Developing a Business Model for Concurrent Enterprising at the Fab Lab

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Abstract

Fab Labs are fabrication laboratories equipped with digital fabrication machines. As digital manufacturing facilities they form the nuclei for collaborative innovation ecologies, based on the paradigm of commons based peer production. For the first time, a study into the business models of Fab Labs has been carried out. This paper reports initial results of this study in terms of value proposition, revenue model, processes, resources, marketing, and innovation partnerships. A distinction between labs providing facilities and labs providing innovation support is suggested. The findings of the study are then used to develop a business model for a new Fab Lab that aims to support concurrent enterprising an innovation among its users, building on four key ingredients, openness, interdisciplinary collaboration, effectiveness, and transferability. A tentative description of the business model is provided and discussed in terms of these four aspects and its contribution to concurrent enterprising.

Keywords

Fab Lab, personal fabrication, innovation ecology

1 Introduction: Fab Lab as a Community-Based Learning and Enterprising Environment

First there was a digital revolution in computation (personal computer), then in communications (convergence and mobile phones). The next digital revolution, according to MIT's Neil Gershenfeld [Gershenfeld 2005], is in the field of manufactured physical goods (personal fabrication). Gershenfeld and his colleagues have created so-called Fab Labs around the world: fabrication laboratories, equipped with digital fabrication machines (e.g. laser cutter, 3D router). Citizen inventors and tinkerers can use the Fab Lab for free or for a nominal fee to produce two- and three-dimensional parts that once could be achieved only using equipment costing hundreds of thousands of Euros. They use digital drawings and open-source software to control the machines. Fab Lab users share their ideas, designs and manufacturing experience with each other and with their counterparts at other Fab Labs around the world through web tools and videoconferencing.

Using the machines in one of these Fab Labs, children in inner city Boston have made saleable jewellery from scrap material. Villagers in India used their lab to develop devices for monitoring food safety and agricultural engine efficiency. Herders in the Lyngen Alps of northern Norway are developing wireless networks and animal tags so that their data can be as nomadic as their animals.

A Fab Lab works on the principle of 'open doors' (analogous to the open source movement). It has a true educational orientation: 'Do it yourself' is key at the Fab Lab. Users actively explore the contents, technologies and possibilities of the Lab themselves at their own pace, the entire workplace itself becoming as a community based learning laboratory [Leonard-Barton, 1992]. This is crucial to be able to live and understand visions and projections of the future that become possible through the Fab Lab. These experiments are the vanguard of a new science and a new

era of ‘post-digital literacy’ in which we will be as familiar with digital fabrication as we are today with information processing.

In terms of activity theory [Engeström 1987], a Fab Lab is a community-based learning and enterprising environment that stimulates learning and development in three aspects: First, it is a ‘make’ place in which thoughts can be externalized and materialized, which is in itself an important learning mechanism [Leont’ev 1982]. Second, it empowers communities that would otherwise often by cut off from the digital revolution to seek their own solutions. Third, and most important, it connects the unique, local Fab Lab communities into a networked ecology [Ward 1999] that through exchange of experience, expertise and knowledge, collective searching for solutions to emergent problems. In this innovation ecology, collaborative interaction of the enterprise and its stakeholders can produce the outcomes needed for today’s high velocity, rapidly changing marketplace. It does so base on the paradigm of ‘Commons Based Peer Production’ that stems from successful projects such as Wikipedia, Open Source Software, Open Design (for a discussion see [Helfrich, 2010]).

2 Models for Operating Fab Labs

Worldwide, there are currently 45 Fab Labs in operation in 16 different countries. Another 30 to 40 labs are in planning. However, in current Fab Lab practice there is no single business model [Boeing, 2003]. Furthermore, literature is mainly focusing on Fab Lab users (e.g. [Mikhak, et al. 2002], [Gershenfeld 2005], [Gjengedal 2006], [Pfeiffer 2009]) rather than the labs and their business environment. The Swiss project to be discussed in this paper will have to develop its own, customized Fab Lab business model for the innovation system Central Switzerland.

Traditional, static approaches of business modelling (see e.g. [Müller-Stewens & Lechner 2005], [Christensen, et. al 2009], [Kagermann & Österle 2007]) have been contrasted with the need for business model innovation (see e.g. [Osterwalder 2009]) and the growing number of social entrepreneurs (for an overview see e.g. [Elkington & Harigan 2008]). In consequence this means that the business model to be developed should ideally be transferable to other labs.

3 Research Approach

The University of Applied Sciences Lucerne is the first to implement the Fab Lab model in Switzerland. Its business model aims to be a boilerplate to stimulate and support more Fab Labs in Switzerland and elsewhere.

We studied business models of the Fab Labs around the world in a two-tiered approach. Firstly, a top-level description of the positioning of the Fab Labs was derived through document analysis. Secondly, by selecting those Fab Labs with a comparative operational positioning we identified and interviewed a subset of nine Fab Labs. Their business model approaches were considered relevant to the further development of a business model template for the Fab Lab innovation ecology. These business models were analyzed more deeply in expert interviews with the Fab Lab managers or, where applicable, with the business managers at their hosting organisations. The interview guideline addressed value proposition, revenue model, processes, resources, marketing, and innovation partnerships.

4 The Business Models of Selected Fab Labs

Results will be described in terms of value proposition, revenue model, processes and resources, marketing, and innovation partnerships.

Regarding the value proposition, all labs indicated that their envisaged clientele be distributed across the board, including students, researchers, companies and the general public. However,

eight labs reported that students were the main users at the labs, only three labs involved the general public, and only one lab attracted researchers and companies respectively (see Table 1).

	Students	**Researchers**	**Companies**	**General Public**
Target user groups	9	8	6	8
Current main users groups	8	1	1	3

Table 1: Target vs. Current Main User Groups at Fab Labs (N=9)

All labs indicated that their core competence was in technology, while five of them explicitly specified IT as additional core competence. Six labs additionally had core competencies in arts and design.

The main contribution to their users' processes was seen equally in education, research, and development and prototyping.

While all labs indicated their main value proposition was providing access to infrastructure that users would have no access to otherwise, and six indicated that access to experts was equally part of their value proposition, only four of the labs saw giving access to knowledge of the Fab Lab network as part of their value proposition (see table 2).

	Infrastructure	**Experts**	**Fab Lab Network**
Part of value proposition	9	6	4

Table 2: Value Proposition of Fab Labs (N=9)

Current revenue of the Fab Labs included in this study came mainly from public sources or from a hosting institution. Revenue from sponsoring or from users so far remained the exception. However, all labs indicated that they needed to become self sufficient within two to three years.

Regarding processes and resources, seven of the nine Fab Labs had their own employees, three were run by a faculty of their host university, and five were supported by volunteers. In terms of manufacturing technology, the labs typically adhered to the equipment proposed by MIT, sometimes excluding one single machine; eight labs offered their users extra equipment (such as 3-D-printers or embroidery machines). Eight of the nine labs included in the study position their offering as 'social-tech', and one as 'green-tech'. None of them, however, positioned themself as 'high-tech' or 'smart-tech' (e.g. intelligen materials etc.).

In terms of marketing, Fab Labs typically have their own Internet presence, however, only three of the nine labs in this study actively engage in PR.

The innovation ecosystems of the labs were relatively limited with few network and industry partners and few, if any sponsors (see

Table 3).

	0	**1…5**	**6…10**
Network partners	0	6	3
Industry partners	4	1	4
Sponsors	7	2	0

Table 3: Innovation Ecosystem of Fab Labs (N=9)

Also, labs rarely made use of the possibilities the Fab Lab innovation ecosystem offers. Only one lab indicated that nearly all projects required support from the network, two reported that on average every third project required support, while for the remaining labs this was the case on even fewer occasions.

In summary, the Fab Labs included in this study were primarily offering infrastructures to students, and they were relatively passive in reaching out to potential other users. Their funding came from government or hosting institutions. They have so far created a limited innovation ecosystem, which gets used rather rarely.

Looking at single labs in the sample, there is a notable tendency that labs engaged more actively in PR attract also non-students as users. Also, labs that more explicitly saw themselves as providing access to the knowledge in the Fab Lab network tended to have more network partners in their innovation ecology and were more often asked by users to support their projects. This seems to indicate a distinction between Fab Labs that are focusing on supporting innovation, and those that primarily offer the lab as a production facility.

Those who focus on offering innovation support provided a complete product-service-system that delivered the experience of effective and fast innovation to their users. Such Fab Labs accompanied their users on a certain section of their innovation journey – as opposed to the facility approach, which accompanies users merely during the time of their stay at the lab, their use of the equipment, and their experience of a well-run personal production process. The difference, hence, is not in the single elements of the offering, but the overall value proposition. For the Fab Lab as a facility, the value proposition is providing the best value in terms of the digital production processes; for the innovation Fab Lab the value proposition is providing the best outcome for its users and their innovation journey using the right mix of ingredients determined by the facilities and (networked) competencies available.

5 Implementing Concurrent Enterprising at the Fab Lab in Switzerland

Switzerland has been leading the European Innovation Scoreboard in 2008 and 2009 [Pro Inno Europe 2009, 2010]. Yet there remains considerable potential for improvement when it comes to knowledge and technology transfer between academia and business and between businesses (see e.g. [Arvantidis, et al. 2006], [Arvantidis, et al. 2008]).

Such an approach focuses on four key ingredients to foster concurrent enterprising: openness, interdisciplinary collaboration, effectiveness, and transferability. The implications of each of them will be discussed in the next sections.

5.1 Openness

Innovative products are developed on the basis of rapid prototyping at R&D departments of privately owned companies or at laboratories of universities and research institutes. This typically happens behind closed doors, and today only a small group of experts has access to these facilities and hence the possibility to produce prototypes in short time and using simple means. Fab Labs practice democratization and demystification of new technologies following some of the most important trends of the 21st century:

Open source and commons based peer production: knowledge about and access to means and methods of production are not any more reserved to a small in-group but are available for everybody.

Open learning in communities: users can build their expertise around the use of these means and methods of production in open, face-to-face and virtual communities rather than in closed training settings. The Fab Lab is a nucleus for communities of practice that allow all their

members to develop mastery, particularly if they share the knowledge and experience they acquire with other members of the community.

Open organisational formats: Fab Labs are typically not purely private or purely public organisations but they build on public-private partnerships.

It is important to note that even the theory of 'open innovation' has so far no explanation for the growth or even the existence of commons based peer production: [Chesbrough 2003], [Chesbrough 2006] calls it the "puzzle of Open Source Software"; [von Hippel, 2005] acknowledges that "the empirical finding that users often freely reveal their innovations has been a major surprise to innovation researchers". The major issue is the absence of a business model built around intellectual property rights: "By construction, open source software is created without any one firm owning the technology. No firm can patent the technology, or exclude anyone else from accessing the software code. Enhancements to the code are available to everyone on an equal basis. Is this simply an exception to the general rule [i.e. that the value of a technology is determined by the business model], is this due to a business model of a different kind, or is there something fundamentally wrong with the above claims of Open Innovation regarding the importance of business model for the behavior of firms?" ([Chesbrough 2006], p. 25). Commons based peer production is, seemingly, not 'obeying the rules'; on the other hand many firms 'obey the rules' while turning their back on the potential of commons based peer production.

5.2 Interdisciplinary collaboration

Fab Labs use the power of diversity and the disciplinary mastery of their staff. The first Fab Lab was set up at the MIT's interdisciplinary Center for Bits and Atoms, the second one in Boston's inner city. They serve youth, tinkerers, inventors as well as companies and students. At the University of Applied Sciences Lucerne, the Fab Lab can be used by members from all disciplines in applied research and research services, teaching and professional development. The Fab Lab is part of the interdisciplinary CreaLab. Disciplines involved in the CreaLab are engineering and IT, product design, architecture, business administration, and arts and design. Hence the Fab Lab business model truly includes opportunities for interdisciplinary collaboration.

5.3 Effectiveness

The Fab Lab model has proven its effectiveness as a driver of regional innovation since 2005 at 45 locations in 16 countries. All Fab Labs succeeded in building bridges between highly qualified experts in technology, design, management or education and a wide range of interested partners – from education (schools, universities, vocational schools, etc.), business (SMEs, entrepreneurs, designers, architects, etc.), arts and culture (artists, museums, non-profit organisations, etc.). The Fab Lab concept builds on social interaction. In projects, it brings together academics and practitioners on an equal level, allowing them to interact directly with each other.

Additionally, the Fab Lab counters two contradictory trends that are dangerous for Switzerland – young people lacking interest in technolgy and technologists becoming disconected from the rest of society.

First, the Fab Lab is well suited to reach people who have lost, or have had interest in technology, e.g. young men who prefer to study business administration or law instead of technology, or young women who still are reluctant to pursue degrees in engineering although these days these jobs require more brain than physical work.

Second, die-hard techies are systematically encouraged to make use of the latest insights of creativity and innovation research: Fab Lab bring together the stimulating power of a diverse community, there is the need to interact with the users of a new technology at an early stage

because they are present at a Fab Lab from the start, and there is the open invitation to use methods and procedures that have been proven successful in R&D processes.

5.4 Transfer Potential

Fab Labs have proven successful all over the world; they have spread quickly and sustainably. Every Fab Lab builds on the experience of the other labs. Within the network of Fab Labs, the exchange on business model, programs and networking is at least as important as sharing technical issues and solutions.

6 The Tentative Business Model

On a more concrete level, the Fab Lab Lucerne has to be more than just a facility for digital personal fabrication in order to implement the above four ingredients of concurrent enterprising (openness, interdisciplinary collaboration, effectiveness, and transferability). Therefore, the envisaged value proposition of Fab Lab Lucerne is of the innovation focused kind. The Fab Lab Lucerne aims to accompany its users during their innovation journey and to provide them with an experience of effective and fast innovation.

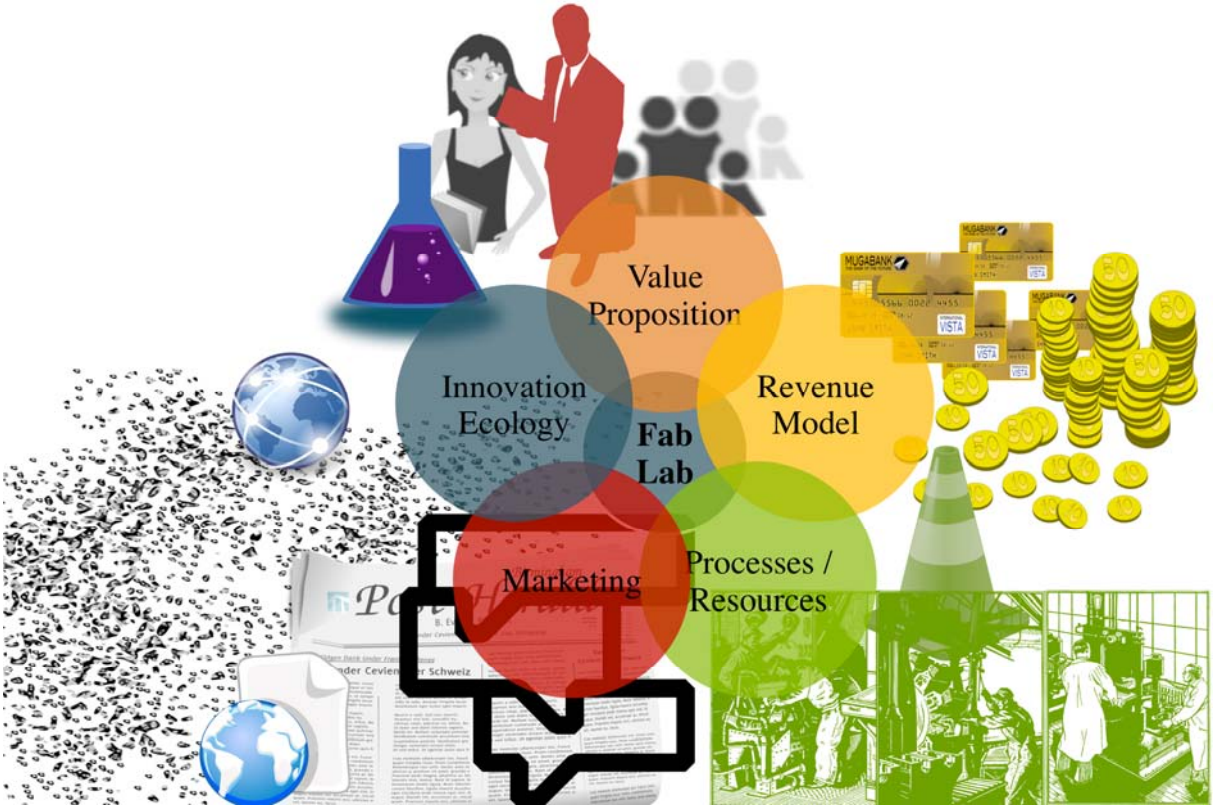

Figure 1 Fab Lab Business Model

The primary clientele therefore are those actually embarking on an innovation journey, i.e. companies and researchers. Students and the general public – while easy to reach and being important multipliers – may therefore not be considered the most important users of the Fab Lab.

As mentioned above, Fab Lab Lucerne can uniquely profit from its interdisciplinary setting at the university, thus providing not only competencies in technology and particularly digital manufacturing, but also in architecture, business administration, arts and design.

Key to establishing the Fab Lab Lucerne's innovation focus is building its own innovation ecology. The two project partners of the Fab Lab Luxderne, Innovation Transfer Central Switzerland (ITZ) and Swiss Productivity Foundation (SPF), will play an important role.

Through them, the Fab Lab will be strongly present with its core target groups. ITZ is an intermediary well connected to other Universities of Applied Science through its membership in national technology transfer consortia. SPS has a strong network of Swiss companies and entrepreneurs.

In terms of marketing, Fab Lab Lucerne will have to actively engage in communication and outreach activities in order to attract attention from its core target user groups.

Regarding processes and resources, finally, Fab Lab Lucerne has its own employees, include faculty of its host university, and aims to build a strong support basis of volunteers. In terms of manufacturing technology, the lab will typically adhere to the equipment proposed by MIT; extra equipment (e.g. a 3-D-printer or heavy duty machinery) may be provided through cooperation with other labs at the host university.

While Fab Lab Lucerne has been initially funded through a starting grant and contributions of its host university, it will have to become financially self-sustaining within 18 months. It is expected that the envisaged primary users will also be able and willing to pay for the services provided.

7 Discussion

We stated above, that the Fab Lab business model needs to include four key ingredients: openness, interdisciplinary collaboration, effectiveness, and transferability.

Openness is already a built-in ingredient of a Fab Lab and the Fab Lab network. However, at the time of writing it remains unsolved if and how users from industry will adopt this model. It is expected that some (if not most) of them will not be familiar with the principles of open source and commons based peer production, and that they might even react hostile to requests for sharing (some of) their Fab Lab experience. It is only through careful community building, we believe, that this fear of opening up innovation to become a source for society beyond particular company interests can be overcome.

Interdisciplinary collaboration between the different disciplines at the host university and with key users will equally need careful attention. As the Fab Lab succeds to establish interdisciplinary collaboration, the traditionally sharp demarcation between teaching, professional development, applied research, and services will also become less relevant. We see this as a positive side-effect, since innovation always stems from the creative destruction of current boundaries.

The business model for Fab Lab Lucerne will be tested and evaluated over the coming 18 months. In this phase, the business model has to prove its effectiveness, primarily for the innovation system Central Switzerland. Eventually, the business model will prove effective if it succeeds to bring together the main actors, i.e. the hosting university, intermediaries, companies and the wider public, to collectively fund the further operation of the lab.

The business model of the Fab Lab Lucerne will be explicitly made public so others can discuss it, improve it and use it themselves. To this end, the University of Applied Sciences will also publicize the potential of Fab Lab in research, teaching and technology transfer in its network of relevant academic communities.

Implementing these four elements, openness, inderdisciplinary collaboration, effectiveness and transferability, the Fab Lab Lucerne will establish a new ‘place to go to’ for support in innovation and concurrent enterprising.

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