WP4 | CASE STUDY Report: Fab Labs

**transformative
social innovation
theory**

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1 Introduction to Fab Labs

The transnational network under study is the network of Fab Labs. Fab Labs can be described as spaces where people come together to learn about versatile digital design and manufacturing technologies and create things in individual or collaborative projects. Some labs are run voluntarily, whilst others receive institutional support (e.g. from universities and libraries), but all share an ethos towards providing labs that can be freely (at least in parts) accessed by the wider public. Fab Lab members are involved in a variety of practices that go beyond tinkering with technologies and making things. For instance, this can include experiments for commons-based peer production that some observers claim might be relevant for a post-consumption society.

Nowadays, labs constitute a global network: they can be found in many major cities around the world; they sometimes network, share projects and knowledge through social media; and meet up physically at international events. Although there is no real formal process of setting up a Fab Lab, all of them have evolved from the first lab that was established as part of MIT's Interdisciplinary Centre for Bits and Atoms course, entitled 'How to Make (almost) Anything' (Gershenfeld 2012; 2005) in 2002. Fab Labs are conceptually embedded in a common set of requirements. This includes a common set of digital technologies (to ease ways of sharing data, including machines such as computer-controlled laser cutter and numerically-controlled milling machine) and a shared Fab Lab Charter (i.e. a document that outlines the shared values of labs) (Troxler 2010).

Over the past few years, Fab Labs have attracted increased attention from media, public, government, businesses, and academia because their activities and projects have been linked to narratives about a digital revolution in fabrication (a revolution not only associated with technologies and producing things but tightly interlinked with social factors and goals). Efforts towards open source, creative commons, peer-to-peer networking, decentralised/ personal/micro manufacturing (such as people producing their own objects in their own home or near to them), non-market and decentralised patterns of production, and collaborative working have been interpreted as being part of a 'third industrial revolution' (Anderson 2012) and a 'revolution 'in the making'' (Ree 2011).

Such rhetoric might not come as a surprise when considering Ree's (2011, p.18 drawing on Turner 2006) statement, 'major advances in digital technology are often born out of grassroots 'countercultural' movements.' Analogies are being made to the development of personal computers by enthusiasts in their garages to illustrate this point and to demonstrate the potential impacts of Fab Labs. Moreover, Walter-Herrmann and Büching (2013) have argued that digital fabrication technologies do not only have a techno-economic role to play in the near future but will also have an impact on different social fields (such as, work and home), in particular, when they are located in community-based workshops. Such impacts are said to facilitate opportunities for sustainable consumption (see, for example, Schor 2010), reductions in transportation worldwide (Birtchnell & Urry 2012) and enhance educational systems, just to mention a few.

Developments have been associated with the emergence of the collaborative economy, including ideas such as commons-based peer production (Benkler & Nissenbaum 2006), open innovation (Chesbrough et al 2006), crowdsourcing (Howe 2009), and wikinomics (Tapscott & Williams 2008). Activities in Fab Labs have been considered to put into question a number of conventions, including: the sources and systems of innovation, intellectual property and patent rights (see for instance, the Peer-to-Peer foundation) and patterns of co-production (Birtchnell & Urry 2012).

Such rhetoric has created a real hype around grassroots digital fabrication, which sometimes risks extrapolating and inflating claims without considering participants' own activities, aims in setting up spaces, and motivations for joining these workshops. To treat such discourses with a bit more caution was also one of the main messages that came out of a recent special issue on Shared Machine Shops in the Journal of Peer Production that stated, 'Fab labs are not the seeds of a revolution' (Troxler & Maxigas, 2014). Little social science research has gone into studying such discourses in relation to practices on the ground.

Although Fab Labs in themselves might not be a source of a transformation, they still have created a global network that increasingly is able to gain resources and attention from a variety of audiences. The network was set up with the idea to support each others learning and encourage collaborating in projects in a relatively structured manner through video conferencing systems hosted by MIT, scheduled conferences, the set up of national and international organisations (such as the Fab Foundation and the Fab Academy training programme) (Walter-Herrmann & Büching 2013). Walter-Herrmann's (2013) survey on Fab Labs has shown that relationships between labs are generally 'informal' (based on project collaborations and friendships, occurring via email or face-to-face interactions) and takes place within their own continent (rather than globally). These relationships can be grounded in strong and loose ties but is often characterised through the exchange of ideas and information (Walter-Herrmann 2013). Similarly, Troxler (2013; 2010) has suggested that 'labs rarely made use of the possibilities the Fab Lab innovation ecosystem offers' (2010, p.8) and therefore the global network of labs currently 'struggles to define its form and purpose' (2013, p.181).

There are currently 440 Fab Labs across 60 countries (Transnational networker B, interview, 15th August 2014), the most up-to-date list can be found here: https://www.fablabs.io/labs. Fab Lab Amersfoort is one of them. It is based in the Netherlands and is part of the Dutch Fab Lab Network. In the Transit project the lab represents one of the local initiative. Four artists, who at the time were interested in the intersections of art, technology and science, have set up the Fab Lab in 2010. They struggled to gain external funding and consequently, decided 'to take matters into their own hands' and set up the lab with their own money (Diana Wildschut and Harmen Zijp, interview, 30th October 2014). Since then, the Fab Lab has been know to be a bottom up grassroots workshop because they were able to set up the lab in '7 days with 4 people and about €5000'. Part of their approach and aspiration is to use mainly 'self-built and open source' machines in their lab, to become sustainable (drawing on Transition Towns and Citizen Science) and develop experiments towards a peer-to-peer society. The Fab Lab is part of a cooperative called 'De War' and is strongly connected to the following activities: Transitielab, OpenToko, Spullenmannen and Amersfoort University. These organisations, projects and activities are highly interlinked with each other and even by the practitioners regarded as inseparable. This report will therefore not only draw on insights gained from visiting Fab Lab Amersfoort but also puts them in the context of De War. Regarding Argentina, we will study mainly the Fab Lab Argentina that is part of the Central Society of Architects in Buenos Aires, but also draw from interactions of this Fab Lab with other labs in Buenos Aires and Latin America.

The report proceeds as follows: Section 2 describes the methodology, drawing on interviews, participant observations and a document review; Section 3 presents the analysis of transnational network i.e. the Fab Lab network, in particular discussing 'innovation', 'change' and 'empowerment', before section 4 and 5 present the analysis of the two local initiative. Conclusively section 6, synthesises the case study.

Fab Labs: International Network	
Fab Lab Amersfoort, Netherlands	Fab Lab Argentina, Buenos Aires - Argentina

International network(ing)	Local Manifestation
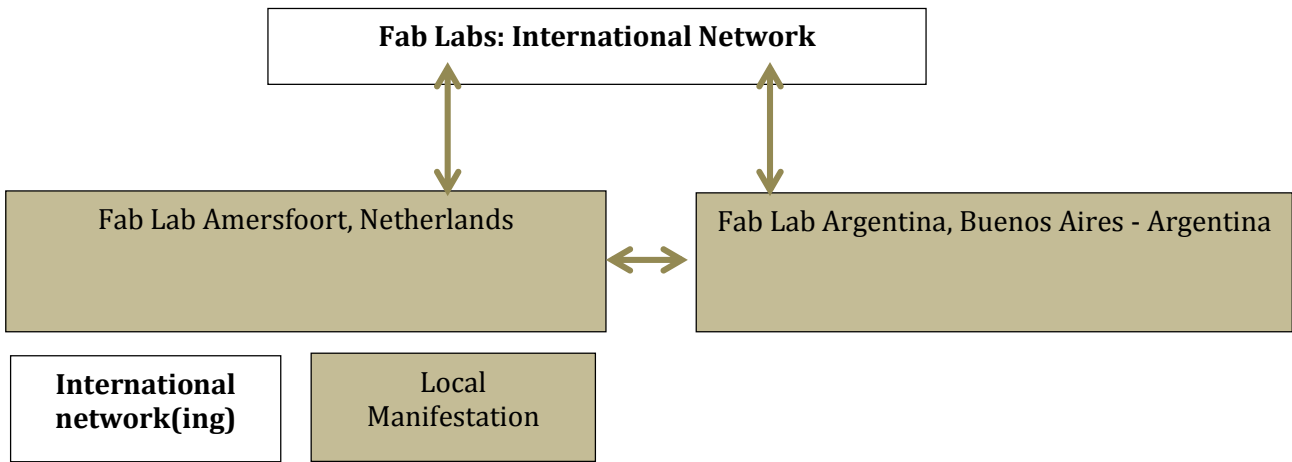
2 Methodology

2.1 Researcher relations to the case

Previous to the Transit project, the research team had an interest in Fab Labs but had not deeply engaged with any of the practitioners. The team therefore decided to have an explorative and flexible approach to identifying local initiatives and transnational network interviewees. Events have been crucial to develop informal relations with practitioners that could be followed up at a later stage. This has particularly been the case for approaching Amersfoort Fab Lab and Fab Lab Argentina. The research team had acknowledged the interactive dynamic of the relationship between the researcher and practitioner. This includes the recognition that during the data gathering a researcher is part of the creation of reality, as knowledge is produced through the interaction between both. The research team offered all of the practitioners who participated in this fieldwork to be able to read and comment on this report with the possibility of creating a separate case study report for Amersfoort Fab Lab.

2.2 Methods

2.2.1 Overall methodology

Over the period of May 2014 – December 2014, the research team has conducted interviews, participants observations and a document review (see details below) for the transnational network: Fab Lab and two local initiatives: Amersfoort Fab Lab (De War) and Fab Lab Argentina. As part of these research activities, the team tried to cover all of the research questions in similar depth but leaving enough flexibility for other themes to emerge. For instance, although, the interview topic guide provided some foundation to each interview, unexpected themes were allowed to emerge, whilst researcher's responses happened spontaneously and in response to the informants' answers. During most of the interviews, it became apparent that there were too many themes to cover within the guide. The researchers had to go through a long list of topics. Some of the answers therefore felt a bit broad and more depth was missing. The researcher had to strike a balance between covering all the themes and gaining enough detail to develop an understanding of the network. Similarly, some of the key conceptual and theoretical terms were frequently 'translated' into terminologies the practitioners used themselves. Practitioners occasionally made use of some of the Transit concepts, including words such as empowerment and innovation but overall this was rather rare.

2.2.2 Interviews

Transnational network:
Sampling: A long list of a wide variety of actors (such as researchers and Fab Lab Managers) and organisations (such as the Fab Foundation) involved in the network was assembled through attending Fab Lab events and conducting internet searches and initial interviews. This list aided the process of choosing the first possible interviewees and developing a sampling strategy.

The first three interviewees consisted of a researcher who had conducted research in the area for the last two years (and had an substantial overview of the network) and practitioners with whom the research team had previous informal conversations in order to gain some first insights into the network and who to interview (drawing on a snowball sampling). The final thirteen interviews consisted of two university researchers, seven practitioners that are involved in current/past organisations within the network and four practitioners that are heavily involved in local and/or regional manifestations and have a good overview of the overall network.

The small sample size meant it was not possible to incorporate all aspects of diversity. In particular, a variety of regional practitioners (such as in Africa, India, Australia and China), high profile practitioners (such as Neil Gershenfeld) and practitioner who are no longer involved in the network have been missing from the sample. The absence of these practitioners might limit the possibility to show the full picture of the network and skew some of the results. For instance, some regions within the global network have developed their own events and ways of networking and sharing knowledge and in the process re-interpreted the Fab Lab idea. The full diversity of these regional diversities can therefore not meaningfully analysed and interpreted in this report. Moreover, some topics and themes, including the history of the network, are being told in several different ways depending on the interviewee's own experiences and interpretations. The telling of multiple narratives makes it challenging to identify one interpretation of the network aims, structures and history. Whenever possible such limitations were addressed through listing to practitioners on internet-based videos or at Fab Lab events and looking at secondary data.

Conducting the interviews: Half of the interviews were conducted face-to-face, either in restaurants or Fab Labs and the other half was carried out over Skype, between August 2014–October 2014 (some of them were conducted earlier since May 2012). The length of the interviews varied between 1.5-3 hours. Three interviews were transcribed verbatim whereas the rest consisted of detailed notes and quotes (some had to be translated into English because two of the interviews were conducted in German).

Sampling local initiatives:
An excel list of Fab Labs, based in Latin America and the UK (and other European labs that have written English or German websites) was assembled, drawing upon the Fab Lab Wiki page (i.e. http://wiki.fablab.is/wiki/Portal:Labs; a website where each lab has the option to introduce their space). These websites were used to familiar ourselves with a variety of labs (i.e. their aims, activities, projects, technologies used) to formulate a sampling strategy and select the two local manifestations (for more information on these Fab Labs see: http://grassrootsinnovations.files.wordpress.com/2014/08/gdf-rb24-uk-web.pdf). From this list several sampling strategy ideas (whilst considering the Transit aims) were brainstorm such as selecting cases that were particularly influential in the network or typical (representing several labs). Attempts to categories these labs into groups often felt like an impossible task because of the sheer diversity in aims, partnerships, resources, etc. Ultimately, considering the Transit aims, the sampling of the two local manifestations draws upon an extreme sampling strategy. Here, an extreme sample is characterised by its engagement in transformational discourses (in the context of Fab Labs these discourses were identified through a literature review of journal and media articles and practitioner websites, reports and blogs; for more information see: http://grassrootsinnovations.org/2014/09/01/grassroots-digital-fabrication-a-literature-review/), interesting governance and social learning activities, creation of new forms of social interactions and attempts to empower people and reshape society.

Amersfoort Fab Lab (De War): Whilst assembling the list of Fab Labs to be able to sample for case studies, the aims and approach of Amersfoort Fab Lab were interesting because of several statements on their website: Firstly, they describe themselves as a 'bottom up grassroots Fab Lab',

rather than relying on $100k of external funding to set up the Lab (something that most Fab Lab try to raise), the people behind the Amersfoort Fab Lab developed an approach of 'how to set of a Fab Lab in 7 days with 4 people and about €5000'. Secondly, they link to several 'transformative discourses': 1) 'We want to become a sustainable Fab Lab', 2) 'We plan to have our whole lab open source as soon as possible' and 3) 'The digital revolution' and 'Personal Fabrication'. Since 2012, the Fab Lab team has also started to organise a 'Grassroots Fab Lab Conference' called 'Fabfuse' to be able to network with the wider network and talk about their approach. One of the researchers attended this event in 2014 and confirmed the existence of the above discourses and activities and that the Amersfoort Fab Lab would fit into our extreme sample.

Fab Lab Argentina: The selection of the Fab Lab Argentina as a local case was made after a wide survey of cases and manifestation of Fab Labs and Makerspaces in Buenos Aires. Fab Lab Argentina has been selected for several reasons. Firstly, the participants of the Fab Lab Argentina are well connected with the transnational networks and Ilaria Lamanna, one of its founders has been a member of the Barcelona Fab Lab and participated in the IAAC academy. As a result, the Fab Lab Argentina became an important node the in the newly created Fat Latinoamerica Network coordinated by Beno Juarez in Perú. Finally, the lab was involved (and still is) in the development of the Floating Fab Lab project hosted by the Latin American Network (Fab Lat). Being involved in this project was a unique opportunity to learn from the dynamic of the local initiative and at the same time try to document and understand the regional manifestation of Fab Labs in Latin America.

Interviews at the Amersfoort Fab Lab (De War), Netherlands: Most of the interviews at the Amersfoort Fab Lab (De War) were conducted as part of the daily activities at De War (see participant observations section) during a seven day visit to the lab and as part of the two day conference at the Fab Lab, called Fabfuse. About twenty-five informal conversations were carried out with Fab Lab users, conference participants, friends of De War and cooperative members. These conversations happened add hoc and were between ten to sixty minutes long. In addition, four recorded interviews were conducted with three of the cooperative members: two, Diana and Harmen, who are heavily involved in the activities at De War and also live on the premises and one, Past regional networker, who occasionally gets involved in activities at De War and was also involved in setting up the Dutch Fab Lab network and an academic researcher who has done participant observations over the last six months at De War. In general, all of the people at De War were happy to talk to the researcher and made themselves approachable for conversations and interviews.

Interviews at the Fab Lab Argentina: Interviews were conducted during the first visit to the space in early August. After this visit parts of the research team was subsequently invited to a workshop on the Floating Fab Lab with Adrian Smith in which the team participated. After that the team became involved in the subsequent meetings of the workshop held in November for the construction of project ideas for the Floating Fab Lab. As part of this participation we have ad hoc conversation and discussion. The participation in the workshop Floating Fab Lab and other activities still continue today. In general, Ilaria Lamanna and the other participants are welcoming the research and reflection on their activities.

2.2.3 Participant observation

Transnational network:
Participant observations were carried out at two conferences: 1) the international Fab10 conference in Barcelona 2014 and 2) Fabfuse in Amersfoort 2014, at the Brighton Makerfaire in

2013, 2014, at ten Fab Labs in the UK, Germany, Spain and the Netherlands throughout 2014 and at a summer school in the Lisbon Fab Lab in 2013. In addition, the research team conducted a World Café discussion with local practitioners about digital fabrication at the 6th Living Knowledge Conference in 2013. During these events, the research team was able to gain an overview of network, in particular its structure, debates, and activities, was able to use and experiment with the technologies in these labs themselves, get an overview of the diversity of local manifestations and talk to a variety of different actors through informal conversations.

Local initiatives:
Participant observation at Amersfoort Fab Lab (De War) consisted of a two day international conference called Fabfuse (2014) and a seven day visit (in October 2014; daily from 10.00-23.00). During the visit, the researcher was able to participate in several daily activities: the Tuesday Open Day at the Fab Lab, the clean up/work day at De War, a semi-public event, project meetings and the overall life at De War (i.e. working in their office). These events and observations helped to gain insights into the daily running of the Fab Lab (and De War) and how they represent themselves to the outside world. Further, it allowed the researcher to speak informally to a variety of different actors and to witness what is being produced and how the machines are used.

Participant observation in the Fab Lab Argentina was conducted during the workshop about the Floating Fab Lab initiative. The first meeting was an introductory workshop chaired by Beno Juarez from the Peru Fab Lab and the Fab Lat on the 22nd of August. Then from the second Tuesday of October onwards, the research team has been participating every Tuesday afternoon in the activities of the Fab Lab Argentina relating to the Floating Fab Lab. These activities included: discussing projects and ideas, writing funding proposal, discussing links and relations with other Fab Labs. These meetings were key to gain a deep understanding of the everyday activities of the Fab Lab, its aims, way of working, and the co-working experience. Participating in the activities has also helped the research team to understand complex ideas about design, open collaboration and how 3D technologies modify the practice of the designer and architect.

2.2.4 Document reviews

Transnational network:
A literature review of journal and media articles and practitioner reports was conducted in from January to May 2014 in order to examine existing analytical themes, methodologies and debates addressed by previous research and practitioner work relevant to community-based digital fabrication workshops. The review provides reflections on three critical issues: sustainability, inclusivity, and creativity. For more information and amount of documents see: http://grassrootsinnovations.org/2014/09/01/grassroots-digital-fabrication-a-literature-review/. In addition, various web-based materials, including videos, wiki pages and more general searches (collated for each interview to familiarise ourselves with the interviewees) were added to the analysis.

Local initiatives:
Various web-based materials, including videos, presentations, more general searches about De War and the Amersfoort Fab Lab were added to the analysis. This selection was substituted with a newspaper articles and brochure about De War. The research team has mainly reviewed websites and web-based material in Argentina and other countries in Latin America. Special attention was placed on the Floating Fab Lab initiative. In relation to this the team took into account videos, power points and other forms of presentation. A sample of newspaper articles were also included in the analysis.

2.2.5 Analysis of the data

The qualitative analysis programme 'Nvivo' aided the process of indexing the interviews, notes coming from observations and secondary data documents. All of the themes were based on the Transit topic guide. The development of detailed descriptions derived from the emergence of patterns and repetition were identified across the interviews.

3 Analysis of transnational network(ing)

3.1   Transnational networking: Fab Labs
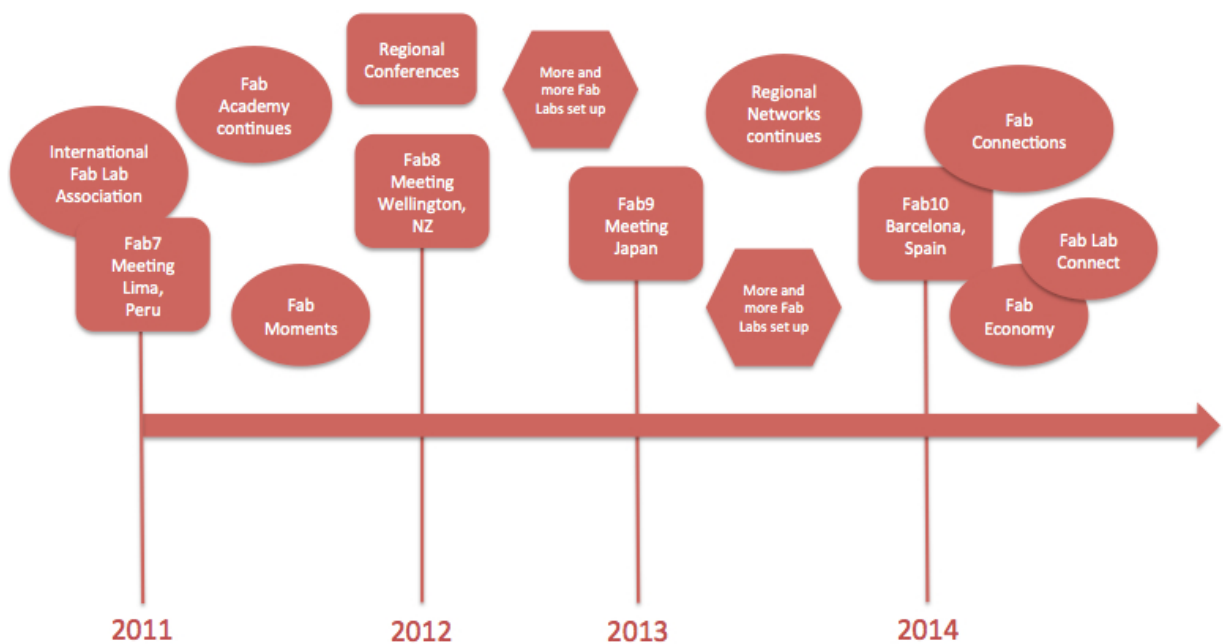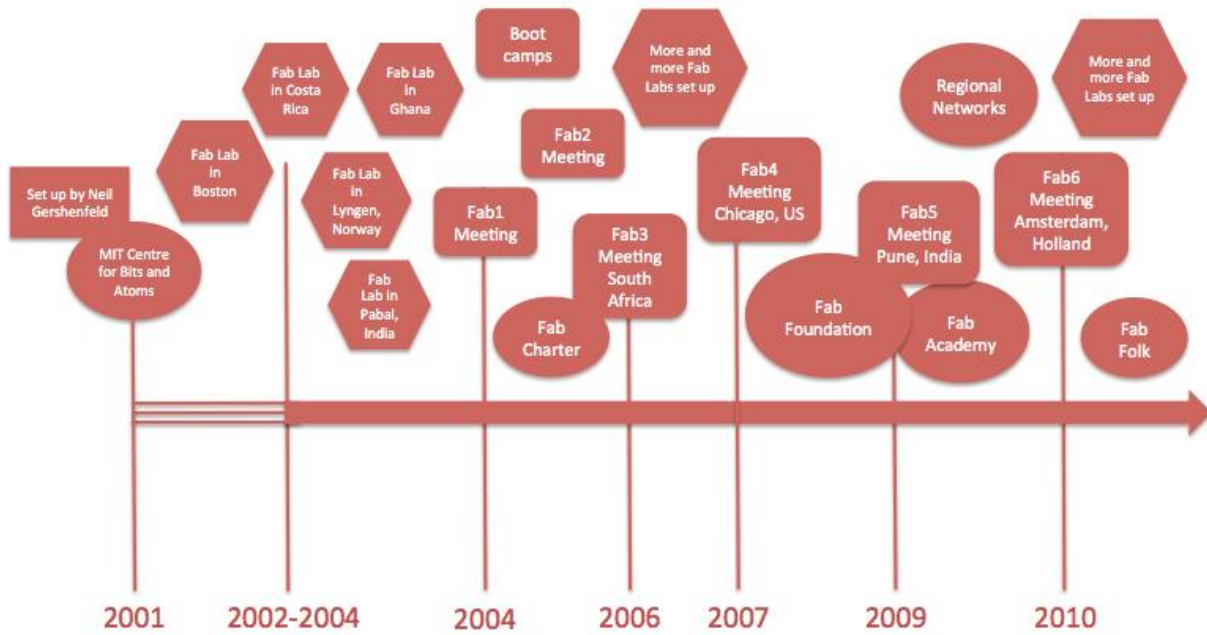
Timeline of Fab Lab network

Mapping the structures, actors, developments and activities

Some say that the Fab Lab network 'started by accident' (Tomas Diez, Fab10 Documentary, you tube, 2014), as part of a public outreach programme run by the Massachusetts Institute of Technology's (MIT) Centre for Bits and Atoms. This programme was a required funding component, coming from the National Science Foundation and consequently, set in motion the establishment of the first labs. Moreover, there was a great global interest in these activities. When setting up the Centre of Bits and Atoms and running a course called 'How to make (almost) anything' the Director of the Centre, Professor Neil Gershenfeld, was surprised about how it was overrun by students, demonstrating the interest in the topic and the possibility to find a wider audience. From the beginning, the aim became to democratise the access to digital design and fabrication technologies where Fab Labs are considered to be 'a tool for 'personal' discovery' where anyone can 'produce some truly revolutionary creations' (Preble 2012). Ambitions are consequently framed around ideas of personal fabrication, personal expression and invention.

In an official press release Neil Gershenfeld argued that 'instead of bringing information technology to the masses, the fab labs bring information technology development to the masses… rather than telling people about what we're doing, we thought we'd help them do it themselves' (NSF 2004).

To be able to follow these ambitions, the Fab Charter was created in 2006 that outlines some of the general norms, which are shared by all labs (the idea is that each Fab Lab subscribes to the Charter and pins it up on the lab's entrance door). These norms are broadly encompassed by the following points: 1) be regarded as a 'community resource' and consequently, open to the public for some of the week; 2) respect open source ideas; 3) consider commercial activities as possible activities, as long they are only incubated in the lab and develop further outside of it; 4) have a common set of tools, capabilities and processes to allow an effortless sharing of projects and people between labs and 5) think about yourself to be part of the wider network.

The first Fab Labs that were set up as part of the outreach programme between 2002-2004. They are based in Boston, in the US (in the South End Technology Centre at Tent City), India (at the science school Vigyan Ashram), Ghana (in the campus of the Takoradi Institute in Ghana) and Costa Rica (at The Costa Rica Institute for Technology as part of the Learning Independence Network that was developed by the Grassroots Invention Group). In addition, a Fab Lab was established on a farm in Lyngen (above the Arctic Circle in Norway) in connection with a company called Telenor to further develop sheep radio collars and antennas to help the process of nomadic herding. As a process of setting up the first few labs, the people from the MIT's Centre for Bits and Atoms were keen to identify several of 'technological protagonists' (Gershenfeld 2005, p.77) within deprived communities with whom they could collaborate.

Although several accounts of the history of Fab Labs can be found on the internet, as pointed out by Kohtala and Bosque (2014, p.2), 'surprising little has been written about germination of the first FabLabs aside from Gershenfeld's own account (2005)'. Whilst conducting their research on FabLabs, they came across several voices that told multiple stories about the beginning of Fab Labs, depending on the labs 'own relationship with MIT as well as the rest of the network and can choose how this relationship is embedded in its identity and, in reverse, how it wants to affect the development of the network' (Kohtala and Bosque 2014, p.2). Such divergence in histories are also apparent in several of the interviews, for example, when asking interviewee J, who has spent some time in the FabLab in Lyngen, when it was set up his answer was, 'no it was the first one… it was basically the first or second, depending on who you speak to' (Jean-Michel Molenaar, interview, 25th August 2014). The history outlined in this report therefore needs to be read with caution. It is

based on interviews and documentary review conducted for this research but might look slightly different if it would be told by other researchers or practitioners.

Since the set up of the first labs, the number of Fab Labs have grown 'virally' (Neil Gershenfeld, Fab10 Documentary, you tube, 2014) and doubled every 18 months for the last ten years and now amount to about 350 labs globally. Although there has been no formal and agreed upon procedure to register a Fab Lab, an official list of Fab Labs has been established on a Wiki page and since 2014 on the recently established FabLabs.io website (to be able to get on the list another registered Fab Lab needs to verify for the new one). Most of the practitioners feel that the international network evolved by chance because of a real global fascination in digital fabrication rather than by design as part of a grand plan. This has partly meant that organisations to structure the activities of network have come and gone over the years and ways to create stable business models, monitor activities and structures to share knowledge are still under development. Early networking activities were based on setting up Fab Labs and organising global boot camps (to mainly work but also discuss together). Nowadays, some of the most established activities have been a yearly international conference (so called FabX that started in 2004) and the creation of the Fab Foundation and Fab Academy in 2009 (set up by MIT).

The international Fab Lab community has organised yearly international conferences from the US, South Africa and India to the Netherlands, Peru, New Zealand and Japan to share knowledge and make together. The conference has consisted of a full week of workshops, Fab Lab introductions, Foo Sessions (i.e. making sessions), exhibitions and a symposium about digital fabrication. They are often organised by the hosting Fab Lab in collaboration with the Fab Lab Foundation and MIT's Centre for Bits and Atoms. The last conference, Fab10, was held in Barcelona in the summer of 2014 supported by IAAC and the Barcelona City Council with about 600 attendees (about double the amount since 2013). Here, Neil Gershenfeld spoke about the atmosphere during the first few conferences,

'At Fab1 we were ten people at MIT and thought we would never meet again... Hakan a crazy guy started his lab above the arctic circle... and we had a meeting there... the meeting in Chicago, I called it Fab4 only as a joke because there was a film out called Fab4... we thought we were done but they kept on growing bigger' (Neil Gershenfeld, Fab10 Documentary, you tube, 2014).

In addition to organising yearly get togethers; the Fab Foundation was set up by the MIT's Center for Bits and Atoms Fab Lab Program, in February 2009. Neil Gershenfeld did not want to create a lead organisation for the network but felt that a body needed to be created to support its activities. The Foundation is a US non-profit organisation that aims 'to facilitate and support the growth of the international fab lab network through the development of regional Fab Foundations and organizations... The Foundation has three programmatic foci: education (.edu), organizational capacity building and service (.org) and business opportunity (.com)' (Fab Foundation website, http://www.fabfoundation.org/about-us/). At the same time as establishing the Fab Foundation, the Fab Academy was set up. More and more people globally became interested in doing MIT's Centre for Bits and Atoms 'How to make (almost) anything' course. The demand became so high; in particular, from people using Fab Labs, the decision was made to establish the Fab Academy. It is a five months part-time course that can be attended at the participating Fab Academy labs all around the world (i.e. currently about thirty different labs, so called 'super-node labs') (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

Over this period, students collaborate with their local Fab Lab, other students on the course and the Fab Lab Manager to keep up with the coursework that consists of hands on project work and weekly lectures (organised and conducted by the Fab Foundation) through global video conferencing facilities. The program is meant to provide 'advanced digital fabrication instruction...

through an unique, hands-on curriculum and access to technological tools and resources' (Fab Academy website, http://www.fabacademy.org/diploma/). Partly because of the intensity of the course, students form close (global) friendships. After finishing the course, they often help to set up new labs and/or run their own Academies - they become so called 'Fab Gurus' (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Currently the course is self-accredited which means that its validation is shown in the capabilities of the students. Some of the people from informal Fab Labs in Argentina questioned the Fab Academy system. In particular, they were critical about the method of affiliation and the cost of participating in the Academy. During one of the interviews, a designer from the Minga Lab in Lanus University questioned the idea that Fab Labs in Latin America should pledge to join a network controlled by the MIT. The critic also underpinned issues about technological autonomy and the need to establish local aims and goals for the local Fab Labs in a context of science and technology from the periphery. However, this form of affiliation is not necessarily discussed by everyone. Core members of the Fab Lab networks, including members of the Fab Lat, were more worried by the cost of the affiliation (5 thousand US dollars) than by the method.

Throughout the first ten years several other organisations (in addition to the Foundation and Academy) have been set up to support the activities within the network. They have come and gone such as FabFolk. One of the earlier organisations has been the International Fab Lab Association, which was established on the 4th of July 2011 and had its first general membership meeting during Fab7 in Peru.

'The fast and substantial increase of the worldwide Fab Lab community leads to the need of a higher degree of self-organization. Because the network diversifies, a formal structure could be supportive for various objectives within the Fab Lab community... At the Fab6 Conference held in August 2010, the Fab Lab community decided to establish an Association' (International Fab Lab Association website, www.fablabinternationl.org/fab-association/why-we-are-here)

Although the idea came up during a conference meeting, the Association was mainly set up by the Dutch Fab Lab Foundation. It was meant to be a democratic organisation ruled by its members (that would regularly be elected by the network). One of the first tasks consisted of developing a policy and budget plan, discussing ways to run the Association and its activities and reworking the Fab Charter. The Association was active for a few years but has not had a general meeting or Board of members for quite some time. During the interviews, some of the practitioners were unsure whether the Association still existed whereas others were of the opinion that it had not survived.

Whatever the case, efforts persist in trying to support and structure the network through its growth. During the recent Fab10 conference in Barcelona, several novel attempts to establish organisations within the network were introduced to the practitioners, including three portals: Fab Economy, Fab Lab Connect and Fab Connections and the fablab.io and Fab Share websites. Such organisations are meant to support the organisational capacity building side of the network (.org) and create business opportunities (.com) within it, as it was believed that these aspects needed particular attention and support (the educational side (.edu) was considered to be covered by the Fab Academy) (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

'The Fab Lab network is not run from the top down. Nobody is in charge and as a result it is very confusing. We are beginning to drain that swamp. So one of the new portals that was developed at this meeting is a wrapper around many different business portals... Fab Economy.com... an infrastructure for economic activity' (Neil Gershenfeld, Fab10 Documentary, you tube, 2014).

As highlighted by the quote, the Fab Economy is about supporting economic possibilities within and outside of the network. The portal is meant to encourage collaborations between Fab Labs,

companies, charities and organisations towards developing 'a novel economic paradigm for everyone, where local fullfilment and customization take the place of mass production and global distribution' (Fab Economy website: http://fabeconomy.com).

Similarly, the novel portal called, Fab Connections is grounded in the need to strengthen business opportunities (.com) within the network but it has slightly different aims. It's 'mission is to help those in the network connect to make a living - especially with external markets. It does aim to make a profit, but it injects this profit back into the (Fab) ecosystem it is part of, instead of paying shareholders' (Fab Connections website, http://www.fabconnections.org). Another recent portal that will focus on economic and business opportunities is called Fab Lab Connect. Its mission is 'to connect innovation, prototyping and fabrication with resources to take them to the next level of the evolution' (Fab Lab Connect website: http://www.fablabconnect.com/about-us/). This includes: 1) 'Offering a Fab project funding platform that showcases Fab Lab's social and business innovation projects; 2) 'Fab Lab Connect runs challenges to get projects funded and mentored by sponsors' and 3) 'Second stage participants will have access to crowdfunding as a second source for the project's support' (Fab Lab Connect website: http://www.fablabconnect.com/about-us/).

There have been several attempts to ease ways to globally collaborate between labs such as the creation of Fab Moments (i.e. Fab Lab users' project descriptions) and more recently the development of the Fab Share (a portal for sharing Fab Lab project developments) and fablab.io (i.e. an attempt to organise/upgrade the wiki list) websites. During Fab10 conference, discussions arose whether there is a need link the two websites (and even some of the activities around the portal). Although there are plenty of attempts, collaborations within the global network are rare (Troxler & Maxigas 2014). A handful of exemplar collaborative projects that the network frequently refers to are the Fab Lab House Project (www.fablabhouse.com), Barcelona Fab City and Fab Fi. For example, the participants of the FabFi project, including FabLabs in Norway, Greece, South Africa, and Afghanistan, have tried to design and construct free and accessible internet systems accessible to anyone, anywhere. Similarly, the creation of the Fab Lab House project drew together a variety of different labs (such as Fablabs in Spain, Lebanon, and Ethiopia) to be able to build an energy self-sufficient, personalised and customised living space.

'The Fab Lab House is developed on a network of fabrication laboratories using CNC machines to design and produce houses than can be customizable by the inhabitants, and at the same time adaptable to the environmental conditions' (Fablabhouse website, http://www.fablabhouse.com/en/).

More recently, connections between labs occur more locally and regionally and are signified through the development of several regional more or less formalised networks such as the 'Fab Lat network'. In 2009, with some Spanish aid programme funding, Fab Lab Peru was established, as well as, the Fab Academy. Since then, in Latin America the Fab Lat network seems very much consolidated. It has started through personal connections made at the Fab Lab Academic and the IAAC in Barcelona, were several Latin American participants like Beno Juarez from Peru, Ilaria Lamanna from Argentina and Italy, and Andres Briceño from Chile and other actors met. Starting with these personal relations the Fab Lat was able to organise two key events in 2014. This are the Fab Lat Fest, a regional festival of digital fabrication hold in Argentina, Bolivia, Brasil, Chile, El Salvador, México and Perú. The Fab Lat Fest was organised to allow local manifestations share their experiences online during the same days from the 19th to the 21st of June 2014. Additionally, at the local level, several Fab Labs (formal and informal) and other spaces from the wider maker community also joined in workshops, demonstration and conferences. In Argentina this event was hold at the Centro Cultural San Martin and shared online with the rest of the Fab Labs in Latin America. The second important event at the regional level in Latin America is the Floating Fab Lab initiative coordinated by the Fab Lab Perú and Beno Juarez in collaboration with Fab Central, Fab

Barcelona and other Fab Labs. The Floating Fab Lab is very much a flagship project aimed to work as a practical and symbolical demonstration of the contributions of digital fabrication to the Latin American context. Focused in the Amazon, the largest hydrographical space in the world and one of the most biodiversity, the Amazon is also a complex environment shared by 7 countries in Latin America. It is also a region inhabited by ancient indigenous populations, local populations and cultures. The Floating Lab is an attempt to bridge the Latin American Fab Labs and bring them together to experiment and provide solutions to some of the problems of the region (see more in the local Latin American case study).

Similarly other regional networks have started to create their own conferences and meet-ups (e.g. the Dutch 'Fabtafels' a regular meet up of regional Fab Labs). These networks have varying links to MIT. Some regard themselves connected to the global network but also autonomous in other ways. For instance, the Dutch FabLab Foundation has developed its own legal body to develop the Fab Lab idea in the Netherlands.

'The story in the Netherlands is somehow different. People were interested in creating the labs (some 100k ones) but did not want to pay for the licences. So pretty quickly they developed the Dutch FabLab Foundation as a legal body, where labs could register and sign up for a yearly fee of one Euro' (Past regional networker, interview, 27th October 2014).

In other countries MIT has taken a more active role. During some of the interviews, it was frequently suggested that in the UK, the Fab Lab in Manchester was set up with the support of MIT (some interviewees said that the Fab Lab had to pay MIT a fee whereas others do not think that such affiliation fees exist). The idea was for Manchester to roll out the Fab Lab concept, being an exemplar in the UK.

'Interest from a few people wanting to develop a few other labs but based on the understanding that they would buy MIT licence and create a $100k labs. This idea was taken on by Manchester Fab Lab that then wanted to earn back the money by rolling out the model in the UK and helping them to create labs' (Harmen Zijp, interview, 30th October 2014).

This has only in parts been successful because since the establishment of the Manchester Fab Lab only a few other labs have been created within the UK. The payment of licence fees has partly prevented other labs to become officially connected with MIT and the network. Most of the cases of Fab Labs in Buenos Aires are not officially part of the International Fab Lab Network. They still call themselves Fab Labs and have aspirations or willing to join the network in the future. The cost of the affiliation has been repeatedly mentioned as a barrier to achieve this. These informal Fab Labs show a great diversity in the participants, vision and goals.

For instance, organisational structures and funding sources vary between Fab Labs. Some of the labs were able to create independent entities, whereas others are hosted by schools, universities, or innovation centres. Funding often comes from public sources or from the host, attached with the condition that labs start to self-fund themselves after a few years. These conditions have partly led to Fab Labs taking up numerous commercial activities, creating 'private-collective (hybrid) innovation' models (Troxler 2010, p.16). Such models are not straightforward to develop and often introduce tensions into the running of the workshop in particular, 'when looking for funding to sustain their ability for private investment while keeping the results open – i.e. gratis and accessible – to the community' (Troxler 2010, p.13). As a result, Fab Labs have not created recognised business models that are being replicated.

Although Fab Lab managers are keen to open up the workshop space for a variety of user groups (such as researchers and general public) (Troxler 2010), a survey of Fab Labs has shown that most

labs mainly attract 'well educated' and 'technology interested' people, who look for a space in which they can 'tinker' with digital technologies (Walter-Herrmann 2013, p.42). Similarly, Carstensen (2013), who has conducted interviews with members from the St Pauli Fab Lab, has found that participants usually have a passion for advanced technologies, experimenting and problem solving. Therefore, not all demographics are represented in the labs. Such exclusions can occur because of the labs' 'geographical location, the opening hours, (sometimes) the fees, their institutional context (whether they are connected to university, connected to a creative milieu or mainly used by business), and culture' (Carstensen 2013, p.56). Some of the labs have tried to proactively reach out to under-represented groups (such as Manchester Fab Lab and Sustainable South Bronx Fab Lab) but this community outreach and development work requires resources and active effort which not all labs can build into their day-to-day activities.

3.2   Aspects of 'innovation' and 'change' of the transnational network(ing)

Over the past few years, the media, public, government, businesses, and academia have shown an increased attention on the activities of Fab Labs, linking them to a revolution not only associated with technologies and producing things but tightly interlinked with social factors and goals. Efforts towards open source, creative commons, peer-to-peer networking, decentralised/ personal/micro manufacturing (such as people producing their own objects in their own home or near to them), non-market and decentralised patterns of production, and collaborative working have been interpreted as being part of a 'third industrial revolution' (Anderson 2012) and 'revolution 'in the making' (Ree 2011). Developments have been associated with the emergence of the collaborative economy, including ideas such as commons-based peer production (Benkler & Nissenbaum 2006), open innovation (Chesbrough et al. 2006), crowdsourcing (Howe 2009), and wikinomics (Tapscott & Williams 2008). Activities in Fab Labs have been considered to put into question a number of conventions, including: the sources and systems of innovation, intellectual property and patent rights (see for instance P2P foundation) and patterns of co-production (Birtchnell & Urry 2012).

The voices of more critical observers have started to appear over the last few months. In a recent blog article, Cohen (2014) points to Buckminster Fuller's claims that 'creatively-minded self-provisioning offers a promising pathway to a less resource-intensive and more personally satisfying future features prominently in the history of sustainable thinking'. Nevertheless, when engaging with the literature on Fab Labs and the Maker Movement in greater depth engagements with sustainability issues are rare (Cohen 2014). This was also confirmed during several interviews with researchers and practitioners (for instance, Academic researcher A, interview 19th August 2014). In her blog article Cohen (2014) concludes,

'One day we will wake up to the vexing realization that the challenge before us is greater than learning how to fabricate a gadget with a computer-guided soldering iron' (Cohen 2014).

Similarly, Sterling (Fab10 Documentary, you tube, 2014) is cautious about the current lack of consideration of possible consequences that might arise through the increase of digital fabrication in labs. He has particularly stressed the need to take into account the politics and power issues that derive from these developments.

 'If you are disrupting means of production and you finding new ways to make things by cheaper methods what is happening to the guys who are making stuff in the established base. What if that is your Dad… did you ever think to talk to these guys? Are they your enemies? Should you treat them

as your enemies... you have maybe 2 or 3 years left where you can play in the sandbox. It is not going to be a sandbox after that, too many labs, too much going on, too much control over the means of production' (Bruce Sterling, Fab10 Documentary, you tube, 2014).

Some of the rhetoric has created a real hype around grassroots digital fabrication, which sometimes risks extrapolating and inflating claims without considering participants' own activities, aims in setting up spaces, and motivations for joining these workshops. Whilst doing the fieldwork in Argentina, one of the researchers thought that it was interesting to notice a proto-generational difference around the visions and aims of digital fabrication. For instance, more established designers and members of public institutions like the National Institute of Industrial Technology or a member of University of Lanus (Minga Lab), mentioned that digital fabrication has been known for a while for designers and architects as additive manufacturing. To then, what is now called digital fabrication is just an extension of additive manufacturing that, in its initial form was mainly about digital and parametric design. On the top of that difference there was some scepticism about the potentials of 3D printer and the fab lab movement in general. They questioned the potentials of 3D printer to fabricate real artefacts beyond toys and industrial cast. In words of one of this designer, so far Fab labs have been building toys but nothing really useful. They specifically wondered how digital fabrication and the Fab Lab movement could really help their stakeholders, meaning small business, cooperatives and the public in general. They also saw contradictions in the discourse over technological autonomy and increasing sustainability. Overall, there were some caveats and prejudices about the co-working, open and sometimes chaotic style of Fab Labs.

Although more critical voices exist, some of the rhetoric coming from the observers can also be found within the network, in particular, ideas suggesting that Fab Labs represent some kind of 'counter-culture' (Peter Troxler, Fab10 Documentary, you tube, 2014). Such mixture of discourses makes writing about 'innovation' and 'change' within the Fab Lab network not a straightforward task because of several reasons. Firstly, there are several stakeholders (in addition to observers, there are network actors, media, governments, etc.), who have written and talked about 'innovation' and 'change', teasing these different positions apart is not clear-cut as they are often interlinked. Secondly, such ideas are often linked to notions that derive from what has been termed the Maker Movement, creating an even greater entanglement of ideas in relation to 'change'. Thirdly, within the network are several (sometimes overlapping or disconnected) more or less formal groupings and labs (such as Fab Gurus, regional networks, individual labs, social change leaders, etc.) that do not necessarily share similar ideas or are concerned with topics of 'innovation' and 'change'.

One starting point to investigate notions of 'innovation' and 'change' is highlighted by Neil Gershenfeld (Fab10 Documentary, you tube, 2014),

'What is striking is not the differences but the similarities. They are used the same way as all around the world for education, research, play and inventions and the people look very different and they come from all kinds of places but they are sort of the same.'

During the interviews with network practitioners other similarities were mentioned. When asked about common aims and objectives, interviewees often referred to the shared Fab Charter. The charter highlights some of the Fab Labs' aims: 'to empower, to educate, and to create 'almost anything' (Nunez 2010, p.24) and values: to provide open access to technologies and workshops, to encourage open and free knowledge sharing, to recognise the protection of intellectual property rights, to take responsibility for the care of machines and others, and to support the Fab Lab's activities (see Fab Charter 2012). In addition to sharing the Charter, each Fab Lab has in practice the same set of digital technologies. Such shared aims and tools are set to provide global

collaborations within the network and local manufacturing possibilities. Such potential within the workings of the network is often describe to be as extremely novel,

'The idea of you having the same machines, you know, in England as a Fab Lab in Peru and you can just email them exactly what your design is, then they can hit one button and create inventions using different machines and then the assembly part is relatively straightforward... and so I think it allows for this rapid prototyping and this form of collaboration, which hasn't been seen before' (Transnational networker B, interview, 15th August 2014).

These foreseen opportunities of collaboration and connectivity has been linked to following three overlapping area of interest: 1) entrepreneurship, innovation and new ways of doing business, 2) education and 3) community and social activities (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). During an interview with a board member of the Fab Foundation, he said that one of Neil Gershenfeld's personal ambitions is to create 'the world's first global distributed university' with no real 'infrastructure apart from services, networks and people' (Chris Wilkinson, interview, 28th August 2014) and with peer-to-peer learning aims. The first two courses would be designing and making ('How to make (almost) anything') and synthetic biology ('How to grow (almost) anything').

'The academy of almost anything is... bigger than digital fabrication... to use infrastructure of the network to teach other classes... globally distributed education organisation... course 2: How to grow almost anything... use Fab Labs to make Bio Labs... turning data into biological systems' (Neil Gershenfeld, Fieldwork notes, Fab10 Documentary, you tube, 2014).

The interest in trying to change the educational system is often also linked to working with schools (in particular, when thinking about the work within a lab) and attempts by the network to develop curriculums for schools that introduce children to the Fab Lab idea (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Such ambitions are driven by attempts to make 'education more relevant and practical and exciting... to bring what self-educators call tinkering back into the classroom' (Transnational networker B, interview, 15th August 2014). More recently, the Fab Lab network has attracted the interest of educators concerned about students' disengagement in so called STEM (science, technology, engineering and mathematics) subjects. The Fab Foundation's programme 'FabEd' actively tries to address this issue through 'a coordinated global effort to provide guidance and fidelity as digital fabrication moves into the formal world of education' (FabEd website, http://www.fabfoundation.org/fab-education/). Member of the Fab Argentina mentioned the tensions between the model of education at University (especially in architecture and design) and the learning by doing model that dominates the Fab Labs. They believed that Fab Labs and related activities like open collaboration will change the way how these careers are taught and suggested that is part of their task to foster these changes at the local level.

Some Fab Labs do not only move in the world of education but also business, as they attempt to create business incubators that focus on designing and entrepreneurship (Transnational networker B, interview, 15th August 2014). In addition to developing new products and services, start-ups companies have been created out of the network (Transnational networker C, interview, 10th September 2014) and the Maker Movement as a whole. The current digital fabrication infrastructure consists of small machine builders (some concentrating on personal manufacturing), online manufacturing shops, website marketplaces for makers, and digital media file sharing websites. For instance, Shapeways is a Dutch founded company which allows users to make, buy, and sell 3D printed items on their website (an example of a hybrid model between a social network side and a digital fabrication manufacturer). In addition to online manufacturing shops, digital media file sharing website have been set up to encourage the open source aspects of digital fabrication and develop an online resource of different digital designs. The idea is to create a

'Universe of Things' (such as Thingiverse and GitHub) that anybody can access and personalise their design.

Similarly, recent attempts within the Fab Lab network to create organisations such as Fab Economy and Fab Connect are on the one hand efforts to create closer links with the business world but also on the other hand a way to develop a new economy. Such visions are best described in the overall aims of the Fab Economy,

'Fab Economy is about creating a new economy for everybody, where local fullfilment and customization take the place of mass production and global distribution. Fab Labs, along companies and organizations can all work together towards reaching this goal' (Fab Economy website, http://fabeconomy.com).

'The people starting Fab Labs and linking them, I see them as part of a new notion of a new economy and it is a very different paradigm from the unemployment being an underclass to be given jobs to empower people to create jobs. So I think the invention is creating a new economy from the bottom up rather than from the top down' (Neil Gershenfeld, Fab10 Documentary, you tube, 2014).

The promise of creating entrepreneurs and jobs within Fab Labs has gathered a lot of interest from industry and governments in these activities (Transnational networker B, interview, 15th August 2014). Even President Obama who held a Makerfaire in the White House stated that 'he wants a nation of makers' (Maker Culture on Wikipedia). Others consider the real potential within the network in relation to the types of people it attracts and connections that can be forged, in particular, when they are linked to technological possibilities and social ambitions.

'Next to me sat the chief technology officer from Roland... $800 million turnover business... Neil brings up one of his students... who are making for a fraction of the price 3D printers... that are better than Roland... six kids from the West Coast' (Chris Wilkinson, interview, 28th August 2014).

'There are those who are probably either because there are naturally gifted... there are natural born leaders of change. They want to make things better. They want to challenge the status quo. They are visionary such as Benno... There are individuals who have something they want to go for and feel passionate about. They see it as an alternative way to go' (Chris Wilkinson, interview, 28th August 2014).

The interviewee linked such activities to particular people, who then get involved in setting up one or several labs. Fab Labs were people get engaged in social possibilities often originate from existing community centres (such as the one in Belfast, Ashton Centre) so there have already been a strong link to community development and involvement. These centers are often run by people who are well-trained, experienced within community development and have a repertoire of techniques that they can use to bring local people together in order to explore what role making together plays as part their endeavours. For example, Derry and Belfast found making things helped people from communities divided by history of conflict to come together and talk more quickly. They have a five level process: 1) Creative collaboration in neutral activity, 2) Creative collaboration with an identity/ issue focus, 3) Accredited skills development in communities impacted by conflict, 4) Therapeutic programme for people with mental health problems from conflict, and 5) Schools based interventions to engage young learners in conflict histories and narratives from the other side. In this context, the thrill of making is said to boost people's confidence (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

Another recent development within the Fab Lab network that represent community building ambitions on a larger scale is the vision for Barcelona to move from Fab Lab to Fab City. Barcelona's Ayuntament present their programme for Ateneus de Fabricación Digital as the first in the world where workshops are dedicated to public service. City leaders behind the initiative describe Ateneus as an important part of the new, high-tech digital infrastructure for the city: the authorities provide libraries and other services, so why not give people tools as well? People will be able to realise their inherent creative potential. As the slogan for the Ateneus puts it, citizens will be able to materialise ideas and create their world. The new urban vision for the city, as articulated by Tony Vives is for self-sufficiency, in which neighbourhoods interconnected globally in terms of knowledge and ideas, will be able to fabricate locally using new fabrication facilities like the Ateneus.

As outlined above, some labs, groups and individuals within the network try to influence and even change several systems, from education to the economy and within their projects the health system (by designing low cost prosthetics), energy systems (through creating DIY renewable energy), just to mention a few. In the case of Latin America, the Floating Fab Lab focus on a couple of game changers challenges: loss of biodiversity, global warming, loss of local cultures and the growing digital divide between the poorest population and the richest. The aim of the Floating Fab Lab is to provide solution and experiment with biodiversity a (developing local materials), digital handicraft, and teaching digital fabrication to the local communities. Nevertheless, Fab Labs created within formal organisations have showed a more cautious approach to the 'revolutionary' visions of digital fabrication. They generally are built around capacity building programmes and experimentation with local technology. For example, the CMD Lab in Buenos Aires, which depends from the local government in Buenos Aires is mainly dedicated to train artisans and workers through accords with the Ministry of Employment and the Ministry of Education

Some of the interviewees expressed the concern that the real potentials of network have not been met yet. Some of the labs still are rather disconnected from the network (Transnational networker B, interview, 15th August 2014), collaborations between and within labs are rare and the sharing of knowledge through Fab Moments occurs even less.

'Knowledge sharing, preferably in a global network, was always part of the concept, but it came without emphasis on community and network building to support that. Indeed, most of the early FabLab network was not a network at all, but a wheel with spokes and MIT at the centre, and it is still usually is that way for any country with one FabLab' (Zijlstra 2013).

He continues by saying that the Fab Lab network is 'bad at being locally relevant' and also 'bad at globally connecting'. Locally Fab Labs have struggled to find business models that make them financially sustainable, frequently turning to commercial endavours whilst keeping the lab less and less open to the public. Moreover, lab managers have not found it easy to gain access to all the recommended machines and to attract a wider range of stakeholders (some labs are mainly populated by design students).

'If you talk about a continent like Africa where three quarters of the people are in the informal sector, most of those people are less educated, a lot less educated, than the formal sector, and they've probably never heard of Fab Labs. I think until Fab Labs start embracing those roadside engineers there will be a lot of class distinction in terms of who's actually using the Fab Labs' (Transnational networker B, interview, 15th August 2014).

Similarly, for one of the interviewees, the biggest challenge for Fab Labs is to attract a wider audience within today's society (Fab Lab manager and Transnational networker B, interview, 31st July 2014). The recently established organisations Fab Economy, Fab Connect and Fab Connections

are meant to address some of these issues but it is still be seen how they will develop and will be taken up.

3.3 Aspects of empowerment and disempowerment of the transnational network(ing)

3.3.1 Governance

3.3.1.1 Internal governance

Several interviewees felt that the Fab Lab network was not organised from the top down. One of the interviewees even thought that it was the other way around that the bottom would influence the top (Chris Wilkinson, interview, 28th August 2014) whereas others felt that there was no structure at all (Jean-Michel Molenaar, interview, 25th August 2014). Although there was the common agreement that Fab Labs should subscribe to the Fab Lab Charter and put together a certain list of machines, there was no one who reinforced these requirements. No attempts were made to trademark the Fab Lab idea or copyright the name and logo.

'It's not very structured in a certain sense, because if you want to be part of the Fab Lab network you don't have to sign anything, you don't have to sign a charter, although there is one... It's a very open thing and in a sense the fact that there is no central government makes it that this network... there are no boxes we have to fit into' (Jean-Michel Molenaar, interview, 25th August 2014).

For instance in the Netherland, the concept of Fab Labs spread rather rapidly and was adopted in various different ways. At the time the Fab Foundation (being heavily understaffed) struggled to register or keep a list of all of the labs, which allowed several ones to call themselves a Fab Lab but interpret the idea in accordance to their locality. There has been a wiki page with all of the labs but anyone could sign their lab up to it.

'So pretty quickly they developed the Dutch Fab Lab Foundation as a legal body where labs could register and sign up for a yearly fee of one euro. So many labs were created so that Sherry could not keep up with registering them or checking whether they had paid for the licence' (Harmen Zijp, interview, 30th October 2014).

A lot of activities that have attempted to structure the network either happened by accident (i.e. that a few people came together and thought it might be a good idea great an organisation that supports certain activities) (Chris Wilkinson, interview, 28th August 2014) or derived as a response to the rapid growth of the network.

'Supporting chaos... You cannot control this' (Chris Wilkinson, interview, 28th August 2014).

'The Fab Lab network itself, I think, has been expanding a lot and also trying to figure out to navigate these changes' (Transnational networker B, interview, 15th August 2014).

This approach has allowed for a lot of diversity within the network and some even say has contributed to its growth (Jean-Michel Molenaar, interview, 25th August 2014). For example, organisational structures and funding sources vary between Fab Labs. Some of the labs were able

to create independent entities, whereas others are hosted by schools, universities, or innovation centres. Funding often comes from public sources or from the host, attached with the condition that labs start to self-fund themselves after a few years. These conditions have partly led to Fab Labs taking up numerous commercial activities, creating 'private-collective (hybrid) innovation' models (Troxler 2010, p.16). This diversity is regarded to be as strength within the network where people experiment not only with different design or machines but also organisational structures and business models. These experiences can potentially be shared in the search of trying to establish more sustainable ways of keeping individual labs going. Although a lot of the interviewees welcomed the diversity within the lab and the lack of top down structure, they also recognised that most of the individual labs are not particularly connected to the network (Jean-Michel Molenaar, interview, 25th August 2014 and Transnational networker B, interview, 15th August 2014). One of the reasons is based on the fact that local Fab Lab manager need to spend a lot of their time and energy into making their lab work locally. One of the interviewees argued that the network was made up of a specific group of people,

'There's really a lot of potential in this global network but to a certain extent what we now call the global network of Fab Labs is, in a way, a handful of people who talk to each other and who are very active on videoconferences and just emailing each other wherever they are on the globe. It is somehow people who seem to cross the borders and who do not consider it interesting just to make their own Fab Lab work' (Jean-Michel Molenaar, interview, 25th August 2014).

The Fab Academy seems to provide an opportunity to feel closer connected to the Fab Lab network. Students are located in a Fab Lab but have regular video conferencing opportunities with Neil Gershenfeld and the Fab Foundation. They often travel to several labs after their studies and therefore create a sense of connectivity between them (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Moreover, they have an alumni mailing list that helps for people to keep in touch. The Fab Foundation board members are also connected to the list (Transnational networker C, interview, 10th September 2014). Similarly, during FabX conferences it is possible to observe various groupings from people connected to the Fab Academy, regional network connections, interest groups (such as in social side of fabbing) to knowing each other from the beginning of the network (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Nevertheless, it is difficult to see in how far these connections carry into the day-to-day life of running a lab. It seems that individuals either put their efforts into a local lab or in creating connections within the network.

'This network is a network of network of networks' (Chris Wilkinson, interview, 28th August 2014).

In the past there have been several attempts to structure the activities within the network. Either through setting up programmes and websites that would allow a more coherent way of sharing knowledge and communicating with each other (such as Fab Moments) (see for instance, Troxler and Zijp 2013) or establishing organisations. The creation of the International Fab Lab Association arose out of one these attempts. According to one of the interviewees, Neil Gershenfeld made it clear that his ambition was not to run the network (Pieter van Hijden, interview, 20th August 2014). During the Fab6 conference in Amsterdam, the interviewee and others therefore proposed the possibility to set up an international association that would be democratically run (with a regularly elected board of members),

'I proposed to set up an international Fab Lab association... And, everybody agreed, even Neil agreed, and said also, well, you can also take care of the Fab charter, and take care of the logo, and the list of Fab Labs. And we started a workgroup' (Pieter van Hijden, interview, 20th August 2014).

A few months later the International Fab Lab Association was established and its first membership meeting was held at Fab7 in Peru. One of the first tasks consisted of developing a policy and budget

plan, discussing ways to run the Association and its activities and reworking the Fab Charter, logo, etc. The Association was active for one year but has not had a general meeting or Board of members since Fab8. During the interviews, some of the practitioners were unsure whether the Association still existed whereas others were of the opinion that it had not survived. The interviewee who set up the Association felt that there were two key issues that prevented the success of the organisations, firstly, the lack of support from Neil Gershenfeld, who once the Association was set up declared he did not like its formal structure and secondly, some internal conflicts that slowed down its activities (Pieter van Hijden, interview, 20th August 2014). Moreover, for him the revival of the Fab Foundation at Fab9 created a possible confusion between the tasks of the two organisations.

'It was Fab9, where Neil and Sherry, the programme director, they revitalised another organisation that always was existing, but barely visible. That was the USA based Fab Foundation' (Pieter van Hijden, interview, 20th August 2014).

It is difficult to know what happened exactly during this time in the network. Two people who took part in the Association felt that it was near to 'impossible' to structure the network and that it was just too much bureaucracy (FabLab manager and networker A, interview, 22nd January 2014). One of them was also cautious about drawing upon existing structure within society, in particular, when trying to explore the more social aspects that are developed within labs,

'Already the "structures" we set up (foundations, associations, industry partnerships, meetings, conferences, newsletters, fora, platforms…) are all so fundamentally rooted in old-style working that they are (or are bound to become) a hindrance rather than a support on the development of the social of Fab… Whatever we do, we need to take that social experiment serious – particularly here in the Netherlands where we six years ago started to deviate from the centralized outreach paradigm by mercy of MIT. We brought the DIY FabLab to the program, the idea that there can exist a fringe community. I think we need to revitalize this "fringe" idea and develop it including all the technology that is at our command – at the service of the community' (Troxler in Zijistra 2013.).

Accept for some of the actors, there seems to be a focus on the content and purpose of the network, and not getting too bogged down or distracted by structure and organisation. If people want to get involved in the network and help to organise it they can do it but need to see whether there will be support for the idea within the network (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

The Fab Foundation has been probably been the most constant organisation within the network. Although Neil Gershenfeld did not want to create a lead organisation for the network, he felt that a body needed to be created to support it network's activities. The Foundation is a US non-profit organisation that aims 'to facilitate and support the growth of the international fab lab network'. Neil Gershenfeld, Sherry Lassiter and three other board members (most the them chosen by Neil Gershenfeld) make up the Foundation with only Sherry Lassiter having some of her time associate with its organisation. For a while now the Foundation has been extremely understaffed and could therefore only very sporadically provide support to the network (Transnational networker B, interview, 15th August 2014). Still, the Foundation has become an important gatekeeper for networking, in particular, with external business to gain funding for the network (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

Being regarded as the founder of the first Fab Labs and a long-standing board member within the Foundation, Neil Gershenfeld has a crucial place within the network. During the Fab10 conference, both researchers felt that he was somehow directing the event through chairing most of the

sessions and frequently being on stage. In particular, during the final day more open discussions, Neil Gershenfeld seemed to held court, giving space to speakers and ideas he liked and closing down those that were less interesting. One of the interviews described him as 'controlling' (Past regional networker, interview, 27th October 2014) whereas others could understand his position as he was the founder of the network and had an amazing technical and creative capacity.

'So Neil still pulls the strings but he is the founder, it is his vision and frankly where he sits intellectually is 5-10 years ahead of what he is doing… this is why I still call this an experiment. He is the only one sitting outside the petri dish' (Chris Wilkinson, interview, 28th August 2014).

'Maybe Neil is not part of the experiment. He is going oh something is happening over there. Let's put some more neutrons on there and see what happens and then something happens and it dies. Oh well, that did not work. I try something over here' (Chris Wilkinson, interview, 28th August 2014)

Neil Gershenfeld's way of working within the network and organising it is further clarified in the following quote,

'We mocked up the website for Neil, we put Fab Lab Economy and he came to me and we looked at the website together and he said take away Lab, because it should be for everyone. You should rethink the whole global economy and not just for Fab Lab. And I really liked that idea and it's that which we're trying to do' (Jean-Michel Molenaar, interview, 25th August 2014).

It seems that his activities are grounded in encouraging some activities within the network (and supporting them) whilst at the same time side-lining others. One thing that could not be ignored by him has been recent growth of the network and the resulting need to create structures to support the network and its activities more effectively. The establishment of Fab Connect, Fab Economy and Fab Connections during the Fab10 event was therefore welcomed.

'And I think it seemed, at least this year, that there's going to start being a lot more restructuring where they are finally hiring some full-time folks for the website and FabLab Connect is up' (Transnational networker B, interview, 15th August 2014).

In addition to setting up these new organisations, greater emphasis is being put on developing and strengthening regional networks. Local Fab Labs have already created several of these networks. They organise conference together, have regular regional meetings and create websites to exchange information. Through these regional networks people are able to gain their own regional funding, share knowledge and come up with locally appropriate sustainable models for running labs, creating their own support systems that does not totally rely on the Fab Foundation (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). It still is to be seen how collaborations between regional labs and interactions with the Foundations will be forged in the future. Similarly, the future of the newly established three organisations is uncertain, seeing that in the past attempts have been made to create comparable structures. Some were able to survive whereas others fizzled out.

3.3.1.2   External governance

Several local and national governments around the globe (such as Iceland) had an interest in supporting Fab Labs from the early beginnings, in particular the link to MIT was important to some of the actors (Past regional networker, interview, 27th October 2014). Over the last few years, there

has been an even greater interest from governments and companies (i.e. large cooperation such as Airbus, Nike and the World Bank) in the network. Often it is hoped that labs might create jobs and increase entrepreneurship (Transnational networker B, interview, 15th August 2014). Moreover, they are regarded as good CSR projects for companies and a source of finding new employees (Chris Wilkinson, interview, 28th August 2014). Such increased excitement about labs can be best exemplified by President Obama's (2014) statement at the Maker Faire in the White House,

'I am proud to host the first-ever White House Maker Faire. This event celebrates every maker — from students learning STEM skills to entrepreneurs launching new businesses to innovators powering the renaissance in American manufacturing. I am calling on people across the country to join us in sparking creativity and encouraging invention in their communities'.

Similarly, the Fab Foundation's announcement during the Fab10 conference of major collaborations with two cooperations (Solidworks and Chevron) is a sign that closer links between the network and companies are being created. It was announced that Dassault System Solidworks donates their CAD suite (3D modelling software) to all affiliated Fab Labs. The Fab Foundation has also received $10 million from Chevron to open up 10 more labs in America (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

'Along with launching new fab labs, Chevron's grant will help build the Fab Foundation's capacity to provide access to digital fabrication across the country and around the world. At the White House Maker Faire, we celebrated how makers are using these tools to innovate for the future' (Gershenfeld in Halterman 2014).

After these announcements, discussions amongst participants were mixed. Some were uneasy and critical about these links whereas others welcomed the extra funding to strengthen the network, develop projects and set up more labs.

'And so, I think, we will need to deal with more ethical considerations in the future and what the ethos of the Fab Lab is and will it further our mission to get funding from these sources and then report back to them and change out plans to match what they want to do. But on the other hand, there are very large amounts of funding that wouldn't be popular otherwise and so there's a whole bunch of potential for new projects, new initiatives, and larger-scale collaborations' (Transnational networker B, interview, 15th August 2014).

'I see that we should be pragmatic, and we should be ready to work with anyone. That is why I am worried that this does not become a religion and we protect that religion. I do not care about creating a new ivory tower in which there is control and access. I care about being embedded into every other aspect of society that includes cooperations. Everything' (Fab Lab manager and Transnational networker B, interview, 31st July 2014).

Others could foresee potential tensions between the community and commercial activities within labs: firstly, labs might run the risk of not being able to open up the lab for the public if they engage too much in commercial activities and secondly, labs might have to scarifies some their open-source values when pursuing commercial endeavours. The supporters of creating links with companies often refer to the Fab Charter in which commercial activities are generally considered to part of spirit of the network as long they do 'not conflict with other uses, they should grow beyond rather than within the lab, and they are expected to benefit the inventors, labs, and network that contribute to their success' (Fab Charter 2012). Three of the interviewees even felt that these developments were important to provide a livelihood for people in the network. According to them links with companies were key to 'boost the efforts from the social innovators to scale up' (Chris Wilkinson, interview, 28th August 2014). All three of them were involved in

setting up the three new organisations: Fab Economy, Fab Lab Connect and Fab Connections that in one way or the other try to facilitate connections between Fab labs and businesses.

In addition to governments and companies, Fab Labs often are considered to be connected to a diverse set of workshops (that make use of digital technologies) such as TechShops, 100k-Garages, Telecottages, Innovation laboratories, Coworking spaces, Media labs and Hackerspaces (Troxler 2011). The aims and motivations of these workshops and their participants vary. Some of the workshops orient their activities solely towards the pragmatic and practical side of experimenting with digital technologies and develop norms and practices that reflect such intentions. Even during the Fab10 conference, a few people from Makerspaces and Hackerspaces joined the sessions. Some even thought about joining the Fab Lab network. Paul The attraction was the credibility it might give when making the case for funding from local authorities and other backers (in particular being connected to MIT). The formality and infrastructure was also seen as problematic and potentially constraining. The boundaries between these workshops are increasingly blurred. Nevertheless, Fab Labs also sometimes clearly distinct themselves from other workshops by stating that they 1) have a good track record about being inclusive and diverse, 2) make the best attempts to document their work and projects, 3) network with each other i.e. organise conferences and common websites, 4) have an open source requirement. Together, they have been regarded as making up a 'maker movement' (Dougherty 2005).

Some practitioners and observers create links between the maker movement (including Fab Labs) with the wider sometimes still small-scale digital fabrication infrastructure, including small machine builders[1], online manufacturing shops, internet based marketplaces for makers[2], and digital media file sharing websites. For instance, Shapeways is a Dutch founded company which allows users to make, buy, and sell 3D printed items on their website (an example of a hybrid model between a social network side and a digital fabrication manufacturer). Similarly, Ponoko is an online manufacturing service, making use of laser cutting, 3D printing and open-source electronic hardware to make customise objects for their clients.[3] The company gained attention from the media because of its novel business model, being a manufacturer to realise on-demand and distributed manufacturing services. In addition to online manufacturing shops, digital media file sharing website have been set up to encourage the open source aspects of digital fabrication and develop an online resource of different digital designs. The idea is to create a 'Universe of Things' (such as Thingiverse and GitHub) that anybody can access and personalise their design. For example, Thingiverse was set up by the MakerBot team so that people could freely exchange their designs.

Most of the start-up firms and software/hardware developments often originate out of the community-based digital fabrication workshops, creating, what Söderberg (2013, p.130) has described as, a 'symbiotic yet constrained relationship' between workshops and companies. For instance, the open source printer from the RepRap community has been closely interlinked with start-up firm MakerBot. MakerBot has modelled their first 3D printer on the RepRap printers but taken only some of the open source values on board. The relationship between the two parties became more tense once the RepRap community realised that some of the parts of their second-generation 3D printer could not be printed on the MakerBot printer. As a result, the MakerBot printer could not be used to print out a RepRap one, at a time, when the MakerBot products gained

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[1] Small machine builders are companies such as MakerBot, LumenLab Micro CNC, and Bits From Bytes Ltc and consumer 3D printers are, for example, 3D systems Cube and Makegear M2.

[2] Such as Etsy (a website where designers can sell their products) and Quirky (this is how it works: person sends in designs, the community can vote on it, if they are enough pre-orders Quirky designer make design ready for manufacturing, Quirky and initial designer share the profit)

[3] Other online manufacturing shops: Big Blue Saw, eMachineShop, Sculpteo, Materialise, and many others

increased interest. Subsequently, the RepRap community re-designed their printer, in order to encourage their own growth and uptake (Söderberg 2013).

3.3.2 Social learning

The sharing of knowledge and learning together occurs in several parts of the network: 1) as part of the Fab Academy and the Fab Lab 'Gurus' that it creates; 2) through the Fab Foundation, regional network and local Fab Labs' efforts of trying to set up labs across the globe; 3) through regional and international meetings and networks; 4) through creating documents and web-portals and establishing organisations that are meant to support the network; 5) within collaborative projects; and 6) generally through creating an atmosphere where people are keen to network with each other and share ideas within and across labs.

'It's a very open and creative collaborative community and Fab Labs in my experience, really like being contacted for collaborations, for new ideas or to work together' (Transnational networker B, interview, 15th August 2014).

'What holds us together is that we, well the culture of the community is quite open, you can easily approach it' (Pieter van Hijden, interview, 20th August 2014).

Endeavours for social learning have often been demand driven and resulted out of informal and ad hoc efforts that over time materialised into organisations, documents, websites and web portals (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). The Fab Academy has become one of the most formalised ways of sharing learning within the network. This is the place where practitioners from within and outside the labs can learn more about the machines, experiment with them (such as producing circuit boards, rapid prototyping and programming micro controllers) and meet other like-minded people. Moreover, they can create connections with MIT and its researchers. The course runs for five months part-time where students find a local Fab Lab (so called Fab Lab Nodes that offer the Fab Academy programme) in which they work and learn together. The other part of the course is taught through a video-conferencing system that is connected to the Fab Foundation and Neil Gershenfeld. Students, who graduate from the course are called 'gurus' and over the years have created a mailing list in which they can keep in touch (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014).

'So I am on the mailing list for the instruct and alarm network and constantly you have people asking: I have some problems with this… and all are helping each other' (Transnational networker C, interview, 10th September 2009).

After attending the Fab10 conference and engaging in some of the networking, it seemed that the attendees connected to the Fab Academy created a close knit circle of friends where people had bonded quite strongly over the duration of the course (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Stories were told about past students who went off around the world to either help set up labs (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). They have become 'travellers' within the network that carry information from one lab to the next. Often these 'gurus' are also the initiators of more collaborative projects within the Fab Labs network (which are still rather rare). For instance, one of these travellers is Jens Dyvik, who travelled over two years to twenty-five different labs all around the world (such as Fab Lab Japan, Fab Lab Lyngen in Norway and HonFabLan Indonesia). As part of his journey, he shared, for example slipper and chair designs between labs and produced a film called 'Making Living Sharing' that has been widely viewed in the network. In the film Jens Dyvik tries to engage with several questions around social learning in

the context of Fab Labs: 'How can I support people in creating their own products? If I share my designs with the world, can I still make a living? How can we achieve global collaboration and local manufacturing' (Dyvik Design 2013).

Similarly, some of the people who entered the network at its beginnings or who are engaged in creating stronger links within the global network seem to have a close bond. 'In know many of the pioneers and they way they talk amongst each other. It is like a small society' (Past regional networker, interview, 27th October 2014). At the beginning, these people were able to keep in touch through a live video conferencing stream between the labs and met each other at regular boot camps. Nevertheless, the growth of the network meant that the limits of video conferencing have been reached. Some of the interviewees also pointed out that, in particular, when it comes to making and being creative together, face-to-face interactions cannot be replaced by video conferencing.

'You can only go so far with video conferencing' (Jean-Michel Molenaar, interview, 25th August 2014).

'I think it's important that we start, we help people communicate better between them and not only via videoconferencing, although it's a very valuable tool. I think it's also important to send people around and to help new labs also physically being there' (Jean-Michel Molenaar, interview, 25th August 2014).

Close connections between lab members can also be found within regional networks. They create relationships build on trust and therefore strengthen social learning processes. For example, the Dutch Fab Lab network was instigated by a group of friends (Past regional networker, interview, 27th October 2014). Although this group has expanded, it still is very active in planning and organising meet ups.

Several interviewees described regional and the international FabX conferences as a 'crucial' (Jean-Michel Molenaar, interview, 25th August 2014) part in creating long-lasting connections that aid the process of sharing learning and building collaborations. For example, both researchers felt that the Fab10 conference was really impressive in its scope and range. There were over 500 participants who wanted to engage and learn from each other. Next to the auditorium was a 'superlab' consisting of ten clusters of digital fabrication equipment. Participants were free to use them and there were workshops, too. Here, people can make everything from new Internet platforms to 3D printers. Organisations like Nesta, Forum for the Future, QuiShare were there, organising workshops and participating in the activities. One day was used as a symposium where keynotes were given by employees from the World Bank, Nike, Airbus, etc. and included presentation from community projects (such as the Wikihouse) and high profile thinkers (such as Jeremy Rifkin). Moreover, during the Fab10 events every morning new Fab Labs got the chance to introduce their lab to the participants, making it easy to forge connections and ask for help.

Conferences are also organised by regional networks (such as FAN, FabLat, Fab Nordic and Fab Benelux/Netherlands) or through labs sharing particular interests (such as the Fabfuse event which brings together labs that are interested in the Fab Lab grassroots approach). Often learning is exchanged readily during these face-to-face meetings that sometimes carry on after the event (i.e. email contacts or visits to each other labs are not uncommon). Conferences and meet ups definitely are the place to forge connections and create organisations, documents, websites, etc. Nevertheless, one of the interviewees highlights a drawback to these international gatherings, they occur globally because of the nature of the network, making it difficult for some of the labs to attend the conferences and participate in the network, considering that travel costs can be high for

some (Fab Lab manager and Transnational networker A, interview, 15th January 2014). In addition, conference fees have gone increasingly up.

Although the sharing of knowledge is one of the key values of Fab Labs, outlined in the Fab Charter, practitioners have recognised that the global sharing of knowledge, in particular when considering the constant growth of the network, is not an easy process. One of the key findings in a current special issue on 'Shared machine shops' in the Journal of Peer Production stated that 'Sharing is not happening'. Similarly, some of the interviewees felt that it is 'difficult to find labs sharing knowledge (Pieter van Hijden, interview, 20th August 2014). These might be strong statements to make but also demonstrates the difficulty of realising efforts to build an infrastructure for the sharing of knowledge and learning. Part of the issue is grounded in how the network produces materials (i.e. websites, documents, etc.) and organisations. Practitioners (and a handful of researchers) have written books, journal articles and blogs about Fab Labs and also share presentation slides, you tube videos and Facebook pages. Still, when coming new to the network, in particular, the web-based materials can be considered to be confusing (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). There are several website (such as Fab Foundation and Fab Wiki) that try to do very similar things. From the outside people might be unsure about which ones are actually connected to the network and who to contact.

One attempt of setting up such an infrastructure for a repository of global Fab Lab projects was instigated during a Fabfuse event (a yearly international Fab Lab event organised by the Amersfoort FabLab) in 2013. The idea was to build upon the existing FabMoments system (i.e. a lab's project repository that is often kept on individual Fab Labs' websites) and to create a more overarching FabML repository. The creation of such repositories had been attempted in the past but during the event it was decided to pick up its development again by writing a paper about the difficulties of setting up the repository and possible suggestions to develop it further but even then a repository never materialised (Troxler & Zijp, 2013). One of the interviewees pointed to a possible wider issue connected to the production of repositories,

'I mean I love making stuff... it actually takes quite some time and specific skills to document things well and to show what you're doing and it's much easier to say you know I made a skateboard so I'm not going to document on how to make a skateboard because I finally know how to make a skateboard so I'm going to I'm going to like do the next step, I mean I'm making skis' (Jean-Michel Molenaar, interview, 25th August 2014).

People are mainly driven by making things and experimenting with machines rather than creating documents. Although there are generally happy to share ideas, the main reason for being in a lab is to design your own products and services. Moreover, it requires certain skills to produce documents that somebody else can pick up and easily make sense of,

'Neil Gershenfeld, he documents stuff but it's a very geeky way of doing it, you know, it's often just HTML and it's just a list of stuff and you still need to figure out a lot of stuff yourself' (Jean-Michel Molenaar, interview, 25th August 2014).

The idea behind the recently developed Fab Lab Connect organisation (and also the fablabs.io website) is to combine the documentation of projects with the possibility of connecting up with businesses and winning awards in order to encourage people to document their work (Transnational networker C, interview, 10th September 2009).

These initiatives often come about ad hoc during meetings when enthusiasm is high but might be difficult to think through once practitioners are back in the day to day running of their lab. This makes some Fab Labs feel isolated from the network (Transnational networker B, interview, 15th

August 2014), as they are so busy trying to sustain their own lab (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Generally, labs are more active locally (rather than in the global network) where they want to create a network of local people who use the lab (which sometimes a challenge in itself). Sometimes there is just enough interest in the network for these particular activities (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014) or maybe not enough endorsement from MIT. This is not to say that a lot of ad hoc and informal networking and sharing of knowledge occurs within the network.

3.3.3 Resources

Funding for the set up and running of individual Fab Labs varies. Frequently, labs rely on, for instance, public funding and membership fees (Troxler 2010) that can partly shape the activities of a lab. For instance, publically funded workshops (hosted by public institutions, such as schools, libraries, or universities or finances by governments and innovation centres) are not totally independent and somewhat need to comply with their hosts or funders ideas. Most of the labs have their own employees and/ or volunteers. Costs are based on paying rent for the space, maintenance of machines, staff costs, just to mention a few. According to one of interviewees, one of the Fab Labs in the Netherlands gained substantial amount of funding from the EU to develop a sustainable business plan for their lab (Past regional networker, interview, 27th October 2014). These workshops are usually expected to be self-funded after a couple of years and therefore have to find commercial models to keep going that potentially conflict with some of their original ideas for the space. In some of the workshops the boundaries between commercial and independent activity has become blurred. For some of the lab it has been difficult to strike a balance between raising revenue and not crowding out the mission to be at least be in parts open to the public.

Some labs have struggled to gain funding to then be able to buy the machine and open their lab for years. For example, the Fab Lab in Bremen has tried to make links with the university, local government and community centres and organised various Fab Lab educational conference to create collaborations in order to find funding. But until now the lab has not been set up yet. Others, such as Amersfoort Fab, have decided after months/years of trying to gather financial support to get their own money together so that they could set up the lab. In particular, the Amersfoort Fab Lab has been famous for developing a grassroots Fab Lab approach where people can create a lab for 5000 Euros (see local manifestation below).

Finding business models that help Fab Labs to become financially sustainable is a 'big issues' (Transnational networker B, interview, 15th August 2014) in the network. Over the years, some of the practitioners have invested time in researching business models that work for the network, publishing the work in papers, presenting the work at conferences and conducting workshops around the topic. As part of this work, Troxler (2010) has found that there is no single business model used within Fab Labs. In 2011 Troxler built on this work by examining what type of business models currently exist within the network (see John Boeck and Peter Troxler 'Sustainable Fab Labs' presentation at Fab7). He and Boeck found five different business models: 1) Access: gaining income through making the lab available for an hourly rate and charge for local production; 2) Education: conducting training courses and workshops within labs; 3) Enabler: supporting others to set up their own lab and in the process provide services to them; 4) Incubator: creating a hub for innovation and business creation; 5) Network: making use of the Fab Lab network by creating innovations across labs. Whilst presenting the work at the Fab7 conferences, two additional models were added: 6) Attraction: becoming a 'tourist' attraction; 7) Human resource: people using and running the lab become consultants for the outside world (Juarez et al 2012). These models are not mutually exclusive. According to Troxler's (2010) study

Fab Labs have created 'limited innovation ecosystems' where marketing strategies are mainly based on having a presence on the internet (not making it their main point of consideration) and links with business and sponsors still are rare.

During the Fab10 conference, Neil Gershenfeld and Sherry Lassiter announced that future efforts would be particularly dedicated towards gaining funds for the network. The Fab Foundation can aggregate and negotiate better deals with vendors and funders. It aims to deal with large grants that might be given to the network, create special deals with vendors and help large companies to interact with the labs (i.e. help to set design challenges for the labs that might be of interest to big cooperation) – for more information see section 2.3.1.2.

3.3.4 Monitoring and evaluation

During the Fab10 event it seemed that discussions around monitoring and evaluation were a rather recent occurrence within the network. One of the interviewees pointed out that the network had reached a level of maturity in which it is important to find measures for impact but also to recognise that this will not be an easy task (Transnational networker C, interview, 10th September 2009). Here, the level of maturity was partly regarded as a place where governments and companies increasingly got interested in the network but were asking labs to demonstrate their impact.

'Many organisations have very rigorous requirements and if you cannot show xyz they cannot be involved even when they think it is a great idea. That is the flipside of the free spirited grassroots movement' (Transnational networker C, interview, 10th September 2009).

During one of the presentations at Fab10, a lab presented some work where they had actually taken an active step towards counting how many jobs had been created because of the labs activities and how much revenue it had produced. The participants seemed impressed by such efforts but also pointed out that in addition to developing measures for job creation and income other impacts should also be highlighted. Such impacts included, for instance, 'how many people became more computer literate or appreciate CAD design' or 'walk out of the Fab Lab with a newfound sense of being artists or being able to create things' (Transnational networker B, interview, 15th August 2014). A lot of the interviewees pointed out how difficult it is to find measures that highlight the social impacts of the labs – 'something that Fab Labs tend to rate very highly on' (Transnational networker B, interview, 15th August 2014). A felt that she had made an impact whenever it was difficult to send the people in the lab home at the end of the day,

'When I was an undergrad teaching at the Ghana FabLab we knew that we were successful when we actually had to kick everyone out of the Fab Lab at 8 o'clock in the evening because we had to go eat dinner' (Transnational networker B, interview, 15th August 2014).

The importance of creating stories and repository of projects were discussed as a way of showing the more social and less obvious impacts of labs (Fieldwork notes, Fab10 conference event, 2nd-7th July 2014). Such stories could bring labs to life, demonstrating what is happening in the labs such as personal journeys and experiences that are so difficult to translate into numbers. It was recognised that such stories were also valuable with politicians, as they regard them as good photo opportunities. A call went out to all labs to produce photos and stories and to send them to the Foundation in order to build up a case for labs that gets some policy traction.

'It is difficult to put numbers to the kinds of things you can do in a lab. It is important to tell stories, to show potentials. Actually I do not see one way to do it. It will keep being an unknown field - I do not trust impact assessment. A complementary story around the Fab Lab helps more. Personal stories, characteristics, goals and visions' (Fab Lab manager and Transnational networker B, interview, 31st July 2014).

The telling of stories might also potentially be helpful to overcome the challenge to find more appropriate impact measure for a quite diverse set of labs. A lab that frames itself as a business incubator might require different ways to evaluate impact than one that mainly engages with schools or are based within a community centre (Transnational networker B, interview, 15th August 2014). The last few paragraphs suggest that the topic of measurement and evaluation in the network is at its infancy. Although individual labs might have already created varies measures, the overall network has just started the discussion. It is to be seen how the network will deal with these issues and whether the topic will persist over time.

3.4   Other issues about the transnational networking

There probably are several issues that have not been explored within this report or during the fieldwork. This was mainly because of the length of the topic guide. At times it was challenging enough to go through all of the topics provided in the guide. It was therefore near to impossible to follow up other issues. Within Fab Lab it would have been interesting to explore the material culture of these labs in more depth. How does the making relate to change and innovation.

4 Local initiative 1: Amersfoort Fab Lab (De War)

4.1 Overview of development in the local initiative
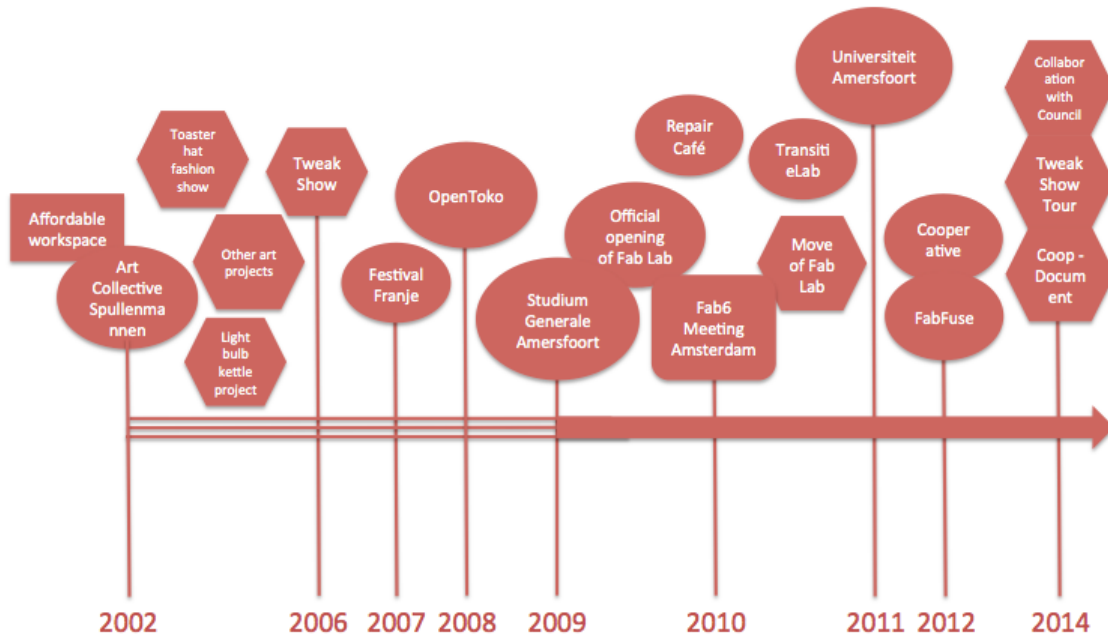
Timeline Amersfoort Fab Lab (De War)

Fab Lab Amersfoort was officially opened in 2010. However, its history is ingrained in several other activities that are all located in an old factory building, the former food dye company Warner & Jenkins dating back to 1881, along the river Eem in Amersfoort. This community run space is called De War. Over the last nine years, it has been a hub for local sustainability, technology, science and art related initiatives. The space houses several overlapping networks that vary in their formality to collaborate on activities. For instance, the Fab Lab consists of 10-15 managers that every Tuesday opens up the doors to the Fab Lab to the public whereas FabFuse is a yearly event that is co-created by the attendees. Harmen (who was there from the beginning) and Diana (who joined in 2005) make a point that Fab Lab Amersfoort is an integral part to the De War activities and cannot be viewed separate from it (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014). Consequently, the start of Fab Lab Amersfoort begins with the history of De War.

So the history begins in 2001 when three friends created a theatre company, called the Spullenmannen in an old school building under the then existing anti-squatting measures. A year later they had to leave the school and through a contact found the factory, which they have rented from the municipalities under anti-squatting law (including a three months notice period) ever since. At the beginning for them it was really about finding an affordable workspace (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014; Diana Wildschut and Harmen Zijp, interview, 30th October 2014). The art practice of the Spullenmannen consisted of pieces relating to 'visual art' whilst dealing with 'absurd humour' and working with Spullen (i.e. things, stuff - often found or handed down objects that were discarded by society) (see for instance, the art pieces called 'Ministry of Goods No Longer in Use' or the 'Toaster Helmet Show').

In 2005, one of the friends started 'withdrawing himself without explicitly saying so... there was no movement in the company and Harmen was a bit frustrated because he had to do everything himself' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014). This was the time when Diana visited De War and decided to stay. In addition to theatre, they got engaged in producing interactive art installation and 'purposeless contraptions' (De War website, http://dewar.nl/?en/home), drawing on the intersections of art, technology and science (which is to this date still a strong focus). During my stay at De War, Harmen described an important trigger that made them explore topics of climate change, non-linear systems and complex behaviours as part of their art work in more depth. The trigger was a lecture about complex systems and limits to growth by Dennis Meadows that they attended as part of the 35 years anniversary of the Club of Rome.

Being partly frustrated about the lack of discussions around climate change in the media, Diana and Harmen started to wonder how they could translate such abstract models into a visual language for anyone to understand.

'All these predictions about climate change, about peak oil, about food stock collapsing, whatever might happen, they are quite abstract if you are not used to this topic and this way of thinking. So then we thought we might be able to convert this theme, or this idea about, or knowledge about complex system into art, and at first we had this idea of making a number of interactive installations' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

This is how the 'Tweak Show' was born, a set of interactive art installations that they have been showing and working on for the last eight years. The Tweak Show is 'a labyrinth full of interactive installations that give the audience an intuitive understanding of the complex systems in science, the environment and society' (Wildschut 2014). The first few pieces were shown at a Dutch festival in 2007. Building on this success, Diana and Harmen decided to enter the installations into an annual theatre festival in Amersfoort that is meant to showcase local art. They soon realised that the organisers 'were not interested' in showing their work (Diana Wildschut and Harmen Zijp, interview, 30th October 2014) and that they were not the only ones who experienced such a reaction.

Soon after talking to some of the other artists who got rejected, they gathered that that they did not need the organisers but only 'the audience of the event'. As a response within three weeks, they found fourteen artists who together with them created a 'fringe' festival next to the 'official' one. Although the organisers did not agree with this and got a civil servant evolved, there was little they could do to close down the 'fringe' festival. Both, Diana and Harmen, defined this experience as a crucial that helped them to define their approach to running De War.

It 'taught us that you can hack systems that you can do that in a smart and lightweight fashion... And we also learnt very quickly that organisations then have two options in how to respond to such parasitic act. Either, be against and frustrated as much as you can or accept and cooperate... This experience gave us an idea of being bolder in how to achieve things... We discovered that it was empowering us, and a lot of other people' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Since then the festival (called Festival Franje) has been organised annually in Amersfoort as a 'fringe' event. A year later, Diana and Harmen did a tour of Europe with their 'Tweak Show' installations, contacting museums along the way to see whether they would show their work but often with little success. Nevertheless, they applied their learning and gate crashed one or two other events along the way, developing their 'guerilla tactics and empowerment mechanisms'

(Diana Wildschut and Harmen Zijp, interview, 30th October 2014). For Harmen these early experiences 'were seeds for a lot of the methods that we now use much more consciously' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

One of the pieces in the 'Tweak Show' was the initiator for another important key development in De War. Although Diana and Harmen had previous knowledge in science, programming interactive videos and making and building things, one of the installations required them to translate brainpower into electricity and for them to have knowledge in neurology, which they did not have at the time. Consequently, they came up with the idea of facilitating a series of open workshops in the area of technology and art (such as about Arduino, open source and programming) that they called 'OpenToko'. During the first 2008 OpenToko, they invited their friends who bought their friends along to sit around the table and work on a common topic. At the beginning, they thought that they needed 'an expert' of the topic each time they met up but soon they realised that their combined knowledge and research skills would be enough to even tackle themes no one really hardly knew anything about (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

'We discovered that there's lots of people who have little blocks of knowledge, and you yourself are probably one of them, and if you combine all that, suddenly everybody has a quick start initiative in a certain topic' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

As well as, recognising the benefits of sharing knowledge in a group setting and of self-teaching yourself previously unfamiliar topics, a side effect of these workshops was that they had created a network of people that enjoyed learning from and with each other.

'The value of this was eventually building a network of nice people and finding out that with such a way of organising you can gain access to a much faster network than people that you see yourself... And because it is about sharing it has a positive vibe. Some people that you do not know yourself personally, but get invited by others, will come to the meeting because of the sharing and social atmosphere for it. And they can get actually get knowledge from experts that you would otherwise pay for' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

In 2009, on of the interviewees (Past regional networker, interview, 27th October 2014) came to De War and told them, 'listen guys what you are doing is called a Fab Lab, you just don't know it yet and you should get some machines' (Zijp 2013). Harmen started to read 'FAB' Neil Gershenfeld's book and initially liked the idea. Even Diana felt that it would be good to be connected to such a network because they were able to create a group where they could exchange knowledge around electronics and programming (i.e. the OpenToko) but less so around making things. The idea of 'personal fabrication... to make almost anything' initially attracted them. The only issue was that most of the labs were able to establish because they had gained some sort of funding ($100k for a Fab Lab) and most of the work at De War so far had been unfunded. They decided to go to the local chamber of commerce, innovation centre and municipality to see whether they could get some funding for the machines, considering that they already had a space and several volunteers that were happy to be lab managers. Although the approached people were generally interested in the idea, they wanted to know more about their business plan. Talks went on for a while but no funding materialised in the end (Zijp 2013; Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

'So we are cake, and we got into the office, and we talked to them for a year, and still nothing...' (Zijp 2013).

One day the team came across a laser cutter on Marktplaats.nl that was advertised for 3000 Euros - a price that they could afford. Initially, the fact that the machine came from China did not deter

them but they were unable to make sense of the manual and warranty because it was written in Chinese. They invited the seller to demonstrate the machine and were convinced that they could make it work. Then five friends decided to put some money together to buy it. The laser cutter enabled the group of friends to build their own 'Ultimaker' 3D printer and a small CNC milling machine (and ever since have started to build their own machines). Later on they found a cheap foil cutter. They were able to open up the Fab Lab to the public in 2010. The group of five friends grew into fifteen in 2011, when a space on the factory premise became free in which they could move in the lab. Since then they have been approached by several Fab Labs practitioners who wanted to know how they set up their lab without any funding, a so called 'Grassroots Fab Lab' (Zijp 2013; Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014). Since then, they have also set up 'FabFuse', an annual international conference that takes place in De War to share knowledge about such a grassroots approach to setting up and running a Fab Lab. Over the last years about 140 people have participated in the event with around a quarter helping out to create it.

From the beginning, they combined the idea of personal fabrication to make almost anything with their grassroots approach that has also included concepts coming from sustainability and open source.

'We use mostly self-built and open source machines. We plan to have our whole lab open source as soon as possible… The focus of Fab Lab Amersfoort is on recycling of materials. We want to become a sustainable Fab Lab' (Amersfoort Fab Lab website, http://www.fablabamersfoort.nl/en).

Over the years, they widened the idea of personal fabrication, linking their Fab Lab to Transition Towns and citizen science (such as Public Labs). These ambitions are also more widely encapsulated in the aims for De War and in the attempts to create a peer-to-peer society, drawing on Michel Bauwen's ideas of a new economy. In order to explore these ideas, soon after setting up the Fab Lab, Diana, Harmen and a few others had the idea of creating a Transitielab (i.e. a lab that tried to combine Fab Labs with Transition Towns to create small-scale low-budget solutions that concern recycling, sustainable energy, biodiversity and food production) and a Repair Cafe (i.e. a meet up where about twenty five people come together once every two months to repair things together, prolonging their life). Shortly after they were contact by the national Repair Café Foundation and asked to become a member if they wanted to keep using the name, which they did.

Whilst setting up the Fab Lab in 2010, their interest in research and science and success in setting up an open workshop network around art and technology led to another regular activity, the Studium Generale Amersfoort, a lectures series where they would invite research scientist to talk about their work (such as crowdsourcing, bio-art and science). A year later this lecture series evolved into the establishment of the independent 'Universiteit Amersfoort'.

The university 'is a place where all research comes together. Independent researchers that are not necessarily connected to a university are welcome here, as well as inventors, and artists that engage in independent research. It is also a place where research that has lost its place elsewhere in society can be done' (De War website, http://dewar.nl).

Over the past thirteen years, more than two hundred people have collaborated in the projects of De War (Academic researcher B, interview, 30th October 2014). There is currently a mix of people involved. Some of them live on the premises (such as Diana and Harmen) or rent a space above the Fab Lab to work on their own projects and help out with other activities such as one of the Fab Lab managers who works on solar boats and another who experiments with PET bottles as construction materials. Others drop in and out of activities in De War such as being part of a temporary communication group, thinking about appropriate organisational structures or

organising FabFuse. They believe in the ideology of De Way but not necessarily have their own project. In addition, a group of ten people have volunteered to be Fab Lab managers, who built the machines in the lab and now look after the visitors (from students, to one time visit, to regular attendance) to the lab. Some of them also are more actively involved in other De War activities. At least two people who started to get involved in Fab Lab activities have now either created their own company or are employed in companies relating to digital fabrication (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

For several years, they had the idea to buy the factory and its premises to be able to create a place where it is possible to fully experiment with ideas of being self-sufficient within a peer-to-peer society. In order to enter negotiations with the local municipality, they have set up a cooperative in 2012 (called Plan B) and developed some principles in association with it since 2014. They currently have fourteen members that make up the cooperative and about five buildings on the factory premises that they rent from the local authority. There are the factory offices in which five people permanently live (including Diana and Harmen) and additionally, the SpullenLab (a workshop and theatre) and an office and meeting space that can be rented. Then there is the Fab Lab with studio spaces on the second floor and communal gardens in front, storage buildings for all sorts of 'spullen' and a large warehouse where also the local food cooperative rents a space.

4.2 Aspects of 'innovation' and 'change' of the local initiative

From the beginning, Fab Lab Amersfoort had some distinct aims that varied from other labs in the network. For instance, issues of sustainability were always part of their core ambitions. Although Harmen feels that there is a potential link between sustainability and Fab Labs, current discourses seems to be too hyped up for him, considering that these relations are not as straightforward as they are made out to be in the media. In addition to issues of sustainability, the people from the Fab Lab Amersfoort are also keen to have a lab that works with open source principles and mainly relies on its own financial resources and therefore developing a grassroots approach to Fab Labs that others have taken up and adopted. Another distinctive aspect is that they have actively announced that their ambition is to change society, 'don't wait for society to change, change it yourself, start small' (Wildschut 2013). Over the years, the Fab Lab has therefore become a place where the aim of personal fabrication to make almost anything was broadened out to ideas coming from citizen science, sustainability (in particular Transition Towns), open source and peer-to-peer thinking. For Diana, this broadening of aims also derived from the realisation that a lot of the people who used the Fab Lab actually just made nonsense such as key rings rather than develop meaningful projects (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

'I think Fab Labs are still narrow minded in a sense that they focus on production and this limited set of digital tools but there are a lot of viable interfaces to connect to others' (Wildschut 2013).

The Transitielab that was established shortly after setting up the Fab Lab is an example of trying to combine personal fabrication ideas with Transition Town ambitions and in the process redefining and broadening the Fab Lab approach. The people from the Transitielab used to meet up every Thursday (during the last few months, meetings have been less regular but the plan exist to conduct a few workshops in the near future) to do sustainability related projects with a DIY twist. Diana, who had joined the local Transition Town group, mainly initiated the creation of this lab. She felt rather frustrated with the local group as they mainly talked about the issues rather than

getting involved in doing something about it. In the Transitielab, people therefore decided to get on with projects and not talk until lunch in order to avoid just chatting about sustainability related issues.

'There was a Transition Town in Amersfoort, but it was mostly about talking, but doing nothing. So we started Transitielab. For people who wanted to make their own solutions for sustainability' (Wildschut 2013).

Projects have been varied and have fallen under the topics of energy, food, awareness and reuse such as 'The Sunflower Energy Solution', the 'Mushroom Garden' and 'keeping bees'. For Harmen, the link between Transition Towns and Fab Labs is important. He regards Transition Towns as a way of connecting with the community and building local resilience for their locality whereas Fab Labs mainly provide tools and technologies but often for personal projects rather than community building. During the Fabfuse event in 2012, Diana initiated discussions about trying to combine these two approaches.

A similar connection is being forged with Citizen Science and Public Lab ideas and approaches to broaden Fab Lab aims. Rather than building things for people's own consumption, the idea is to built instruments that can be used to measure, for example, environmental impacts.

'Science is about research and developing new stuff or finding out new stuff that was not known before. And the people who come into the Fab Lab usually have the tendency to be interested in that kind of stuff as well... I think there is a link with Fab Lab there... and it is a laboratory, it is in the name and in the environment, there is some equipment there to do research' (Zijp 2013).

Both links do not seem unlikely when considering Diana and Harmen's interest in producing art installation that work at the intersections of science, art, technology and sustainability. In particular, the bee project has been a constant source of inspiration in this area. Diana has around ten beehives up on the roof of the Spullenmannen for which she had built the boxes and the material where the bees built their honeycomb in the Fab Lab. Beekeeping is not uncommon in the Fab Lab network specifically when members in the lab are interested in sustainability issues. In addition to building some of the material, Diana has collaborated with Utrecht University to create various sensors (such as temperature) that measure the well being of the hives and advocated the need for similar beehive projects in the local area (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

Through this work, connections were forged with the local sustainability department within the council and when a project came up to develop sensors to measure various local environmental changes (such as flood levels) De War was asked to conduct the work. After long discussions, recently the work has been agreed and the work on the project will start soon. Diana still needs to think through the details of the project but the idea currently is to create various citizen groups for the different project related areas such as the development of the software. The idea is also to organise workshops where people could debate various aspects of scientific data and measurement in order to develop some valuable science data collected by citizens. All the designs and measurement would be open source (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

All these activities are set within an experiment of trying to create a peer-to-peer society that influences modes of ownership, production and governance within societies.

'There are a couple of interconnected, intertwined core themes, and one is sustainability or resilience, local resilience, like Transition Town input. The other one is about open source

development, which is more the Fab Lab input. The third one is grassroots organisation or peer-to-peer phenomenon, and building networks that empower individuals' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Peer-to-peer (P2P) is based on distributed network approaches where people work on common goals and outcomes in projects whilst sharing information, resources, knowledge and outcomes (i.e. the believe that they belong to the commons). There is no centralised intermediary that coordinates the activities but consists of flexible hierarchies and structures. Participants freely make connection and take on board tasks and responsibilities. Anyone can participate as long as they have the skills and knowledge to contribute to a common endeavour. The validation process regularly occurs through reputation and demonstrating these skills. P2P has been around in universities and companies for the last thirty years. However, more recent developments come from software areas such as Napster, a peer-to-peer internet-based file sharing service.

When speaking to Harmen about De War and its activities, he refers to Michel Bauwen's writings on peer-to-peer. He particularly focuses on Bauwens' (2012) efforts to draw out the 'similarities between the slavery-to-feudal transition and the capitalism to P2P transition'. According to Bauwens (2012), in both transitions the logic of the whole (and mainly social) system was fundamentally changed. From slavery to feudal was marked by a time where slaves became serfs. Instead of relying on 'conquering lands depleting their populations for slavery... Feudalism was a retreat to the local, to the manor, but within that manor, serfs could' have certain rights, producing 'directly for use value not for a monetary economy'. Bauwens has predicted a similar transition within the current world system from capitalism to a P2P. He reckons that the current challenge within a capitalist global system is based on 'hitting ecological, energy and natural resource limits' and has therefore foreseen that there will be a 'return to the local' that is characterised by a P2P society:

- 'The relocalization of the economy will be matched by the globalization of intellectual and spiritual cultures... Global-local open design communities will co-exit with more localized production communities and enterprises' (Bauwens 2005).
- 'No longer relying on the ownership of the means of production, hiring workers to create value, but rather, they create proprietary platforms to enable and empower sharing and peer production to occur' (Bauwens 2005).
- 'Unlike the traditional workers who had no means of production and had to sell their labour, the emerging class of knowledge workers does again own its means of production' (Bauwens 2005).
- 'There will be a shift from extensive material development, to intensive immaterial development. The core logic of the creation of immaterial cultural, intellectual and spiritual value in this coming world of open design, will be non-reciprocal peer production' (Bauwens 2005).

For Harmen in a P2P society, people will be less connected to work systems where the economy is driven by growth but rather engage in activities because of personal motivations and interests. With such a shift of emphasis, for him, people will start to question existing power relations and ways of working and subsidise these with self-organising and horizontal distribution processes (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014). Although activities within De War are structured in different ways (Academic researcher B, interview, 30th October 2014), they all try to explore such P2P ideas in relation to governance (see section 1.3.1.1. below), ownership and production. Similarly, Harmen's interest in being involved a local group that thinks about distributed ways of setting local agendas and making decisions (based on David Reybrouck's book Against Elections) are attempts to explore different ways of structuring society and 'hacking

systems' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014). Harmen feels that 'keeping this in mind helps to make decisions in day to day life'. It is about holding onto shared values and ambitions as a way of making decision together and realise different ways of living. The difficulty of this endeavour is that these ideas have been realised within immaterial, virtual and software related projects but are only slowly moving into developments in hardware.

'The key question is: can peer to peer be expanded beyond the immaterial sphere in which it was born?' (Bauwens 2005). In particular, the issue of the material survival of P2P participants has not been solved. It therefore still heavily relies on market related processes i.e. having a job outside the P2P activities (Bauwens 2005; Academic researcher B, interview, 30th October 2014). Such dynamics can also be observed in De War (see section 1.3.1.1. below for more information).

The plan to buy the factory and its premises from the local authority (and the creation of the cooperative – see section 1.3.3.) is part of the overall vision for De War to develop a space where they can experiment and establish P2P projects, drawing on sustainability, art, science and technology related issues and creating a hub of local activities.

'Now we are really actively looking for a way to get in touch with more initiatives like ours… we can make a hub of the house' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

'And that's recognising that we're not the only ones trying to do this, but there's other places in the world as well, and it's nice to connect, reach out and collaborate, although it is not necessary at all, because you can just run your own thing without doing this' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Architectural drawings and plans have been drawn up to visualise these ideas. The Fab Lab, theatre, exhibition and work related spaces would still exist, in addition to creating a café, several biodomes and a biosphere on top of the roof of the factory. At the moment, the cooperative suspects that the ground in and around the premises is quite polluted because of past factory activities, hence the plan is to develop various projects with the university to find ways for plants to clean the soil.

4.3   Aspects of empowerment and disempowerment of the local initiative

4.3.1 Governance

4.3.1.1   Internal governance

In general, Fab Lab Amersfoort is an open space for people to work and collaborate on projects where decisions are made through discussions and mutual agreements. The more you contribute to the running of the lab, its maintenance and the sharing of knowledge, the more access you have to the machines and space. This idea of people taking responsibility for the space and their own learning runs through the lab's governance, norms and activities. Regular and one off visitors and also Fab Lab managers are required to contribute to the lab (in return they gain free access to the lab all week), which can take several forms. On arrival (and by looking on the website) newcomers get this idea very quickly, as they are asked to pay 50 Euros to be able to use the space and

machines that they can earn back through sharing their design in the form of a FabMoment (a website based template to share projects), conducting maintenance work or developing the existing machines (i.e. repairing or building them or creating manuals for others) (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014). The visitor is not obliged to earn back the money but instead is able to pay for her/his visit.

Visitors are welcomed by one of the Fab Lab Managers. Currently, there are about 10 Fab Lab managers, who meet up about once a months to discuss a diverse set of issues that have come up in relation to the lab. This group of people has derived from the previous networks that have been created, in particular, through the OpenToko workshops, and have provided a steady stream of managers, who keep the lab open to the public once a week on a Tuesday. In return for volunteering and keeping the lab open, they all have free access to the technologies for the rest of the week. During the open days, at least one manager is in the Fab Lab, either working on his/her own projects or helping others to get started and with particular enquiries. On the whole, there is an atmosphere of autodidactic learning within a supportive, sharing environment.

'You will have to at least try and figure things out yourself or with fellow visitors' before approaching the lab manager (Fab Lab Amersfoort website, http://www.fablabamersfoort.nl/en).

During FabFuse in 2012, Harmen talked about the ideas behind running the Fab Lab through referring to a book called 'The Unstoppable Power of Leaderless Organizations'.

'If you chop off the head or legs [of a spider] it does not know what to do… the starfish on the other hand is like a decentralised organisation if you chop off one leg a new one will grow' (Zijp 2013). In practice this means, for example, when planning the FabFuse event 'no one was in charge or on top… there a whiteboard with to do items… people talk about topics… and common values… and people would tick off the list… and people who get frustrated there is a chance to change it'. These ideas are based on the principle of 'don't organise, discuss values' (Zijp 2013).

For him, it is about managing expectations, learning together how this way or working might work and in the process 'reinventing culture and society and dealing with each other in a different way' (Zijp 2013) There have been times where it has been difficult to hold onto these ideas. But they also create a space to come back to in order to re-evaluate particular challenging situations and discussions in the light of these shared ideas, norms and expectations.

These ideas are shared across all of the organisations within De War (such as OpenToko) but play out in several ways depending on who takes part and the format of the activities (Academic researcher B, interview, 30th October 2014). More recently, these ideas have been translated into a constitution and several bylaws as part of setting up a cooperative for De War. With the ambitions to buy the factory from the municipalities came the need to create a legal body that could help the group to enter the negotiations. A cooperative was considered to be the most likely body to represent their ideas and norms, although, taking on board the standard list of bylaws attached to cooperative did not seem appropriate. Consequently, the group of members spent a long time to find lawyers that would help them to develop together an alternative constitution and set of bylaws (which had not been an easy process, in particular, lawyers felt uncomfortable to sign such 'unconventional' bylaws). For the members it was important that these bylaws represented the group's values and norms of sharing knowledge and resources, self-governance, peer-to-peer working and decentralisation. In order to maintain these values and norms and manage expectations, four levels of collaboration have been outlined as part of the constitutions where all of the members are able to position themselves (Academic researcher B, interview, 30th October 2014; Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Level 1 and 2 are the lower levels of involvement, which constitute mainly in sharing knowledge, space, tools, machines and resources. Level 1 participants do not need to join the cooperative but also do not benefit from its legal form and the persons ability to set up her/his own project within De War. Level 3 and 4 require higher levels of involvement from the members. Level 3 members commit themselves to maintain the internal network of the cooperative, deciding on visions for De War, finances and the development of the facilities. Level 4 members share these responsibilities but also are involved in external work such as creating collaborations with initiatives (locally and globally) that have similar aims and ways of organising (such as Voedselkollektief, a local food initiative that is also based in the factory). There will be two sub-committees consisting of the members: one that develops a vision for De War and the other that tries to create connections with other initiatives. At present, there is no formal procedure to monitor whether members keep up with their contributions and responsibilities outlined in their chosen level (Academic researcher B, interview, 30th October 2014; Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

The formulation of a constitution and its bylaws has been a rather recent development within De War. Although this constitution derived through a collaborative process, in day-to-day life at De War some of the people find it easier to translate these norms and responsibilities than others. When talking to some of the people involved and participating in some of the activities, it seemed that over the last few years there has been a process of growing from a group of friends to a network of interconnected activities whilst trying to keep particular ways of making decisions and working together alive and incorporating them into the organisations core values. Within this Diana and Harmen have found it difficult not to be considered to be the 'leaders', as they initiate a lot of the activities, live on the premises and constantly work hard (with great persistence and reflection) on realising the ambitions of De War. They would appreciate it if more people would want to get more fully involved and cannot quite understand why people consider them as the leaders.

'We found out that it is really a lightweight thing to organise, and it is very valuable, but that as soon as we stop doing it... organising it, yes. No one steps in... It hardly gets copied either... I really don't know if this is because people feel they cannot step into our core ground.' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014)

Even so, some of the people have found it difficult to understand the structure of De War and make sense of the varying levels of perceived authority (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014; Academic researcher B, interview, 30th October 2014). Consequently, they have expressed being unsure about their role and corresponding responsibilities. For instance, De War member A expressed that she used to be a lot more engaged in the general activities of De War (because she believed in what people were trying to achieve) but nowadays less so because she felt that she needed to have her own project to be fully involved.

'She finds it very necessary to collaborate and give back to society but she does not see herself as a person in a role where I am going to create my own project... these kind of environments are still not able to cater to everyone's needs' (Academic researcher B, interview, 30th October 2014).

A researcher, who has been at De War over the last six months can understand both sides. On the one hand, some people struggle to fit in. On the other hand, 'the people who organise De War have to protect themselves and have to find ways to organise themselves and making sure that people do things according to the values and culture in De War' (Academic researcher B, interview, 30th October 2014). For the researcher, a 'system of rewards' seems to be missing within this structure that might be necessary for some people to keep connected to the activities but this partly seem to go against De War's norms.

'You have to step in and do your bit. That you have to accept that probably you will not get praise for it anyway... And that you have to do it because you benefit from it yourself' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Similarly to De War member A, one of the interviewees struggles to combine his daily work and leisure commitments with the activities within De War. He appreciates the informality of the place but is also unsure about his role and how much time he can actually commit to it.

'What I bring away from it is that it is possible not to have a boss or plan... they [Diana and Harmen] pick up values that people pick up on or not... it is not always clear how it works' (Past regional networker, interview, 27th October 2014).

For him, processes and structures in De War are too fluid and therefore it is difficult to know when, how and to what extent it is possible to get involved in activities (Academic researcher B, interview, 30th October 2014). Moreover, through the recent creation of the cooperative, he felt that there was an expectation for a high involvement in De War and so no longer a space for him.

Being unsure about his role, possible commitment and ability to make decisions for De War materialised itself during a communication project that was set up this summer. A group of people came together to develop various communication materials for De War (that could be taken, for instance, to events) that could explain its story. Part of this material was a placard for the entrance wall of De War. At the time Diana and Harmen were away for a few weeks so nobody could ask them whether it would be okay to hang up the placard. Moreover, the group was unsure whether they needed to ask them at all.

'So we had the text and the pictures done and I thought it is a good idea to show it to Harmen. In the end, it is going to hang up on his wall and he is going to be there most of the time and then most people in the group thought we don't have to do it' (Past regional networker, interview, 27th October 2014).

Nowadays he has started to drift in and out of activities. Usually he becomes more involved when there is a concrete thing to organise such as the creating a placard or planning the FabFuse conference. This is the work that he enjoys. Discussions about De War's ideology or talks with the municipalities often become to long and drawn out for him so he can easily loose interest. From spring onwards there will be a spare living space within De way, the interviewee has considered moving in in order to commit more of his time to De War activities. He reckons to make it work (i.e. combining it with life outside De War and finding your role in De War) he would need to integrate himself more and moving in might be one option. But currently, he is even unsure whether he still wants to be a member of the cooperative (Past regional networker, interview, 27th October 2014). Diana and Harmen understand people's dilemmas of trying to combine their work and family life with activities of De War and are aware that some have left in the past because other life commitments were prioritised.

According to Harmen, people who have their own project within De War (such as Fab Lab manager A who builds solar boats or De War member B who works on PET bottle structures) and invest time and money in it (such as through renting a space) often find it easier to find their own role within De War in relation to their commitment to it and its norms (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

'Fab Lab manager A has his project and pays for his space, making his own thing, and the rest is like a supportive structure, empowerment, that makes him perform well in doing his own thing. And De War member A is lacking this core activity for herself... she is just interested in the

ideology… it is not more than a gut feeling that it is important to have very down to earth economics, yes, as well as collaboration [when being part of De War]… Once things get hard, and you get disappointed for whatever reason, or maybe personal conflicts that come and go, it could be anything. Then you discover that is the only thing you have [the ideology], and then your motivation can go very easily and you not have this safe refuge of, well, this other project that can go' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

'I think this is really the core of everything, that we are building culture, a culture, and that is open and that's inclusive, for anyone who wants to participate, but does have positive filters in place. So you cannot get anyway with anything, although it is open to anyone, you know, and that provides a friendly community that gives nudges and helping hands wherever needed, but allows you, or stimulates you empower yourself making use of that' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

The empowerment of people (and finding the means to empower yourself) is actually key to De War's norms and activities, which can be partly connect to having your own project. Later on in the conversation Harmen pointed out that all of the mentioned people have not left De War yet and so it still is to be seen how these dynamics will influence in how far people feel connect to De War and stay or decide to leave.

4.3.1.2 External governance

The boundaries between internal and external governance is not always clear-cut within activities in De War, considering that the people are keen to collaborate and create networks with groups that have similar aims and ways of working. For instance, the local food sovereignty initiative (called Voedselkollectief) is separate from De War's activities but has its base on its premises and a lot of the people from De War are involved in it. Similarly, the activities in De War (such as Festival Franje, Repair Café, Studium Generale, FabFuse and Fab Lab) have blurred boundaries where people are free to join and take part, choose to no longer participate or join various activities. All are structured in slightly different ways but with the ambition to create decentralised and horizontal ways of working. Even the people within De War create links with external networks and groups through participating in other activities. For example, E regularly comes to the Fab Lab and helps out at the Repair Café but is also heavily involved in the Dutch Hackerspace scene. The forging and overlapping of networks where internal and external boundaries become blurred has become quite a purposeful undertaking within De War. It is a form of sharing knowledge and resources in an open manner (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

Similarly, past connections with the Fab Lab network consisted of Harmen being involved in 'The International Fab Lab Association', developing a grassroots approach (such as creating 'The Grassroots Fab Lab Instructable' document and organising FabFuse), creating a 're-fab manifesto' (a guidance note on how to make labs sustainable) and working on an approach to collectively share 'FabMoments' (i.e. Fab Lab projects) (several websites). Nowadays, these activities have been reduced mainly because of attempts to broaden out the Fab Lab idea of personal fabrication. They still enjoy doing their own projects but feel less the need to connect with the global network. Other networks, such as the Open Hardware Conference, have become more relevant to the projects that they have been involved in. Fab Labs around the world still contact the people from the lab to enquire about their grassroots' approach but interactions are less connected to the Fab Foundation and general network activities. Regular enquires about the approach usually come from labs in Brazil, Ethiopia and India, asking Diana and Harmen, in particular, to talk about their self-funded way of working and projects around sustainability in the lab (Fieldwork notes,

Amersfoort Fab Lab, 25th-31st October 2014). Harmen sometimes feels uncomfortable talking about recycling and reuse to this audience because he reckons that knowledge and ideas within this area is much greater in this context than what they could gather over the last years. People often also show an interest in the 'Tweak Show' when getting to know the Fab Lab and relate these art activities very much to what is happening in De War. Currently, Diana and Harmen work on the idea of creating a 'Peer Lab' course where people from the network can learn about their grassroots approach that emphasises the self-funded, open knowledge, social and sustainability aspects of their lab rather than the technologies involved (Fieldwork notes Amersfoort visit; Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Over the years, some of De War's projects and activities have been positively noticed by the local authority, in particular, the sustainability and cultural departments are interested in supporting their endeavours. The recently agreed upon citizen science projects is one of the first more formal collaborations with the council (see section 1.2). As part of this collaboration, they were meant to work with a local consultant but talks slowly discontinued because the consultant struggled with the idea of working with open source software and producing open knowledge (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014). This break down in relation demonstrates the difficulty to work with external actors who do not follow similar norms. Connections with other departments within the council have been less productive so far. Diana and Harmen have been regularly in touch with the economics, regeneration and planning departments because of their interest to buy the factory but conversations have been slow. Harmen and a local activist (who is interested in preserving the industrial heritage of the town) try to stress the cultural value of premises and activities of De War in order to agree on a reasonable price for the grounds (Past regional networker, interview, 27th October 2014). However, there is little understanding from the council workers for such projects. The most recent idea is to invite some of the councillors and the major to De War to show them what his happening there and propose their future plans to them. In addition to talking to council, the cooperative has started to talk to possible investors and the bank to be able to buy the factory. Harmen developed a flexible finance model that would show how they could pay back the money and proposed it to the bank. They were so impressed that they offered him a job but it is still unsure whether the bank would actually help with the finance (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

Although the people from De War have taken part in local art and cultural events (such as the Open Monument Day) to open their doors to the local public, some of them feel that the external communication has been neglected over the years (Past regional networker, interview, 27th October 2014). Recently a group has been formed to actively develop communication materials that help to explain what De War is about.

'We have a lot of people coming… but they have no idea what else is happening and a lot of time people ask what it is but it not easy to tell' (Past regional networker, interview, 27th October 2014).

The group developed a placard for the space and other material that explain some of the activities in De War. Some of the issues of trying to communicate the ideas surrounding De War to external actors seems to grounded in its deeper values and norms and how they are perceived in existing common systems. Often the people of De War get asked about their business plan and model but for them this is not really their main concern. Their ambitions are grounded in creating social and environmental projects that benefit the local community rather than to create a financially beneficial business (Academic researcher B, interview, 30th October 2014).

4.3.2 Social learning

Social learning is deeply engrained in the activities of De War and the Fab Lab and incorporated in some of the norms and values. During one of the early projects for the Spullenmannen, Diana and Harmen realised that to be able to create their idea of lighting a bulb through human brainwaves in the shape of a kettle would require for them to understand neuroscience in great depth. Instead of giving up on the idea and knowing that they already had submitted it to a neurological event, they organised a series of workshops (around topics such as programming, electronics and neurology) to which they invited some of their friends and asked them to bring other people along who might be interested in the proposed topics. Only after a few workshops, Diana and Harmen with the help of the others were able to get the installation working (at least for one day during the event). This was one of the first experiences for them to appreciate the possibilities involved in sharing knowledge (Zijp 2013).

'We realised the real value of this machine was about the network that we had built. All people meeting here and sharing some knowledge about technical skills' (Zijp 2013).

Since then, Diana and Harmen have more purposefully set up several networks and associated projects in De War, starting from the OpenToko to Studium Generale. For instance, the establishment of the Fab Lab was a reflection on wanting to find more people involved in making processes, 'we made lots of friends who taught us and now we can do it ourselves but we were also lacking people who can make and design things and fabricate them so that is why we set up a Fab Lab' (Wildshut 2013).

When talking to Diana and Harmen, it seems that a lot of their learning and experiences have been shaped by them trying to overcome several obstacles (such as not getting into exhibitions, lacking certain knowledge to realise ideas or not gaining funding) and persisting with their efforts (Diana Wildschut and Harmen Zijp, interview, 30th October 2014). Over the years, they have started to utilise this approach more and more, whilst relating it to ideas of 'hacking systems' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014) and not just things. Through these experiences Diana and Harmen have formulated several lessons that they have presented to several audiences:

- 'Don't wait for funding, Do it anyway and Do it yourself and Do it open source'
- 'Don't wait for approval, do it Anyway and do it with others'
- 'Don't finish a detailed plan, don't wait until you have convinced yourself of a destination start moving'
- 'Don't wait for society to change, change it yourself, start small'

(Zijp 2013) Within the Fab Lab network, these learnt lessons have been associated with a grassroots approach to setting up and running labs, which is outlined in greater detail within 'The Grassroots Fab Lab Instructable' (i.e. 'how to set up a Fab Lab in 7 days with 4 people and about €5000') that can be freely downloaded from the internet (produced by Harmen and Fab Lab Amersfoort). In addition, this approach was presented at several conferences (such as FabFuse 2012 and Fab6 in Amsterdam) and the Fab Lab has been more informally approached by others asking for their support and help in setting up these types of labs.

Within these lessons and the running of the Fab Lab is also a strong enthusiasm for autodidacticism (Fieldwork notes, FabFuse event, 8th-10th August 2014) when it comes to learning processes in De War. In particular, for Diana being an autodidact is connected to feeling empowered, something that is important for her to translate in what she does and others can

potentially find within themselves within De War. The sharing of knowledge is constantly aspired to within the Fab Lab by encouraging people to earn back the 50 Euros through sharing their designs as FabMoments on the Fab Lab Amersfoort website but also more indirectly in the ways the lab is run. Fab Lab managers try to create a supportive environment in which they provide support when needed nonetheless they are keen to leave people to work things out by themselves. Harmen has affirmed this attitude by stating that he is keen for the Fab Lab not to become a 'copy shop' (Academic researcher A, interview, 19th August 2014) but a place where everyone is expected to contribute to sustaining the lab.

Values that relate to learning through sharing knowledge and self-teaching become very quickly visible when spending a day at the Amersfoort Fab Lab. Fab Lab user A is the first person to turn up at the lab. He has already got a digital design file for a part that he wants to print out on the 3D printer to be able to assemble a lamp that he has recently designed. It is his first time at the lab. F, who is the morning's Fab Lab manager, introduces Fab Lab user A to the lab and its machines. He likes to help out because of the current shortage of managers but is also aware that he does not know about the in and outs of the machines. Turning on the 3D printer and getting the WIFI to work is one of the first instances where a combined effort from all of the people present is required to get things started. After everything is set up, Fab Lab user A tries to change the format of his drawing from the AutoCAD software to Cura to be able to safe it on a memory card and print it on the 'Ultimaker' machine. He has never used a 3D printer before and even Fab Lab manager A is unsure about its exact workings. Consequently, Fab Lab user A resorts to checking the user manual of the 3D printer on the Fab Lab Amersfoort website that has been produced and updated by previous visitors/members of the lab. Fab Lab manager A also shows him a diagram (that hangs on the wall) where he can see which machine runs on what software.

A while later, the 3D printer makes a noise and starts to print the shape. Fab Lab user A had worked it out. Ten minutes into the printing process, the needle of the printer starts to smudge the already printed material and in the process damaging its shape. There must be something wrong with the setting of the Ultimaker. Fab Lab user A tries to fix things but has to give up. Fab Lab manager A advises him to come back later; Diana will arrive and might be able to help him. In the meantime, Fab Lab manager A speaks to Fab Lab user B (who is trying to repair one of the self-build machines, a computer-controlled 3D milling machine that cuts out printed circuit boards (PCBs)). They are both interested in being able to create their own printed circuit boards and share some of their acquired knowledge. When Diana arrives at the Fab Lab, after a few goes, she is able to slightly adjust some of the settings on the printer and help Fab Lab user A to print out his piece. Fab Lab user A earns back his 50 Euros by painting a door that had been fixed the previous day and plans to come back to the lab (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

When considering this short extract from the visit to De War, it becomes apparent that the approach of sharing knowledge and self-teaching runs through various aspects within the Fab Lab, including introductions to the lab, in particular, to its values and 'rules' of being part of it (as described above) and the self-built machines (and their developments and additions) and efforts to make them more user friendly (through the way that they are built and manuals are created). For instance, the CNC router has been a 1.5 years project on which about eight people worked to develop a workable machine. On a smaller scale, the open source Ultimaker 3D printer was built by a group of people within the lab. Once the printer had been built the development of the machine did not stop there. Diana remembers a time where she had post-it notes all around the printer where she noted down all the experiments with the different settings combinations on the printer. In particular, one of the Fab Lab managers took on board the task to programme the printer in such a way that some of the settings could be used more implicitly without having to refer to the post-it notes and in the process making it user-friendlier for the visitors to the lab. Nowadays, he rarely comes to the lab because through developing the printer he was asked to work for

Ultimaker. Similarly, another manager developed a programme called 'Doodle3D' where people could easily create a digital drawing to then print it out on the 3D printer. He has now created a business out of the programme and tried to create a base for it at De War but because of numerous complications had to go somewhere else (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

Such efforts of sharing knowledge, helping each other to find out things nobody might not know about and encouraging people to learn and experiment for themselves runs through all the machines and activities in the lab. This approach is deeply engrained in De War's ambitions to experiment with a peer-to-peer society on a local scale.

4.3.3 Resources

After years of applying for grants with the Spullenmannen and sometimes gaining a small amount that created more work (and bureaucracy) than it was worth, Diana and Harmen have found ways to become autonomous and value this status (Diana Wildschut and Harmen Zijp, interview, 30th October 2014; FabFuse fieldwork notes). Creating your own resources within the networks at De War has become an important part of their values and norms and links to ideas of becoming self-sufficient and resilient. The Fab Lab signifies one learning experience along this path. At the beginning, the network connected to the Fab Lab actively approached several institutions to gain financial support for their idea but without any success (see section 5.1). As a result, they slowly have been able to buy and build their own machines through financing these activities themselves, whilst at the same time developing a grassroots model for Fab Labs. This has predominantly been possible through a pre-existing group of friends and networks (such as the OpenToko) where people could come together to support the creation of the Fab Lab financially but also through sharing time and knowledge.

Partly through the lack of finance (but also in accordance to their values and norms), the group took the opportunity to buy a laser cutter through Ebay that required them to create an alternative user manual in Dutch and work with some 'illegal' software to make the machine workable. In the process of understanding and adapting the machine, they learnt so much about the laser cutter that they modified it to such an extent that it can be used in an 'open software' mode or closed one (constantly indicated by a large manual switch at the front of the laser cutter). From then onwards, this experience has formed the lab's thinking of doing things in an autonomous, open source and peer-to-peer way and in the meantime, attracted additional people who could bring necessary time, skills and knowledge to the lab (often sharing similar believes). Such self-building approach with volunteer enthusiasm has kept costs low and created a network of people who maintain and run the lab. Nowadays, the Fab Lab mainly covers its own costs (through visitor fees, paid workshops (which occur infrequently) and renting out the lab to external bodies) only during some months it is partly subsidised through Diana and Harmen's art practice (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

Such resourcefulness is applied to several De War activities, finding alternative ways to do things without relying on external funding. Even renting out the factory under the anti-squatting law where rents are cheap but they could loose the premises with only three months notice represents part of their approach to make the finance of their activities possible. This approach is partly based on their experience of 'hacking systems' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014) in previous projects and therefore finding unconventional ways to support their projects (that are often cheaper). Similarly, the cooperative is meant to provide a way to finance projects within De War. Each member pays 500 Euros each year in a fund. Then the members

propose a project that needs funding and they would like to work on. After considering all the applications, the group then decides in which order the projects should be prioritised to gain funds (the projects with the most benefits for the cooperative are prioritised). Such ambitious are based on having a more stable source of finances to realise a variety of projects without having to rely on external support (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

'And that's what we also want to do with the co-op. Everybody pays, I think, €500 a year, but you can also pay half and do the rest in work, or something... and we put this all into one little thing, and then together we decide what projects are going to be funded from this money' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014).

In addition to the above, some regular income comes from renting out parts of the factory space (for studios and offices), gaining donations and offering various services (such as away days for companies). Although several approaches are applied to resource the activities in De War with the ambition of staying free from any type of funding (i.e. being autonomous), it is near to impossible for the group to fully disengage from external (for instance, financial) systems such as when trying to buy the factory and premises.

Monitoring and evaluation

Thinking about the fieldwork at Fab Lab Amersfoort, monitoring and evaluation does not really seem to play a role in their activities (even for De War). Most of the resources come through alternative funds rather than from external funding programmes that often bring along monitoring and evaluation requirements. There has therefore not been the need to comply with external obligations.

'Because we did not have funding we don't have the obligations that come with funding' (Zijp 2013).

Their attitude to 'hacking systems' (Diana Wildschut and Harmen Zijp, interview, 30th October 2014) can even be considered to challenge existing evaluation systems. For instance, the establishment of an university without going through the official channels to validate it, is for them a way of doing (and advocating) research that is 'open, independent, and unconventional'.

'The most exciting developments come to life in places that don't constrain ideas to existing frames, that are open for play and experiment, where accidental encounters open new paths' (De War website, http://dewar.nl).

More recently, Diana and Harmen got invited to do an art piece for the 25th anniversary of the Centre for Science and Technology Studies (CWTS) at Leiden University. An institution that develops ranking systems for science in universities. At first, Diana felt uneasy about working with such an institution because the way they thought about evaluations in science was rather different. But when Diana and Harmen met up with them, they received a sympathetic view about doing an alternative university and trying measure impact in different ways. Since then, they have been back to the CWTS several times to discuss these issues together (Fieldwork notes, Amersfoort Fab Lab, 25th-31st October 2014).

Outside this type of work (actively 'hacking' conventional measures), in the daily work at De War measures and evaluation are less explicit. Evaluations are probably based upon more reflective means of thinking about whether ambitions and norms are being met over longer periods of time.

4.4   Other issues about the local initiative

There probably are several issues that have not been explored within this report or during the fieldwork. This was mainly because of the length of the topic guide. At times it was challenging enough to go through all of the topics provided in the guide. It was therefore near to impossible to follow up other issues. Within Fab Lab it would have been interesting to explore the material culture of these labs in more depth. How does the making relate to change and innovation.

5 Local initiative (2): Fab Lab Argentina

5.1   Overview of development in the local initiative
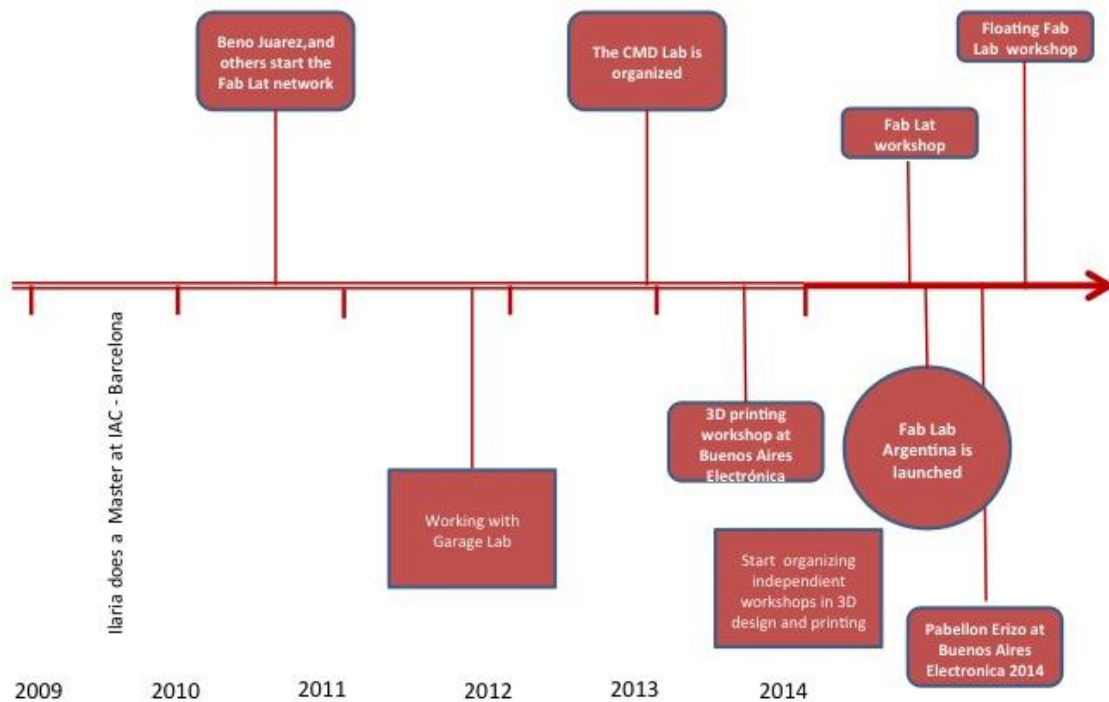
Fab Lab Argentina just opened its door in July 2014 at the Central Society of Architects in central Buenos Aires. Although new in this location, the members of Fab Lab Argentina have been working together for a couple of years and they are very much a central actor in the Fab Lab and maker scene in Buenos Aires. They also are a key node of the networks of Fab Labs in Latino America, or Fab Lat.

Interestingly, the history of Fab Lab Argentina started at a hackerspace called GarageLab, a workshop where scientist and makers meet a couple of day a month. GarageLab was the space where a lot of the members of the maker movement first met in Argentina. There, Ilaria Lammanna started working with and teaching about 3D printing. In 2012 they met with Francesco and Arturo de la Fuente. The three founder members have a background in architecture and have been researching previously in parametric design and digital fabrication. Ilaria in particular did a Master at IAAC in Barcelona in 2010. There she met Beno Juarez from Fab Lab Peru, and Andres Briceño from Fab Lab Santiago and already have started the organization of Fat Lat.

The idea of doing the Fab Lab grow of the interest to find a space for creating things and experimenting with digital fabrication.

Francesco: *"I think everyone of us have previous experience with Digital Fabrication and got interested in the activity of creating products and materialize things, beyond the digital design of computers. And for me, personally, I was eager to create objects. And Arturo was also doing courses and researching on digital fabrication and Francisco is the maker of the team, the one who has more experience in electronics and mechanics"*

Arturo: *"I started by learning computer design and parametric design in architecture, and offering workshops we started to get into digital fabrication with the people of Garage Lab. So we built a chair, we built a library. Francesco then contacted me. For me, it was the need to have a space to build things and knowing about fab labs, I knew that his could be the space to fabricate. Specially, since outsorcing the fabrication is much costlier. So, it was an opportunity to have a physical space to design and make prototypes and test"*

They first helped to organize a Fab Lab for the Local Government of Buenos Aires at the Metropolitan Design Center (CMD in Spanish) in 2013. The CMDLab (as it is called this Fab Lab), started by initiative of Javier Parysow a sociologist as a way to make use of some router and machines they had without use at the centre. They got in touch with Ilaria, Arturo, Francesco and other person. Since the CMD Lab did not have enough support from the local government, beyond the free space and utilities, they had to get funding and material from other sources. They managed to get a good funding to buy some machines and some workshops on digital fabrication at the CMDLab.

As the CMD grew, they started to have some problems with one of their colleagues who self-appointed to manage the CMDLab. Ilaria, Arturo and Francesco realized that this person was taking charge of the direction and turn the lab for this own business. As a result, there were some internal tensions and Ilaria and their colleagues left the CMD Lab at the end of 2013.

This was a hard lesson for them since they realized they have played naïve in a place full of micro-politics and driven by results and symbolic projection to get positions around a much larger organization that is CMD. Furthermore, they were frustrated by the fact they lost access to the space they helped to build and enlarge.

However, they kept doing workshops and activities at different locations and nurture their previous relations.

So, after the issues with the CMD, they support from former students and people who realized what had happened to them there. They kept going offering workshops and then decided to re-start at the SCA.

So, after a long time discussing this, they convinced the people of the Central Society of Architects to have a Fab Lab. The argument was that the Fab Lab provides access to new technology and enhances the value of the space, attracting young people and young architects. The idea is that the space should be private but also public to let other people join and share activities.

The profile of people joining at courses has been widening from architects and designers to textile designers and even medical doctors.

Ilaria: *First, we share the space and the machines. We want to have a space of co-working, to include other labs that do not have a space like Wasabi or Neti (No todo está inventado) can share the space with us. Thus, it is not only Fab Lab Argentina, it is us with other labs. Thus the concept of Fab lab Argentina is that "la union hace la fuerza".*

So, they understood that we have capabilities and also, we have connections that is the most important thing to participate in the network of fab labs.

Now even, we have re-arranged things with the CMD. The past, passed away and we restarted relations with then. I was able to confirm the story with Javier Parysow from the CMD Lab who told me he made a mistake by letting Ilaria and the rest go.

5.2   Aspects of 'innovation' and 'change' of the local initiative

The main focus of the Fab Lab Argentina is to support Digital Fabrication as a practice. They do so by teaching and doing capacity building. They also have become very active in the organization of event and community building activities in the digital culture in Buenos Aires.

One of the central implicit threads of the digital fabrication culture is co-working as a practice. This is based in peer-to-peer practice where projects are organized by some kind of soft direction. This aspect is the most appealing for other actors but also the most subversive since it is used to question the form of learning/teaching from traditional institutions like Universities.

A second aspect of peer-to-peer practice is that it allows horizontal collaborations between people from different disciplines. This is the case for other Fab Labs, like in the case of the CMD Lab, where it is possible to observe novel collaborations between for instance medical doctors and designers for 3D printing of models for surgery. This open collaboration practice acts as a enabler in relation to other institutions, like for instance looking to get some funding or share space (see resources). Not every space however, follows this open collaboration practices. Some have their own limits and prefer to separate activities.

At the same time, open collaboration has sometimes been despised as problematic for more formal institutions like INTI.

There is social inclusion aspect of the Fab Lab activism. There is also a widespread idea that everyone should be able to operate their own digital fabrication tools and create their own artefacts, materials and technologies. This aspect is of course reinforced by the "rules" of Fab Lab concerning openness and open collaboration. Fab labs that do not operate according to these rules are regarded as poor examples. For instance, in Heloisa Neves visit to Fab Argentian, they discussed the Fab USP at San Pablo and critized it because it was only open to students. This was a mark they did not play open and were avoiding open collaboration.

But at the same time, Fab Labs participate in specific activities of engagement with the community. One of them is Fab Kids, which aims to encourage small kinds to learn about digital fabrication and play with some of the Tools. Fab Kids is an activity organized by the Fab Network and they have

regular skype meetings about new events and coordination of workshops. In Fab Argentina, the coordinator of Fab Kids is Ilaria who organized a workshop in 2013? called: "Being a superhero for one day". The activity encouraged kids to reflect on things they did not like about reality and let them think imaginary solutions as superheros. The core of the activity was related with the (supervised) use of some tools like the laser cutter. There are plans to extend Fab Kids and organized regionally along with Fab Brasil and Fab Peru. Ilaria is also looking for fund to organize Fab Kids in a shantytown in Argentina.

Another important initiative related with game changers is the Flotating Fab Lab. The idea of the Floating Fab Lab arises from the will to diversify Fab Lab locations and take Fab Labs to places where it is difficult to get access to digital fabrication. One of the first initiative in this sense was to take Fab Labs to Africa.

The Floating Fab Lab is very much a flagship project aimed to work as a practical and symbolical demonstration of the contributions of digital fabrication to the Latin American context. Focused in the Amazon, the largest hydrographical space in the world and one of the most biodiverse, the Amazon is also a complex environment shared by 7 countries in Latin America. It is also a region inhabited by ancient indigenous populations, local populations and cultures. The Floating Lab is an attempt to bridge the Latin American Fabs Labs and bring them together to experiment and provide solutions to some of the problems of the region (see more in the local Latin American case study).
In particular, the Floating Fab Lab for the Amazon aims to address the challenges of de-forestation of the amazon and loss of biodiversity, the endangering of local cultures and local populations, poverty and lack of access to services and pollution.

The Floating Fab Lab combines local problematic and global challenges with game changers technologies. The main focus is biodiversity, digital handicraft and eco-production. Therefore the initiative aims to address the problem of biodiversity through bio-hacking and bio-research of materials (drawing form the renewed effort to experiment with biohacking at Fab Labs). Digital handicraft is also a long term concern for Fab Lab Peru (they have created a digital loom in 2013) and it is seem as a way to connect and empower the local artisans. Eco-fabrication involves the production of the boat itself and the use of local material for their construction.

The initiative is a coordinated effort between Fab Lima, Fab Argentina, Fab Costa Rica, Fab Central at MIT, and Fab Barcelona with some individual support from people in Canada, Belgium and Brazil. The mentor of the initiative is Beno Juarez, a pioneer of Fab Labs in Latin America and the coordinator of Fab Lat. Beno Juarez has also a background on Technological Projects for Social Innovation (See Emily Smith, 2014) and a vision for digital fabrication as a tool for democratization of knowledge and technologies.

The vision of the Floating Lab it is interesting since not only proposes to raise awareness about conservation of culture and the biodiversity of the region, but wants to explore ways to empower this.

In Beno's words: "We face a revolution that is transforming the daily lives of people (digital fabrication) and a territory (Amazon rainforest) that has great potential to give response to world challenges. Its condition of green heart makes it the ideal place where the manufacturing of the future could be incubated, exploring alternatives towards a responsible and responsive industry; integrating local and global process; providing access to the benefits of digital manufacturing to native population to solve their problems as health, energy, and education; and integrating people, institutions, and countries worldwide for the conservation of the Amazon." (Emily Smith, 2014)

So, when talking about bio-diversity the aim is to explore local bio-material but also to experiment with them. In the most radical formulation, Beno has talked about helping biodiversity to grow and differentiated. In the presentation he showed at the Central Society of Architects, Beno Juarez proposed to look after the Inca's Moray terraces used as a place that allowed different sunlight and temperatures which acted as experimentation ground for agriculture. The Floating Fab could act somehow as a Moray, helping experimentation to take off. This is a very different lecture of conservations, one which is full of confidence and unworried about closed visions of nature.

To what extend these visions has been fully shared by other Fab Labs it is difficult to say. For instance, at Fab Lab Argentina, they fully grasped the idea of taking the Fab to the Amazonas and include people through digital fabrication. Although, at the same time more complex issues like bio-hacking and biodiversity that are beyond the practice of the Argentina Lab.

The Floating Lab is very much a work in progress. The first series of talks and workshops were organized through August and September 2014. Between October and November Fab Argentina, along with Fab Costa Rica and Fab Perú worked on several project ideas on materials, structure and connection. In Fab Argentina, these were 4 weeks to explore concepts and make some designs on the computer, very much in the abstract. Other Labs, like Costa Rica put much more attention to local materials.

As part of the initiative, Fab Argentina applied for funds from the Ministry of Culture in a bid that was called to support digital arts laboratories. I myself was able to help with the bid and its results are pending. The idea was to get some funding to buy materials, contract a naval engineer and a biologist to experiment with bio mimesis and floating structure. If the bid is successful they will organize a 6 month experimentation course that will end with the construction of a 1:1 Prototype of a module of the Floating Lab to be tested in the Delta of Parana River, near Buenos Aires.

Relation with Narratives of change:

Francesco: *"It is true that digital Fabrication is related with a drastic change of the productive system. At the same time it is connected with open source and ICTs. So you can print a digital file that has been developed elsewhere. You can develop a design in Argentina and print it everywhere. It is a projet that has a very important social impact. But the impact is not only to teach digital fabrication, is the possibility to develop a project that has bigger impact and mobilize this knowledge through the digital networks. This is a bit what Fab Labs are for. Is not only teaching digital fabrication but building a network that allows the fact that I can build something here that can be replicated in another country. This is also a political issue. The 3D printer for me is exceptional, is great. It is kind of a Marxist thought, that men can suddenly take control of the machine. It is about empowerment, and the passage from the consumer to the producer which is fundamental for me. There is so this aspect more philosophical, as you said, that call us to be more active."*

"For me internet is still a thing we have to came to terms with, in order to fully understand what is really going to be its impact in our life. The thing is that these are tools that connect each other, internet is the network and the 3D printer is the machine that is here in Buenos Aires, but suddenly can make something designed in other place."

"So, the social aspect of Digital Fabrication is expressed trough several projects like prosthesis, systems of irrigation that can be make with digitally produced parts, etc.."

5.3 Aspects of empowerment and disempowerment of the local initiative

5.3.1 Governance

5.3.1.1 Internal governance

Decisions at the Fab are generally discussed within the group. Then there is some division of task for projects and according to interest and speciality of each member. However, they have build enough trustworthy relations to be flexible and allow some decisions to be taken by one member without the need to ask in advance. Therefore, sometimes meetings are informative about ongoing activities and then if there is the need, they have a debate about new projects.

5.3.1.2 External governance

The Fab Lab Argentina, as other Fab Labs in Buenos Aires has an informal relation with the Fab Lab Network. It is recognized by other other members of the network as a Lab, but it is not formally affiliated to the network due to lack of funding to do the Fab Academy. However, this loose relation does not stop the member of the lab to follow whenever possible some of the rules and requirements of the Fab Labs. So, for instance they pledge to have an open activity once a week when it is possible. In discussions with Heloisa Neves from Fab Brazil during a visit to Fab Argentina it was discussed that a lab that did not have a day open to the community could not be really considered a Fab Lab. Other rule that is being followed is open source technologies, specially in the case of the Floating Fab Lab.

It is interesting to note that this is quite loose, but also based in some kind of auto-regulation of the fab labs. Andres Briceño from Fab Santiago for instance mentioned that some labs that did not comply with these rules regarding openness were qualified as closed spaces.

5.3.2 Social learning

Social Learning is a very important part of the process of creating a Fab Lab and becoming a member of the networks. There are apparently several layers of social learning. Probably the stronger is learning through the institutional arrangements of the Fab Lab International Network like the Fab Academy and the IAAC in Barcelona. These courses were important for the key members of Fab Labs in Latina in order to get the skills but also social contacts that later lead to the creation of Fab Lat. In the case of Ilaria, she learned about digital fabrication in the IAAC master.

Other members of the Fab Lab, like Arturo learned through courses and independent research. Courses are very much the core of the process of social learning, specially regarding the use of complex tools like the software Grasshopper or other parametric design tools.

In parallel, much of the social learning is made through tutorials or instructables in internet or in networks like RepRap. So, if they find something technical they do not understand, they simple googled it or ask about in forums. There is some discussion on what could be your ceiling if you try

to learn digital fabrication only through tutorials. In the case of some software like Grasshopper, Arturo for instance argued that you can find your ceiling very fast.

Other important source of learning is social meeting and workshops. This is the place where the members of the Fab Lab encounter their peers and learn about common issues like funding, internal organization, other events and work opportunities and new technologies. For instance, during Fab10, Ilaria realized that their issues with CMDlab were indeed very common through the Fab Network. Learning this was important to encourage then to speak openly about what has happened (they lost their sense of self-blame) and also to reflect in how to do things differently in the Fab Lab Argentina. So, one of the things they would like to make different is avoid being naïve at the time of organizing events or courses and recognize the micropolitics involved.

The different between the easy access to learn about technical stuff , design or digital fabrication and the difficulties to self-learn to path on how to organize a fab lab is interesting, because somehow shows the tensions between openness and the ludic character of fabs and the institutional requirements and micro politics involved.

Beyond that, what has struck me is how fast students or enthusiast of the Fab Lab become peers of the laboratory. Much of the people that come to the Lab has their own expertice in architecture or design and come looking for some knowledge. But after they pass through the course, they are accepted almost naturally as peer in the design of projects. There is not much fuss about who "has" the knowledge.

5.3.3 Resources

Funding. They have applied for funding to get new machines like Laser cutter and CNC Router. They built their own 3D printers. They have a accord with the Central Society of Architects where they lend then the space and the lab offers some capacity building courses in return.

Francesco: "The material capital is the most important investment, because it is high technology and is costly. 3D printers are not so important since we can build then, but 3D laser printers and routers are the most expensive investment"

A router or could cost around 10 thousand dollars or more, depending on its quality and functions. Overall, it is acknowledged that a well-equipped Fab Lab could cost around 100 thousand dollars or more. Trying to organize a workshop without this investment have proved difficult but not impossible.

More recently, they have applied in partnership with the Central Society of Architects for funding from the Ministry of Culture in a bid for 800 thousand pesos, roughly the cost of a fully equipped shop. The results of the bid are pending.

So far, they have been able to borrow machines and tools from several companies. They also got a router at the home of one of the members.
They also have made a pre-arrangement with Trotec international at Fab 10 to gather a pool of companies willing to access a router. Thus, Fab Lab Argentina will have a the router and the companies can get access and support at the Fab lab.

They have been collaborating with Trimaker, a local 3D printer company to develop new material. Trimaker funded their trip to Fab10 and they helped to show the machine at the event. And they might get some machines from Trimaker for the new fab lab Argentina.

So, much of the resources and income of the Fab Lab comes from teaching courses, doing some small projects for companies and getting funds from public bids to buy machines or tools. On the top of this they relied in a kind of barter-economy where they offer some courses or advice in exchange from materials or the free space at the Central Society of Architects or with local digital tool companies like Trimaker. Another form of this is sponsoring where they can get materials or services like lasser cutting for an event. How fair these deals are is hard to say. For example, they have not been able to fix an overhead with Central Society of Architects for the courses they teach there.

It might be possible to regard this broad range of semi-formal arrangements as closer to the artistic practices of funding where, for instance visual artist got funded by their work and courses than to a service style economy. The closeness between these practices is interesting, especially since the members of the Fab Argentina insist in called themselves professionals.

5.3.4 Monitoring and evaluation

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5.4   Other issues about the local initiative

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6 Synthesis of FabLab case study

FabLabs are about more than the TRANSIT research themes. Indeed, the diversity of FabLabs globally and the varied participation of individual Labs in different networks is a key finding that makes generalising to TRANSIT research questions quite challenging. Moreover, the general research design for TRANSIT, including limited interviews and two specific initiatives studied, presents a methodological constraint that means analytical interpretations must be reflected upon carefully. Selecting two local initiatives across the diversity of FabLabs has been particularly difficult. In the end, we chose a fairly established grassroots initiative (FabLab Amersfoort in the Netherlands), and a more recent initiative (FabLab Argentina) created through FabAcademy networks. Neither reflects the full variety of Labs and activities. Drawing firm conclusions is consequently difficult, and our analytical interpretations should be read with caution.

6.1   Condensed time-line

FabLabs and their networks developed and evolved out of an initiative begun by the Centre for Bits and Atoms at the Massachusetts Institute of Technology. Prof. Neil Gershenfeld began a popular course in digital design and fabrication in 1998, and that developed into the FabLab concept. The FabLab concept is to provide spaces open to the public where people can access tools, training and designs in digital fabrication, and to base this around a global network of physical workshops with access to on-line and other support services, as well as being networked with one another.

National Science Foundation funding supported the initial implementation of the concept. The first FabLab was created in Boston in 2001, and others followed in Costa Rica, India, and Ghana in 2003. Developers in Lyngen in the north of Norway also established a FabLab very early on. Others heard of the concept and have initiated a wide variety of FabLabs, with different funding sources, and sometimes independently of MIT. Whilst MIT's Centre for Bits and Atoms has remained involved, and Prof. Gershenfeld continues to be a key figure representing FabLab developments, the rapid growth of Labs and development of networks has taken on a life of its own, driven by demand and initiative in different locations, and the desire to network and forge links for varied purposes. Some Labs have been created by grassroots groups interested in new technologies, some have been set up by entrepreneurs wanting to run a space, and others have been created by public agencies, foundations, and charities. As one interviewee put it, the FabLab phenomenon is 'accidental'. A dynamic in the evolution of FabLab networks consists in a desire for coherence and coordination across Labs, but without hindering the experimentation flourishing in Labs around the world.

FabLabs take advantage of increasing accessibility to versatile and powerful digital design and fabrication tools. The FabLabs concept has also benefitted from a wave of social interest in making, hacking and tinkering globally. Some FabLabs connect to these wider developments, such as involvement in Maker Faires, and featuring in maker publications. Growth in FabLabs numbers has consequently been rapid. In 2014, there were more than 440 FabLabs in over 60 countries (www.fablabs.io/labs).

All FabLabs follow principles in a common charter (created in 2006), and new Labs affiliate to the network by being validated by an existing, trustworthy Lab. The Fab Charter requires Labs to: 1) regard their Lab as a community resource, and therefore must be open to the public for part of the week; 2) respect open source approaches to design and fabrication; 3) commercial activities are

legitimate, but any business development beyond initial prototyping and incubation should be outside the Lab; 4) equip themselves with a common set of tools, capabilities and processes that facilitates sharing between people and Labs; and 5) identify with the wider network of FabLabs.

The initial MIT model, still upheld by the Fab Foundation, provides a blueprint of equipment that cost around $100,000 (more in countries with import tariffs). Equipment vendors are increasingly interested in promoting into the Labs. As a peak association, the Fab Foundation can negotiate deals for Labs. So, for example, Solidworks are promoting their CAD package to all Labs, and Chevron has donated $10 million to help the Foundation promote and establish more FabLabs in the US. However, not all Labs follow MIT equipment specifications, and there has been experimentation in ways of meeting the basic charter aims through organising and equipping Labs in different ways. In practice, for example, some Labs are more 'open' to the public than others.

The Fab Foundation was established formally in 2009 as the node for coordinating activity. A parallel attempt from the Netherlands to form a FabLab International Association does not seem to have lasted. Nevertheless, regional networks are emerging as well as connections between Labs nationally and locally. In addition, some Labs and groups have created web platforms for sharing designs and projects; and there has been some networking between Labs interested in specific topics, such as grassroots activity, or linking to education in schools, or other topics and projects. So, networks come and go, spread and specialise, all initiated by demands and ideas amongst the FabLabs.

The Foundation helps some of these activities, as well as providing support for those FabLabs that wish to take part. Recent supportive platforms include a FabEconomy initiative, which seeks to network and promote a new economic paradigm based on globally distributed peer design with customization and production locally. FabConnections is a web-based platform for linking business ideas incubated in FabLabs to development services including crowd-funding, enterprise advice, and attaining sponsorship. FabShare tries to make it easier for collaborative projects and sharing between FabLabs. The latter initiative is an example of individuals in some Labs trying to make the FabLab concept work better. Whilst the potential for global collaboration is possible in principle, FabShare want to make it work better in practice, since the technical possibilities have not been taken up very often.

A more established network initiative is the Fab Academy for training people in digital fabrication. The Academy was launched in 2009, and provides 5 month, part-time courses at a cost of $5000. Students are based at one of 40 or so affiliated FabLabs, where they are helped by the local manager in a series of project-based tasks that complement on-line instructions and video-conferencing classes involving students at other Labs around the world. The course is intense, and a strong esprit de corps develops. Alumni from earlier Fab Academies have been a driving force in the creation of later FabLabs.

One of our local initiatives, FabLab Argentina, is an example of this expansion through a cadre of Fab 'gurus'. One of FabLab Argentina's founders was a student at the Institute for Advanced Architecture in Catalunya (IAAC) and where the Barcelona FabLab was established in 2007. At FabLab Barcelona, the Fab Argentina founder met other students from Latin America, including Benito Juarez and Andres Briceño from Chile. Benito returned to Peru to help establish FabLab Lima, and Andres similarly at a FabLab in Santiago de Chile. FabLab Argentina was able to start running properly in July 2014 with the provision of workshop space at the Central Society of Architects in Buenos Aires.

FabLab Barcelona rapidly became a prominent Lab and has helped others to become established, e.g. with development aid from the Spanish government, which helped create FabLab Lima. Indeed,

the founder of IAAC, Vicente Guallart, became City Architect for Barcelona, and with Deputy Mayor Tony Vives, has been pushing a FabCity vision through the gradual opening of publicly-funded Ateneus de Fabricación Digital in each of Barcelona's neighbourhoods. The network of Ateneus is envisaged as becoming part of the public infrastructure of a sustainable city that, within 40 years, it is hoped will manufacture over half of its material needs locally.

Personal connections through and beyond FabLab Barcelona have assisted in FabLab Argentina becoming established within a network of Labs in Latin America. A FabLat regional network is collaborating in the FabLab Flotante project. The project uses FabLab facilities to build a floating FabLab designed to travel through the rivers of the Amazon region and serve communities by working with biodiversity, digital handicrafts, and eco-production. Each participating FabLab is developing a module for the project. FabLab Flotante is one in a handful of high-profile joint projects that have come to symbolise the international collaborative spirit between FabLabs, and the vision for globally-connected, locally-fabricated development of peer-to-peer solutions. Earlier projects included design and fabrication of a low-cost, open wifi network (involving FabLabs in Norway, Afghanistan, Greece and South Africa), and an eco-house (involving FabLabs in Spain, Lebanon and Ethiopia). Though, as noted earlier with FabShare, these remain exceptional possibilities rather than general practice in the network.

FabLab Amersfoort in the Netherlands is a contrasting case because it comes from outside the more organised FabLab networks of the Academy and Foundation. Amersfoort was a grassroots initiative that went about providing a community-based workshop very differently. They presented their experience to the FabLab community at the 6th international meeting of FabLabs in Amsterdam in 2010. Amersfoort's approach has influenced others to create FabLabs similarly.

FabLab Amersfoort opened officially in 2010. It was created to support a group of activities under the De War collective based in an old factory in Amersfoort. FabLabs were an interesting idea introduced to De War by a participant in one of their workshops. It was an extension of some of the making activities they were already doing, but they also liked the idea of encouraging people to become more familiar with technologies, and creating networks of makers empowered to shape their own lives and environments. However, De War did not like the $100,000 price tag for the MIT-style FabLab, nor were they able to get funding. And so, with a few friends, De War went about creating a FabLab in a week and with about €5000. This provided initial equipment, added to over time by self-built machines and other purchases. But what enabled this was the prior existence of a group of people wanting to do it and work at it. An ethos of just getting on and doing projects with the resources available to the group, and without seeking permission or funds, and encouraging others to do so similarly, was a key motivation.

FabLab Amersfoort has shared their experiences with others interested in setting up FabLabs. They also organise a FabFuse event each year for people interested in grassroots digital fabrication, and which has attracted around 140 people. However, much of FabLab Amersfoort's networking is through De War and operates locally. There are the regular open days, and people using the workshop for personal projects, as at many other FabLabs globally. FabLab Amersfoort has also connected with local Transition Town initiatives and citizen science activity and broadened ideas about what a FabLab is for (in this case, sustainability transitions, and projects for promoting green ideas).

6.2   Aspects of 'innovation' and 'change'

All FabLabs share a commitment in giving tools to people and helping creativity to flourish. However, what people then do with those tools is an open question. Whilst issues like sustainability or social inclusion might get mentioned sometimes, there appears little appetite in the networks to channel FabLab activities in certain directions. Indeed, this would seem to be imposing structures that contradict the basic FabLab idea, which is to give people tools that can potentially empower and even liberate them. In practice, many people want to have fun with the tools and work on cool devices and personal projects. Whilst ideas about social transformation are prevalent, these are ill-defined, and often related to ideas about a new economic paradigm arising from entrepreneurial 'fabbers'. In our view, and from the perspective of TRANSIT research interests (cf. FabLab aims), there is either a limited notion of or reluctance to engage with programmes to transform wider structures beyond the Lab implied by new economic paradigms or cultures of production and consumption.

FabLabs are emerging into a world that is already structured in complex ways, and which will have some bearing upon the future development of FabLabs. Many FabLabs experience this already in trying to navigate the different worlds of serving local communities, providing education services, and incubating business. Each places different demands on Labs, and has different implications for financing and running the Labs. So, for example, as outside interest translate into funding and growth opportunities for Labs, so it also introduces expectations and criteria that will influence patterns of activity, priorities and culture in the Labs. This presents an uneasy zone between the open and experimental spirit amongst the various Labs and their networks, and a more structured and coordinated set of sponsored activities that align with partnering institutions.

Whilst both our local initiatives are connected to projects with sustainability as a focus, the topic has a low profile generally. Having grown rapidly, FabLabs are exploring different ways of using the facilities they provide. Many are turning to the education possibilities of FabLabs, for instance. Other Labs are promoting design skills and entrepreneurship. There are other exciting possibilities being glimpsed through experiments in the promotion of everyday access to open, collaborative principles and digital fabrication tools. In our view, FabLabs might become a potentially transformative social innovation through their development of strategies to exploit structural changes in society favourably and on their own terms. So, for example, situating FabLabs favourably in activities that are already changing institutions in education (e.g. more hands-on, practice-based learning in schools), investment (e.g. crowd-funding and alternative finance), consumption (e.g. post-consumerist interest in how things are made), knowledge production (e.g. free culture), and other key areas of social life.

At FabLab Amersfoort, and particularly in the projects of De War, the emphasis is in using the tools of the Lab for the purposes of social change. The facilities are used to make objects such as monitoring systems and beehives. But really it is the organisation of these activities, and how they connect to bigger ideas and community building that is important. De War at FabLab Amersfoort is seeking to put into practice ideas about open design, peer-to-peer production, and local sustainability. They want to expand the old factory site, including the FabLab, into a hub for local social change networks, and that they are involved in and helping to build. So for FabLab Amersfoort, the way they are trying to insert the innovative possibilities of FabLabs into Transition Town activities and in other directions of change they seek (such as citizen science, and an open, collaborative and sustainable society generally) is by embedding the Lab into networks of local activity that are working in similar directions. Transformation rests in the new relationships built through these networking activities.

FabLab Argentina, in contrast, is involved in more conventional FabLab activities that seek to popularise and train people in digital fabrication. They are providing facilities for people and students. However, FabLab Argentina is also involved in the FabLab Flotante international project, and which does have a strong social vision. That vision is an extension of the FabLab vision, in the sense that the project wishes to bring the tools of digital fabrication to the communities of the Amazonas for the purposes of biodiverse and community-sensitive sustainable development. Work in collaborative projects such as FabLab Flotante may help develop and improve new forms of knowledge sharing and skills swapping between different FabLabs internationally (provided one understands Spanish, English, and local languages of the Amazonas), and which interviewees from FabLab networks say is still short of its potential. Some innovative effort is still needed at developing the global knowledge sharing claimed for FabLabs.

The other transformational claim is for using that global knowledge in locally produced solutions. This too is relevant to FabLab Flotante, and also to Amersfoort. Indeed, for all FabLabs ultimately. Connections with communities locally will be an important test of whether and how the facilities designed and developed by FabLab networks address local needs and priorities amidst which FabLabs are set up (needs which can include international trade and investment). So, quite apart from innovations in the design of modular floating structures, bio-mimesis, beehive designs, and use of local materials, the transformational affects of FabLabs on the basis of our analysis is likely to work through the articulation of ideas underpinning the FabLab concept with networks for social change at two scales: locally, around the Labs; and regionally/globally, through the possibilities for sharing knowledge and design solutions from a diversity of localities.

6.3   Aspects of empowerment and disempowerment

As FabLabs have grown rapidly in number, and waves of networking initiatives have multiplied, so questions of direction, focus and identity have arisen. Prof. Gershenfeld and other people key to the early development of the network, and still very prominent, have been generous in allowing FabLabs to flourish and people to experiment. The broad parameters of the Fab Charter are the only requirement that is sought: apart from this, people can try different initiatives if they are able to garner interest. So on the one hand, the networks are quite open.

However, we have observed through our research that certain initiatives attract more approval and support from key individuals in FabLabs than do others. And as Fab Foundation attracts increasing funds from different agencies, such as corporations and international donors wishing to contribute to FabLabs, and seeing in the Fab Foundation a convenient 'representative' with whom to negotiate, so the Foundation's role may become more material and influential. We found no evidence of any desire from the Foundation to control or micro-manage the development of FabLabs, but what they do will nevertheless have a big impact on the FabLab community, and especially how it becomes perceived by different publics.

Decisions to accept support from different organisations (e.g. Chevron), the priority given to some agendas over others (e.g. biohacking), the kinds of future people and culture implied in FabLab promotional visions (e.g. a kind of Silicon Valley entrepreneurialism endorsed by the US President), and so forth, will affect the ethical associations and identifications different people have with FabLabs. Others in the networks might seek different associations, such as in commons-based peer production and sustainability, and might try to forge that through different networks. In our view, despite an apparently non-ideological commitment to give tools to people, the governance of FabLabs is likely to become increasingly entangled in the politics of technology (e.g. tools for what?), as well as pressures to become more structured and organised.

FabLab Argentina is still new and preoccupied with getting equipped and established. Decisions are discussed by the core group and tasks divided accordingly. Opening the Lab was based in difficulties experienced by the founding team at another FabLab in the city, and where leadership and organisation difficulties arose. The FabLab Argentina group are taking care not to be side-lined again, and are trying to ensure they retain a say in the way the Lab develops. However, some interdependencies are already shaping the way the workshop operates. For example, providing training for students associated with the Centre that hosts the workshop as a condition for having the space. And negotiations to host technology from a company in return for allowing local businesses access to that technology in the space. If bids to the government for funds to equip the space are successful, then the Lab will be less dependent on informal arrangements such as these.

Amersfoort was luckier in the sense of already having space for its activities. It addressed similar challenges of getting established by building machines themselves and adapting cheap equipment to their needs (such as a second-hand laser cutter). They retain a DIY ethos and resourcefulness towards the acquisition and use of tools and materials. The commitment to openness and autonomy in De War influences the way the FabLab is governed. People are encouraged to get involved and can earn free access by helping out in the management of the space. It is recognised that people bring different motivations and commitments to the space. Some share the ideas and orientation towards peer production and collaborative effort of De War, whereas others are more interested in pursuing personal projects.

Some participants find the relatively open format at Labs like Amersfoort to be quite empowering, whilst others find it harder to know how to fit in with the apparent absence of structured positions and incentives (see Hackerspaces report also).

Knowledge about design and fabrication, and the cultivation of skills to practice digital fabrication, are the primary sources of empowerment sought by the FabLab concept. As such, processes for the acquisition and sharing of learning are an important part of the Labs and networks. Whether through the provision of web platforms, on-line tutorials, videos, events, workshops, training programmes, helping one another informally in Labs, and so on, there is a strong commitment to learning. There are a variety of mechanisms for supporting learning processes: 1) the Fab Academy course and alumni networks; 2) Fab Foundation support for creating new FabLabs around the globe; 3) through regional and international meetings; 4) through the provision of documentation via web-portals and organisations that support those platforms; 5) within collaborative projects between FabLabs; 6) through the nurturing of a culture that celebrates the sharing of ideas, skills and enthusiasm for learning.

The wealth of materials and activity is impressive. However, the documentation of projects is patchy. FabLab managers can encourage workshop users to document their projects, but there can be little enthusiasm amongst people eager to move on and make the next thing, and the Lab staff can be simply too busy running the workshop to chase any documentation requirements.

There are also limits to the extent to which knowledge can be codified and shared over digital media. Surprisingly to us, the importance of tacit knowledge in making things did not seem to be something widely discussed in the FabLabs and network events that we observed (although neither did we explore it with our TRANSIT-themed interviews). We witnessed the sharing of tacit knowledge in action in Labs, as people showed each other how to do things with their hands, and interacting with the various tools in practice. Whilst videos and commentary can try to convey this knowledge at a distance, there is always at least a residual 'knack' that needs face-to-face collaboration and closely guided experience building through a shared task. The access people

have to this in FabLabs, in combination with on-line resources, is part of the strength of the workshop-network model.

Another aspect of social learning that takes place in FabLabs yet seems to receive little explicit and critical reflection, relates to the positioning of FabLabs within community and social development. Understandably, emphasis rests in learning how to use tools, and how to go about developing projects. There is much less space within the networks for learning about different theories and evidence for how communities build, change and develop, and particularly what roles technologies play in processes of social change. As pointed out above, theories of change implied by many FabLab discussions and enthusiasm is for a kind of Silicon Valley start-up entrepreneurialism. In our view, it would be useful to debate how the FabLab concept sits within other theories of social change and widen praxis to other possibilities. We think it would be interesting to explore this more, and how opening the technical focus to social emphasis affects participation in FabLabs.

Having noted that, Amersfoort is a FabLab where there is reflection on social change, and a commitment to grassroots forms of change that informs their organisation of activities. Indeed, there is discussion of sharing the insights they have gained through the production of a 'peer lab' course for other FabLabs and people. When discussing lessons with local initiatives then a lot of the learning involved relates to keeping the FabLab running and building and maintaining a community. Learning about community building can be even more demanding than the acquisition of technical skills. FabLab Argentina is on a different trajectory to Amersfoort. It is not yet fully open to the public. The core members are still getting the space established. Here they bring lessons over from earlier experiences. They are also training others in digital fabrication, so any community building is limited to people seeking technical experience.

In the majority of cases, the initial funding for FabLabs has come from an outside source, be it through a funding agency or institutional affiliation. FabLab Argentina, for instance, benefits from being hosted by the Central Society of Architects in Buenos Aires on the basis that the FabLab will attract innovative young people to architecture. However, after initial pump priming, there is an expectation for many FabLabs that they will become financially self-sufficient after a period. Having found resources to provide the space and furnish it with tools, so on-going funding is needed for expanding the staffing required to fully realise FabLab potentials, and rely less on voluntary efforts. A number of overlapping business models are developing: 1) Access: gaining income through making the lab available for an hourly rate and charge for local production; 2) Education: conducting training courses and workshops within labs; 3) Enabler: supporting others to set up their own lab and in the process provide services to them; 4) Incubator: creating a hub for innovation and business creation; 5) Network: making use of the Fab Lab network by creating innovations across labs; 6) Attraction: becoming a 'tourist' attraction; 7) Human resource: people using and running the lab become consultants for the outside world.

Amersfoort provides a quite different approach, which is to situate the Lab within a wider range of grassroots activity, and seeking to retain a self-funded operational basis.

The space FabLabs devote to 'transformational' activities will, in our view, depend upon the extent to which efforts required to raise resources can align with social change activities. Even public funding without immediate or narrow economic returns may nevertheless require performance criteria that may come to shape the operation and direction of FabLabs. Given the multi-purpose and flexible advantages of FabLab facilities, then there may be a variety of accounting goals pushing and pulling activities in different directions. At the moment, monitoring and reporting is in its infancy. A few Labs have tried to estimate their added economic value, or the jobs and products spinning off from their workshops. Other FabLabs are wary of indicators, preferring to present inspiring narratives about varied success stories.

Finally, of course, FabLabs must have the interest and will to engage in social rather than personal transformational activities, which is not always the case. This is not a criticism. Rather it reflects TRANSIT interests. FabLabs are primarily a social innovation in the provision of tools for people, and the social transformations that ensue are incidental.

6.4   Other issues

There are important issues particular to this case study being rooted in design and fabrication, and that relate to consequences for material culture, on the one hand, and relations with the political economy of production and consumption on the other hand.

7 List of references

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Annex 2: List of interviews

Interviewee	Purpose of interview	Date	Duration of interview	Interviewer
Makerspace founder	Transnational networking	06/12/13	0.5 hours	Adrian Smith
Fab Lab manager and networker A	Transnational networking	22/01/14	2 Hours	Adrian Smith & Sabine Hielscher
Fab Lab manager and networker B	Transnational networking	31/07/14		Adrian Smith
Transnational networker A	Transnational networking	22/08/12	2 Hours	Sabine Hielscher
Fab Lab manager A		05/04/12		Adrian Smith
Fab Lab manager B		18/08/12		Adrian Smith
Transnational networker B	Transnational networking	15/08/14	2.5 Hours	Sabine Hielscher
Academic researcher A	Transnational networking	19/08/14	45 Minutes	Sabine Hielscher
Pieter van der Hijden, International Fab Lab Association	Transnational networking	20/08/14	2.5 Hours	Sabine Hielscher
Jean-Michel Molenaar, Fab Connections	Transnational networking	25/08/14	2.5 Hours	Sabine Hielscher
Local initiative coordinator	Local Initiative	28/08/14	1 Hour	Sabine Hielscher
Chris Wilkinson, Fab Foundation	Transnational networking	27/08/14	4 Hours	Sabine Hielscher
Transnational networker C	Transnational networking	10/09/14	1 Hour	Sabine Hielscher
Diana Wildschut, Fab Lab Amersfoort	Local Initiative	25-31/10/14	7 Days	Sabine Hielscher
Harmen Zijp, Fab Lab Amersfoort	Local Initiative	25-31/10/14	7 Days	Sabine Hielscher
Past regional networker	Local Initiative	25-31/10/14	2 Hours	Sabine Hielscher
Academic researcher B	Local Initiative	25-31/10/14	2 Hours	Sabine Hielscher
Several shorter interviews as part of participant observations (see methodology) – Referenced FabLab manager, De War member or FabLab user	Local Initiative	25-31/10/14	10-30 Minutes	Sabine Hielscher
Andres Briceño	Fab Lab Santiago - Chile	15/06/14	1 Hour	Mariano Fressoli
Andrei Vashnov	Trimaker	22/7/14	1 hour	Mariano Fressoli
Andres Ruscitti	Minga Lab UNLu	16/7/14	1 Hour	Mariano Fressoli
Rodrigo Perez Weiss	3D Café Lab	23/7/14	1 Hour	Mariano Fressoli
Ilaria Lamanna /Arturo de la Fuente / Francesco Milano	Fab Lab Argentina	5/8/14	2 hours	Mariano Fressoli
Raquel Ariza / Pablo Herrero / Jorge Ceballos	Inti Prototipado Rápido	10/9/14	1 hour	Mariano Fressoli
Alejandro Repetto	Neti Makerspace	27/9/14	1 hour	Mariano Fressoli
Javier Parisow	CMD Lab Buenos Aires	2/10/14	1 hour	Mariano Fressoli
Jordi Reynes Garces	Ateneus de Fabricación, Barcelona	11/11/14	2.5 hours	Adrian Smith
Pere Losantos	Universidad Politecnic de Barcelona	11/11/14	1.5 hours	Adrian Smith
José Garcia Puga	Public Administrator, Les Corts, Barcelona	12/11/14	2 hours	Adrian Smith
César Reyes Nájera	DPR-Barcelona	12/11/14	2.5 hours	Adrian Smith
Roger Uceda	Fundació CIM	13/11/14	2 hours	Adrian Smith

Tomas Diez	FabLab Barcelona	13/11/14	1 hour	Adrian Smith
David Alcoba	Vailets HackLab	13/11/14	2 hours	Adrian Smith
Cecilia Tam	Fab Café, Barcelona	14/11/14	1 hour	Adrian Smith
Ivan Miró	La Ciutat Invisible	14/11/14	1 hour	Adrian Smith
Didac Ferrer Balas	Tarpuna Co-Op	14/11/14	1.5 hours	Adrian Smith
Sara Alvarellos	Madrid Makespace	4/12/14	1 hour	Adrian Smith

Annex 3: List of meetings and events attended

Meeting and events attended as part of data collection, dialogues, etc.	Purpose of attending	Date and duration	Attending from the research group
Fab 10 Conference, Barcelona	Transnational networking	02-09/07/14	Adrian Smith & Sabine Hielscher
FabFuse, Amersfoort	Transnational networking & Local initiative	08-10/08/14	Adrian Smith
Lisbon Summer School	Transnational networking	Summer 2013	Sabine Hielscher
Brighton Makerfaire	Transnational networking	06/09/14	Adrian Smith & Sabine Hielscher
Brighton Makerfaire	Transnational networking	07/09/13	Adrian Smith & Sabine Hielscher
Hacking toys workshop	Local initiative	08/09/13	Adrian Smith & Ruby Smith
Living Knowledge Conference: World Café on Digital Fabrication	Transnational networking	10/04/14	Adrian Smith & Sabine Hielscher
Interacción 3D – Congreso de Fabricación digital	Local Networking	22nd and 23rd November 2014	Mariano Fressoli
Floating Fab Lab	Transnational Networking	October to December 2014	Mariano Fressoli