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Community-based business models
Insights from an emerging maker economy

Patricia Wolf[1], Peter Troxler[2]

[1] Future Laboratory CreaLab, Lucerne University of Applied Sciences and Arts, CH-6002 Lucerne, Switzerland, patricia.wolf@hslu.ch
[2] Rotterdam University of Applied Sciences, Research Centre Creating 010, Wijnhaven 103, P.O. Box 25035, 3001 HA Rotterdam, The Netherlands, p.troxler@hr.nl

Abstract. Community-based business models are an emerging phenomenon in business reality, particularly in new economic developments such as making. They are a form of commons-based peer production. This paper contributes to advancing research through a multiple case study of eleven community-based maker businesses. The study elaborates on altruism and hedonism as emerging design themes, it addresses aspects of fairness and reciprocity in the interactions with the community, it looks into what values are created, and it reflects on the maker context where businesses strive not purely for profit maximization.

Keywords: making, community-based business models, business model portfolio, activity system, commons-based peer production

1 Introduction

The maker movement is one of the recent approaches that strive for democratizing access to knowledge and production devices ([1], [2]). Participants in the maker movement form open design communities of digital makers ([1]) who engage in commons-based peer-production ([1], [3]). Similar to open source software communities, maker communities strive to use open design principles to make project details like design blueprints freely online available to everybody.[1] One of the best known examples of an online maker community is Thingiverse (http://www.thingiverse.com/): The Thingiverse community forms around a website dedicated to the sharing of user-created digital design files for physical objects, providing primarily open source hardware designs. It is widely used in the DIY and maker communities and by 3D Printer operators as a repository for sharing innovation and dissemination of designs to the public. Thingiverse was started in November 2008 as a companion site to MakerBot Industries, a 3D printer manufacturer, now part of

[1] It is worthwhile to note that the term "community" (and "community-based" in consequence) has been used in a broad variety of contexts with significant decrepancy of significations. In this article we use the term "community" in the sense of Internet communities as [1], [3]. [6] and [36] use it; this use is thus different from the conceptions of "community" (and "community-based") in anthropology or critical studies.

Stratasys. The repository currently contains to over 500.000 designs and connects over 130.000 community members.

Openness – such as the sharing of digital designs on Thingiverse – becomes a key governing principle that promises to create new business models based on peer-production principles such as co-creation, open knowledge sharing, altruism, collaboration, and common ownership of the resources for and the results of production ([3]; [4]; [5]; [6]; [7]). Opennes is supposed to benefit all participants in the value creation system by contributing to a commons. This paper aimes to contribute to the understanding of how openness plays a role for makers to establish their business model. From their extensive literature review, [8] define a business model as a "*unit of analysis*, offering a *systemic perspective* on how to 'do business', encompassing *boundary-spanning activities* (performed by a focal firm or others), and focusing on *value creation* as well as value capture" (ibid; 1038; accentuation in the original paper). With [9], we think that "unrealized value in the business model idea lies in what it can capture outside of the traditional business profit equation, where money is not the primary currency, and the customer and the firm are not the only primary players" (395). In response to [9], [10] confirm "a shift in the locus of competitive advantage from the firm and its internal stakeholders (e.g. management, shareholders, and employees) to its activity system, which encompasses external stakeholders such as partners, vendors and customers" (404) – and indeed the whole community.

2 Open Business Model Research

Over the past decade openness has started to attracted attention in strategy research. Such research mostly focuses on the issues of established strategy development interfacing with a wider audience ([9]). [11] discussed the dilemmas of transparency and inclusion in the development of strategy and the role of the strategy profession; they conclude that the "evolution towards greater openness is exposing its members to significant strain." [12] studied the implications of Web 2.0 tools and communities on how companies create value on the internet and how they strategically developed their business models. They found that "the firm's customers are becoming an increasingly important source of information about these changes, as evidenced by the growing relevance of user-added value and interaction orientation identified in our study" (287). [13] suggested a taxonomy for community-focused firm strategies based on the congruence of firm-community values and power of the firm over the identities of the target community.

The increased attention of strategists on openness as a strategic dimension in business model development has created a broad echo in business model research. In general, we can differentiate between two streams of scholarly work: First, there is a large, comprehensive and substantial stream that investigates community-oriented strategies and business models of which the focus is to extend a central firm's business model with the firm's interaction with a community of user-client-stakeholders. Second, there is a rather marginal stream that studies community-based strategies and business models of firms that emerge from the community by making

use of shared community resources, work with members of the community as peers and contibute back to the shared resources.

2.1 Community-oriented business models

Value creation in the context of community-*oriented* business models implies that focal firms strive "to find an appropriate revenue model (…) that would be both acceptable to their (…) clients and allow them to maximize their profits." ([14] 218). Particularly value creation with communities of customers and end-users has attracted high interest as a strategy for business model innovation (for a summary, see [15]). The appearance of the Internet in combination with virtual rapid prototyping technologies, web 2.0 applications ([15] 344) and social software ([16]) "changed the traditional balance between customer and supplier" ([17] 172) and thereby incumbent ways of doing business ([17]; [18]; [[8]]).

The transition towards community-oriented business models is thus challenging because of the relation of the focal firm with users and user communities. Literature revealed tensions between the profit maximization logic of the open, user centric business models and the values in open user communities. From the perspective of large firms, these communities are difficult to be governed because they often do not accept traditional mechanisms of power, control and expropriation and "tend to favour self-organization, informal relationships and transactions based on reciprocity and fairness. (…) those attributes encourage information sharing and aggregation, but are less effective for offering formal protections" ([19] 74). [20] therefore suggest investigating "the role of incentives and values in large-scale, multiparty collaboration" (746). [16] confirm these potential frictions between the concepts of strategically maximizing profits and open knowledge sharing and altruism. Research is needed on the interaction between communities and firms – on firm strategies for accessing communities and for defining the properties, management approaches and leadership issues of firm-community interaction, on influence and community sponsorship by firms and whether these are seen as beneficial or obtrusive. Such research might find "generic patterns in business models that take advantage of assets co-created with consumers and users ([16] 307) – and create value for firms and customers,

2.2 Community-based business models

Community-*based* business models, however, do not start from the focal firm aiming to create a community surrounding it ([7], [16], [20], [22], [45]). Rather, they are concerned with a (focal) firm that emerges from the context of some collaborative – often online – user community. Thus, community-based business models are inextricably linked to a co-creation process that tends to include elements of altruism, open knowledge sharing, and common ownership of production resources and results. [21] finds that traditional business modelling instruments such as the Business Model Canvas [69] fail to adequately capture the business model of collaborative communities because "often Open Source and P2P distributed systems have fuzzier

boundaries and more units" (207). Yet, scholarly analysis of community-based business models and their design parameters is sparse. Such business models would theoretically not be driven by profit maximization and have probably therefore not grasped the attention of management scholars. There are however some insights that resulted as by-product from three different streams of research that might inform the analysis:

First, in the context of large scale inter-firm collaboration, [22] use the concept of collaborative entrepreneurship to describe a potential business model at the heart of which lies "the creation of something of economic value based on new jointly generated ideas that emerge from the sharing of information and knowledge" (2). [20] studied cases of multiparty collaboration within large distributed organisations (Network Centric Operations in the US military and within Accenture) and across organisational boundaries (Linux open software community, Balde.org as collaborative community of more than 70 firms). They offer suggestions for organizational designs based on "(1) actors who have the capabilities and values to self-organize; (2) commons where the actors accumulate and share resources; and (3) protocols, processes, and infrastructures that enable multi-actor collaboration" (734). These suggestions build on earlier contributions on peer-production by self-organizing actors ([23]), on the concept of common resources ([24]), and on the prevention of free riding ([25]; [26]). Governing principles are transparency, shared values, reciprocity, trust, and altruism ([24]; [27]; [28]), and lateral decision making mechanisms instead of hierarchic control ([20]). [20] however do not draw the ultimate consequence to a collaborative managerial philosophy built on values that include a concern for the welfare of collaborating partners and the equitable distribution of rewards ([29]).

Second, research on business models often addresses community and network aspects in e-business. [30] distinguishes between eleven generic e-business models. [31] discusses communities of loyal users as an element of value proposition and a mode of generating revenue for firms.

Third, online communities of volunteers are known to contribute to value creation through supporting societal development. The Open Source Software movement is frequently cited as example of networked social capital ([32]; [33]). The motivations of programmers to contribute to open source projects were a matter of research and were found to be extremely multidimensional. Intrinsic, hedonistic motives such as enjoyment, amusement, fulfilment, satisfaction, sense of scientific discovery and creativity, and challenge exist next to extrinsic (reputation, signalling incentives), political-ideological (anticommercialism, hacker culture) and social motives like sense of belonging, altruism, contribution to public good and generalized reciprocity (e.g. [33]; [34]; [35]).

Investigating projects in consumer electronics and ICT hardware, [36] found that many of them attracted high numbers of contributors to sustain the project development flow and were structured and governed similar to open source software projects. The global Fab Lab network and the maker movement offers open access to a range of low-cost fabricators and platforms to share design blueprints and project details, realizing a commons-based peer production ecosystem ([7]; [37]; [38]; [39]; [40]; [41]; [42]). [43] highlight that hackerspaces adopt hybrid modes of governance

to realise aspects of peer-production project principles. These communities practice open, reciprocal knowledge sharing and understand knowledge as a commons ([24]).

[44] who investigated entrepreneurial dynamics originating from communities find that "unprecedented opportunities arise for a creative recombination of so far unrelated elements of practices" (9). Similar motivational structures were found in open design communities ([2]).

2.3 Open research questions

Literature on openness in business models acknowledges that community-based business models may become important for strategy development in the future (e.g. [20]; [22]). At the same time, scholars underline that there are many open issues that should be investigated to gain a better understanding of such business models (e.g. [7]; [16]; [45]).

Literature suggests identifying business models that practice multi-dimensional value creation and include altruistic activities as well as governance mechanisms that enable open knowledge sharing, peer production and commons development. Most recently, [9] sketched six areas for business model research among which two immediately appear pertinent to the research focus on online peer-production governed community-based business models:

- "the study of business models involving outside parties, especially in nontraditional ways (e.g. not paying users to create content that others see at the cost of being exposed to advertising)" (395); and
- "the unintended and unforeseen effects that occur within the organization when new business models – especially those involving the delegation of operations and control to a network residing mostly outside of the focal organization – are adopted" (394).

[9] further suggests that regarding the social context there is a lack of theory of how to trade "various forms of stuff (…) (money, knowledge, improvements in living conditions, and so on)" (398). The open design movement is said to create value in multiple dimensions, but little is so far known about how these values as well as the community principles of openness, collaboration, sharing and common ownership are in practice translated and reflected in the design parameters of community-based business models. [46] (93-94) noted that "commons-based peer production has found ways to generate monetary returns", but that there are no clear examples how peer production would tap into other dimensions of value creation, such as hedonic rewards or income generation under non-market conditions. It is unclear how commons-based peer production activities which have strong relations to craftivism and hactivism sustain a livelihood or create a viable enterprise ([47]; [48]).

The explorative study presented in this paper was therefore aimed at shedding light on the research question "What are the design parameters of commons-based business models of companies that are originate from and are active in the context of maker communities?" The paper is thus aimed as a contribution on understanding how making is brought to a business model. To do so, we looked into the business models of start-ups that emerged from and operate within the context of collaborative, peer-production governed online user communities.

3 Methods

Given the limited empirical theoretical foundations on community-based business models as our "phenomenon of interest" ([49]; [50]), we decided to use a multiple case studies approach as overall research design. Qualitative research helps to study complex phenomena when there is no previous research available ([51]; [52]).

We used the concept to view business models as activity systems proposed by [14] for the analysis of our data.

> The business model is described as
> *"the system of activities performed by the focal firm as well as by third parties (partners, suppliers, customers)"*
> with two sets of design parameters:
> *"design elements (content, structure and governance) that describe an activity system's architecture"*, and
> *"design themes (novelty, lock-in, complementarities and efficiency) that describe the sources of its value creation."* ([14] 217).

Our main motivation was that the activity system perspective on business models seemed particularly appropriate for an exploratory multiple case study because it theoretically offers to study "what goes on within the 'black box' of activities, and suggests possibilities for probing deeper and gaining a better understanding of the micro-mechanisms of business models" ([14] 224).

3.1 Sampling

The core sample of a multiple case study must include the so-called "pivotal target group" ([51] 143), i.e. informants able to provide essential insights to answer a research question. The objective of our study was to understand community-based business models that are used by companies that originate from and are active in open design communities, for the purpose of this study specifically the Thingiverse community. For the sake of simplicity and readability, we will call this group further "digital maker CEOs".

We purposively sampled cases from which we expected a maximal variation in business models ([53]) "to disclose the range of variation and differentiation in the field." ([52] 122).

We applied a 5-step-approach to arrive at a manageable sample size:

(1) To start with, we used the public statistics of the open design platform "Thingiverse" ([54]) to identify users who actively engage in co-creation, i.e. whose design blueprints were revised by many other users.
(2) From an initial list of about 60 Thingiverse users, we filtered 25 users who were additionally (co-)founders and CEOs of their own company related to their activities in the open design community.
(3) We then analysed the information from the company websites and the Thingiverse user profiles to understand the salient design parameters of their business models that resulted in five categories: participation in

online brokerage and sales platforms, direct sale of object via web shops, 3D printer retail, customized prototyping, and research and education. All of them exposed some variation in their business models that made it necessary to hold at least two interviews per category.

(4) In order to balance the sample, we broadly decided to approach three digital maker CEOs per category, fifteen in total, and we were allowed to interview eight of them.

(5) To enlarge the sample purposefully, we asked interview partners to recommend others who ran companies with the design principles we were still looking for. The method of snowball sampling is used "to obtain a sample when there is no adequate list to use as a sampling frame" ([70] 63). Through this sampling approach, we identified three additional interviewees.

In the end we conducted qualitative in-depth expert interviews with eleven digital maker CEOs (table 1).

Table 1: Sample

Case No.	Experiences of informants with business model category	Offerings of companies
1.	Direct sale of object via web shops; online brokerage and sales platforms	Custom 3D printed smartphone cases
2.	Direct sale of object via web shops; online brokerage and sales platforms	3D printed open source design based objects
3.	Direct sale of object via web shops	3D printed design based objects / fan ware
4	Customized prototyping; 3D printer retail	Personalized merchandize and arts performance, 3D printers
5.	Customized prototyping; online brokerage and sales platforms, research and education	Industrial prototypes and fan ware, courses
6.	Direct sale of object via web shops; research and education; online brokerage and sales platforms	Technical parts of 3D printer (nozzles), courses
7.	Customized prototyping; online brokerage and sales platforms; research and education	Neurobiological devices, 3D objects for educational purposes
8.	Research and education; customized prototyping	Open Worm project, 3D objects for educational purposes, courses
9.	3D printer retail	3D printer and services (training and tech support)
10	Customized prototyping	Product prototypes for industry
11.	Customized prototyping; online brokerage and sales platforms s	3D design objects and design exhibitions

3.2 Data collection and analysis

Data collection happened in a two-stage approach: First, we run a document analysis ([55]) of the Thingiverse user profiles and the company websites to achieve an overview on types of business models that arose from activities in open design communities. Second, we held expert interviews with narrative parts ([56]) that used a chronological approach ([57]; [58]).

Interviewees were first asked to tell the process from the idea to the business, and were then invited to present and reflect upon their business model and its underlying design parameters according to the framework provided by [14]. The interview guideline was therefore designed to retrieve information regarding all of their three activity system design parameters. These are (220) content (*what* activities are performed by the company), structure (*how* are the activities linked and sequenced), and governance (who should perform activities, and where).

As the value drivers seemed particularly important to understand the basis of community-based business models, we included questions that asked for the design themes according to [14] (222), novelty (innovative content, structure or governance), lock-in (elements to retain business model stakeholders), complementarities (bundling of activities to generate more value), efficiency (organisation of activities reduces transaction costs).

Interviews lasted between 24 and 79 minutes. They were tape recorded and transcribed verbatim. The transcripts constituted a body of 146 pages of data.

The data analysis process consisted of several steps of classifying, comparing, weighing and combining the material in order to extract meaning, implications, patterns or descriptions to come up with coherent findings ([56]; 201). Following [59] (5) the transcripts were coded using the theoretical background of design elements and design themes as proposed by [14]. To these categories, we added an "open theme" category that allowed to gather emerging themes ([56]; 207).

Two professors and one student-researcher participated in the data analysis. First, the two professors and the student-researcher coded the data individually. The codes obtained were then discussed and refined into a common interpretation, i.e. a list of codes and related text passages. In the next step, a code map was set up to gain an overview on the topics identified. The code map was the basis for a a cross-case analysis and to deepen the understanding and explanation of the question at hand ([50]; [60]).

4 Findings

The case analysis produced two major types of results. On the one hand, we were able to describe the five salient categories of business models we identified during the case selection process in more detail (see 4.1 to 4.5 below). On the other hand, we found that with the exception of one case all companies operated a portfolio of simultaneous business models as building blocks, and only the combination of these building blocks resulted in a description of how the overall business operated (see 4.6 below). The way in which the different building blocks were combined seems to be unique for online communities that operate based upon peer-production principles – the business

models exhibiting multi-dimensional value creation and including altruistic activities as well as governance mechanisms that enabled open knowledge sharing and commons development.

From the multiple case analysis we were able to describe the activity systems of the five salient business models we specified earlier:

1. (Participation in) online brokerage and sales platforms
2. Direct sale of objects via web shops
3. 3D printer retail
4. Customized prototyping for industry or private clients
5. Research and education activities

These five business models are described in more detail below.

4.1 Participation in online brokerage and sales platforms

Four interviewees (1, 2, 5, 11) were using online platforms as part of their business model. The activity system of online brokerage and sales platforms consisted of an internet-based infrastructure that allowed suppliers to expose themselves to a potential clientele and helped customers to find services and products from a range of suppliers. Platforms typically facilitated activities such as information exchange between the parties and support transactions such as ordering, payment, escrow and order fulfilment. Sharing did not appear to be part of the activities of the platforms we found.

The business model of platforms was mainly built around the design themes of novelty and efficiency. In the case of makexyz the novelty aspect was easy access to local 3D printing suppliers that could manufacture an object from a digital file. Makexyz included complementarity design themes in their platform as they also had a web shop where designers offered their creations, and they also offered CNC machining. Possibly, their lock-in strategy was based on providing customers with access to local suppliers. Both platforms offered web portfolios for the participating designers which as a hedonistic reward served as a lock-in design theme aspect. In the case of etsy, access to a wide range of handcrafted design objects was a novelty design theme aspect. etsy also realised a certain lock-in design theme aspect: “etsy was the first place we tried to sell online because it is a huge pre-existing market (…and) infrastructure for selling.” (interviewee 2). Both platforms needed to operate efficiently to keep operations smooth and overheads low.

4.2 Direct sale of objects via web shops

Five interviewees (1, 2, 3, 5, 6) were selling their designs directly via a web shop of their own. The designs were either delineated by the web shop owners or by other designers. Objects sold were often fan articles related to games.

The activity system of the web shops were built around the main business of selling products. Activities thus included displaying objects, ordering, payment and order fulfilment. We found two distinct groups of web shop business models: One group (interviewees 1, 2, 6) explicitly included revenue sharing in their activities for

design that they did not create themselves (interviewee 1 and 2). The other group (interviewee 3 and partly interviewee 5) was not considering this.

In terms of activity system structure, interviewees did not build their web shop from scratch but used readily available technology. The governance of the web shop was under the control of the web shop owner, both in terms of creating the offer and in terms of accepting and fulfilling orders. The business models of web shop owners we spoke to were built around offering cool and cheap design objects, fan gear and paraphernalia. This played particularly on the novelty design theme, while some lock-in aspects might be supposed as well.

4.3 3D printer retail

The business models of interviewees 4 and 9 were focused on 3D printer retail. Both interviewees included activities such as stocking and selling 3D printers and supplies to a mainly hobbyist clientele in their business models. While the activities of interviewee 4 appeared to stop at this, interviewee 9 also sold support services to clients. None of them actually includeed any sharing element in their activities. The activity system of this business model was structured and governed as a traditional retail operation with a physical shop.

The business models revolved mainly around the novelty design theme and the hype around 3D printers. Interviewee 9 furthermore seeked some complementarity when offering support and additional services.

4.4 Customized prototyping

Six interviewees reported to develop and 3D print customized prototypes for industry (interviewees 7, 8, 10 and 11) or private clients (interviewees 5, 7 and 8, specifically in order to repair broken objects or to create personal things). Interviewees 4 and 11 were also scanning people and printing miniatures of them as part of events at art galleries.

Activities in this business model were creating a 3D model – either by drawing them on a computer or by scanning physical originals (people) – and printing them.

The business models appeared to work on the lock-in and novelty design themes – the design skills for developing and creating 3D printed prototypes, replacement parts and figurines were scarce in the market, and there was some demand for items produced with the somewhat overhyped 3D printing technology. Altruism as a theme (free work and support) emerged which could also be read as a lock-in design theme aspect, particularly in the interaction with private clients. Neither efficiency nor complementarity seemed to play a prominent role here.

4.5 Research and education

The activities of business models in research and education consisted either in providing 3D printing courses (interviewees 5, 6 and 8), creating physical objects for

educational purposes (interviewees 7 and 8), or improving 3D printing technology (interviewees 6, 8, 9 and 11). These activity systems explicitly included sharing of knowledge.

The structure of the course model reflected structures found with conventional training providers. The other models showed much more ad-hoc structures, additionally they explicitly included a community element, and the community had a more governing or self-organizing role in determining the directions of work.

The research and education business models mainly built on two design themes: novelty and lock-in. Novelty, once more, was drawing on the current state of 3D printing technology. A supposed lock-in was built on creating a community around the main activities of the business model – this contribution was not financially remunerated but probably based on altruism or hedonic rewards. There was also a complementarity design theme aspect when people from various backgrounds worked together online on solving problems and developing solutions: "it's people like myself (…) getting together to do this really interesting and amazing things and kind of push the technology forward" (interviewee 6).

4.6 Business models as business model portfolios

Table 2 shows that except for interviewees 3 and 10 all interviewees reported using more than one business model in their practice. We therefore argue that the interviewees used the business models that we identified based on the framework of [14] rather as building blocks than as stand-alone business models. We posit that the overall business models appear only in the combination of these building blocks.

Table 2: Business model building blocks used by the interviewees

Interview	Sharing	Participation in (online) platforms	Direct sale of objects (web shop)	3D printer retail	Customized prototypes for industry or private clients	Research and education
1	S	x	x			
2	S	x	x			
3	–		x			
4	–			x	x	
5	S	x	x		x	x
6	S		x			x
7	S				x	x
8	S				x	x
9	S			x		x
10	–				x	
11	S	x			x	x

Legend for "Sharing": S = practiced sharing; – = no sharing

The relatively small sample appears to suggest that there are three main clusters of business models that are combined in online community-based open design business models: (1) the sale of open design objects via platforms and web shops, (2) the sale of 3D printers combined with other activities in prototyping or research and education, and (3) the production of customized prototypes in combination with research and education. Interviewees 5 and 11 even reported a broader range of building blocks in their business models, combining prototyping, research and education and sales through platforms and web shops. Interviewee 6 is an interesting case as they combined research and education with a direct sales model.

From the interviews we understood that the design theme of complementarity of building blocks in individual business model activity systems was essential to sustain a business. This can be an indicator that sufficient volumes and margins in individual building blocks are only emerging. Interviewees confirmed this view particularly when indicating that they experienced little or no competition from big companies in the market and that they felt well positioned as early adopters of open design business models in face of an incumbent industry that was literally "sitting on its hands" (interviewee 6).

Furthermore, and this seems to be unique to online community-based peer production business models, building blocks exhibiting altruism were combined with building blocks focused on covering basic costs – instead of maximising profits. Particularly research activities are commonly carried out in communities to which participants contribute for free out of interest – "lovers who have extensive experience in 3D printing and (…) they give us a lot of feedback" (interviewee 9) – or because they believe that only by collaborating in a community more value can be generated: "most of my ideas were derived at least partially from other's work, and I always love to see more designs derived from mine" (interviewee 11).

5 Discussion

From the multiple case study, several topics emerged that contribute to advancing research on open business models as a strategic issue and that will be discussed below: First, we compare the nature of the community-based business models we found with traditional and community-oriented business models. Second, we elaborated altruism and hedonism as emerging design themes. Third, we addressed aspects of fairness and reciprocity in the interactions with the community which clearly differentiate community-based from community-oriented business models. Fourth, we looked into what values were created by the businesses we studied as we expected to find multi-dimensional value creation. Fifth, we reflected on the applicability of the theoretical framework for describing business models as activity systems in terms of design parameters developed by [14] to a context where businesses strive not only for profit maximization.

5.1 Traditional parameters in community-based business models

Most of the business models that we identified from our exploratory multiple case study contained traditional design parameters. As we had expected business models based upon altruism, we were surprised to see that most of them differed little from business models that we already knew from e-business ([30]; [31]; [61]; [62]; [62; [45]) and traditional business models ([17]). Even the integration of the community into the development of 3D printing technology that was reported in interview 9 could be read as part of the Freemium model that has been described many times as underlying business model of companies cooperating with open software communities like Linux (e.g. [17] 179; [20] 741-742; [63] 21-22).

However, it is remarkable that nine out of eleven of our interviewees reported using more than one business model – they combined several models into a business portfolio. Only the identification of the combination revealed the complete business models.

This combination of building blocks could possibly create difficulties for large companies that wish to cooperate commercially with small firms that also operate community-based building blocks. As knowledge flows from the community-based model into the commercial model, this could create tensions within the community. Inversely, when the small firms start to share experience gained in a commercial model with the community in the community-based model, this could make it difficult for the large firm to sustain the commercial relationship, depending on the type of experience shared.

5.2 Altruism and hedonism as emerging parameters of design themes

Apart from traditional business model parameters, we also found that most business models – free education activities, prototype production for private clients without charge and gratuitous participation into research activities – included activities driven by altruism and/or hedonism. This clearly distinguishes community-based from community-oriented business models where such activities are expected to be carried out by private contributors but don't form part of the (mostly large) companies' business models.

We furthermore discovered in eight out of our eleven cases an idiosyncratic and unique combination of capitalistic and peer-production building blocks in online community-based business models. For example, interviewees 5, 7 and 8 both produced prototypes that they sold to industrial clients for a usual market price and offered a combination of free education and repair services to private clients. Another altruistic building block were free tutorials and education courses for community members offered by interviewees 6, 7, 8, 9, and 11. All of them however covered their costs by including one or more building blocks that provided them with revenues based on traditional principles to their business models. A further example is interviewee 9 who sold 3D printers and participated in open hardware research projects. Their motivations were curiosity, sense of belonging to a community, the aim to push the boundaries of knowledge and technology, and hedonism. Here we confirm earlier findings ([2]) suggesting that motivational structures to participate in

open design communities resemble those found in open software communities (e.g. [34]; [35]; [33]).

Altruism and hedonism emerged as parameters that allowed such combined business models to realize design themes like lock-in due to personal relationships, novelty from the development of 3D printing technology and complementarity in the knowledge community users would share in their collaboration. Maximising profits and not just covering basic costs was at the same time not a main theme in the interviews. Particularly research and education activities or prototyping services for private clients were commonly carried out for free because they believed that only by collaborating in a community more value can be generated. Contrarily to what literature on traditional capitalistic business models suggests (e.g. [14] 218; [17] 173; [8] 1034), earning a living instead of maximizing profits was the predominant topic in all interviews.

5.3 Reciprocity and fairness as governance principles

From the perspective of the digital maker CEOs, community-based innovation emerged not from leveraging the knowledge of community members like this was described by like in the literature on community-oriented business models (e.g. [14]; [63]). We found more symbiotic business models and revenue sharing in the building blocks. Interviewees 1, 2 and 6 who run a web shop understood the designers in the community as their co-creators and paid them back when they sold their designs. For these building blocks we can confirm that when peer production values are lived, transactions in the value chain are "based on reciprocity and fairness" ([19];74) – and this makes revenue sharing a must.

Patenting and trying to control the user community was not an issue in the interviews as opposed to the views of large companies expressed in the community-oriented literature (for a summary, see [16] 297). Instead, interviewee 9 considered the community to be "a free R&D department" – but he shared amendments in designs and technology back for the benefit of others. Companies that close down innovation processes face the risk of losing such a community – something that happened to the 3D printing company MakerBot when they sold their business to Stratasys as interviewee 4 reported. Of the interviewees, only one hobbyist (interview 3) reported a business model building block that resembled free riding: He capitalized on the designs of others that he modified and sold in his web shop without sharing design amendments and revenues back. Interestingly, such behaviour was not sanctioned by the community, most probably because he did not make big money with the small amount of cheap fan ware.

5.4 Multiple value dimensions

From the literature review, we expected to find community-based business models to create value in multiple dimensions ([64]). From our findings, we can confirm that the value created in online open design communities was not just commercial/financial value. The web shop owners rather highlighted the social value ([64]) of providing

customers with more choices, particularly of handcrafted objects and supporting craftsmanship instead of mass production. The opportunity to gain access to local 3D printer suppliers was in line with values of saving the natural environment ([65]) and the social value of neighbourhood community building ([64]).

Education and research activities contributed to the development of human capabilities as [66] suggests and to the development of knowledge and technology in the society ([64]). Social entrepreneurship was reflected in community-based business models not as value creation mechanism in contexts of deep poverty (e.g. [67]; [68]) but as an expression of self-empowerment of a community of users that openly shared access to production technology and knowledge ([2]).

5.5 Testing the activity systems framework

The theoretical framework proposed by [14] (224) worked well as a guiding framework for our analysis. Particularly the orientation provided by the design parameters allowed developing a thick description of "what is going on in the black box of activities", thereby paving the way for "a better understanding of the micro-mechanisms of business models." ([14]; 224) We found that this framework is applicable as analytical framework also to a context where businesses partly do not strive for profit maximization.

The insight that the digital maker CEOs in our sample used more than one business model as building blocks for their overall, composite business model implies an important specification on how the activity system framework should be used by researchers studying community-based – but also in general start-up business models. Instead of assuming single business models like [14], researchers should expect composite business models in these contexts. In our context, this finding confirms and explains research by [21] who found that applying traditional business modelling instruments such as the Business Model Canvas [69] failed to adequately capture the business model of collaborative communities because "often Open Source and P2P distributed systems have fuzzier boundaries and more units" ([21]; 207).

6 Conclusions

Scholars agree that the maker movement holds the potential to come up with a new economic model that is not based on mass production [8, 9]. This paper was aimed to contribute to understanding how making is brought to business models.With this research, we aimed at contributing to theoretical and empirical work on business models in three ways: First, we aimed at advancing theory informing research on making and strategic organization by conceptualizing and refining the distinction between community-oriented and community-based business models. We did so both at theoretical and empirical level: From our literature review, we identified differences in the governance philosophy of company-community-interaction. While literature shows that the so-called user centric or open innovation community-oriented business models solely focus on creating company value, maximizing profits from leveraged user knowledge and on protecting it, community-based business models are

said to be based on peer-production principles like open knowledge sharing, reciprocity and commons development ([2]; [7]; [24]; [40]; [41]; [42]; [43]). As expected, we could identify these community-based governance mechanisms in the business models of our sample and could thereby confirm theory in a under-researched area.

The findings bring about important insights that answer open questions on the relationship between firms and communities. Our findings indicate that corporate strategists could take maker community values – open knowledge sharing, altruism, collaboration, and common ownership of resources and results of production ([3]; [4]; [6]) – and think about symbiotic ways of practicing business models where revenues, access to technology or knowledge are shared back with the contributors and the community. This would help them to avoid potential frictions that emerge from the conflicting concepts of strategically maximizing profits and open knowledge sharing and altruism ([16] 307; [19] 74).

Second, with our empirical data, we strived for revealing design parameters that constitute the activity systems of community-based business models using the example of the maker community Thingiverse. Based on extant literature, we expected finding business models that practice multi-dimensional value creation ([64]) and include altruistic and hedonistic activities. Our data provide some first and rather anecdotal evidence for a novel phenomenon, i.e. the existence and operating modes of community-based business models involving nonmonetary exchanges ([9]). The identification of community-based business models is therefore a major contribution of this article.

Third, we sought for testing the applicability of the theoretical framework for describing business models as activity systems in terms of design parameters developed by [14] to a context where businesses probably not strive only for profit maximization. The framework was helpful as an analytical grid for identifying and describing business models, but we also found that the community-based business models emerge from the combination of market and peer-production business models that were used by the digital maker CEOs as building blocks.

This might be an indicator that sufficient volumes and margins in single business models are only emerging. It might however also be a specific phenomenon that emerges from the open knowledge sharing values in peer production communities. A longitudinal study of these developments is strongly recommended to future research because issues like maturation of community-based business models over time or success factors in managing and sustaining such composite business models remain beyond the focus of this study.

Overall, our research contributes to the understanding of business models and strategies in non-traditional contexts [9] called for – here: maker communities governed by peer production principles. Such studies help to understand challenges for existing companies to deal in their business strategies with “the increasingly powerful and important position that individuals outside the firm hold, particularly when organized in communities” ([16] 298). This is also important because maker communities can be understood as early indication of a societal transformation that requires new, more community-based types of business models and forms of value creation to sustain commercial activities. From our findings, we therefore agree with [16] that a “logic of co-creating strategy may (…) create opportunities for strategists

who understand and internalize the two perspectives of inside and outside the company." (310-311)

Being a multiple case study, the research presented here is not without limitations. The latter particularly concern the fact that the main perspective of our research was the one of the digital maker CEOs and not the community members. Furthermore, the experiences of our interviewees certainly do not include the whole range of business models. Future research based upon large scale surveys is needed for testing and complementing our findings that give first empirical insights into community-based business models.

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