



Review

Open Principles in New Business Models for Information Systems

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Abstract: Open source software and open innovation are an important resource for today's industries. Communities collaboratively create different kind of publicly available value, boosting innovation and also technology. However, whereas this value is generated and captured by various involved parties, the outcomes are, in many cases, commercialized by companies who build their business models on this openness. Thus, current business model representations used for these open systems mainly focus on the commercial side of companies, not directly regarding the value creation and distribution by the underlying communities. This results in a lack of potential representation of alternative value created by individuals and communities that are not necessarily aiming for direct monetary compensation. In this work, we show, by the example of open source projects, how communities create value and their potential to be represented by the upcoming domain of new business models. The emerging idea of new business models, based on sharing, collaboration, and the circular economy, not only considers economical viewpoints, but also social and ecological. New trends in research are intensively starting to investigate these models and how they can be brought to practice. The co-creation of value, collaboration of various actors, and following a shared vision are just some of the identified overlaps that are also essential for a potential representation of open communities. This first review unveils that new business models and open source software projects have a variety of aspects in common. We highlight the potential of open communities to be seen as new business models themselves, instead of just being a pure enabler for firms' business models. This approach is leaving room to explore new organizational and economical aspects of open ecosystems, enhancing the understanding of co-creative communities and the definition of collaborative value.

Keywords: open source software; new business models; open innovation; value co-creation; information systems

1. Introduction

Business models have been a trending topic for academia and industry in recent years. Especially new business models (NBMs) are increasingly gaining importance not only for today's society, but also research. Driven, beyond others, by sustainability, sharing, and collaboration, they gather more and more attention by a manifold audience and got an emerging topic for economic research. These upcoming models are built upon diverse communities co-creating value and are enabling a new view on today's businesses. However, no general definition of what new business models are, is currently available, leaving space for interpretations. Regardless of the definition, technology has been a main enabler for business models and innovation in recent decades. One of the technologies that has often been connected to this is the development of open source

software. The focus of this connection has mostly been how open source enables business models and supports innovation. Already early the collaborative nature of users and other actors in open source projects has driven innovation that was able to compete with professional businesses [1]. However, open communities also provide chances for these businesses. Early on, companies started to create value from open (source) projects and to gain benefits out of them in various business models [2]. However, the social aspect of collaboration in and value creation of the underlying open communities has not been considered in or as a business model itself yet. Although we can see innovation originating from communities which is in a certain way commercialized by firms, these communities still innovate for free in the terms of money, but for gaining alternative rewards [3,4]. Failing to represent these communities, their value creation and distribution process by common business model notations points out a current gap in research.

Especially in times in which more and more companies get connected to communities that innovate and create open value it is essential that companies understand the communities, but also the communities get insights into their value creation and delivery process. Traditional business models are usually focusing on monetary values, but as we can observe, the current characterization of NBMs pays also respect to this alternative definition of value and its co-creation [5]. By regarding communities through new business models further implications on how to improve the value, independently of its definition, for all involved actors may be made. This might help to support innovative and open communities in their value creation and increase the thereby created net-benefit. Due to the large amount of published work and cases we focus in this first work on open source projects and their communities, representing collaborative value creation and innovation. We target to investigate similarities between the emerging trends in NBMs and the already well-investigated domain of open source software. We expect that a holistic view on these domains will provide further insights to both of them, enhancing the understanding of how (open source) communities create value in new business models that are not necessarily focusing on monetary values or business objectives.

Open source projects have already been subject of extensive research in the past, considering a variety of domains and different projects. As current trends in research and industry show, these open projects are evolving, strengthening the involvement of businesses in the ecosystem and collaboratively creating value for different involved parties. This review aims to enhance this research by fostering the understanding of how open source projects can be represented by the currently emerging definitions of new business models. Therefore, similarities in research on these two domains get pointed out by outlining the status quo in these fields and comparing their recent progress. We intend to build the foundation for further research in combining these research strands and to establish the base for following project-related practical and action-based scientific work by reviewing current literature covering these specific fields [6]. This work may give further insights into how collaborative value is created by communities, not necessarily following monetary profit, but also paying respect to social aspects and individual motivations for participation. Whereas the idea of NBM is relatively new, research on open source software emerged in the late 1990s, resulting in a large base of available resources for analysis. The objective of this work is to analyze whether open source software communities match the current definition of NBMs. This would allow new perspectives for research on open source communities and ecosystems, but would also add additional cases for further studies on NBMs. For this analysis, current literature on business models and open source software gets reviewed and upcoming trends pointed out. Publications from both domains and a variety of sources get considered, trying to avoid a bias of focusing on publications from single geographical regions or only from top-publishers [6]. Furthermore, emerging ideas and new approaches in these fields that might also foster the potential connection between open source software projects and NBMs are highlighted.

2. Aims

This article aims to show a gap in business model research when it comes to co-creative open communities. Communities, open for contribution from everyone, in the last decades intensively impacted innovation and have especially been an active driver for technology. However, whereas in many cases firms realized these innovations in monetary terms, also other values have been created for and captured by the communities and their individuals that have been involved in the innovation process. Especially in times in which business models need to evolve and firms more and more engage in open communities, the need to better understand these communities comes up. As an often-used example for these communities, the well-defined domain of open source communities, also directly connected to the principles of open innovation, has been used in this work.

First, we sum up the current state of research and highlight upcoming trends in the emerging work on business models. We therefore focus on frameworks that origin from reputable sources in this field and that have been applied in various published cases. We line out the progress of development in this field, especially regarding the representation and characteristics of business models as well as the increasing consideration of social aspects. As indexing databases show, further studies and ideas in the field of NBMs are constantly emerging in specially dedicated conferences and different international journals on production and sustainability issues. Furthermore, this topic has been discussed in a variety of business publications that get considered and analyzed in our review.

Second, we review existing literature on open source software projects. The therefore considered open source literature primarily focuses on the underlying communities, the role of individual contributors in them, and the connection to industry and businesses. A variety of publications, primarily originating from international journals and conference-proceedings especially focusing on this domain, has been evaluated from common index databases, e.g., Scopus or IEEE Xplore, and taken into consideration to line out the current state of research on open source. These publications include peer-reviewed empirical research results, case studies and literature reviews focusing on open source software development and communities. Especially results from published and analyzed cases from community and industry driven open source projects within recent years provide detailed insights and have been used for this work.

Third, the connection between open communities, firms' innovation processes, and business models gets highlighted. Especially in the research strand of open innovation the community aspect gets pointed out in various publications. Furthermore, these publications also relate to the connection between business model (innovation) and open innovation. We show how this strand is connected to this review and potential implications for communities involved in open innovation approaches.

As main work, we combine these two fields by regarding open source software communities from a NBM perspective. We map the existing insights gained from open source projects to the emerging definitions and characteristics of NBMs. This approach of mapping is intended to make a statement if open communities may be adequately represented by frameworks and tools originating from research on NBMs. In the following discussion and conclusion we point out similarities as well as potential room for further action-based research in combining both domains.

3. Background

3.1. New Business Models

Creating and capturing value can be a simple description of the functions of a business model [2]. However, today's literature provides a variety of definitions of what a business model is and how it can be described and represented (e.g., [7,8], or [9]). Depending on the field of application and targeted usage of the model, researchers contributed various definitions to this domain [10]. They all differ in several aspects such as the number of elements, scope, and viewpoint, as the currently common representations of business models demonstrate:

- Early concepts to describe business models such as the “Fribourg ICT-Management Framework” [11] and the “STOF Model” [12] focus on basic building blocks consisting of technology, service, finance in an socio-economic context.
- The widespread “Business Model Canvas” (BMC) by Osterwalder [8] and its derivations such as the “Business Model Starter Kit” by Breuer and Ketabdar [13] have a focus on the value proposition for customers while also including important concepts for value generation on customer and provider side.
- Frameworks such as the “BIZTEKON Business Model Skeleton” [14] and the “Service Innovation Triangle” [15] provide more detailed views on selected aspects of business model elements.

Research on business models gained further popularity in recent years and the social aspect of business models is getting increasingly important. The concept of business models is now also used for the analysis of social and inclusive businesses [16]. This can be seen in new upcoming business model frameworks focusing on additional therewith connected aspects:

- The “Social Business Model Canvas” [17] for instance focuses on social innovation to create business models that also have a social impact in addition to commercial revenues.
- Similar, the “Triple Layered Business Model Canvas”, enhances Osterwalder’s notation with an environmental and social layer [18].
- The “Service Business Model Canvas”, also based on the building blocks of the BMC, allows a holistic view on services that are based on co-creation of value [19].
- A stand-alone approach not grounding on Osterwalder is provided by Bocken et al. [20] who provide a framework and a process to innovate business models with a strong social and sustainable focus.

All in all, one can see that research on business models is increasingly paying respect to new components, such as social aspects, environmental issues, and an alternative definition of value/profit, not only seen from a monetary perspective. Constantly new frameworks emerge, adding additional perspectives to business models and enhancing our understanding of them.

Business models can be seen as a driver for management research, since these models may be regarded in different non-exclusive roles (e.g., scientific or descriptive as role-model) the same time [21]. Research in recent years on business models is further enhancing the understanding of the domain in general, but is also intensively paying respect to new trends in our society and economy. Business models are changing due to a new way of thinking [5]. As an example, sustainable business models that create value and not primarily focus on profit generation got in the focus of research in recent years [22]. Evaluating this work highlights the potential of this emerging field for academics and practitioners [23]. However, part of innovation and technology is also changing today’s business models [24].

As already mentioned, there are multiple ways to define business models, all considering different viewpoints. Similar to business models, also these upcoming new business models can be formalized in different ways. One approach by Jonker [5] preliminary identified seven features that shape new business models:

- Cooperative collaboration
- Creation of multiple value(s)
- Money not only mean of trade (e.g., to be earned or traded)
- Economy based on needs and uses
- Access over ownership
- Parties’ long-term commitment
- Alternative forms of money (e.g., points)

This definition also fosters the aspect of (co-)creating multiple values for various actors within a business model. In comparison, current models often lack in managing this creation of multiple

values that can especially be found in services [5,19]. The involvement of stakeholders in the value-creation process also comes along with certain challenges that are also interesting for research [22]. Co-creative organizations of different actors can lead to complex ecosystems that are hard to manage and understand [25]. However, the fact that today's boundary between for-profit and non-profit organizations is blurring, proves that creating shared value for the involved actors is possible [26]. As an example, the investment in communities in inclusive business models also allows companies to increase their profit [16]. As a result of these manifold benefits, new viewpoints in this field are emerging rapidly, fostering a multi-value and actor centered understanding of business models. These models are also focusing more on a value perspective independently of the definition of value as monetary currency and taking into account current needs of the related actors, society and environment.

3.2. Open Source Software

Although open source software got in the focus of research and industry in the end of the 1990s with the definition of licenses and principles, its origins go as far in the back as in the 1960s, when it was common for programmers to share their code [27]. Over the last 20 years a variety of projects established using these widely accepted and well defined open licenses. Although they all refer to develop open source software, projects are following varying characteristics and licenses, slightly differing in certain aspects [28]. Typically, open source projects get considered by the public and developers solely in a technical view, only peripherally connected to business objects [29]. Especially early publications focused primarily on the collaborative aspect of this development method. As best-known example, Raymond [30] presents in "The Cathedral and the Bazaar" 19 lessons describing the process of producing open source software based on his experience in this open domain. The described collaborative process of open development, also including users and stakeholders, differs from conventional software development approaches in the dimensions of incentives, control, and coordination [31]. Whereas conventional software development is often compared to building a closed cathedral, where just a few people are involved in the construction progress that is not public, Open Source Software (OSS) development can be seen similar to an open bazaar of different people co-creating and sharing value [30]. This aspect is also in the focus of several of Raymond's principles:

- *Every good work of software starts by scratching a developer's personal itch.*
- *Good programmers know what to write. Great ones know what to rewrite (and reuse).*
- *When you lose interest in a program, your last duty to it is to hand it off to a competent successor.*
- *Release early. Release often. And listen to your customers.*
- *If you treat your beta-testers as if they are your most valuable resource, they will respond by becoming your most valuable resource.*
- *The next best thing to having good ideas is recognizing good ideas from your users. Sometimes the latter is better.*
- *Any tool should be useful in the expected way but a truly great tool lends itself to uses you never expected.*

Excerpt of Raymond's lessons in "The Cathedral and the Bazaar" [30].

Besides Raymond's OSS movement, also the Free Software (FS) community, initiated by Richard Stallman, established. In his essays [32], he outlines that software needs four freedoms:

- The freedom to run it
- The freedom to study and to change it
- The freedom to redistribute it
- The freedom to distribute modified copies

Whereas the latter definition of OSS is primarily focusing on collaborative and development aspects, the characterization of FS is more of a philosophical nature. This perspective and the

ethical reasons for it are often unknown by users, who are just regarding open source as one single ideology [33]. Today several FS licenses pay respect to this movement's philosophy and are widely used by developers. However, due to their similar nature, most open source software can also be considered as free software [33]. Therefore, in this work we will refer to open source as the definition of Free/Libre Open Source Software (FLOSS), meaning that they comply to the principles of both communities.

Due to its character and availability for researchers, open source software has been the subject in a large number of publications since its emergence [34]. Not only computer scientists, but also researchers from other disciplines such as management, economics, or law considered open source for their work [28]. Therefore, a broad research-basis and numerous published cases are available to investigate open source from various perspectives and combine it with other disciplines, such as in this case with research on NBMs new business models.

3.3. Communities for Open Innovation

Fast progress in technology, shorter product cycles and the therewith connected high costs of innovation challenged firms in the late 20th century, leading to the need for new and more efficient ways to innovate [35]. As a result, the open innovation approach came up. This approach treads internal and external ideas and ways to market the same way [36]. Various movements, e.g., user innovation, crowdsourcing or open source innovation are based on this principle and are referred to open innovation [37]. Whereas this phenomenon started in the high-tech sector and at large international firms, today the stream of open innovation got mainstream and is also common in smaller enterprises [38]. Furthermore, in recent times we can see an increasing interest of firms to collaborate with external communities as potential source of (open) innovation [39]. This idea of innovation by communities is not new and has already been subject of extensive research in the past. As pointed out by von Hippel [1], user innovation communities can be found in a variety of domains and they can differ in their structure. One of the most referenced communities in this context is the one of Linux, originating from the open source movement. However, especially the fourth industrial revolution, coming along with various new technologies, will influence the economy and bring many potential new opportunities also for open innovation [40]. Already now the outcomes of these innovations get visible and impact economic structures on different levels [41]. One famous example for these new innovative possibilities is the emergence of the sharing economy business model [40], building on technology enabled collaboration and connection of internal and external actors.

Especially in the (direct or indirect) creation of technological innovation, communities play an important role [39]. Thus, especially when it is related to innovation, firms actively engage in such open communities, e.g., by sponsoring the projects or paying active contributors [3]. This direct involvement, often intended to ensure sustainable innovation, comes with certain risks for the viability of the communities, especially when the main contribution is done by employees [42]. The connection between firms and communities is still raising questions and may be challenging, e.g., if firms ignore the communities' needs or if the created output is not meeting the firms' expectations [3]. However, still, current models show that users, consumers, and communities play an important role in firms' (open) innovation process towards new business models [10]. Therefore, a proper understanding of the related communities and individuals, their aims and needs is essential to successfully innovate in an open way and to respond to future economic challenges.

As already mentioned, open innovation also relates to business models and their innovation. When the term open innovation came up, it has been early actively connected to business models, referring to the fact that the economic value of (innovative) technology is created through commercialization [36]. Today, we can see that the connection between business models and technology is far from clearly defined, resulting in two main research movements within this domain [43]. Especially the ongoing progress in this field, the different current movements in research, and practical application in various industries leads constantly to new insights and questions connected to open innovation and its relation to as well as influence on business models. However, since in current times

more and more disruptive innovation is on its way, we can see that new combinations of technologies will also lead to new innovative business models in various sectors [41]. Business models will be further defined by value creation happening through the interplay of technologies and markets, in which open innovation will be essential [10]. Therefore, we will see in future even more progress in this domain, outlining the important correlation between business models, technology and (internal as well as external) open innovation.

Open innovation, also originating by communities, firms' business models and technological progress are connected in various ways. As a result, communities got an important source of potential innovation and directly influence the business models of companies following this open innovation approach. The community construct in open innovation is still raising questions and has in previous work often just been considered peripherally, leaving room for future research [3]. This work, focusing on open source communities, may therefore also contribute to this field and give important insights into the community aspects of open innovation.

4. Open Source Business Models

Already early a connection between technology, such as (open source) software, and business models has been identified. As an example, in 1998 Timmers [24] lined out that technology will either be complementary to traditional businesses or will provide totally new approaches to make business. Furthermore, the emergence of new technologies provided new ways of value creation, enabling innovative business models [44]. Today, one can see a complex two-way relationship between business models and technology [43]. Already on from the early 2000s open source got associated in various ways to business models, providing a potential benefit by introducing it in industry or building business models around it (e.g., [2,8,28,45,46]). Since the projects' output is publicly available, there are often just limited direct benefits for companies involving in open source, but indirect benefits and advantages in businesses leads firms to invest in such projects [47]. In addition, open source software projects have established themselves as an important driver for innovation by communities, also relevant for and supported by businesses [3,46]. Especially innovation can get fostered by collaboration that is enabled through new technologies and virtual markets [44]. Whereas in former times especially firms, e.g., manufacturers, have been the force of innovation, also individuals and communities with the pure intention on personal benefit and without financial resources started to become compatible innovators especially in open source communities [1]. This innovation by open source projects is ironically also protected by the open character, supporting business models around it. As an example, companies started to donate their intellectual property to the public, therewith reducing the risks of lawsuits and also lowering the costs for the company itself and also related businesses [2]. Today, one can see that free innovation communities and companies are increasingly getting connected, in the best case creating benefits for both [4]. Especially in technology industries we can see many firms currently profiting from a mixed approach of combining closed internal and open community-driven innovation, e.g., by having an open source approach for software development and closed approach for the hardware on that the software is shipped [37].

However, the traditional business models that have been considered for open source research in the past are in most cases not necessarily fulfilled by the projects that produce software themselves, but enable firms to base a business model on them, e.g., by acting as distributor, providing additional services, or offering hardware [29,45,46]. In general, open source business models can be defined as clear and distinct business models built around the open source movement [2]. Famous examples therefore are RedHat, Suse, or MySQL who built business models on open source projects that are also strongly driven by volunteer communities. Which exact business model can be built around open source software is dependent on the license, since copy-left or other restrictions may influence them [29]. However, all licenses, even Free Software licenses, do not restrict selling software, as long as the defined freedoms are given [33].

Many open source projects receive commercial support or find themselves in ecosystems with companies and other partners, helping to drive the projects forward by e.g., stimulating the communities, employing developers to contribute or to build strategic alliances [29,46,48]. In these settings businesses in certain cases also see a moral obligation to contribute to such projects and give value back to the communities [46]. Besides that, also firms or governments established open source projects, so called sponsored open source communities, themselves where defined goals are controlled by the founding entity [47]. In general, the chosen business model connected to or built around an open source project might affect which individuals, or also corporations, are engaging in these organizations [28]. However, still, as one can see by browsing through the projects' websites is that many projects are non-profit and just have loose ties to commercial businesses. The emerging definition of NBMs might also allow seeing these projects, not following commercial goals but focusing on the community and its needs, from a business model point of view. This view can consider not only value defined as monetary profit, but also alternative forms of value that are present in these open ecosystems.

5. Open Source from a NBM Perspective

Open source gets developed by a diverse community of contributors, adding different values to these projects. These communities are well defined and known, but in many cases not arranged in a clear structure [28]. However, analyzing these communities shows the complex ecosystem built around such projects [25]. Leadership in open source communities is often fulfilled by the project's initiator [49], but already Raymond highlighted that these initiators, in case of their retirement from the project, have to take care to define successor, ensuring the sustainable and long-lasting development of these projects [30]. The absence of this leader role can bring a whole project to halt, till someone fulfills this role again [50]. Therefore, it is necessary that project leaders, who do not have any formal authority in the meaning of giving instructions to contributors, are present to the community and provide and communicate an initial shared vision and goal that this community is following [27]. Failing to pay respect to the community, including its greater goal, is a common source of failure in open source projects [48]. In vital projects, the structure and evolution over time are collaboratively driven to the individual needs of the communities and their members [49]. As an example, shifting open source projects to commercial business models potentially leads to project collapse [48]. Thus, we can clearly see that intentions of profit-generation, in the terms of money, is not a driver for value creation in community founded open source. Furthermore, social aspects are strongly leading to a personal motivation to contribute to open source projects. However, it is important to note that sponsored open source communities that are backed by a corporate entity, behave different since conflicting goals, i.e., control of the entity and openness of the community, must be balanced [47].

Although many open source projects get backed by paid contributors, volunteers play an important role for such projects [51]. Regardless if paid or voluntarily, individuals contribute to open and also innovative projects if there is an immediate or delayed net-benefit defined as individual benefit (e.g., reputation, knowledge, or experience) minus costs (e.g., time, effort, or innovation) of contribution [1,27]. Such communities innovate even without direct monetary compensation [42], making it necessary to understand their motivation that generates the mentioned benefit. Hence, various motivations to participate in open source communities have been identified in literature in the past and highlighted its complexity and impact on open source projects [31]. Similar to this described contributors' net-benefit, the outcome of a value oriented win-win situation is also important for new business models [5]. In the case of different stakeholders and also users, net benefit as described by [52], needs also to be ensured in the given context of value creation. As a result, it is necessary to know all actors involved in the open value creation and capturing process and their motivation that links to their individual received net benefit.

Each community has a unique structure of different formal or informal roles that are either well defined or just loosely connected [28,49,50]. In general contributors can be characterized by their

contribution. Each community has a core that is responsible for most of the code and has the biggest influence on the community and the future direction of the project, whereas peripheral contributors and users play a less important, but still essential, role [53]. Especially regarding these peripheral developers, one can see that in such communities there is a large number of contributors that just make one commit (code contribution) to the project and then disappear [27,50]. Contributors do not get formally assigned to a role, they rather decide on their own how much effort and work they want to contribute, enabling them to evolve to more responsible roles over time, but also to leave the community at any point [28,31,49,50]. Furthermore, as also the described open source software-based business models have shown, such projects are connected to a variety of external stakeholders, resulting in this complex ecosystem of different relations and multiple (intangible) values exchanged [25].

Bringing together contributors, users and other stakeholders, e.g., involved businesses supporting a project, got essential for the success open source software. Open source organizations, driving innovation, not only consist of a community of different individuals, but for various reasons also firms actively engage, either directly or indirectly, in these ecosystems [3]. Companies directly stimulate communities to innovate, but also give something back to them [46]. The same co-creation process and transfer of various values by various actors seems to take place in NBM. Different interests need to be balanced in a way to ensure socio, economic and ecological goals of a business. Therefore, holistic stakeholder analysis and understanding got vital to create new business models. Tools such as the Power Versus Interests Grid [54] as described in [55], or the Stake Model of a Firm [56] may support stakeholder identification and analysis. Analyzing stakeholders and actors of open source ecosystems unveils the complex relationships and highlights the co-creation of value [25]. Such manifold relationships in ecosystems, collaboratively creating value, got common in businesses and foster innovation especially in the current digital age. Therefore, current research on business models is increasingly focusing on the collaborative multi-value creation by various interconnected stakeholders.

Especially since value is co-created, no direct ownership exists in new business models. Instead of ownership, these models focus on the aspect of access [5]. This aligns with the before described principles and movement of free software. The freedoms of software ensure this access and even extend it by the rights to modify and redistribute it. As Chesbrough puts it [2], no one owns the right to exclude others from using open source technology. This goes along with the principle of open source software to not necessarily write code on your own, but also reuse code of others [30]. This leads to the conclusion that the defined characteristics of access over ownership has already been present in open source communities within recent years. This aspect also already required firms to adopt their processes when they introduced open innovation, making it necessary to change their business models to the new open character [42].

The co-creation of value by different contributors in a community, the exchange of intangible values in the ecosystem, following a vision that is not founded on monetary profit or business objectives, and the principle of openness over ownership are strong characteristics shared by both practical oriented research strands. By outlining the characteristics of these domains we can see similarities between open communities and new business models that are heavily influential for both domains.

6. Discussion

Current trends in business model research show that there is high potential for open source ecosystems of contributors, users, and stakeholders who are collaboratively creating value to be considered as a new business model. Existing and widely used frameworks to represent general business models lack in regarding the before mentioned alternative definition of value that gets co-created and distributed by communities of individuals that participate for a variety of different reasons in this process. Although research on NBMs is still in its beginning, the current state indicates that this might impact the understanding of how open communities create value not only from a profit, respectively commercial, viewpoint, but also from a social or individual viewpoint of the

involved actors. This leaves room for further research in combining these domains, allowing to see open communities not only to enable firms to build business models on them, but as (new) business models themselves.

The created intangible net-benefit in open source communities can be analyzed with these upcoming models and help practitioners to gain a better understanding of their ecosystems, as well as firms to understand the communities they are working with in their innovation process. Not only monetary value is generated by the developed software or innovation, but also an individual net-benefit for each actor involved in this co-creative value generation and distribution process. The co-creative approach potentially involves a variety of actors, e.g., individuals, firms, or governments that work jointly towards a shared, as well as different individual goals. This collaborative approach can be captured by new representations of business models that might help to also explain the goals of a community, motivation of the individual contributors, and co-creation of mostly intangible value, such as innovation.

Till now, NBMs often focused on sustainability issues and stakeholder relations. However, as this first review outlines, doing research on new business models is also a potential chance for researchers in the area of collaborative open source organizations and open innovation approaches. These open communities are more and more situated in complex ecosystems of individuals, firms, users and other partners, all creating, but also expecting, value. This co-creative nature, based on needs and individual motivations, can be a role-model for other communities not necessarily only connected to ICT, but due to their social nature of sharing and collaboration also for cases in the emerging field of NBMs. The state of art in these domains shows many similarities when it comes to the research strands' main characteristics. Although the sustainability character outlined in most work about NBMs is not explicitly related to open source software development, the social aspect strongly is. This aspect leaves room for further research in combining the fields in explicit cases, targeting to gain further insights into the social character and the intangible needs originating from the individuals' motivations in communities that result in the collaborative creation of various values for all entities in the connected ecosystem. Not only open source projects can benefit from these insights, but also other open communities that drive free innovation or create alternative kinds of value. Open innovation got common in different industries, facing different challenges that still need to be solved. The outlined application of the proposed tools for NBMs in a variety of such open communities is expected to give further implications how researchers and practitioners can understand their value creation and delivery process that lead to innovation and their sustainable long-term existence.

7. Conclusions

As we showed, current economic research is going towards a new understanding of business models and the creation of value. Involvement of various actors, creating multiple values and replacing money as main currency of value can get identified as key points of emerging new business models. This still developing field has the potential to also provide new insights into information systems, especially related to the collaborative development of open source software. Communities driving the movement of open source have been mainly seen in literature as enablers of business models that generate profit for firms in a project's ecosystem. However, in recent years also businesses started to sponsor and support these innovative communities themselves, making open communities an active part of their ecosystems. New trends in business model research allow seeing these open communities through a new perspective, co-creating and realizing different values for several involved actors. We showed that both research strands, open source communities and NBMs, are following trends of collaboration in heterogeneous ecosystems that heavily depend on intangible values often also connected to social and individual needs. Representations and further definitions of NBMs have the potential to foster the understanding of the therewith connected mainly non-monetary values transferred, which are essential for the viable management of open ecosystems. The growing involvement of firms in these ecosystems, actively driving innovation, makes it necessary to gain

a better understanding of the processes that cannot be represented with previous business model notations, not considering social and other non-economic aspects.

Therefore, based on current literature, this work points out the chances that are provided by combining research on (open) information systems and new business models in practice, to enhance the understanding of both research strands. Tools and frameworks that come up with research on NBMs can be applied to open communities and ecosystems, helping to see them from a holistic point of view and various relevant perspectives for the communities. Although the focus of this work has been on open source communities, it indicates to be also valid for the related field of open innovation communities. This review is intended to build the theoretical basis for action-based research, initiating cases that take into account the outlined similarities between the two domains of NBMs and value creating open communities.

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