Brief for GSDR 2015

Fabrication laboratories – fab labs – tools for sustainable development

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Introduction

FabLabs are open high-tech workshops where individuals have the opportunity to develop and produce custom-made things which are not accessible by conventional industrial scale technologies (Knips et al., 2014)

FabLabs are organized in a global network of local labs, enabling invention by providing access to tools for rapid digital fabrication (FabFoundation, 2013). Fab labs offer the possibility of digital fabrication and rapid prototyping (especially additive manufacturing) for projects in the fields of science, education and sustainable development (ICTPScientificFabLab, 2014).

Fablabs started as the educational outreach component of MIT's Center for Bits and Atoms (CBA) and continued to develop as prototyping platforms for local entrepreneurship. Fablabs are increasingly being adopted by schools as platforms for project-based, hands-on STEM (science, technology, engineering, math) education (FabFoundation, 2013). There are currently more than 350 fablabs in more than 40 countries.

At the heart of the fablab concept is the belief that the most sustainable way to bring the deepest results of the digital revolution to developing communities is to enable them to participate in creating their own technological tools for finding solutions to their own problems (Mikhak et al., 2002). Each fablab consists of a collection of tools for design and modeling (e.g. 3D printers/scanners), prototyping and fabrication (CNC milling machines, laser cutters etc.), instrumentation and testing and debugging, and documentation for a wide range of applications in formal and informal education, health and environmental monitoring, as well as economic and social development.

Fablab concept/approach based on the ideas of collaboration, decentralization, participation and democratization (Gershenfeld, 2008) has been recognized by the World bank (WorldBank, 2014) as a very efficient way for:

- supporting STEM (science, tech, engineering, math) education
- commercialization of research at higher education institutions
- evolution of smart cities & waste management
- local industry development and entrepreneurship

Main principles at fablab – DYI and DIWO

Key principles used at fablabs are Do-It- Yourself (DIY) and Do-It-With-Others (DIWO) implemented by the users who actively explore contents, technologies and possibilities of the Lab themselves and collaborate/share with their peers.

A fablab is per definition an open place for everyone: youth, students, researchers,

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entrepreneurs, startups, small & medium enterprises and university faculty. They all get support from fablab coaches and international fablab community. Fablab's DIY and DIWO hands-on approach is also known as "maker philosophy", the essence of the so-called "Maker Movement" which leverages do-it-yourself technologies – 3D printers, laser cutters, sensors, etc. – and organic communities of innovators to address local challenges and which is seen by many authors as "third industrial revolution" (Anderson, 2012, Gershenfeld, 2008, Gershenfeld, 2005, Rifkin, 2011). Basically, as Chris Anderson, the author of the **Makers: the new industrial revolution** (Anderson, 2012), curator of TED and former editor in chief of *Wired* magazine, defines it: the maker movement represents physical goods created with the web's digital innovation model. This is what the fablabs enable as well, but in a more regulated way. This is how the fablabs are becoming tools of sustainable development.

Fablabs and sustainable development

The technological evolution of "desktop manufacturing" tools such as 3D printer, laser cutter, 3D scanner, CAD (computer aided design) software etc., made all formerly expensive and complex industrial tools now available in personal size, and with prices to match (Anderson, 2013). Barriers to access are decreasing exponentially; 3D printers, for example, will cost less than a personal computer by 2016 (WorldBank, 2014).

As the tools of creation became digital, so did the designs, which can be now easily shared online. Makers i.e. fablab users can tap into open source practices and the other social forces (such as the Kickstarter and Indiegogo crowdfunding platforms) that have emerged over the past two decades (Anderson, 2013).

In addition widespread internet access and inexpensive computing has made new means of open design capable of accelerating self-directed sustainable development. Open source 3D printers, such as the RepRap and Fab@home, enable the use of designs in the public domain to fabricate open source appropriate technology (OSAT), which are easily and economically made from readily available resources by local communities to meet their needs (Pearce et al., 2010).

Fablabs are emerging not only in developed Western world, but also in Africa, South America and Asia. Especially for developing countries, additive manufacturing (3D printing) made accessible via fablabs, holds a high potential to overcome the poor availability of spare parts, high-tech and customised objects. Thus the fablab-movement affects one of the main ideas of sustainable development: balancing human welfare, fairness and participation on a global scale (Knips et al., 2014) .

However, decentralized production made possible through the makerspaces and fablabs holds a twofold potential: on the one hand new possibilities for sufficiency, ecological design and repair-culture and on the other the risk of exploding production and consumption of easy-to-make, easy-to throw-away gadgets (Knips et al., 2014). This indicates the high need for regulated production and waste-management in the fablabs and other maker communities.

There are various types of community-based digital fabrication facilities, interchangeably labeled as coworking spaces, innovation laboratories, media labs, techshops, hacklabs, makerspaces, hackerspaces, fablabs which can lead to confusion. The main types are presented here according to (Cavalcanti, 2013).

Fablabs: very specific set of requirements for space, tools, software and curriculum	Community maintained through Fab Foundation
Hackerspaces: largely focus on repurposing hardware, working on electronic components, and programming.	Strong global online community
Makerspaces: more mainstream vision of a publicly-accessible creative space, intended to enable as many crafts to the most significant extent possible	Associated with Maker Faire and Make: Magazine: http://makerspace.com
Techshops: a chain of for-profit spaces offering public access to high-end manufacturing equipment in exchange for membership fees	http://techshop.ws

Fablabs have the most regulated requirements and the closest connection to the universities and research centers. This renders the global fablab network a very suitable platform for technology transfer options and STEM entrepreneurship and for regulated digital fabrication performed in a sustainable way.
In fact, there are initiatives like Grassroots digital fabrication that aim to develop a conceptual framework for analyzing whether and how makerspaces and fablabs open new niches for sustainable innovation in society.

Key messages/Issues for further consideration/

- In general, it can be said from the currently available studies, that fablabs do enable design and innovation for recycling, re-manufacturing, and feeding user-led prototypes into sustainable local enterprise (Smith and Hielscher, 2014, Knips et al., 2014, Pearce et al., 2010, Heßbrüggen, 2012).
- Fablabs can reinforce virtues relevant to post-consumption societies through peer production, the sharing economy, and collaborative consumption
- More developed institutional and regulatory environment is needed to maximize the effects of fablabs – this is still an emerging, evolving and relatively undefined field and some suggestions entail:
  - More initiatives to raise awareness of the innovation within the Fab Lab such as the competitions hosted by the World Bank, USAID and Intel
  - Establishing connections between fablabs and venture capitalist funds to promote fablab-based entrepreneurship - potentially starting fablab-startup accelerators
  - Better connection of the fablabs with the state-facilitated waste-management options
  - Regulatory control by the founding universities and the state to achieve responsible use of local resources (physical and social)

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