The Sensitivity of Innovation Communities: Desktop 3D Printing between Open Source and Market Exploitation

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Abstract: Extensive networking among various social actors fosters a novel notion of communities, which inter alia is considered as a fruitful environment for innovation. By drawing on references from research on Open Innovation and Open Source Software, this paper identifies Open Hardware as a novel context for community-based innovation. Focusing on legitimacy as a crucial and sensitive precondition for participation in innovation communities, it is shown that corporate organizations in particular may struggle when facing the different, often contradictory logics of communities and markets. To illustrate this organizational challenge, this paper interprets the rise of a company producing 3D printers, which initially emerged from an open source hardware community and has become one of the most popular players in the market of desktop 3D-printing.

1 Setting the Scene: Communities as Sources for distributed Innovation

In recent decades, the way we work, the ways we communicate, and the ways we enact our creativity are massively influenced by the rise of information and communication technologies (ICT), especially in the form of social media, ubiquitous computing and other Web2.0 applications (Castells 1996; Shirky 2008). At the intersection of these tendencies, novel modes of innovation have emerged that challenge traditional economic patterns of product and service development. The new modes of innovation build upon extensive networking between social actors (individuals as well as organizations). They reveal decentralized, bottom-up and non-linear properties (Lakhani & Panetta 2007; Brabham 2008; Gassmann et al. 2010).

In convergence with these social-level dynamics, research from various fields has focused on networks as the prevalent governance mode for widely distributed innovation processes (Granovetter 1973; Powell 1990). Networks consist of relational ties between individual units that are engaged in reciprocal, preferential and mutually supportive actions (ibid., 303). Where hierarchies, as another prominent governance mode, regulate collective action (here: corporate innovation) through more or less bureaucratic rules, like the vertical division of power (Weber 1934), networks build on independent contributions that trigger mutual benefits and complementary strengths for the participating actors. Although hierarchies and networks reveal significant differences in their specific characteristics and also

relate to different levels of analysis, in the given context, both can be considered as complementary means for commercial organizations that are seeking the same end: the increase of efficiency in innovation to gain competitive strength in capitalist markets. However, since innovation is sometimes not conducive to strategic planning in one or the other way, the concepts of hierarchy and networks have recently been challenged by another mode of coordinating action that may foster innovation when established modes fail.

Communities, like networks, consist of independent actors that are connected through mutual and reciprocal ties. What makes them a unique phenomenon is that shared values, common beliefs and a collective identity between the individual units are constitutive to their existence (Brint 2001); there is not an explicit purpose for establishing ties between communal actors, but a broader claim of collectivity that is reproduced within community-based interactions.

Although communities have been considered relevant to sociology since the discipline's early days (see Hellmann 2012), their relevance to innovation and the creation of novelty has been omitted for a long time. Effected by the broad applications of ICT, which were already sketched out at the beginning, the dominant notion of community has changed from spatially limited, tightly bounded village unions or religious groups to widely distributed online communities that adopt the multiple potentials of modern communication (Wellman 1999). These new varieties of communal forms have given rise to a new wave of conceptual work that focuses on communities and their implications for organizations, markets and the related dynamics of innovation (West & Lakhani 2008; Faraj et al. 2011; Seidel & Stewart 2011).

Within the field of innovation studies, work on "Open Innovation" (OI), in general, and on "Open Source Software" (OSS), in particular, have provided various findings on communities as a relevant source for novelty. For instance, von Hippel's notion of Open Innovation starts with "user-innovators", who seek to develop, improve or customize products that fit their specific needs, i.e. sports-related equipment (Baldwin et al. 2006), household devices (von Hippel et al. 2011) or electronics (Jeppesen & Frederiksen 2006; Stuermer u. a. 2009). Von Hippel states that user innovation may be a widely distributed process between different actors who are interconnected in communities via information transfer links that involve face-to-face, electronic-mediated or other types of communication and provide sociability, support, information, a sense of belonging and collective identity (von Hippel 2005, S.96). What makes his argument so progressive is the emphasis on openness and free access to knowledge as constitutive elements for these communities. Since partici-

pation in innovation communities typically lacks monetary incentives, hierarchical authority and formal membership, the hallmark of open knowledge is critical for most actors who join these voluntarily assembled, informal groups because it is the necessary precondition for collective contributions towards common goals.

This emphasis is even higher when it comes to Open Source Software. Since the motif of OSS builds on a social movement that has explicitly emerged as an antipode of the proprietary software industry, the free revealing of knowledge and access to software is the backbone of all open source projects, even if they possess links to commercial exploitation (Raymond 1999; von Hippel & von Krogh 2003; Dahlander & Magnusson 2005). In the case of OSS, openness reflects both the most important value and the basic norm that is acknowledged by all actors participating in this field. Although the strong political momentum of OSS has gradually faded, along with its increase in competitiveness, the core principals of related production and innovation patterns can still be revealed best by contrasting them with traditional, firm-based modes of knowledge creation. Doing so, Lee and Cole (2003)show that OSS projects typically break with three core assumptions of firm-based organizing, namely that the locus of organizational action (resp.: innovation) takes place at the level of a firm or a set of firms (1), the physical proximity of the firms supports the development of trust through repeated interactions and shared social norms (2), and that knowledge creation takes place under conditions of authority and hierarchy, where the production of sophisticated knowledge products requires complex divisions of labor (3). Obviously, the development of OSS neglects these assumptions, as trust-building results mainly from knowledge sharing and the collective assignment of intellectual property rights. Additionally, contributors of OSS are dispersed around the globe, and participation is voluntary and engaged in without the supervision of direct authorities (ibid., p. 634f., see also O'Mahony 2003). Benkler summarizes these new properties in his broader concept of "commons-based peer production," which he defines as "decentralized, collaborative, and nonproprietary; based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on either market signals or managerial commands" (Benkler 2006, p.60). Against this background, the organizing principles behind product and service innovation in OI/OSS contrast sharply with the established modes of proprietary and labor-based innovation in firms or firm-networks.

2 What this Paper is about: the Hybrid of Open Hardware

The case of Open Hardware (OH, resp. "Open Source Hardware") represents a relatively new phenomenon, one which—thriving on a growing maker movement and the renais-

sance of DIY (see Anderson 2012)—has acquired some popularity in recent years. OH describes the development of material devices as an innovation path, which, in many aspects, is quite similar to the innovation patterns in commons-based peer production. The definition of open hardware as "hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design"[1] reveals that the *blueprints* (which means the "source code" of OH, like original design files, lists of materials/components and photos), can obviously be characterized as commons (Ostrom 1990). But since OH needs to be materialized by production as well, OH devices like 3D printers, (media)artistic equipment, micro-controllers and others don't imply the nonrival properties of information-based goods like software. The hybrid nature of OH, which, on the one hand adopts the radical approach of OSS by freely revealing product blueprints within peer communities, and on the other hand requires investments in scarce resources (i.e. raw materials and production facilities to turn the open blueprints into real products),makes the whole phenomenon an interesting topic to research.

2.1 Research Focus and theoretical Background

The research interest of this work is mainly motivated by organization science. Therefore, the organizational contexts of the creation of OH, rather than the material artifacts of OH by itself, reflect the general focus in this paper.

Starting with an economical perspective, the allocation of scarce resources required for realizing Open Hardware would generally favor corporate organizations that invest in OH production and innovation in order to gain revenues by selling the devices on the market (Coase 1937; see also Williamson 1981). However, since the innovativeness of exploitable products is incorporated in open, freely revealed blueprints, traditional investment-revenue-relations don't suit this context very well. This ambiguity of OH development implicates a broad range of research questions regarding different interests, motivations and purposes at the intersection of corporate organizations, peer communities and markets for Open Hardware. Focusing on legitimacy as an initial precondition for interaction in the social sphere, this paper addresses an aspect that reflects the whole heterogeneity of *logics* within the field of Open Hardware.

Based in the theoretical framework of new institutionalism (Scott 2001; Powell & DiMaggio 1991), the notion of institutional logics generally relates to the discussion of agency within institutional environments (Friedland & Alford 1991). Against this background, one

[1]http://www.oshwa.org/definition/

common interpretation identifies them on the level of (organizational) fields, where logics "encode the criteria of legitimacy by which role identities, strategic behaviors, organizational forms, and relationships between organizations are constructed and sustained." (Suddaby & Greenwood 2005, p.38; see also Thornton et al. 2012). As a consequence of increasing complexities in contemporary societies, fields are typically influenced by various logics. Hence, actors who are embedded in multiple influenced or overlapping fields often face ambiguous criteria for legitimate action. Especially in such situations of institutional pluralism, "knowledgeable agents" necessarily need to elaborate on these different criteria to reflect upon the consequences of their own behavior (Giddens 1984; Kraatz & Block 2008; see also Friedland & Alford 1991, S.248).

To break it down to the field of Open Hardware, one can identify at least two different logics. Of these, one refers to communal norms and values, such as open knowledge sharing, volunteerism and heterarchy, while the other resembles an orientation on commercialization and competiveness as usual in capitalist markets. Departing from this analytical framework, this paper reconstructs the rise of Makerbot Industries, a company that emerged on the seedbed of open source 3D printing and now is one of the most popular players in the thriving market of desktop 3D printers. It aims to depict how Makerbot's organizational challenge of facing contradictive institutional logics resulted in a struggle for legitimacy. This reveals the restrictive attitudes of communities against market mechanisms. The case of Makerbot will be analyzed in the next section, but first the community-based background of open source 3D printing will be sketched out more fully.

2.2 The Origins of Open Source 3D Printing

Although the idea behind 3D printing, which is basically grounded in the layer-wise creation of any physical object, has existed since the invention of early rapid prototyping methods like stereolithography in the 1980s (Jacobs 1992), related promises of the "freedom of creation" or "a new industrial revolution" have mainly spread during the last decade (Hopkinson et al. 2006; Pine & Korn 2011). One of the major drivers behind the rise of 3D printing is certainly its adoption by non-professional users who have fostered the vision of StarTrek-like replicators that are able to build almost anything (anything, that is, that can be made from plastics). Accordingly, the *RepRap project* started in 2005 with the aim of developing self-replicating 3D printers that are able to print most of their own components, as well as any other object that can be represented in 3D modeling (see: http://reprap.org). From its beginning, RepRap started as an open-source and community-based project that tries to apply an evolutionary approach to the development and diffusion of a technological

device. It also aims to include as many people as possible to spread the idea and the printers (Jones et al. 2011). Although some online shops sell kits for RepRaps, usually community members who already own a printer produce all the printable parts for new members just for the cost of the raw materials. Open access to any sources of knowledge that are required to rebuild and further develop the RepRaps is thus the key condition of its diffusion.

Today, there are more than 400 derivatives of 3D printers that are descended from the initial RepRap "Darwin"(see Appendix for tree graphic of the "evolution" of RepRap3D printers). Furthermore, the various types of RepRaps together represent the most common application of desktop 3D printing (see: http://surveys.peerproduction.net/2012/05/manufacturing-in-motion/). Both facts reveal the innovative potential of RepRap as an open source hardware project that is driven by the communal logic of shared values (i.e. the hallmark of open knowledge), the common belief of being at the edge of a new technological path creation and a collective identity that is shaped by various mailing lists, online forums and—last but not least—face-to-face meet-ups at conferences, hacker-, and makerspaces.

3 The Case of Makerbot

While the RepRap project is very successful for its given purpose, it remains a geeky niche phenomenon that mainly spreads within groups of tech-inclined tinkerers – and against its close community background this doesn't seem to be a surprise at all. But with the increasing popularity of 3D printing and with its broad reception in public media, many attempts at bringing desktop 3D printers to broader customer markets have recently been observed. Some of these attempts are grounded in commercial tech-firms that originally specialized in professional, factory-scale applications of 3D printing. Others have their roots in the in the RepRap community, where some members tried to spin off entrepreneurial organizations to exploit the innovative potential of the RepRap community in more or less commercial ways. *Makerbot Industries* is certainly the most influential and successful example of entrepreneurship within the RepRap community. In the following paragraphs, I'll introduce this example more explicitly to reveal its evidence as a case where different institutional logics become an issue for organizations that are embedded in heterogenic institutional environments. Afterwards, I'll analyze the organizational implications of the tensions Makerbot had to face as a result.

3.1 The Rise of Makerbot as the Poster Child of Open Hardware

Makerbot Industries was founded in the beginning of 2009 in Brooklyn, NY and released its first 3D printer, called "Cupcake CNC," shortly thereafter. The Cupcake CNC obviously built on the technological developments made within the RepRap community and was a truly open source device whose design files were provided on the internet platform "www.thingiverse.com". Thingeverse was set up by Makerbot to spread its own designs as well as the 3D design files of printable objects that Makerbot users wanted to share with the community. The combination of 3D printing as a promising technology, the growth of the so called "Maker Movement" and a good marketing practice that focused on the unique backgrounds of this Brooklyn-based, open source company generated a significant momentum for the company's public perception right from its inception.

What follows is an entrepreneurial success story that, in its first phase, was marked by several new incarnations of the initial Cupcake CNC and a newly developed 3D printer called "Thing-O-Matic," which triggered a growing public interest (see fig. 1).In addition to this firm-related progress, the community around Makerbot, which still consists of many RepRap enthusiasts and other early adopters of 3D printing (who use Makerbot's Thingiverse as the dominant exchange platform for 3D printable designs), grows steadily. Although the emerging success of Makerbot was widely grounded on the achievements of the RepRap community, the RepRap and OSH communities hardly criticized Makerbot for exploiting their ideas. Instead, because they revealed their design files freely, Makerbot received much support from these communities, be it in form of suggestions for further improvements of their devices, or in the form of product purchases. Furthermore, the evolution of Makerbot seemed to provide valuable proof that viable business models for hardware companies can be built on openness and commons.

With the acquirement of $10 million in venture capital from a hardware investment group (www.foundrygroup.com), Makerbot entered a second phase in its evolution, one which was mainly affected by growth in organizational size and increasing sales numbers.[2]Supported by the monetary investment, the company launched the 3rd generation printer "Replicator" with a huge medial response that catapulted the company to the forefront of the 3D printing industry (see fig. 1) and the company's co-founder Bre Pettis to the status of a poster child of the "3D printing revolution" (see. e. g. fig.2). At this time, the promise that 3D printing was spurring a new industrial revolution became a mainstream topic that was

[2]http://www.makerbot.com/blog/2011/08/23/all-star-lineup-invests-in-makerbot/).

discussed in various newspapers and magazines and caused 3D printing hit the "Peak of Inflated Expectations" in Gartner's "Hype Cycle for Emerging Technologies" in 2012.[3]

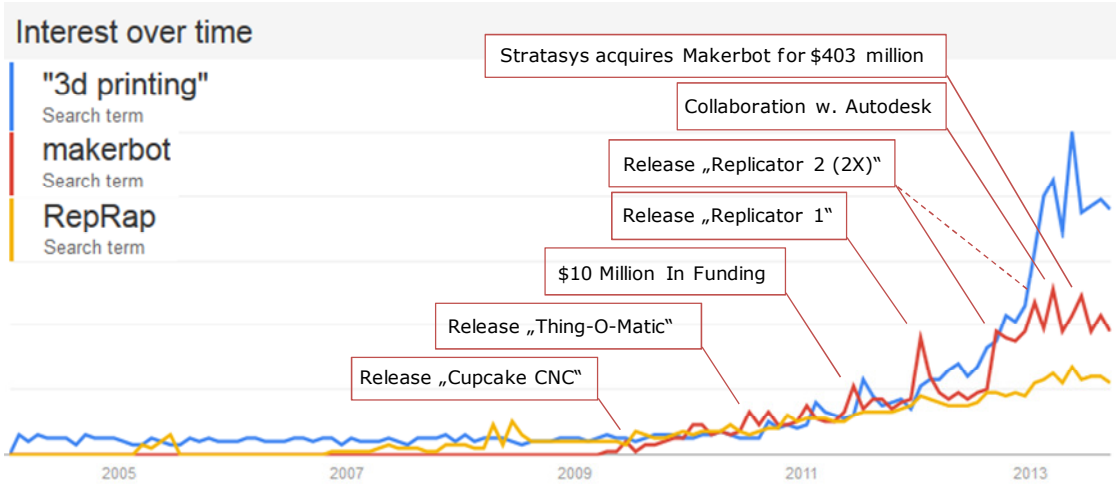

Fig.1: Search volumes for terms "3D printing", "Makerbot", and "RepRap" (conducted via google trends: http://www.google.com/trends/)

Fig.2: Make:zine Cover with Bre Pettis and Makerbot "Cupcake CNC" (vol. 21, released 01/2010, ©Maker Media, Inc); Wired Cover with Pre Pettis and Makerbot "Replicator 2" (released 10/2012, ©Condé Nast)

The product launch of the improved "Replicator 2" seemed to be the logical next step in Makerbot's rise, as it made 3D printing even more accessible for users who don't have in-depth technological expertise and just want to print out favored objects. But this turn to

[3]http://www.forbes.com/sites/gartnergroup/2012/09/18/key-trends-to-watch-in-gartner-2012-emerging-technologies-hype-cycle-2/. In 2013, 3D printing is still on top of the peak but this time it is specified as" consumer 3D printing" which emphasizes the relevance of desktop applications in the general discussion (see: http://www.zdnet.com/gartners-2013-emerging-technologies-hype-cycle-focuses-on-humans-and-machines-7000019564/)

consumer friendliness was also accompanied by the company's decision to stop freely revealing its entire design files for the Printer anymore.

This turn from an open to a more closed source approach of innovation (and business) caused some serious controversy in the RepRap and OSH groups of Makerbot's community and constituted my initial motivation for this research paper. Before I analyze the related tensions in the next chapter, I will mention, for the sake of completeness, that Makerbot was acquired by one the leading factories of professional, industry-based rapid prototyping and manufacturing, called "Stratasys," for more than $400 million in 2013.Stratasys' related press release pointed out that the user community around Makerbot was one of the main reasons for the deal: "The merger enhances Stratasys' leadership position in the rapidly growing 3D printer market, by enabling Stratasys to offer affordable desktop 3D printers together with a seamless user experience. […] The MakerBot3D Ecosystem drives the accessibility and rapid adoption of their desktop 3D printers. It includes Thingiverse.com, the largest collection of downloadable digital designs for making physical objects, and which is empowered by a growing community of makers and creators."[4]

3.2 Dissonances between Open Source Origins and Consumer-Market Future

With the Replicator 2, Makerbot presented a 3D printer that deviates considerably from its origins in the RepRap and Open Source communities in two different ways: First, the device itself changed from a plywood model that can be assembled and even entirely built by people who don't have access to industry-like machine tools to a powder coated steel frame that needs a more sophisticated knowledge of manufacturing to be built (see fig. 2). Second, the constitutional claim of openness wasn't consistent with the Replicator 2, since the blueprints of the physical machine are not freely revealed.

During the product launch, Makerbot's credibility as a legitimate member of the OH community was discussed heavily by its former peer groups. The Makerbot CEO and co-founder Bre Bettis entered this discussion offensively by posting two articles concerning this issue on the Makerbot News Blog. For the aim of this paper, Pettis' posts and the community's reaction to them (which can be reproduced by related comments to the initial

[4] http://investors.stratasys.com/releasedetail.cfm?ReleaseID=772534

Makerbot posts) represent the empirical source to retrace the tensions of contradictive logics that the company had to face.[5]

Although it can be assumed that the releases on the Makerbot blog are to some extend influenced by professional PR/marketing ambitions, they show some interesting standpoints regarding the way Makerbot, specifically Bre Bettis, evaluated the shift in the company's orientation and the related turbulences in its environment. There are three main aspects that can be inferred on the basis of the two articles:

- The big shift: Concerning the self-perception of Makerbot, it becomes obvious that Pettis is exceedingly aware of the transition his company has to make. The core of this transition relates to the orientation towards the emerging consumer market of 3D printing. He assumes that customers prefer easy-to-use devices; openness is supposed
- to be of minor importance to them.. Pettis reflects upon the tensions that follow the improvements to the printer's robustness and accessibility by summarizing that "It's a paradox because all this makes the hardware much less hacker friendly, but more user friendly!" (bp#2).
- Community heart, business mind: the second main aspect can be summarized as the de-coupling of Makerbot's RepRap origin and its future as the "new standard in desktop 3D printing" (bp#2) and "more of a professional business" (bp#1). On the one hand, Pettis claims that he seeks to "continue to contribute to the open technology of 3D printing" (bp#1), and maintains his "love" for the community, "the power of sharing" (bp#2) and his belief that "MakerBot has done a LOT for the community" (ibid). On the other hand, he also states that "from a business perspective, we've been absurdly open" (bp#1) and that "MakerBot is coming of age" (bp#2). To keep contact with the members of the RepRap/OH community, Pettis also announced a "developer program" to sustain the potentials of external contributions in innovation processes. This can be seen as an approach to apply the instruments of Open Innovation to Makerbot's business model.
- Openness as a threat: As a consequence of the prior aspects, Pettis' comments on openness reveal that for Makerbot, the free revealing of design files is interpreted more as a threat for a sustainable business than a commitment to the shared values of the

[5]A choice of relevant quotes and comments can be found in the appendix of this paper – they resemble, in my personal view, the most common arguments in this discussion. The label bp#1 indicates that this quote is taken from the statement "Fixing Misinformation with Information" (posted by Bre Pettis on Sept. 20, 2013; see http://www.makerbot.com/blog/2012/09/20/fixing-misinformation-with-information/) while bp#2 indicates the second contribution "Let's try that again." (posted on Sept. 24, 2012; see http://www.makerbot.com/blog/2012/09/24/lets-try-that-again/)

OH community. By making the strong point that he "doesn't plan on letting the vulnerabilities of being open hardware destroy what we've created" (bp#1). Pettis indicates that the constitutive element of his former peer group is likely to harm the recent economic success of Makerbot as a company that employs 150 people.

Taken together, Pettis makes it clear that Makerbot has made the decision to meet the requirements of the consumer market, which also means that there are no doubts that his company is on the path towards a more commercial way of doing business, even if this limits the openness of its products. On the one hand, this indicates that Makerbot considers itself no longer a part of the RepRap community. On the other hand, it seems obvious that Makerbot is not willing to break completely with this community, although the aspired relationship remains fuzzy.

As a reaction to Pettis' statements, both of his blog-posts were heavily commented upon by Makerbot users and members of the OH community. Although a few comments acknowledge the need for Makerbot's shift in business model, the majority of them explicitly criticize this decision and reflect a broad skepticism that is often accompanied with criticisms of Bre Pettis (mainly as a person) for engaging in illegitimate behavior. The three main aspects within the discussion are related to the emphasis on community principles (1), the reproach of community violation (2) or the remarks made on possible community exclusion (3):[6]

- Emphasis on community principles: Some actors describe their critical attitudes by describing what the essentials of the OH and RepRap communities. They either point out the strong ties of "camaraderie, competition, acknowledgement, praise, disagreement, and sharing of resources" (cbp#1) that are sustained by openness or "that feeling of respect, inclusion, and potential" (ibid) that motivates them to be part of the community.
- Community violation: In close connection to the emphasis on community principles, many aspects of the violation of these principles were identified in other comments. Blaming Pettis that"[he]want to leach the work of the open community, [he] no longer want to give, but only take, and [he is] desperately looking for a pacifier to give to the community so they shut up and continue to work for you for free." (cbp#1) conveys a common attitude in this context. Additionally, people seem to feel disappointed and betrayed because the novel shift in Makerbot's strategy affects the whole community in

[6]Complementary to the quotes of Bre Pettis above, the label cbp#1 indicates that this is a comment related to the blog post "Fixing Misinformation with Information" while cbp#2 is used for comments on "Let's try that again."

negative ways: "This all [community support and goodwill] happened because they agreed with what you said. You became one of the people held up when talking about OSHW [open source hardware], including magazine covers. […] So yes, people bring up your past words, and it is completely fair. Had you never used those words, and become a poster child for the OSHW movement, then people wouldn't care that you are closed source now. People care, because you are currently damaging a community, and that is sad." (cbp#2)

- Community exclusion: Following the attribution of community violation, the exclusion of Makerbot from the OH/RepRap communities is considered an appropriate consequence in some comments (e.g., "For me you are already no longer part of the community,"cbp#1). Since the definition of OH points out clearly what it takes to be "open source hardware", this estimation seems to be consistent. What surprises are the explicit and reflexive ways in which this is articulated: "MakerBot needs to choose. Either you are going to be an open source hardware company and continue having the support of the community that you helped build….or you are going to close down and become a normal company – sell some printers in the short term and the community will move elsewhere." (cbp#1)

The comments show that the communities that supported Makerbot before it chose to close the source for design blueprints, reacted either with anger or disappointment upon learning of Makerbot's decision. In the most cases, the people that comment on Bettis' statements consider his company's decision to be incompatible to the shared principles of open hardware.

4 Summary and Discussion

The case of Makerbot provides an example of an entrepreneurial organization that was founded out of an open source community and became, until recently, an enviable business company. Regarding the described shift in the organization's strategic orientation, its consequences and the related reactions within the community, some interesting findings can be inferred:

Considering communities as an environment for organizational action that is institutionalized to some extent, it becomes obvious that shared values, on the one hand, create a collective identity that shapes the feeling of communal membership and, on the other hand, produce logics for appropriate action and the criteria for legitimacy that are mutually acknowledged among community members (Cohen 1985; see also Scott 2001; DiMaggio & Powell 1983). In general, corporate organizations can participate in such communities as

long as they share the community's constitutive values and behave in accordance with the particular meaning system.

Regarding the community in which Makerbot was embedded, it was shown that the free revealing of knowledge is the core value that shapes practical actions, as well as the cognitive evaluation principles of the participating actors. Since most of these actors are not exclusively embedded in the OH or RepRap communities but hold ties to other institutional environments, like science- or economy-oriented fields, situations may occur in which they are faced with multiple, potentially contradictive logics. With the release of the Replicator 2, Makerbot had to decide whether to correspond either to the community logic of openness or to the requirements of consumer markets that favor easy-to-use and professionally manufactured products. By choosing the corporate strategy of closing the access to the design files of their 3D printer and entering consumer markets, Makerbot failed the community's criteria for legitimacy and consequently lost most of its credibility as a member..

Furthermore, Bre Pettis' effort to personally explain Makerbot's decision to the community and the harsh reactions he triggered with his statements illustrate the individual-related, affective nature of community relationships that seem to be crucial for the reproduction of reciprocity, mutual support and trust. Accordingly, the shared values at the core of a community are emotionally protected, since the collective identity of it members is constituted around them. At least in the case of Makerbot, it seems that this kind of sensitivity fosters a restrictive handling of associated membership: anyone who isn't *in* has to be *out*.

For Bre Pettis and Makerbot, exclusion from the OH and RepRap communities will probably not prove fatal, because novel references for legitimate action that are influenced by market environments have become more important to them. But from an analytical point of view, it is interesting to see how the similarities between traditional conceptions of communities and newer, innovation-related notions become apparent against this background (Weber 2002, S.29). Further research should seek to determine whether (resp.: under which conditions) corporate organizations that want to profit from interactions with communities on a sustained basis, can handle the tensions they face when participating in this particular relations of affective collectivity – be it in contexts of innovation or in other contexts.

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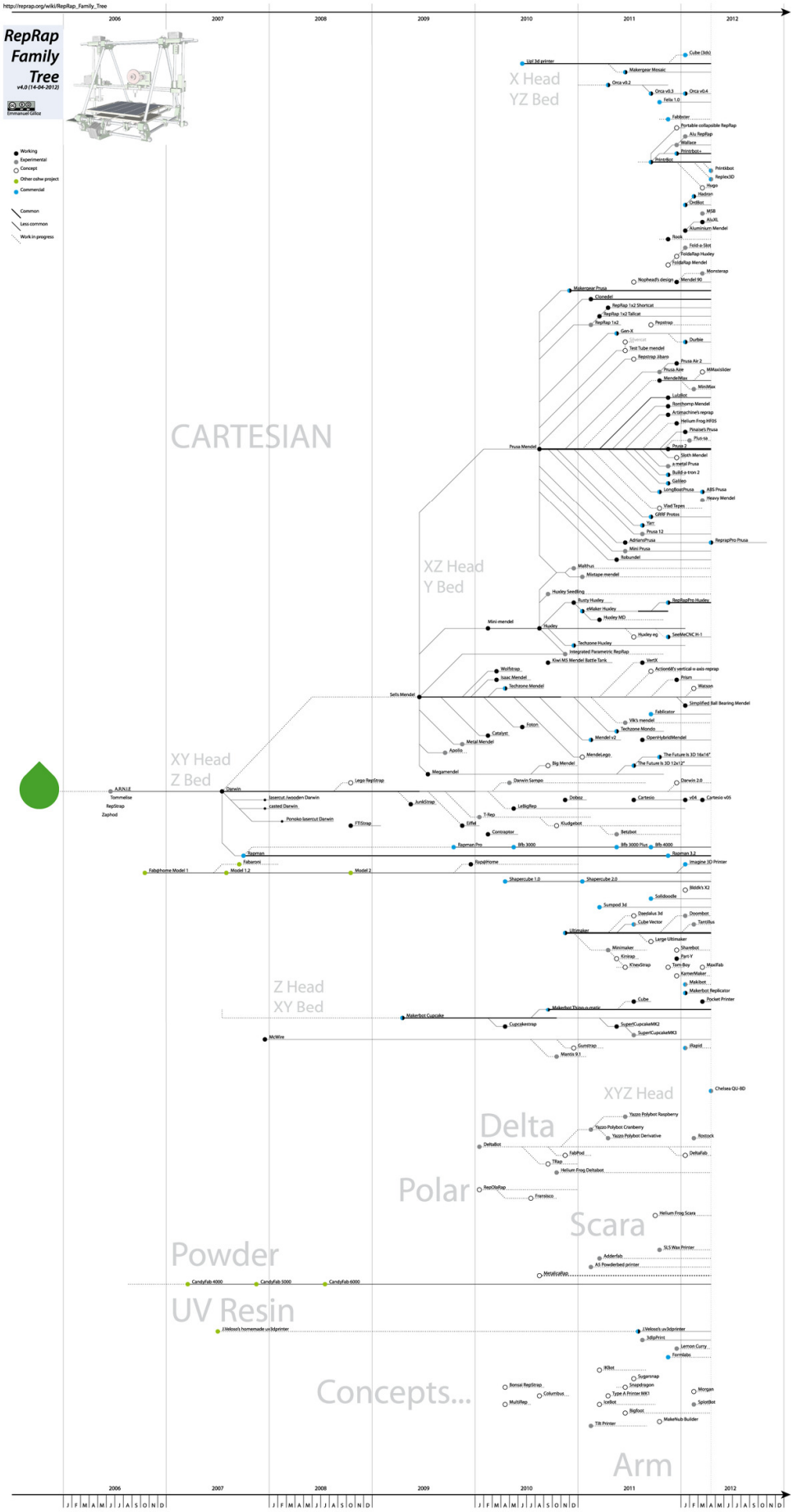
"RepRap Family Tree" (for detailed image see: reprap.org/wiki/RepRap_Family_Tree)



Selected quotes from Makerbot's blog-posts and related comments

Fixing Misinformation with Information (9/20/2012)[7]	**Comments**
"[…] we are going to be as open as we possibly can while building a sustainable business. We are going to continue to respect licenses and continue to contribute to the open technology of 3D printing, some of which we initiated. We don't want to abuse the goodwill and support of our community. We love what we do, we love sharing, and we love what our community creates." "From a business perspective, we've been absurdly open, more open than any other business I know. There are no models or companies that I know of that have more than 150 employees that are more open. [...] We are experimenting so that we can be as open as possible and still have a business at the end of the day. […] I personally hope that we succeed, not just because I love what people make with MakerBots and I love the employees that make these machines but because I believe that MakerBot as a business can create a new model for businesses to learn from. I don't plan on letting the vulnerabilities of being open hardware destroy what we've created." "We are actively working on a developer program to create cutting edge emerging stuff. We look forward to finding ways of creating win/win situations with developers and companies." "This isn't the first change we've made to become more of a professional business, and it won't be our last."	"What you are doing is by no means unique (from a business perspective) however you built your company on the backs of the community. You may not agree but ask yourself if you would be on the map, or even solvent if you didn't have the project to work from. […]I'm a business person myself so I can understand your position but I think you are disrespecting the community with your above post, take a clear stand and stick with it since they deserve that much respect. "MakerBot needs to choose. Either you are going to be an open source hardware company and continue having the support of the community that you helped build….or you are going to close down and become a normal company – sell some printers in the short term and the community will move elsewhere." "[…] there is more to the OSHW community than just the schematics and CAD files. There is an entire ecosystem of camaraderie, competition, acknowledgement, praise, disagreement, and sharing of resources. This is what makes OSHW projects actually work. And this is what you lose if you slight that community, even though you obey the written rules." "You know very well what to do to be open. There is nothing to figure out, the rules of that game haven't changed. But what you want is to have the cake and eat it. You want to leach the work of the open community, you no longer want to give, but only take, and you are desperately looking for a pacifier to give to the community so they shut up and continue to work for you for free. You have already started to lie to us. For that weasel behavior alone you deserve to be shunned by the community. For me you are already no longer part of the community." "As keeps coming up, products like Makerbot's incorporate the benefits of uncountable hobbyist development and testing hours, both indirectly as you benefit from prior and parallel efforts such as RepRap, and directly as you get feedback from people working with your own designs. Those hobbyists don't get any portion of your profits or celebrity. What they do get – or have gotten – is access to the latest designs, both hardware and software. Many of them won't make any use of that, sure. Many of them can't, as you say. But some do, and for many others, it's a matter of principle. That principle – that feeling of respect, inclusion, and potential – is both central and fundamental to the OSHW community."

[7] http://www.makerbot.com/blog/2012/09/20/fixing-misinformation-with-information/

[a comment by Bre Pettis related to user comments above] "The fact that the people who can benefit from us sharing all of our files are not the users, but the cloners is one of the issues we face. We've shifted the product into the realm of things that are really only practical for competitive manufacturers who are not motivated to spend money improving the technology, since we've already spent millions of dollars doing that. I'm not saying we've done this without the support of the community, but I am saying that for us to compete in this new market, we have to speak at least one of the unspoken rules of open source out loud. I think that some folks don't realize that since the original Replicator, we've started competing with billion dollar companies with arsenals of weapons that make depending on the open source hardware unspoken rules feel like a vulnerable position." "Do I love this community and want to support it? Yes, but competing outside the hobbyist market with big companies is going to be one of our biggest challenges. […] The cloners are getting better and faster and are ignoring the unspoken rules of open source hardware. We can't depend on being able to innovate faster anymore. Our community has changed over the years from mostly developers to mostly people who just want to use the thing as a product instead of a project, we intend to support both parts of our community, the developers and the users. I agree that having advocates is a great competitive advantage."	"I understand your reluctance to state that answer clearly. I also understand your reluctance to open your design sufficiently that someone else can take those designs and make a clone. But that's what open source is. If you're going to hold back enough to prevent cloning, it's not open. You can be a company that shares a lot, and maybe I'll think well of you. But if you want to make open-source hardware, it's all or nothing. "We do have two MakerBots – an early Cupcake and a Replicator -, and when i use them i feel the same way as I do every single time when i open my Linux machine… I feel happy. Because it is Free, and makes me feel free, because it embodies the power of generosity and cooperation and collective ingenuity against business-as-usual, greed, exploitation and so on. A better world. We bought them the MBots because of that. The last one after having been told that there are some Chinese clones… Made us want to buy them much more because of that… I guess if Mbot becomes proprietary we will switch to whatever the OSH community will be making when it comes to it." "The key point to remember about open source is that IT'S NOT ABOUT THE LICENSE. It's about the COMMUNITY. You can have a closed product with a thriving user community, and that's okay. Bre has to worry about competition from above and competition from below. The incredibly cheap 3D printer is coming from HP, Lexmark, and Canon. You KNOW it is, and if Bre doesn't have a product that can compete in that market, he's toast. One of the characteristics of that market is that people just want to make stuff."
Let's try that again. 9/24/2012[8]	**Comments**
"MakerBot has done a LOT for the community. There are thousands of non-MakerBot 3D printers, projects, and businesses that have benefited from our sharing. " "At MakerBot, we've transitioned from a company that made Cupcake CNC and Thing-O-Matic kits that were hard to put together for a lot of people and they were an education in assembly techniques. We've transitioned into a company that makes a tool, the MakerBot Replicator 2, that has set a new standard in desktop 3D printing because it just works. […] Because we've shifted away from the hobbyist-enabling tools like lasercutting and started using traditional manufacturing to meet scale, we've started creating injection molded parts, bent steel, and	"It is those words [what's meant here is a blog post by Bre Pettis called "Open Source Ethics and and Dead End Derivatives" in March 2010, http://www.makerbot.com/blog/2010/03/25/open-source-ethics-and-dead-end-derivatives/) that caused people to support you, to give you goodwill, and to spread the word as unpaid salespeople for your product. This all happened because they agreed with what you said. You became one of the people held up when talking about OSHW, including magazine covers. […] So yes, people bring up your past words, and it is completely fair. Had you never used those words, and become a poster child for the OSHW movement, then people wouldn't care that you are closed source now. People care, because you are currently damaging a community, and that is sad."

[8] http://www.makerbot.com/blog/2012/09/24/lets-try-that-again/

other CNC custom parts. It's a paradox because all this makes the hardware much less hacker friendly, but more user friendly!" "MakerBot is coming of age and we need to evolve our relationship with RepRap. We hope and expect it will continue to be a strong one." "Despite all the drama, we believe in the power of sharing to change the world. Please understand that our shift to become a more professional company does not decrease the amount of love and support we have for the sharers of the world."	"You built your machine based on RepRap technology and created a company around it and its community. MBI promised to be an open source hardware company. People have supported you and been loyal customers to you because of that and a lot of that trust has gone into your brand. Now that you are 'on top' you suddenly decide to do an 180 degree turn and go closed source, taking advantage of your now strong brand and even patenting (!?) some of the technology coming out of the community. Personally I believe it is a bad business decision as well since you just removed the extra value that made your 3d printer superior from all the other 'RepRap mods' out there. Now you just told your supporters and customers that they are not important anyway since you are going to make millions selling to all the people who do not care. Well, good luck with that."