in line with intermediation, brokerage and agency rules in consumer relations, found in a Draft Directive on Online Intermediary Platforms (Draft Directive, 2016). These include a duty to be clear about how privacy and payment are intertwined. Data are todays' currency and the concept of "free membership" should get a stricter meaning.

Third, there should be a clear explanation for prosumers as well about the exemptions from liability that a prosumer can rely on vis-à-vis the consumer. In contract law, the way in which the contracts were agreed to is a circumstance which should be taken into account in the doctrine of *third party effects of contracts* (or *exceptions to the privity of contract*) or stipulation of payment to a third party. It might be the case that prosumers get many responsibilities but are not aware of that because the platform shows no warning signs.

5.2 The "Better Price"

Digital platforms that match supply and demand create a more transparent market with lower prices and higher quality. Research shows that this is only the case if rating-systems are reliable and capable to push trustworthiness (Pluess et al., 2016). An important issue is whether these very low prices should be considered as a positive development. Platforms could use their role and scale to combat the poverty—employees without status earning below minimum wage—they create (Pluess et al., 2016). The low wages are not sustainable on a societal level either; they result in efforts to hide income from the tax authorities. A positive policy to take into consideration is to address inclusivity and poverty. Platforms could draw attention to this problem and incorporate an extra layer in the interface: when people offer only a tiny amount for a gig, ask them "Are you sure the value of the work is this little?" Platforms could try to prevent very low prices in the gig economy, invest in human capital and not force those who want to deliver food to buy special equipment to become a member of the team. Platforms could aim at creating inclusivity instead of a "modern kind of slavery". Moreover, within the subject of pricing, it is vital to give information about the use of data for pricing purposes and to re-calculate whether "sharing" really is a cheaper alternative to the traditional contracts when we start taking into account the "costs" in terms of use of data and deviations from liabilities.

5.3 The Content of the Sharing Contract

A third concern related to pricing and fair dealings, was whether a supplier of a good or service may be expected to offer more than the core of the contract. May we expect a guarantee or a liability arrangement, a safety net from the supplier or service supplier who agrees to the lowest price? The difficulty here is that platforms create a professional environment in which consumers might expect that. They do not see the non-professionals behind the platform that is willing to do a gig for a very low income. It is common that a friendly service and a "*nudum pactum*" (not-remunerated agreement, one-sided obligation) entail less liabilities for the performing party. Generosity is in both common law and civil law legal systems compensated with a decrease of liabilities (Koolhoven, 2016). The fair division of rights and obligations should be promoted.

In addition, here, providing information and clarity is the solution. In contract law, parties are largely free to determine the terms of their contracts. Peers are not used to contract about liabilities and guarantees and unforeseen circumstances. Here the platform's contractual framework and the standard rules of the Civil Codes (such as on borrowing and rent) will come into play. Since party autonomy is largely the key message platforms give, it could be beneficial if they warn their users about the key elements of the contract, to make sure they understand what they are engaged in. Some platforms do set out the core elements of the contract and create so-called "super contractual liabilities", which are liabilities that are usually not imposed on a

certain party to the contract. By shifting the liability to another party—which does not have a specific insurance for that—platforms can earn money offering the insurance that the party suddenly needs. In legal economic terms, this is overall expensive: both parties are now insured against the same risk. Those who are not aware are misinformed. That should be prevented.

5.4 The Identity and Quality of the Parties

There is doubt whether suppliers in the sharing economy who are consumers themselves should fulfil all the information duties about their identity based on E-Commerce and Consumer legislation. This doubt could technically be taken away easily, by enabling only the use of real names, or by offering verification of identity. There might be professionals hiding behind a platform acting as "prosumers". This kind of fraud is detrimental to the platform's credibility. At the same time, the prosumer who gradually turns into a professional needs to know that his rights vis-a-vis the platform will change, because he will no longer be the consumer covered and supported by consumer law. In addition, he needs to be warned because as soon as he turns into a professional, he will need to fulfil the obligations of a professional vis-à-vis the other consumer. A "professional barometer" provided by platforms would help both parties gain clarity about their status and the status of the contracting partner which is the key information aspect that many other obligations depend of.

A "professional barometer", in my imagination, could "count" key aspects of the activities. These aspects are, as mentioned: regularity, duration and number of the activities, profit, revenue, planning and organization, commercial intentions, the impression to and perception by the outside world. Each element could contribute a percentage to the professional barometer, which then keeps track of the "professional status". This would resolve the issue that platforms are creating a confusing mixture of a professional environment in which non-professional services are offered, pushing the black market, and an easy way to escape from obligations (Busch, Schulte-Nölke, et al., 2016).

6 Future Platforms

Malhotra and Van Alstyne predict that consumers and governments aware of the platform power play, shift of liabilities and risk of new poverty, will ultimately choose platforms based on "long and short-terms gains as well as individual and community benefits" (Malhotra & Van Alstyne, 2014). I think that overcoming the current concerns will be a contribution to the shaping of these beneficial platforms, and—based on the concerns that make governments want to regulate—that these steps should be taken into consideration to act ahead of that. The credo that the sharing economy can be inclusive is true, as long as the platforms facilitating it will not endanger that potential (Koolhoven, Neppelenbroek, Santamaría Echeverria, & Verdi, 2016). Another perspective shows that, in order to grow, there is a need for

sharing economy platforms to collaborate with governments. New policies will then integrate new business models into long-term planning, public services and tax frameworks, but of course only under the condition that they "create more benefits for more people and mitigate negative impacts" (Steinmetz, 2016).

With greater involvement platforms will no longer be the intermediary passing on information, supported by the liability exemption in article 14 E-Commerce Directive. If we take into account the European Commissions "Agenda for the Collaborative Economy" and "Communication on Online Platforms and the Digital Single Market", as well as the opinion of Advocate-General Szpunar in the *Uber* case, the growing amount of additional services, the strong algorithmic influence, the fear of fraud and illegal content, I would conclude with Cauffman (2016) that todays' and future sharing platforms are too active for the liability exemption. If this development continues, the best anticipation is to design a sharing platform that is inclusive, transparent and fair.

References

Brief aan de Voorzitter van de Tweede Kamer. (2015). Betreft Werken aan toekomstbestendige wetgeving: digitale platforms en de deeleconomie, waaronder particuliere verhuur aan toeristen (Airbnb),d.d. 18 december 2015, kenmerk DGBI-R&I/15166286. Translation: Letter of the Dutch Minister for Economic Affairs to the Parliament about digital platforms and the sharing economy.

Busch, C. (2017). BGB §312i, (2017) BeckOGK, no. 5–8.

Busch, C., Dannemann, G., & Schulte-Nölke, H. (2016). Ein neues Vertrags- und Verbraucherrecht für Online-Plattformen im Digitalen Binnenmarkt? *Multimedia und Recht, 2016*(12), 787–792.

Busch, C., Dannemann, G., Schulte-Nölke, H., Wiewiorowska-Domagalska, A., & Zoll, F. (2016). Discussion draft of a directive on online intermediary platforms. *Journal of European Consumer and Market Law, 5*(4), 164–169.

Busch, C., Schulte-Nölke, H., Wiewiorowska-Domagalska, A., & Zoll, F. (2016). The rise of the platform economy: A new challenge for EU consumer law? *Journal of European Consumer and Market Law, 5*(1), 3–10.

Cauffman, C. (2016). The commission's European agenda for the collaborative economy – (Too) platform and service provider friendly? *Journal of European Consumer and Market Law, 5*(6), 235–243.

Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the internal market, (2000) Official Journal L 178/1.

Ebenroth/Boujong/Joost/Strohn. (2014). Handelsgesetzbuch Band I §93. C.H. Beck.

ECJ 20 december 2017, Case C-434/15, Asociación Profesional Elite Taxi v. Uber Systems Spain SL. ECLI:EU:C:2017:981.

European Commission. (2014). Guidance document concerning Directive 2011/83 on Consumer Rights. Retrieved April 12, 2018, from ec.europa.eu/justice/consumer-marketing/files/crd_guidance_en.pdf

European Commission. (2016a). *A European agenda for the collaborative economy – Supporting analysis*. COM (2016) 184 final. Retrieved April 12, 2018, from ec.europa.eu/docsroom/documents/16881/attachments/3/translations/en/renditions/pdf

European Commission. (2016b). *Online platforms and the digital single market – Communication*. COM (2016) 288 final. Retrieved April 12, 2018, from ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-288-EN-F1-1.PDF

Hatzopoulos, V., & Roma, S. (2017). Caring for sharing? The collaborative economy under EU law. *Common Market Law Review, 54*(1), 81–127.

Joined Cases C-236/08 to C-238/08 Google France SARL and Google Inc. v. Louis Vuitton. (2010). ECLI:EU:C:2010:159. Consideration confirmed in Case C-324/09 L'Oréal SA and Others v. eBay International AG and Others (2011). ECLI:EU:C:2011:474.

Koolhoven, R. (2016). The private law's reflection on sharing intentions. In J. P. Wulfsberg, T. Redlich, & M. Moritz (Eds.), *Interdisziplinäre Konferenz zur Zukunft der Wertschöpfung: Konferenzband* (pp. 349–357). Hamburg: Laboratorium Fertigungstechnik, Helmut-Schmidt-Universität.

Koolhoven, R., Neppelenbroek, E. D. C., Santamaría Echeverria, O. E., & Verdi, T. P. L. (2016). *Impulse paper on specific liability issues raised by the collaborative economy in the accommodation sector*. Retrieved April 12, 2018, from ec.europa.eu/docsroom/documents/16946/attachments/1/translations/en/renditions/native

Lessig, L. (2008). *Remix: Making art and commerce thrive in the hybrid economy* (p. Penguin). New York.

Malhotra, A., & Van Alstyne, M. (2014). The dark side of the sharing economy and how to lighten it. *Communications of the ACM, 57*(11), 24–27.

Meyer, J. (2016). *Uber-Positive: Why Americans love the sharing economy*. New York.: Encounter books.

Mol-Verver, S. J. (2017). Nodigt groei deeleconomie uit tot nieuwe fiscale wetgevingsinitatieven? *Nederlands Tijdschrift voor Fiscaal Recht* (2), no. 55.

Mozina, D. (2016). Retail business, platform services and information duties. *Journal of European Consumer and Market Law, 5*(1), 25–30.

Oberlandesgericht Hamburg 28. 8. 1985 – 5 U 135/84, 'Partnervermittlungsvertrag als Maklervertrag', Neue Juristische Wochenschrift 1986/325.

Opinion of Advocate General Szpunar delivered on 11 May 2017, in case C-434/15, Asociación Profesional Elite Taxi/Uber Systems Spain SL. ECLI:EU:C:2017:364. Retrieved April 12, 2018, from http://curia.europa.eu/juris/document/document.jsf?text=&docid=190593&doclang=EN

Organisation for Economic Co-operation and Development (OECD). (2016). Protecting consumer in Peer Platform Markets, OECD Digital Economy Papers, No. 253. Retrieved April 12, 2018, from https://www.oecd-ilibrary.org/science-and-technology/protecting-consumers-in-peer-platform-markets_5jlwvz39m1zw-en

Pluess, J. D., Kim, L. E., Lee, M., & Paula Pelaez (2016). An inclusive sharing economy. Working Paper. BSR. Retrieved April 12, 2018, from bsr.org/reports/BSR_An_Inclusive_Sharing_Economy.pdf

Renkers, C. (2017). Ondernemersbegrip in de deeleconomie: Eerlijk zullen we alles delen?. BtwBrief 2017/68.

Sénéchal, J. (2016). The diversity of the services provided by online platforms and the specificity of the counter-performance of these services – A double Challenge for European and national contract law. *Journal of European Consumer and Market Law, 5*(1), 39–44.

Sørensen, M. J. (2016). Uber – A business model in search of a new contractual legal frame. *Journal of European Consumer and Market Law, 5*(1), 15–19.

Steinmetz, K. (2016). Lyft and Uber are 'Allies' in the transit revolution. *Time*. Retrieved April 12, 2018, from http://time.com/4259615/lyft-uber-apta-mobility-study

The Economist. (2013). *All eyes on the sharing economy*. Retrieved April 12, 2018, from https://www.economist.com/news/technology-quarterly/21572914-collaborative-consumption-technology-makes-it-easier-people-rent-items

Tripathi, S. (2015). *Uber and passenger safety: Human rights aren't an optional app for cab rides*. Institute of Human Rights and Business. Retrieved April 12, 2018, from ihrb.org/other/india/uber-and-passenger-safetyhuman-rights-arent-an-optional-app-for-cab-rides

VVA, Milieu, & GfK. (2017). *Exploratory study of consumer issues in online peer-to-peer platform markets – Final Report*. Retrieved April 12, 2018, from ec.europa.eu/newsroom/just/item-detail.cfm?&item_id=77704

Wendehorst, C. (2016). Platform intermediary services and duties under the e-commerce directive and the consumer rights directive. *Journal of European Consumer and Market Law, 5*(1), 30–34.

Rosalie Koolhoven, assistant professor at the University of Groningen (Netherlands), teaches a.o. the course 'Law & IT in a circular economy'. In her teaching and research she focuses on questions of contract and property law that stem from technological change and new business models in the platform, sharing and circular economy.

Index

T. Redlich et al. (eds.), *Co-Creation*, Management for Professionals,
https://doi.org/10.1007/978-3-319-97788-1