Peer-based design, prototyping and construction of a Floating Fab Lab in the Amazon

Emilio Velis, Paula Baptista, James Brazil, Rafael Machado, Carlos Valladares, Nicholas Waissbluth

Emilio Velis, Fab Lab El Salvador
San Salvador, El Salvador
contacto@emiliovelis.com

Paula Baptista, Independent Researcher
Berlin, Germany
arqpbap@gmail.com

James Brazil, uAbureau
Perth, Australia
jamesbraziljb@gmail.com

Rafael Machado, uAbureau
Caracas, Venezuela
machado.gamez@gmail.com

Carlos Valladares, Fab Lab El Salvador
San Salvador, El Salvador
carlosvalladares.sv@gmail.com

Nicholas Waissbluth, uAbureau
Vancouver, Canada
nicholaswaissbluth@gmail.com

Abstract

The proposed methodology for the design, prototyping and manufacturing of the infrastructure for the Floating Fab Lab Amazon project is based on the efforts from various international collaborative members working within the field of technology, education, design, and community engagement. Working within Fab Lab and private practice, each member of the teach shares the common goal of working as a network to collectively design and build an environmentally friendly as well as culturally adaptive system that showcases the use of collaborative tools and digital tools for design and fabrication. Focusing on the methodologies of open and participatory practices, this paper aims to briefly summarize the first three years (2014-2016) of the FFLA project to outline future implementation stages as well as the benefits of using peer-based design strategies within the Fab Lab network. The project ultimately serve to develop new fabrication and educational infrastructures for these new global and local contexts by taking advantage of the interchange of knowledge and technical expertise around the world.

Keywords

Fab Lab, peer production, digital fabrication, Amazon, architecture

1 Introduction

The proposed methodology for the design, prototyping and manufacturing of the infrastructure for the Floating Fab Lab Amazon project is based on the efforts from various international collaborative members working within the field of technology, education, design, and community engagement. Working within Fab Lab and private practice, each member of the teach shares the common goal of working as a network to collectively design and build an environmentally friendly as well as culturally adaptive system that showcases the use of collaborative tools and digital tools for design and fabrication. Focusing on the methodologies of open and participatory practices, this paper aims to briefly summarize the first three years (2014-2016) of the FFLA project to outline future implementation stages as well as the benefits of using peer-based design strategies within the Fab Lab network. The project ultimately serve to develop new fabrication and educational infrastructures for these new global and local contexts by taking advantage of the interchange of knowledge and technical expertise around the world.

1.1 Floating Fab Lab Amazon

In 2013, Fab Lab Peru proposed the original concept of the Floating Fab Lab Amazon (FFLA) based on the concept of digital laboratories developed by the Center for Bits and Atoms at MIT (Mikhak et al., 2002) , with the goal to provide greater access to fabrication technology and education to citizens according to their local context and needs.

Following this core foundation of the Fab Lab network, the FFLA project is an ambitious initiative to bring such concepts to the Amazon region, providing educational and design-build facilities to communities that may not have access to new technologies. Beyond the purely infrastructural function of the project, the primary goal is to facilitate a way to merge the highly developed low-tech construction systems that exists across the Amazon with new, easily accessible digital tools, to create new processes to improve the built environment and adapt to the ever-changing environment of the dynamic region.

Today, the team behind FFLA is a collaboration between local citizens, environmental conservation and technology institutions, naval engineers and builders, as well as global technology and design specialists within the Fab Lab network. Looking back, the road to this point began with a series of in-person workshops at events such as Fab10 (Barcelona) and eventually grew rapidly during an global brainstorming event in the Fall of 2014 where the many facets of the project were explored, including design proposals for the Fab Lab and community engagement strategies, through the understanding of the diverse climatic and environmental landscapes across the Amazon, as well as social and cultural constructs that exist in the region.

Focusing on the Peruvian Amazon region of Iquitos, the first phase of the project implementation (2014- present) has spread into 3 primary subjects: the design of the boat and the fabrication facilities, community research to better understand the existing systems and built environment of Iquitos, and exploring new technologies that can be applied into the community. Furthermore, with the expanding educational programs within the Fab Lab network, including the Bio Academy as well as the ongoing global efforts in open-source information, the subjects within the technology application team is growing every day exploring concepts that would not have been imagined in 2013 when the project began. Although the project contains several layers, each with its own function, it is through an ongoing exchange of information and open dialogue between all team members where unforeseen relationships and opportunities arise.

1.2 The social impact of peer production

The ability attained by designers to develop ideas ranging from conceptualization to prototypes gives fab labs the opportunity to not be merely defined as infrastructures to democratize the access to tools of prototyping and fabrication, but also as global communities of innovation and generation of social value in different regions of the world within their own contexts and interests. Whether in North America, Europe or Asia, Fab Labs have created a global network and support system allowing users to call upon local and international members to develop their projects. As more people join and contribute to these communities, the possibility of adaptively shaping the way solutions worldwide are created and designed becomes more tangible.

The availability and accessibility of digital tools has become vital for the development of new ways of generating and sharing content (Diez, 2012). Furthermore, the creation of relationships through the use of these communication and sharing structures has also opened the possibility for global networks to come up with new and more efficient ways of distributing innovation processes, starting from the idea and ranging through design, prototyping and testing, to the fabrication, implementation, and operations. With this in mind, the challenge of implementing a Fab Lab in the Amazonian rainforest forks into two main points of focus. Firstly, the use digital technologies to find appropriate opportunities for economic and social development within the communities being benefited by the project, and secondly, to implement a technology transfer model that takes into account different actors and stakeholders during the project development process into a local context. Together, the methodologies applied require making sure to safeguard aspects such as the protection of environmental resources and taking into account the ancestral knowledge for the regions involved.

Although current models of peer production are commonplace in an open and globalized economy, their application to a large project has been widely underdeveloped and requires greater participation in order to define new methodologies that differ from small scaled projects. Troxler (2010) has stated that many existing peer-production initiatives around the world focus mainly on the generation of intangible goods such as software, and very few of them that have left the realm of intangible goods have attained a large scale in terms of what they produce. However, the organizational structure of Fab Labs and network capabilities creates an environment to foster innovation and peer production (Dyvik, 2013), even at the scale of a project like the FFLA.

2 Organization

2.1 Structure

This refers to the capability of systems to generate products or services based on their organizational structure. According to Benkler (2006), systems that generate with a heavy emphasis on the commons in terms of their governance, methodology and motivations can be analyzed through three main characteristics and is evident in large-scale intangible projects such as software development. However, the sharing culture within the fab lab network has allowed to develop a strategy for a product to be built collaboratively, which embodies a common and tangible goal within all members. The model can be characterized by the following: modularity of its processes, granularity of its parts and a low cost of implementation, which are expected characteristics of a large system comprised of designers, co-designers, technical experts and researchers involved in the project on multi-dimensional bottom-up structures.

In this sense, the first version of the FFLA is expected to be able to grow, adapt, expand and disseminate into smaller projects, yet at the same time remain integrated to allow for continual exchange of information. Because of team is geographically spread all over the world, and working on individual processes and layers within the project, the adaptability in how the project operates must be flexible and implement processes such as funding, design, and research in an integrated manner.

Internally, FFLA utilizes a horizontal work structure divided in commissions with specific and complementary roles, which allows for both the attainment of separate goals and the articulation of common activities through the use of constant communications and feedback mechanisms. These five work teams are: .LAB (laboratory design and fabrication), .EDU (education), .COM (production), .ORG (community development), and .BIO (biotechnology research). Other commissions will be created once the project starts its operations in the Amazon.

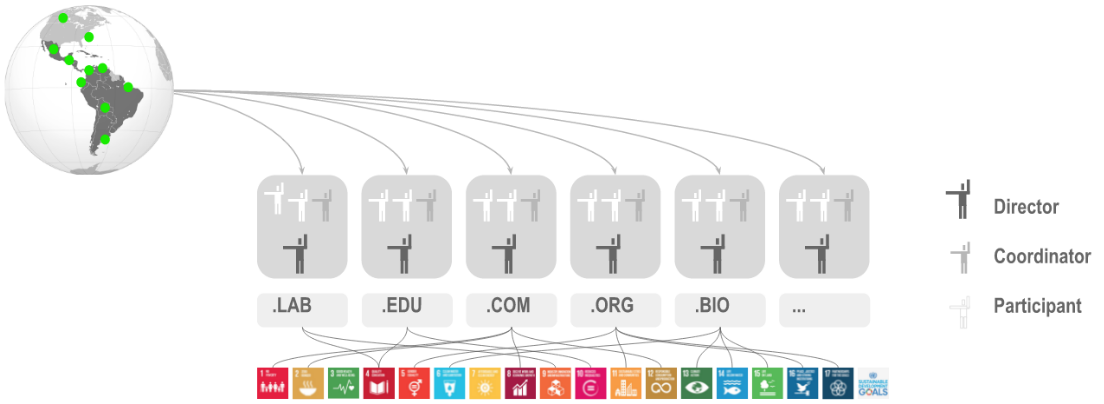

Figure 1. FFLA. Commissions, Benito Juárez (2015)

2.2 Meta-design

One of the biggest challenges for this project lies in the conceptualization of the scale in terms of its design requirements. Meninchinelli and Valsecchi (2016) describe systems that grow in terms of size and capabilities, as becoming more diffused, distributed and decentralized. A system that engages its diverse user base into design tasks measures its effectiveness as how it grows from diverse inputs into an organized system, and can be correctly managed through information management and the ability of users of the system to take decisions.

This organizational structure and information basis related to design, known as meta-design, is needed for actors in order to participate of the initiative in a relevant and integrated manner (van Amstel et al., 2012). Three important aspects seem to have been taken into account for its conceptualization:

- First, to generate a sustainable environment for design, research and social interchange though a paradigm of education of conscious users instead of consumers (Cristo, 2012) contrary to current design paradigm which often focuses on experiences. All actors are prompted to design, build, implement projects and generate feedback in a conscious manner that relates to the needs of other actors, the Amazonian environment, the local communities that participate in the process, and the research goals of the project.
- Second, a broad view of the concept of actors, such as local communities and organizations of artisans or producers, international groups with research interests, actors in charge of the project implementation, the maker community, donors, supporters of the project, and how all of these relate to each other for bringing the project into fruition. Documentation procedures, constant communication platforms and open repositories of information have been set up for sharing information and generating discussions.
- Finally, the capability to turn users into designers through co-design methodologies and participative approaches for all actors (Fisher, 2003). All actors see Fab Labs as a working platform to develop the project through its organizational structure, infrastructure and equipment, design processes and methodologies, and thus all are taken into account during the process of conceptualization and design

2.3 Global-local articulation

The FFLA initiative aims for a solution that will allow local communities to have access to technological tools which will lead them to solve aspects of their daily lives such as water, energy, health, food security and education, among others, while at the same time serve as a place for research and development for initiatives to better understand the Amazonia. This is an ideal scenario to explore alternative solutions in order to create and nurture responsible, sensible and integrated industrial alternatives to integrate to the local context and to the attainment of global research goals.

Locally, the project aims:

- To gather information regarding the Amazonia: biodiversity, environmental measurements, the river and social patterns through the monitoring of variables by means of the implementation of sensors.
- To generate novel and alternative development opportunities for social aspects such as education, income generation and community development through the responsible and participative integration of technology for the improvement of the local context.
- To integrate the project and other initiatives of the fab lab network in order to share results of local research for its replication at a global scale.

Globally, the project aims to:

- The participation from the global fab lab community through research projects, territorial integration and cultural exchange of experiences.
- To raise awareness and interest from the global community about the importance of conservation of natural resources and to search for new productive models that are less damaging to the environment.
- To facilitate the participation of academic institutions on the research streams in order to generate new knowledge on areas such as medicine, biology and engineering.

With this in mind, the success of the initiative will depend on how these are coordinated so that different actors are able to maintain engaged in all stages of the development of infrastructure, either through direct involvement, support or resource allocation. The generation of feedback between the different participants involved in the project during the iterative stages of the project are vital for maintaining traction of the project.

GLOBAL SCOPE	FORMULATION	FLOATING FAB LAB 1.0	FLOATING FAB LAB 2.0	FLOATING FAB LAB 3.0
FAB LAB NETWORK	Crowdsourced innovation	Prototype validation	Fab Funding	Iteration proposals
PROJECT COORDINATION	Methodological support	Project management	Project management Operations	Local-global coordination
DESIGN TEAM	Design specifications	On-site technical advice Construction coordination	Design improvement	Documentation
LOCAL ACTORS	Co-design and validation	Logistic coordination Construction	Construction Operations	Feedback
LOCAL SCOPE				

Figure 2. Roles of the main actor groups for the FFLA infrastructure construction stages.

3 Methodology

The project has successfully established a large scale peer-production system in terms of project size, level of involvement from a geographically distributed network, technical needs and scientific scope by utilizing the fab lab model and already-existing network as a basis for its organizational design and dynamics, through the use of information technologies and the articulation of efforts among actors into a varied range of interests. The remaining activities regarding the development will be grouped in relation to milestones for the FFLA implementation which are part of all iterations of the project.

The goal for the methodological approach was to outline an implementation plan that is scalable depending on how the design unfolds, and adaptable to the contexts and capabilities of participating parties, through the use of relevant modes of engagement, a set of tools, knowledge, and processes.

3.1 Ideation

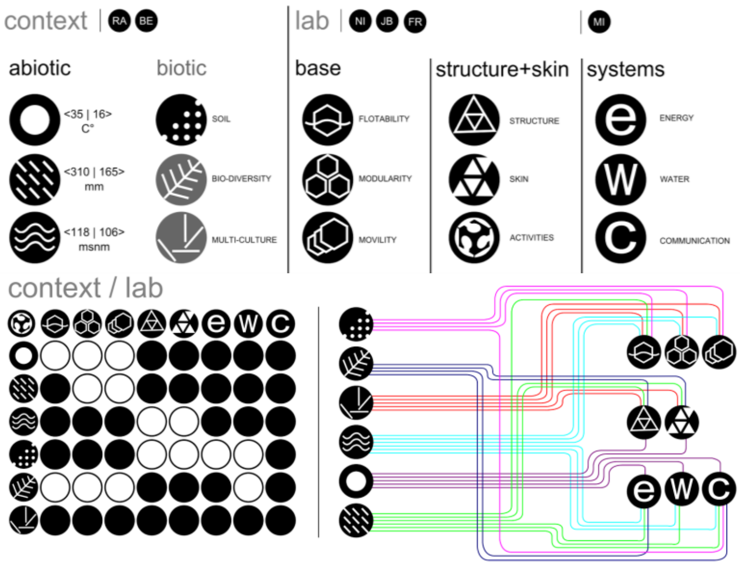

Figure 3. Methodological design components (2014), Fab Lab Peru

The basis for this phase was to generate distributed exploration through the contextualization of concepts and variables to be analyzed from the Amazonian perspective and the specification of work streams for fab labs to choose from according to three conditions: resource availability as invested by local fab labs, local expertise of their teams and coming from already existing research projects to be integrated into the initiative. This stage is characterized by the facilitation of divergent analysis and the openness in terms of the variety of input from the actors involved.

In November-December 2014, for example, a series of workshops were organized for a period of five weeks. Fab labs around the world were invited to take part of four different sessions on which participant teams had the chance to broadly research and propose ideas, and a final session for presenting results. The workshops included lectures regarding the local context, mapping of natural and social intelligences, and their further analysis into components for the FFLA. The initial framework for the project consisted of the following: a name and general objective for the project, and a set of research streams based on the contextual aspects of the Amazonia. The design process was iterated to the point where work teams were able to develop various proposal according to the design needs and the expertise of their teams.

A second workshop with a similar ideation methodology took place in 2015, based on the interest of the participants from the first stage to continue on the development of the design. The workshops focused on technical specifications of the design regarding features of the barge: structure, connection detail, skin, prefabricated spaces, and deployment.

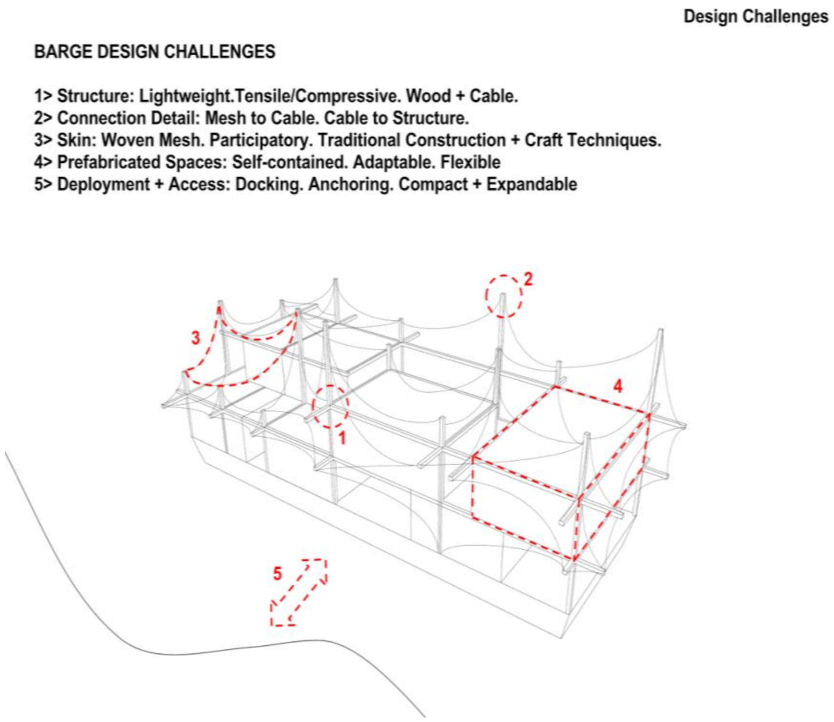

Figure 4. Design Strategy (2015), .LAB commission.

3.2 Prototyping

During this stage, a materialization of the physical elements of the FFLA was generated and analyzed in terms of its technical, operational and social needs. Some of the activities of this stage will be directed to articulate the design process with other actors, taking into accounts aspects such as:

- Analysis of environmental and contextual aspects such as the local terrain and the characteristics of the Amazon River, local population demographics, social dynamics, and information on technical scope and limitations for the design.
- Previous project conceptualizations and their validations at different levels. This procedure was carried out with participation from different actors.
- An analysis of the viability of implementation.
- Digital fabrication tools will be used to manufacture prototypes, to test and generate feedback.

Open and fast-paced methodologies for design have been used in order to generate proposals based on the initial design specifications drawn from previous workshops. A feasible model of fast development is the Makerthon (Fab Lab El Salvador, 2016), which aimed for the articulation of multiple laboratories for the solution to specific challenges on a short time period and their systematization across different fab labs working simultaneously. A well-defined work strategy and the use of information technologies are key components of these methodologies. An example of this is the process that Robert Garita led in 2014 for the creation of a test prototype of a floating structure, which was curated and critiqued by members of various fab labs simultaneously.

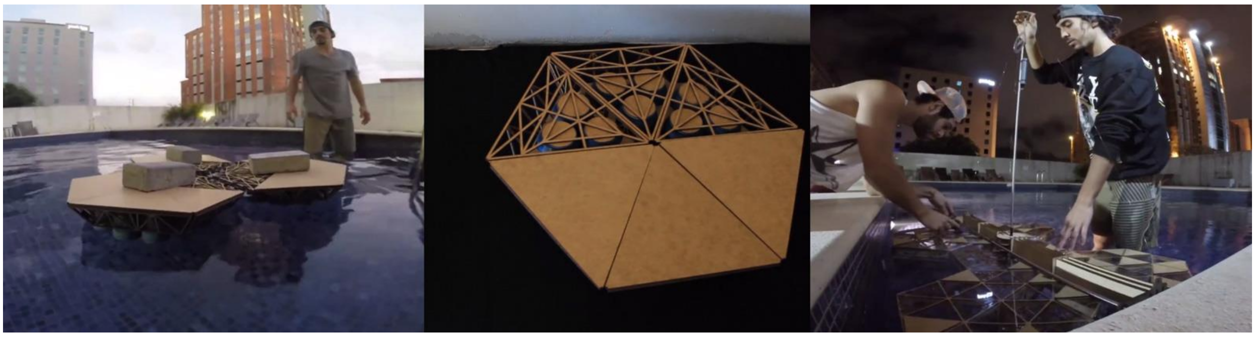

Figure 5. Floating structure prototype designed by students from Veritas University, Costa Rica (Garita, 2015)

3.3 Construction

Implementations of the FFLA will be gradual, according to the level of development of either the organizational capabilities in multiple: design, technical validation, co-creation, funding. So far, a total of four main iterations have been planned for the project:

1. Floating Fab Lab 1.0: Takes into account the adaptation of the first floating structure on site, and implementing operations. This stage started with a floating structures workshop in Belen, Iquitos, and expanded into the current version of the Floating Fab Lab. Currently, efforts are being focused on Yonatan, a vessel provided by a local organization (Engle, 2016), which will be eventually adapted according to the desired specifications for the FFLA.
2. Floating Fab Lab 2.0: The intervention model will be replicated through the construction of a barge network in the region, in order to diversify research capabilities. It is expected to implement three self-propelled boats for three capitals of the Amazonia.
3. Floating Fab Lab 3.0: An infrastructure of floating fab labs will perform research alongside local communities. The project will be adapted according to new applications and models of intervention that can branch into new projects and implementations led by other fab labs or institutions in different regions of the world.

Construction activities will be carried out by local groups comprised of artisans, community organizations and local institutions, supported by teams of representatives of the fab lab network to provide technical advice and collaborate with all activities of the implementation.

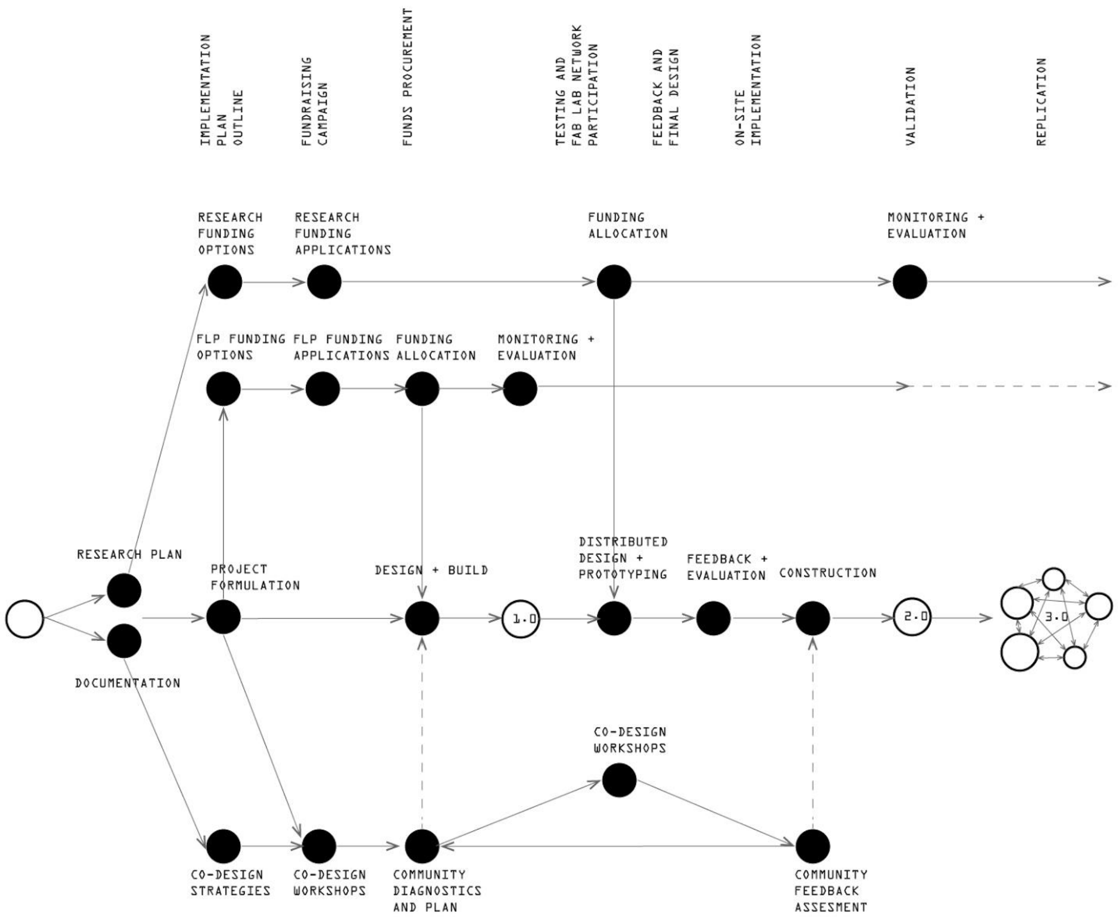

Figure 6. Project design implementation plan.

3.4 Validation and feedback

Due to the size and organizational characteristics of the project, an ongoing process of revision and feedback has been vital in order to ensure the participation of all actors and the development of the project. In this sense, the process of monitoring and evaluation for the project is an ongoing initiative. The mechanisms put into place for this work in different directions.

Bottom up: local actors evaluate the proposals made by fab labs and members of the design team in order to adapt ideas to the local context and needs. For example, in June 2016, a workshop was carried out by an international team in the Iquitos locality in order to validate the FFLA proposal, as well as to strengthen the capabilities of local actors for formulating proposals

Top down: New iterations of designs are made based on the baseline analysis of a given community, or the feedback generated by communities. The Floating Fab Lab 1.0 was designed and will be implemented based on the baseline analysis of the needs of specific communities in the region of Iquitos.

Collaborative: Design and prototyping made on a participative manner will be held during field trips made by members of fab labs in order to validate solutions in terms of technical and operational aspects, as well as to maximize the impact made by the project in general.

4 Conclusions

The project has managed to ensure that the use of a peer production system can foster the role of the global network of fab labs, to serve as facilitators of innovation initiatives, on which the actors engaged can participate during all stages of implementation process of a project. The involvement of actors is open to different scopes and levels of participation, through different resources: funding, innovation, human resources or scientific knowledge, all of these represented in the strengths and specialization of different fab labs around the world.

An initiative like this raises the question of the dimensionality of fab labs, hackerspaces, makerspaces, and other spaces for innovation. In order to have this discussion, a multidimensionality of the concept of fab labs has to be taken into account: a quantitative standpoint, related to how fab labs are being implemented, and a social standpoint, one of sustainability for nurturing a community of makers.

The Amazon is a good starting point to analyze how communities based on innovation and the maker culture can flourish to mirror those already existing in other countries in the world. This allows for an opportunity of low-cost design to implement in developing regions such as Asia and Africa through the use of parametric design, digital fabrication in order to solve problems such as climate change, social resilience, income generation, cultural exchange, and ultimately, fostering the creation of digital communities around participative design in a way that can even develop valuable attributes in terms of relevant contexts.

Acknowledgments

The authors recognize the support of the FFLA team, and thank our colleagues Benito Juárez, Norella Coronell, Gabriela García, Delia Barriga, the .LAB commission and collaborators for their assistance in our research.

References

Benkler, Y. (2016) Peer Production and Cooperation. In: Handbook on the Economics of the Internet. Edited by Johannes Bauer and Michael Latzer. Edward Elgar Publishing Inc.

Benkler, Y. and Nissenbaum, H. (2006) ‘Commons-based peer production and virtue’, J Political Philosophy, 14(4), pp. 394–419. doi: 10.1111/j.1467-9760.2006.00235.x.

Cristo, H. (2012) ‘O design do Futuro, no presente’, Revista Balaio, 01(01).

Diez, T. (2012) ‘Personal fabrication: Fab labs as platforms for citizen-based innovation, from Microcontrollers to cities’, Nexus Network Journal, 14(3), pp. 457–468. doi: 10.1007/s00004-012-0131-7.

Dyvik, J. (2013) Making living sharing - a FabLab world tour documentary. Available at: https://www.youtube.com/watch?v=PNr1yBIgQCY (Accessed: 28 July 2016).

Engle, M. (2016) ‘Project Updates’, FFLA, 13 June. Available at: http://amazon.fablat.org/en/english-project-updates/ (Accessed: 28 July 2016).

Fischer, G. (2003) ‘Meta—Design: Beyond user-centered and participatory design’, 10th International Conference on Human-Computer Interaction. Crete, Greece, Available at: http://l3d.cs.colorado.edu/~gerhard/papers/hci2003-meta-design.pdf.

Garita, R. (2016) Workshop: Superficie flotante. Available at: https://vimeo.com/114221695 (Accessed: 29 July 2016).

LAB commission (2015) Design Strategy. Unpublished research.

Menichinelli, M. (2013) How to build a FabLab. Available at: http://www.shareable.net/blog/how-to-build-a-fablab (Accessed: 15 July 2016).

Menichinelli, M. and Valsecchi, F. (2016) ‘The meta-design of systems: How design, data and software enable the organizing of open, distributed, and collaborative processes’, Systems & Design: Beyond

Processes and Thinking. ETSID - Universitat Politècnica de València, June 2016. Available at: http://ocs.editorial.upv.es/index.php/IFDP/IFDP/paper/view/3301 (Accessed: 20 July 2016).

Mikhak, B., Lyon, C., Gorton, T., Gershenfeld, N., Mcennis, C. and Taylor, J. (2002) 'Fab Lab: An Alternate Model of ICT for Development', 2nd. International Conference on Open Collaborative Design for Sustainable Innovation. Available at: http://cba.mit.edu/events/03.05.fablab/fablab-dyd02.pdf (Accessed: 27 July 2016).

Red de Acción Comunitaria (2016) 1a Makerthon. San Salvador, El Salvador: Asociación Fab Lab El Salvador.

Troxler, P. (2010) 'Commons-based peer-production of physical goods: Is there room for a hybrid innovation ecology? By Peter Troxler: SSRN', 3rd Free Culture Research Conference. Berlin, Germany, 2010. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1692617 (Accessed: 28 July 2016).

Van Amstel, F., Gonzatto, R., Junges, E., Costa, R., Veloso, D., Costa, K. da C., Marins, P., Giuliano, R., Chuves, V., Fuchs, F., Ferraz, G. and Rückert, A. (2012) Design Livre. Available at: http://corais.org/sites/default/files/livro_design_livre_versao1.pdf (Accessed: 15 June 2016).