Independent Laboratories of Fabrication in Latin America

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Abstract

After analyzing Schools of Architecture and Urbanism in Latin America between 2014 and 2015, we mapped 22 academic research labs and 9 independent initiatives. 29 of them have a 3D printer, 23 a laser cutter, 21 a CNC router, 14 different machinery and 11 outsource manufacturing services. 27 of said labs used their resources for the production of architectural models, aiming to visualize, simulate and analyze. Many of those were small objects, and artistic and museum models. They prefer architecture, followed by furniture and urban space. In every country, the mapping followed three criteria: to show examples of the presented action lines, to represent the region's institutional diversity, and to express what distinguish the different countries of the region. The objective was to characterize labs and quantify data, to compare the installed capacity, the use of applications as determined by studies, independent labs and universities, and to characterize the two main lines of action: 1) technological development; 2) social and environmental development. Our contribution is the presentation of qualitative and quantitative data, in order to show a broad matrix of how digital fabrication labs work outside the official Fab Lab network, by presenting case studies. We hope that, starting with this first record, we will be able to 1) offer a frame for analysis that can be shared and 2) generate from said analysis research tools on the state of the art in digital fabrication in Latin America.

Keywords

digital fabrication, Latin America, fabrication laboratories, architecture, Fab Lab, 3D printing, CNC, laser cutting, academia, independent labs

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Introduction

In the last 10 years, the impact of "How to Make (almost) Anything" has been the starting point for the experiences of MIT Center of Bits and Atoms in different parts of the world. Today, in 2015 it has already established 547 labs, from which only 8% are located in South America. RhinoFabLab (RhinoFabStudio since 2013) has 27 certificates and South America represents its 15%. These examples develop a wide range of experiences, from toys for children to the fabrication of prosthesis, solar houses or house furniture.

On the other hand, self-help initiatives in the region, and especially inside academia, are an important example of how these technologies are being used inside the architecture and urbanism industry, mostly in Brazil and Chile. Said self-help implementations, which appeared nearly 10 years ago as a complement to existing pedagogic proposals, are represented today by alumni from the very same study programs, by directing architecture offices or by teaching in masters programs in universities or research centers that so far have not being catalogued or showed in detail.

Context

In 2009, Lima in Peru and Addis Ababa in Ethiopia were the two cities selected by AECID (Agency of International Development Cooperation) of Spain as the future promises for decentralizing MIT Fab Academy project. The case of Peru starts in Latin America the establishment of FabLabs associated to the official MIT network. Between 2009 and 2010, the first specialists studied in FabLab Barcelona (IaaC). When returning to their own countries, they

demonstrated that computerized and computational technologies can adapt to different local problems and needs, emphasizing in social aspects. Even though FabLab Lima was hosted by the Universidad Nacional de Ingeniería, which could have been a cluster for further academic programs, the management structure of said university did not help to establish links with existing curricular structures. Instead, its main characteristic was to support experiences outside the reality of academia, working with different communities and groups of artisans that gained from this new way for exploring creative possibilities.

In the very same context, McNeel Associates' RhinoFabStudio would promote in Colombia and Brazil the creation of entrepreneur experiences that aimed to encourage the design of products as a solution for both academy and industry (Herrera, 2012).

Finally, as an important social phenomenon, world economic crisis in the Northern Hemisphere in 2008 was one of the reasons for the coming home to Latin America of masters and doctorate alumni, that had gone to the USA, Europe and Australia to pursue grad school. This is the beginning of a series of implementations in academic environments, especially in grad school and later in undergrad classes.

This research follows the analysis previously made on digital fabrication in Latin America, conducted by Herrera and Juárez (2013). Said research categorized 18 laboratories characterized by three types of initiatives: 1) promoted by academics from outside Latin America; 2) promoted by academics that return to their countries in Latin America; 3) self-helped. For this research the starting point was a selection of said research, which was later enlarged taking in consideration the criteria explained in the methodology.

Starting from the self-help group, in Figure 1 we see that Boston, Los Angeles and Atlanta (USA), London (UK) and Barcelona (Spain) are the main centers from which these groups came back to their countries, making possible the creation of labs in research institutes and universities, where they associate permanently or for short stages.

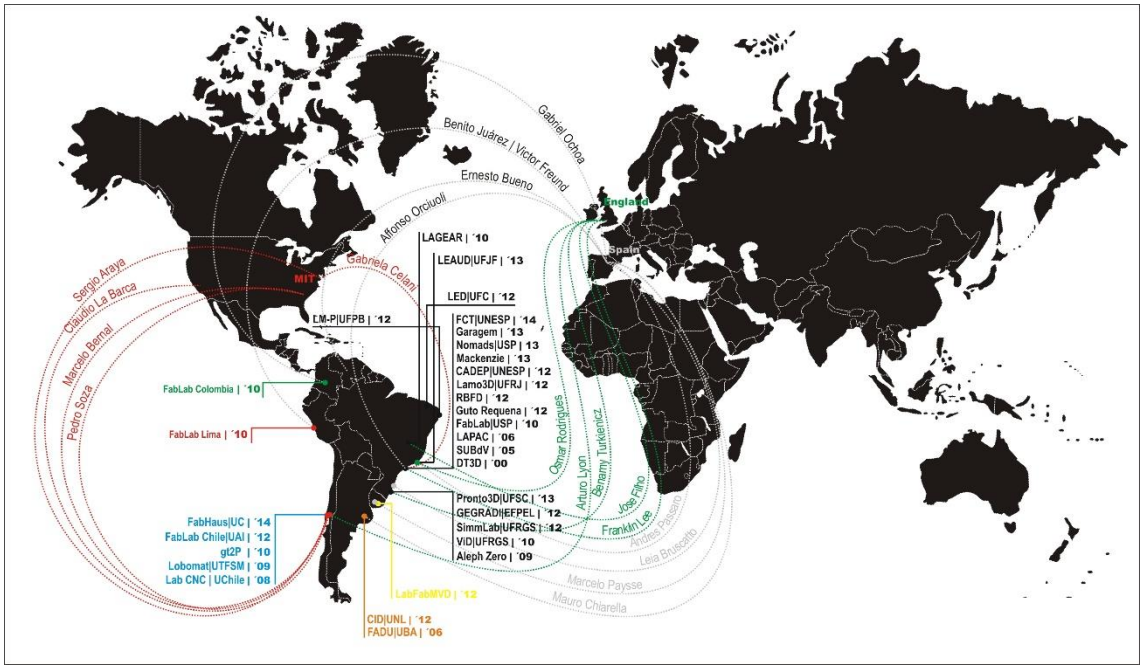

Fig. 1. Migratory movements to Latin America of master and doctorate alumni, and the creation of labs in the region.

Taking into consideration that emerging technologies in Latin America are not part of the industry or the professional practice, but appear in academia (Herrera, 2010), it has been our focus of interest to enquire about independent and self-help groups, which without an association to MIT Fab Labs or RhinoFabStudio were created more than a decade ago and have so far developed a steady academic practice in the region. This first mapping was part of the exhibition Homo Faber: Digital Fabrication in Latin America (Sperling and Herrera, 2015) and

recently published (Sperling, Herrera and Scheeren, 2015). This research focuses on presenting some relevant data on the matter that could not be published previously.

Searching for Independent fabrication laboratories in Latin America

The classification used in previous researches based in Bethell (Herrera, 2011) divide the region in geographic groups that maintain commercial relations, such as the countries members of Mercosur (Argentina, Brazil, Chile, Uruguay and Paraguay) and focused on development, such as Pacto Andino (Bolivia, Colombia, Ecuador and Peru). This allows to define patterns that reflect a first approach to shared realities in a specific area of Latin America.
In our scheme, the studied initiatives are associated to these same commercial and development groups, where antiquity and investment continue to be the common trait amongst the groups.
The mapping in each country followed three criteria: 1) to define the presented lines of action; 2) to represent the region's institutional variety; 3) to express diversity in the region's countries.
Brazil (2005), Argentina (2006) and Chile (2008) have been the first countries to establish and use digital fabrication equipment and, throughout their histories, have been also the first ones to promote diverse emergent technologies, such as textual programming and later on, visual programming. Chile, even though the implementations were established later than its peers, has extended its results outside its geographic limits, being the only country in Mercosur where a Maker Fair had taken place (Santiago de Chile, 2013). Moreover, in Chile has been founded the first mobile lab, Aconcagua FabLab (June, 2015), developed by the Architecture and Design School of the Pontificia Universidad Católica de Valparaiso, with assistance of the region's Government. It has been placed in public squares in said region. It aims to socialize digital fabrication technologies and to assist entrepreneurs' initiatives.
Inside the group belonging to Pacto Andino, with the creation of FabLab Lima (now FabLab UNI) in 2011, Peru continued to grow under the advice of MIT and in 2015 Lima has 7 MIT FabLabs registries (https://www.fablabs.io/map). Thus there are very few self-help initiatives outside this network that would not just limit themselves to brief workshops or classes, appearing in different universities in the capital. A case of progressive experience is that of the School of Architecture at the Universidad Peruana de Ciencias Aplicadas, for second year students, starting in 2009 with the implementation of a mandatory Digital Fabrication class. Since 2014 it has as standard MakerBot Replicator printers in each of its premises. With a demand around 250 students each semester, the service of laser cutters spontaneously appeared around campus. A similar phenomenon happened on Medellín at the Pontificia Universidad Bolivariana, after the implementation of their RhinoFabStudio and a Minor in Digital Fabrication.
Ecuador and Bolivia have not had a visible active self-help participation. In Bolivia there is an interest, motivated by the coming back of alumni of the program at Advanced Architecture Institute of Catalonia, but it has not yet surpassed the limits of mild curiosity in very specific contexts in architecture and design.
As documented in previous researches, the fact that these initiatives are born in academia and not industry makes it very difficult the initiatives of short-term implementation.

Methodology

The methodological procedure used for mapping was a survey sent to 48 centers for Digital Fabrication in South America. We gathered answers from 31 centers in 6 countries: Argentina (2), Brazil (22), Colombia (1), Chile (4), Peru (1) and Uruguay (1), distributed in 22 academic research labs associated to universities and 9 independent initiatives.
The centers that took part of the survey are: ARGENTINA: CID | FADU Universidad Nacional del Litoral FADU; Universidad de Buenos Aires. BRAZIL: Aleph Zero; CADEP | FAAC/UNESP; FCT/UNESP; DT3D | Renato Archer; Estudio Guto Requena; Fab Lab | FAU/USP; Fab Social; Garagem Fab Lab; GEGRADI | FAU UFPel; LAGEAR | FAU/UFMG; Lamo3D | FAU/UFRJ; LAPAC | FEC/UNICAMP; FAU | Mackenzie; LEAUD - DAUR/UFJF;

LED | FAU/UFC; LM+P | DA-CT/UFPA; Nomads IAU/USP; PRONTO 3D | Design/UFSC; Rede Brasileira de Fabricaçao Digital; SimmLab | FAU/UFRGS; SUBdV Architecture; ViD | UFRGS; CHILE: Area Computacional | UTFSM; gt2P | great things to People; Lab CNC.FAU | Universidad de CHILE; Fabhaus UC PUC-Chile; COLOMBIA: Frontis3D.R+D; PERU; Fab Lab LIMA. URUGUAY: LabFabMVD

For this research, 3 centers located in Brazil and Peru and associated to MIT FabLab were not considered. In our classification these belong to Laboratories Bond to Network. These were selected for a previous research, which aimed to analyze the social aspect of its proposals.

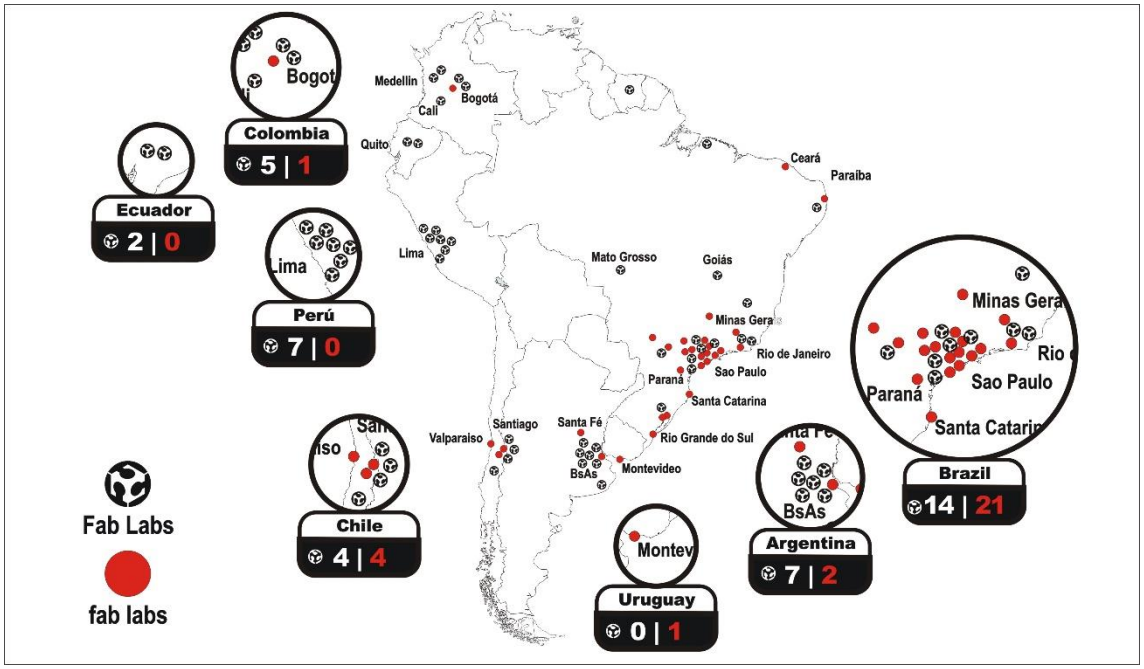

Fig. 2. Comparison of the existing MIT FabLabs and the ones mapped for this research.

The survey has questions related to the identification of the lab, its localization, founding date, members, its affiliation to any institution (or independence), a brief historical perspective, activities, equipment it posses (quantity and type), uses of said equipment, and if they are applied to fabrication processes or if the lab promotes workshops amongst its activities.
It was limited to schools of architecture and urbanism in Latin America and took place between 2014 and 2015, taking into consideration workshops and conferences in the region, that appeared in the Cumincad database (Cumulative index of computer aided architectural design).
Our contribution with this mapping is to show quantitative and qualitative date that show as a matrix how currently active fabrication laboratories work outside the official FabLab network. It is expected from this first registration and analysis: 1) to offer a framework for analysis that can be shared; and 2) to generate from said analysis research and knowledge tools about the state of the art in digital fabrication in Latin America.
The objective was to characterize the different laboratories and to quantify its data, to compare their installed capacity, use of applications as determined by architecture studios, independent laboratories and universities, in order to establish two main lines of action: 1) technological development; 2) social and environmental development.

Results

Inside the proposed categories, we can associate 25 laboratories oriented towards technological development and 6 to social and environmental development. All of them in a greater group of experiences associated to teaching.

Figure 3 shows the classification and localization of fabrication laboratories. There are 22 laboratories in academic research institutions and 9 in independent initiatives, divided into 4 categories according to type of equipment. Brazil has all categories and is the country with a broader academic diversity.
MIT FabLab start with a minimum infrastructure and follow a strict teaching program inside Fab Academy, where participants learn the use of tools and processes that would help them develop a personal project. In order to begin their operation, after this process, workshops are organized, as well as other activities related to digital fabrication. On the other hand, the analyzed laboratories have been the result of pedagogic experiments, strengthening every semester with new themes and experiences.

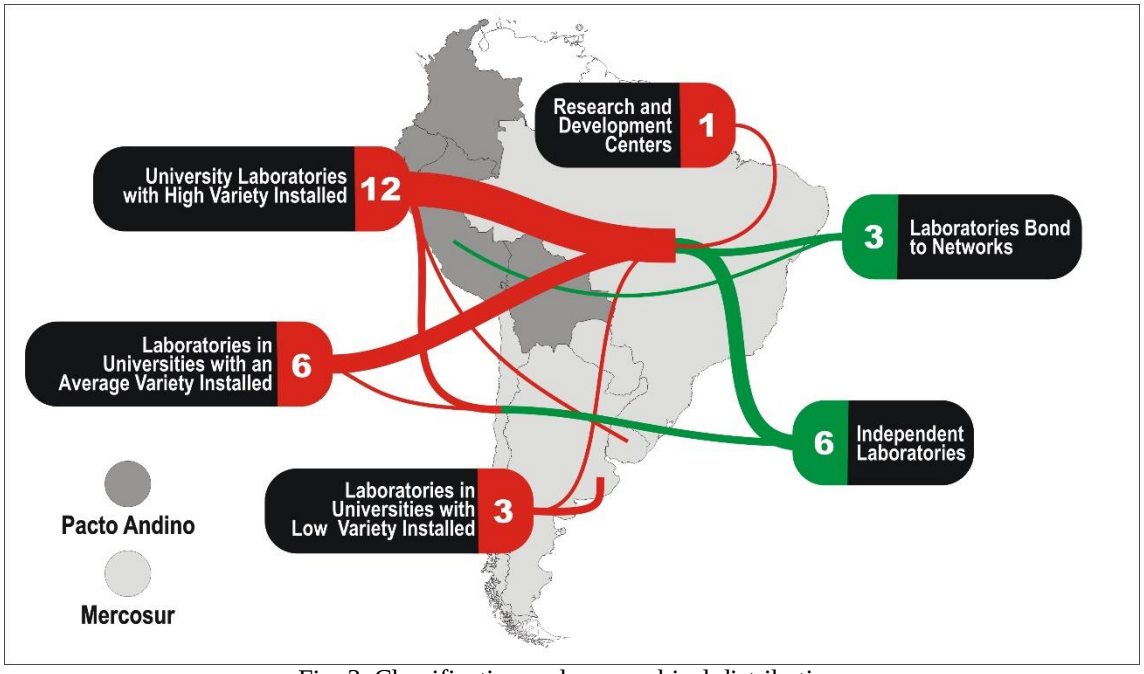

Fig. 3. Classification and geographical distribution.

In regard to equipment, 29 have 3D printers (93%) as the equipment with more demand, followed by laser cut in 23 laboratories (74%), 21 with CNC Router (68%), 14 have other machines (45%) and 11 use external sources for the fabrication service (35%).

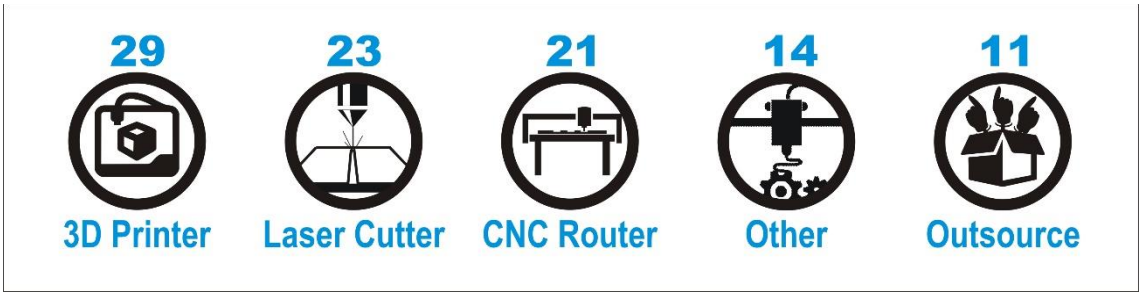

Fig. 4. Quantity of laboratories and types of equipment used.

From the results obtained by the different centers, 27 used their resources for the production of architecture models (87%), for visualizing, simulating and analyzing, mostly small scale objects, and artistic and museum models. After the architectonic object, urban space and furniture follow. For details, see Table 1.

Workshops and courses	
Software training	16
Preparation Courses	12
Workshops	7
Architecture and Urbanism	6
Programming	2
Robotics	1
Use of Digital Fabrication	
Small Objects	31
Architectural Models	27
Architectural Components	27
Construction Molds	15
Fabrication Machines	10
Others	10
Application of the fabrication process	
Analysis, Simulation, Visualization Prototypes	28
Pedagogical Objects	26
Component Construction	16
Art and Museology	16
Development Community	15
Historical Buildings	14
Impaired people	10
Others	2

Table 1. Main uses of the equipment.

Conclusions

Geographically, São Paulo (Brazil), Buenos Aires (Argentina), Santiago de Chile (Chile), Montevideo (Uruguay) and Lima (Perú) are cities with labs clusters in their countries, since they gather most initiatives. Universities associated to these initiatives, such as Universidad de São Paulo, Universidade Campinas, Universidad de Buenos Aires, Universidad de Chile, Universidad República en Uruguay and Universidad Peruana de Ciencias Aplicadas, are considered amongst the top 5 in their countries. The cities and universities mentioned have been focus of expansion, especially in the countries belonging to Mercosur, which have taken experiences outside their cities of origins to close-by regions.

These centers have a great impact in their countries for being the first to show the possibilities and advantages in the use of digital fabrication in academic environments in the region.

In infrastructure, the cheaper 3D printing equipment allowed it to be the most used one, reflected also in its use for the production of small objects. This result shows that the implementation of program techniques for the fabrication of objects that to surpass the limitations of the small volume in cheap 3D printers is nonexistent, and people prefer to produce results based on what the machine offers and not in its personalization. Buying equipment is limited by the scarce founding, reflected in the small quantity of groups in each type.

Another process found in cities such as Buenos Aires or Lima, in universities or even architecture studies is the use of external services. This happens because of the growth of the student population and the lack of planning for the acquisition of new equipment inside institutions, that could balance the situation.

In terms of collaboration, there is a clear difference between MIT FabLab and RhinoFabStudio, which articulate a network for the exchange of information and knowledge amongst the member of each group, and the analyzed independent laboratories. The studied self-help initiatives belong to internal networks inside one organization and in most cases, the information of their production is accessible only to their members, which makes difficult to show them outside their environment. The lack of free access repositories and, in many cases, the difficulties to obtain a repository in the university's web site forces the research groups or instructors to use personal accounts to store information on their experiences. In the process, a lot of material is lost. Therefore, part of the limitations of this research was to gain access to privileged

information on works and experiences, that we hope to obtain in a next stage, aiming also to broaden the number of case studies.
The great distances between our cities is another factor that does not allow a constant mobility, so that the cases are limited to very few discussion spaces in order to share experiences. Very specific cases are the congresses of the Sociedad Iberoamericana de Gráfica Digital (SIGraDi).
The qualitative perception is that there is a growth in terms of creating strategies and the appropriation of technologies, focused on research and creation strategies.
The common trait in these initiatives is the result of its proposals, focused on academic projects and problems not proposed by students but taken from reality and proposed as exercises by the instructors, taking as a pedagogic framework the model of a design studio. Unlike the MIT FabLab created in Latin American cities, which propose a model where each student has a model to resolve with a group of counselors, the large quantity of students in the region universities difficult the replication of that model, a situation that differs from that in the USA or Europe.
In Latin American there are mandatory classes with more than 200 students, as in Universidad de Buenos Aires or Universidad Peruana de Ciencias Aplicadas that do not possess the necessary equipment. However, their success in sustainability and production is owed not to infrastructure but to the awakening in their students the connection between reality and the exercises that turn digital fabrication into an ally in their own processes. They discover, just as they do when working on design exercises, that the results do not depend on a machine, but on the correct interaction between variables and restraints that we create for ourselves.

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