

Sissy-Ve Basmer-Birkenfeld, M.A.; Jan-Hauke Branding, M.A.; Sonja Buxbaum-Conradi, Dr. rer. nat.; Babasile Daniel Oladele-Emmanuel, M. Sc.; Tobias Redlich, Dr.-Ing.; Jens Wulfsberg Prof. Dr.-Ing.
All authors are from Department of Design and Production Engineering, Helmut Schmidt University, basmers@hsu-hh.de

Cui bono? Nodes of Participation in the Maker Movement

- A Case Analysis of FabLabs and Makerspaces in German- and Arabic-speaking countries

Abstract

The maker movement is represented by autonomous Makerspaces and FabLabs worldwide. These open workshops enable people to transfer their ideas into physical objects. They deliver an infrastructure of digital manufacturing technologies and the corresponding knowledge to use this infrastructure. At the same time, they are regarded as the first pioneers of a new economy, in concrete terms: bottom-up economics. But what about the framework conditions of Makerspaces and FabLabs that are conditional to foster the participation in value creation, e.g. participatory design and co-creation? Based on a case analysis of FabLabs and Makerspaces in German- and Arabic-speaking countries qualitative interviews with FabLab representatives have been analysed. The attitudes of Makerspace and FabLab managers became clear; especially, their assumptions underlying their strategies of action according to participatory design and co-creation. How can the virtual and the physical participation be integrated? Which barriers prevent them from unfolding the full potential of their labs? And what measures promote their potential? The paper gives an overview of the country-specific results and allows general insights into the actual barriers and promoting measures. Based on the results, general recommendations can be given to foster participation in design and production processes. In the outlook, the development of bottom-up economics and its participatory characteristic can be illustrated by the analysis of the maker movement.

Keywords: Makerspace; FabLab; participation; co-creation; digital manufacturing

Introduction

3dprinters, laser cutters, milling machines... these technologies and more are offered by FabLabs and Makerspaces, mostly for free and open access for public. Anyone can produce anything (Gershenfeld, 2005). Therefore, FabLabs and Makerspaces represent first pioneers of bottom-up-economics (Redlich & Wulfsberg,

2011, Gershenfeld, 2005, Redlich & Moritz 2017). They enable anyone to participate in value (co-)creation if the one wants to prototype an idea or just tinker around.

After a short description of the status quo and the lack of research, we describe our approach to grasp the actual paradigm shift of value creation and, afterwards, how we conducted a case analysis of FabLabs and Makerspaces to analyse the central driving forces and obstacles of the development of FabLabs in different countries from the viewpoint of FabLab representatives. The attitudes of Makerspace and FabLab managers became clear; especially, their assumptions underlying their strategies of action according to participatory design and co-creation. Which barriers prevent them from unfolding the full potential of their labs? And what measures promote their potential? The paper gives an overview of the country-specific results and allows general insights into the actual barriers and promoting measures. Based on the results, general recommendations can be given to foster participation in design and production processes. In the outlook, the development of bottom-up economics and its participatory characteristics can be illustrated by the analysis of the maker movement.

FabLabs and Makerspaces

The FabLab idea is spread all over the world. Ultimately, more FabLabs can be found in Europe than in the USA (Ramella & Manzo, 2018). But there are only a few international studies about FabLabs and those focus on specific fields of the phenomenon. Dolata & Schrape (2016) grasp the phenomenon of a maker movement and common knowledge transfer. Thus, Smith et al. (2016a, 2016b) speaks of grassroots innovation (Blikstein, 2013). Voigt, Unterfrauner & Kieslinger (2017) conduct an in-depth case analysis of selected FabLabs and Makerspaces. Ramella & Manzo (2018) look into the Italian FabLabs. Troxler (2013) describes the international structure of FabLabs and the international associations FabFoundation and FabAcademy. Wolf et al. (2014) conducted research concerning the general aspects of the sharing-culture in FabLabs. Especially Arabic-speaking countries are underrepresented in research. At first Osunyomi et al. (2016a, 2016b) gives an overview of strengths and shortcomings of FabLabs worldwide as well as the FabLab ecosystem throughout the world: Only few approaches of knowledge transfer and collaboration between the FabLab and Makerspace organisations could be observed.

Osunyomi et al. (2016a) observed a lack of research according to the sharing of information and the culture of global co-creation. Further in-depth questions arise about people's attitudes and their basic convictions (see, according to sustainability aspects, Kohtala, 2017; Fleischmann, Hielscher & Merritt, 2016). How do FabLab representatives themselves reflect the maker movement, what hinders them, what are their strengths? According to the undisclosed field an explorative method is mostly suitable to disclose the following hypothesis: FabLabs and Makerspaces have a big potential in order to increase self-organized immaterial value creation through enabling and empowering multiple stakeholders to participate in value creation.

Theoretical background: changing terms of value creation

We are actually observing a paradigm-shift in value creation driven by globalization and new information and communication as well as production technologies (Reichwald & Piller, 2009; Redlich & Wulfsberg, 2011). Technologies like 3dprinters, laser cutters etc. enable stakeholders to co-create value in a decentralized, networked and collaborative manner (Redlich & Wulfsberg, 2011; Redlich et al., 2015). People are able to connect nearly anywhere and anytime via the internet. The new production technologies and the information and communication technologies have a massive impact on our ability to create value. Beside the well-known 'material value creation', the 'immaterial value creation', which has been nearly neglected in prior research, has to be included (Rifkin, 2014). This is part of the paradigm-shift in value creation and changes the configuration of value creation processes, structures and artefacts. From a social scientist's point of view, it is important to describe why the actors in value creation show high engagement against the absence of any financial reward. Further values have to be integrated and show the importance of the understanding of the relationship between the producer and consumer in form of co-creation (Prahalad & Ramaswamy, 2004), and intangible assets (Daum, 2003) created by e.g. a crowd which is motivated by fame, fortune, fulfilment and fun (Marsden, 2009). The term and understanding of value creation is changing in the light of the analysis of the bandwidth of new value creation patterns (Prahalad & Ramaswamy, 2004; Prahalad, 2005; Redlich & Wulfsberg, 2011). For example, free products

are more distributed than the common user or decision maker might know (Tapscott & Williams, 2006; Rifkin, 2014). On the one hand the existence of free products are common to users, but on the other hand it is mostly unknown why business models are successful, what underlying implications there are and which consequences they will result in (Anderson, 2009; Rifkin, 2014).

At first, the insight into the new perspectives and opportunities of value creation is essential. Most of the decision makers understand e.g. crowdsourcing as an instrument of receiving low cost personnel or free research and development as well as marketing tools (Gassmann, 2010). In relation to the theory of the *Commons* (Ostrom, 1990) open approaches as Open Innovation, Open Production, Open Tourism, Open Data, Open Government are inspired by a mind-set of sharing and solidarity (Lakhani, Jeppesen, Lohse & Panetta, 2007; Egger, Gula & Walcher, 2016; Powell, 2012). The change of value creation processes, e.g. the so-called sharing economy will result in an attitude of more cooperation rather than competition (Howard, 2015; Basmer-Birkenfeld et al. 2015). We are in the middle of an ethical discussion which is connected to the new patterns of value creation. A value decision is underlying every value creation activity: Do I want to share my insights with a community? What business model suits my preferences best? Hence, it is necessary to look into the term value and derive the understanding of value creation as well as implications of value creation activities for the whole society (Rifkin, 2014; Moritz, Redlich & Wulfsberg, 2018).

The meaning of value and the process of value creation are rapidly shifting from a product and firm-centric view to personalized consumer experiences. Informed, networked, empowered and active consumers are increasingly co-creating value with the firm (Prahalad & Ramaswamy, 2004, p.5).

Value creation is ambiguous as much as the term capability. A capability represents the capacities of an owner and, furthermore, his assets. The immaterial value creation moves beyond the immaterial assets in terms of accounting financial means (i.a. customers, patents etc.). The immaterial value creation also integrates knowledge, social relations and innovation capacity. Therefore, immaterial value creation has to be measured in terms of those elements, e.g. knowledge or social relations, which is hard to manage. Concluding, at first the central shift of value creation/bottom-up economics has to be recognized in order to get a clear understanding of relevant terms in the scope of a study according to FabLabs and Makerspaces (Redlich & Wulfsberg, 2011; Redlich et al., 2015; Tapscott, 2006). The concepts of co-creation and participatory design can be seen as two phenomena of the changing value creation in general. Already in 2004 Prahalad and Ramaswamy wrote about value creation that becomes less and less company-centric, but is mere an act of a common creation. The co-creation experience itself becomes the central base for value (Prahalad & Ramaswamy, 2004). Participatory design refers to including stakeholders in the design process and most parts or all design activities (Bratteteig & Wagner, 2016).

Research design: methodology and case selection

This article is based on findings on FabLabs and Makerspaces of the working group Value Creation Systematics at the Institute of Production Engineering at Helmut Schmidt University, Hamburg. At first Osunyomi et al. observed major shortcomings in the FabLab Community, published in 2016a, 2016b. Based on these insights we conducted the research project "Twinning for Innovation" that has been funded by the German Federal Ministry of Education and Research. The project has been initiated and conducted by the Working Group "Innovation" of the Arab-German Young Academy (AGYA) and the Institute of Production Engineering at Helmut Schmidt University in Hamburg.

The objective of the project was to enhance the collaboration and embedding of the Labs. The concept of twinning has been applied in development cooperation, business management and public administration (Askvik, 1999; Saha & Saha, 2015; Karré & Twist, 2012). "The concept thus promotes joint learning, understanding and collaboration" (Buxbaum-Conradi et al., 2018, p.85). Research subject are FabLabs and Makerspaces, workshops that offer (free or low-level) access to technologies. The general description of a FabLab as small-scale workshop where anyone can make almost anything with the offered machines conveys a great significance but does not yet convey the scope of the idea as it has been developed by Neil Gershenfeld, professor

at Massachusetts Institute of Technology (Gershenfeld, 2005). Buxbaum-Conradi et al. (2018) find that they not only offer users the opportunity to put ideas and projects into practice, but can also be understood as spaces of shared creativity, learning and experimentation as well as shared value creation.

The focus of research of “Twinning for Innovation” has been set on the themes of local socio-economic, socio-institutional structures and integration into the global and virtual cooperation and sharing infrastructure (Buxbaum-Conradi et al., 2018). As such, FabLabs and Makerspaces conduct cost effective research and development and the valorisation of bottom-up innovations. Nevertheless, the fundamental condition for the success of a FabLab is an appropriate embedding in local socio-economic structures and in the global virtual knowledge and practice community. Previous surveys at the Institute of Production Engineering (LaFT) at the Helmut Schmidt University (HSU) have shown that FabLabs have a significant influence on factors that promote innovation (Osunyomi et al., 2016a, 2016b). They can promote crucial development of key innovative practices by user communities, particularly in the fields of agriculture, (renewable) energy, health and education (Osunyomi et al., 2016a, 2016b).

Case selection

In table 1 the case selection is shown. The FabLabs and Makerspaces have been selected from the existing pool of German- and Arabic-speaking countries according to their suitability and availability for the study; there has been no further categorization before the study. As an explorative approach the cases have been treated as equal cases, chosen randomly and there has been no further ranking or prioritisation.

Qualitative interviews have been conducted with the FabLab representatives alongside a guiding questionnaire in all cases. The interviewers were research assistants of the working group Value Creation Systematics that is part of the Laboratory of Production Engineering of the Faculty of Engineering at Helmut Schmidt University, University of the German Federal Armed Forces in Hamburg. The working group Value Creation Systematics is an interdisciplinary group, which focusses on research activities in the field of value creation, innovation and knowledge management especially from the viewpoint of the paradigm shift of value creation and observes the changes on different levels of value creation processes, structures and artefacts. The working group Value Creation Systematics and, thus, authors of this article developed the research approach, conducted the interviews and collected the data material; photos and video material in 2017. The researchers visited FabLabs and Makerspaces in Germany (8), Austria (2), Tunisia (3), Morocco (3), Egypt (4), Saudi-Arabia (2), Jordan (2), Oman (1), Lebanon (1), and Qatar (1). The years of founding of the FabLabs and Makerspaces show the relatively short time of existence of the labs, as well as the fact that the maker movement is in an early stage (see Table 1).

Table 1: Case selection and year of founding

	Name of FabLab/Makerspace	Town, Country	Year of Founding
1	FabLab Aachen	Aachen, Germany	2009
2	FabLab Kamp-Lintfort	Kamp-Lintfort, Germany	2015
3	FabLab Berlin	Berlin, Germany	2013
4	FabLab Bremen	Bremen, Germany	2013
5	FabLab Potsdam	Potsdam, Germany	2012
6	FabLab.SH	Kiel, Germany	2016
7	OpenLab Augsburg	Augsburg, Germany	2013
8	Dingfabrik Köln	Cologne, Germany	2011
9	HappyLab Salzburg	Salzburg, Austria	2014
10	FabLab Innsbruck	Innsbruck, Austria	2016
11	El FabLab	Marsa, Tunisia	2015
12	El Space	Tunis, Tunisia	2013
13	FabLab Enit	Tunis, Tunisia	2014
14	Innotech	Alseeb, Oman	2016
15	FabLab Casablanca	Casablanca, Morocco	2015
16	FabLab Temara	Témara, Morocco	2015
17	Dare Space	Rabat, Morocco	2012
18	FabLab Egypt	Cairo, Egypt	2012
19	Assiut STEM FabLab	Assiut, Egypt	2012
20	Karakeeb Makerspace	Alexandria, Egypt	2014
21	FabLab 10th City	Th. Of Ramadan City, Egypt	2016
22	FabLab Irbid	Irbid, Jordan	2016
23	FabLab Amman	Amman, Jordan	2011
24	FabLab Dhahran	Khobar, Saudi-Arabia	2014
25	FabLab Arabia	Jeddah, Saudi-Arabia	2011
26	Innovation Factory	Beirut, Lebanon	2016
27	FabLab Qatar	Doha, Qatar	2011

Methodology

In each case the researchers conducted qualitative interviews in order to analyse the single cases and compare the respective outcomes (Yin, 2009; Buxbaum-Conradi et al., 2018). The interviews with FabLab and Makerspace representatives of each case have been conducted along a prepared interview guideline. The resulting transcripts were analysed based on qualitative content analysis by Atlas.ti, a software for qualitative data evaluation. According to the explorative research approach of a case analysis one has to keep in mind that each case can count as one experiment. A representative result is therefore not an objective of this explorative study, as one would expect at the end of a quantitative approach (Yin, 2009).

A comparison of the FabLab representatives' statements and interference reveals certain basic assumptions that are available in the respective labs. Buxbaum-Conradi et al. (2018) published first insights of the research project: The FabCharter was nearly used by all FabLabs. The results showed different degrees of embedding in local institutional and economic structures that in turn resulted in the emergence of different types of labs. Besides, results confirm the lack of cooperation between the labs (Buxbaum-Conradi et al., 2018). Country-specific differences have been stated in the focus on exchange relationships:

While the rentier states of the Middle East want to prepare for the post-oil period in this way, the Levant and North Africa are trying to create job opportunities for the young population (Buxbaum-Conradi et al. 2018; p.89).

In the following, general statements will be derived based on the most clearly emerging categories from the case analysis with relevance for our research questions.

Results: Strengthening and weakening factors, motivation and visions, potential

We identified the following results: strengthening and weakening factors (according to the development of a FabLab) from the viewpoint of the interviewed FabLab representatives as well as motivation and visions of the FabLab representatives and the potential of the new way of value creation which is enabled in FabLabs. At first, the strengthening and weakening factors are described in detail and exemplified by quotations from the interviews.

Strengthening factors: Creative spaces, collaboration, inter- and transdisciplinarity

FabLabs and Makerspaces enable collaboration alongside the whole value chain. Some of the interviewed FabLab operators reported that the traditional obstacles of limited disciplinary viewpoints have less effects in FabLabs and Makerspaces: Application-oriented group work and a common vision deliver an atmosphere of solidarity and effective collaboration. Direct user feedback is an apparent phenomenon in FabLabs. In FabLabs and Makerspaces the people overcome disciplinary restrictions and work together in an *interdisciplinary manner*. This emerges in *creativity* that contains new opportunities for design and making based on participatory design and co-creation.

Without wanting to overestimate that now, but there are really many products that are modified a bit over the last few meters because you get direct feedback from users from another area. This allows you to react much faster to potential problems of the product in the future, because you get a very quick feedback. (interview partner FabLab, German-speaking country).

The knowledge about the *whole value chain* and the *transdisciplinary* exchange between e.g. craftsman, designers, and artists is another aspect that supports the development of a holistic understanding of design and production:

They [designers] don't learn [...] anything about materials and those who are solving the critical problems are craftsman and production experts. But they don't know anything about design. So we are stuck, unless we breach this, and we teach people (interview partner FabLab, Arabic-speaking country).

Weakening factors: Mistrust, demand, resources

In one case, clear competition and *mistrust* between regional FabLabs was reported. The mistrust was a consequence of different visions and business models. Knowledge sharing between organisations based on a common understanding of open source is not naturally given (Redlich et al., 2014). There is still a fear present that one might steal a good idea or concept for a marketable product. Despite common ideas and shared enthusiasm for the FabLab idea, Open Source Hardware and the maker movement, regional FabLabs and Makerspaces compete for resources, financial regional support and visitors or lab memberships. In principle, the labs whose financing is secured can be distinguished from labs that are exposed to greater competitive pressure. This leads to the fact that the lab operators also tend to focus on the competitive character and competitive advantages. The viability of FabLabs and Makerspaces depend on the *demand* of the spaces where the technology is accessible and people meet to make artefacts and share knowledge. But in nearly all cases we analysed, the FabLab idea must be actively disseminated to increase the demand. Some FabLab operators talked about a high share of their time that they invest in the announcement of the space and describing the idea of FabLabs and Makerspaces to the public. They have to do basic work in convincing users, customers and so on, either in view of the fact that the technologies exist or in view of the fact that it is a free offer not a service and the people have to work themselves.

I think it's [a] great opportunity for us. Suddenly people understand that they are able to do everything, since everything is available. So we benefit from this movement, there are many platforms where people share their ideas and inventions (interview FabLab, Arabic-speaking country).

While *transfer of knowledge* within a laboratory is a regular phenomenon, *the virtual sharing of knowledge* is not a commonplace. There is a gap between the wish to share and the actual amount of sharing. One reality that cannot be denied is the workload of the daily life that might hinder doing everything to live up to the vision of sharing. Technical documentation standards are missing and the time-effort necessary to invest in knowledge sharing online often runs counter to the vision of sharing in everyday life. Moreover, there are a lot of parallel structures that can be found in form of many documentation platforms via the internet as for example GitHub, Thingiverse and instructables (see Buxbaum-Conradi et al., 2018).

Motivation and visions of FabLab representatives

The core of the FabLab idea is technology – one might think at first. The observed motivation of the interviewed FabLab operators in German and Arabic-speaking countries, however, goes way beyond this. The motivation of the operators is not only to offer access to the new possibilities of technologies for their respective community, they want to deliver *low-level* access to new technologies, *connect* competencies, and use *Open Source* technology. This basic conviction has been found in almost all cases. There is no difference between German and Arabic-speaking countries according to the existence of such motivational arguments. Interestingly, there even cannot be simply stated a difference between FabLabs with different business models.

In the research study we found FabLabs with business models that are focused on initiating innovation and start-ups, but nevertheless, they were still convinced by the idea of open source, sharing and transnational collaboration. Some FabLab operators even looked at the possibilities of the laboratories from a superordinate perspective: They want to help with the next industrial revolution, bring back making and DIY, thereby turning the society from a consumer society into a producer society:

The founders [...] told us that the motivation was, you know, after the revolution everybody has a positive energy to shape something, that could be beneficial to the community. So, I think, the motivation was changing the mind-set of the [...] community and the believe, that [...] that the maker community will put [the country] on the right track, to overcome the circumstances and challenges that we face right now (interview FabLab, Arabic-speaking country).

We were also able to interview more “realistic” FabLab operators who regard their work as work and were not so visionary in their statements. These operators also say that the economy will not change so much as a result of the new technologies and open source movement. On the other hand, for countries with a high unemployment rate, FabLabs seem to raise hope and initiate visions of increased economic wealth that is necessary for these countries and the local people to participate in global value creation and reconnect in terms of globalisation.

Country-specific obstacles

From the perspective of some FabLab operators FabLabs are a method to overcome country-specific local problems such as unemployment or waste problems. FabLabs give people hope to change the mind-set of the people, to change the economy and to change certain policies. From this perspective the international network of FabLabs works as an intermediary to overcome intercultural differences and foster transnational knowledge sharing to find solutions for local problems. Further country-specific problems are a lack of resources in countries with a surplus of imports, *Brain Drain* as well as country-specific legal requirements for organisation forms in some Arabic-speaking countries. Brain Drain describes that well-educated people leave the countries and are no longer available for the local maker scene as they have ambitions to start their living and projects in countries with better conditions. And the legal requirements for the operation of a FabLab or Makerspace are difficult in some countries as one has to choose the organisational form (e.g. operate it as a small company or as an association). Another factor that proved to be an obstacle is language.

The exchange of technical documentation between Arab- and English- or German-speaking FabLabs is in most cases in English. This excludes, at least to some extent, makers in Arabic-speaking-countries that cannot fully

understand the English documentations. But according to the mentioned barriers, the FabLab representatives are already working on solutions: To overcome the *language barrier* some FabLab operators are working on a central platform to enable exchange between Arab- and English-speaking countries. In relation to the FabLab idea the operators are very interested in open access and open source and they are not driven by financial aspects. On the other hand, they need funding for their lab and have to develop suitable business models in the long-term.

Cui bono? What is the potential of FabLabs and Makerspaces?

The majority of FabLab operators do not see themselves as political stakeholders. Some FabLab operators mentioned that they do not want to be included in politics, because they want to avoid getting blocked by political factors, like corruption, nepotism, dependence etc. Nevertheless, the totality of operators interviewed can be ascribed a power within the local structures. In this power lies the chance to change mind-sets, overcome intercultural differences and (at least to some extent) change the economy.

Thus, even if the majority of lab operators see themselves as apolitical, they must be seen in their entirety as a movement as a political factor. It is a value decision to be part of the FabLab community that implicates the values described above, e.g. solidarity, sharing and collaboration. The identification with the maker movement cannot be dismissed in many cases and has also to be seen as a political statement.

A central achievement, but also cause of some problems, in our high-industrialized societies, is the division of labour. It can count as one reason for the widespread alienation from value creation. Participation is concerned with enabling people to take their part in processes that affect them directly or indirectly; in other terms: stakeholders. From this perspectives stakeholders are getting empowered within FabLabs. FabLabs are working as enabler for people, so that they are able to participate in value creation.

The real issue in [name of the country] is that our parents and grandparents used to create things. And the issue for us is not to lose this culture and empower it with technology. So people who have our age and even younger start to lose the ability to make things and no longer make things (interview FabLab, Arabic-speaking country).

The paradigm-shift of value creation is a rethinking on a concrete level. FabLabs and Makerspaces deliver work on site and form a community that is crucial for bottom-up economics (Redlich & Wulfsberg, 2011). Intangible assets can be found in these achievements of FabLabs and Makerspaces that are not mentioned in the common balance sheets of economic organisations, but they maybe be observed by community developers.

General recommendations to foster participation in design and production processes

General recommendations can be given to foster participation in design and production processes. We have shown that there is a realistic and an idealistic approach to run a FabLab or Makerspace. The more realistic side recognizes fears of Open Source, the workload of the individual, who practically opposes the implementation of the sharing ideal. The representatives of FabLabs are conducting basic convincing and educational work. This starts with the concept of FabLabs, the new technology, sharing, Open Source and the DIY-mentality as well as creativity and an entrepreneur-mindset.

In relation to these points, firstly, political support could be promoting standards of Open Source licences and technical documentation.

Secondly, knowledge sharing (locally and globally) could be rewarded through incentives. Within a system, in terms of crowd-related effects, one can also integrate Nudge as a method to foster changes in mind-sets and communication to strengthen the sense of the future and protect against unnecessary risk taking (Thaler & Sunstein, 2008). For example, a sharing award for the best website or similar incentives.

Thirdly, the labs could be promoted through better financing. Human cooperation is usually relatively unstable. The central recommendation regarding FabLabs is to consider it as a value decision to initiate a FabLab and/or

engage in this local organisation. As shown above, the creation of values extends to the intangible area. So far, the underlying values which characterize co-creation processes have been neglected in wide parts of society. FabLab representatives try to raise awareness for those production technologies that enable to participate in value creation. The small-scale approach and the overarching standardization by MIT is showing success. Most FabLabs are committed to the FabCharter (Buxbaum-Conradi et al., 2018). Instruments should be based on values of respect, solidarity and cooperation. If the conscious value decision of the implementation of FabLabs is conducted at the beginning, these values can also be shared with the community, and it develops value-oriented community-building at eye level in the long-term. Decision makers should be more aware of the underlying value decisions at the beginning and initiation of FabLabs. The involvement of different individuals requires a value-oriented support also by political representatives. In this sense, politics could foster programs to theme-centered interaction to accompany a greater part of local communities (Cohn, 2013).

However, more research is needed. Especially the effects of FabLabs and Makerspaces on uniting community-forces to support civil society in transnational crises and develop solutions e.g. to deal with the refugee crises. Troxler for example states that open design is already taken into account within the EU; but

Understanding developments of common-pool resources and inverse infrastructures and policy recommendations aimed to promote more collaboration and networks is not sufficient (Troxler, 2013, p.190).

In a nutshell, a FabLab can be seen as node of participation, places paving the way for a new mind-set that reflects new value creation patterns. People have the chance to develop from consumers to makers, which is connected to a new mind-set. Barriers are especially the misunderstanding of new value creation patterns that one can find throughout all countries. Every single FabLab is working on changing preoccupied mind-sets and showing what is actually possible based on new technologies and community-building.

Without overestimating the movement, it can be said that FabLabs and Makerspaces represent an enormous value and nodes of interdisciplinary and intercultural community in regional development, community development, and technology education (Hamalainen & Karjalainen, 2017). This should not be underestimated, although these are parts of the immaterial value creation. In the end, the movement is still at the beginning and it will be interesting to follow its outcomes.

Conclusion

Yes. I mean the maker movement is growing rapidly. But being part of a global network it always gives us the edge in terms of impact and that's why the impact of FabLabs around the world is way stronger and bigger than other individual makers. The global network has helped us to do new projects and it opens lots of doors within different industries (interview FabLab, Arabic-speaking country).

FabLabs form a counterpoint to our current consumer-oriented societies. They enable digital citizenship across language and country borders and work as nodes of participation and, thus, places of empowerment. FabLab operators are basically interested in solving local problems. They regard the empowerment of technology use and technology design for peer production as a central empowerment factor, which ultimately leads to a solution of social problems. FabLab representatives could also be considered as digital citizens. Digital citizens naturally know how to network with each other via the internet and to exchange information about the existence and availability of the infrastructure, but there is a lack of content exchange about technologies between FabLabs (Osunoyomi et al., 2016a; 2016b); Buxbaum-Conradi et al, 2018). There are no underlying responsibility ascriptions among FabLab operators which would attribute the cause of societal problems, e.g. unemployment to the individual, for example, to the people themselves. Rather, most FabLab operators have a humanistic world view that motivates them to create technological infrastructures for their communities. However, as research by Osunoyomi et al. shows, FabLab operators lack a true global network that promotes knowledge exchange. This can ultimately be attributed to the fact that FabLabs are still young and everyone is fighting for their survival in

one of the different types/models of labs mentioned (Buxbaum-Conradi et al., 2018; Branding et al., 2018; Troxler, 2013).

In general, the project enabled interesting insights into the actual status quo of FabLabs. The attitudes of Makerspace and FabLab managers became clear; especially, the assumptions underlying their strategies of action to foster participatory design and co-creation.

Limitation and outlook

And not only for the founders, not only for the workers, or the people who use this place, but everybody in the community, everyone, who is linked in some sort of way. They get knowledge, get money, get space, get potential, get opportunities (interview, FabLab Arabic-speaking country).

The general recommendations are derived from the qualitative analysis of the conducted interviews. It has to be taken into account, that the qualitative research counts as a process of a hermeneutic circle and cannot deliver validated results in terms of a quantitative research. A general picture of the explored field can be shown and follow-up questions raised.

In terms of bottom-up-economics the vision has already been created that processes in development cooperation may be conducted at eye level and, in the long-term, has the opportunity to change from a top-down-oriented cooperation, determined by a power elite, to a collaboration-oriented industrialization (Basmer et al., 2015).

The development of the FabLab movement over the next 10 years will be interesting as most of the FabLabs are only a few years old (see Table 1). A follow-up study in 10 years would be most welcome, in terms of what has changed, especially according to the global FabLab development and the individual development of the young organisations. Further evaluation studies of long-term effects of FabLabs should be conducted and will give us more insights into the possibilities and successful strategies in the long-term. To what extent will the viability of the FabLabs depend on the individual committed digital citizen?

To conclude, as we look for an answer to the question 'cui bono', one has to state that it depends on the country-specific framework a FabLab is embedded in, the motivation and the vision of the FabLab representatives as well as the described strengthening and weakening factors of the development of a FabLab and, thus, of a successful participation in the global maker movement.

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^{i i} Neil Gershenfeld, inventor of FabLabs teaches at the MIT diverse classes in the field of electronics and production. He and his network support the idea of a global education and collaboration of all FabLabs worldwide. Therefore, he set up the so-called FabAcademy where students can learn via webinars about the different approaches to make almost anything in the FabLab.