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popularização tecnológica e colaboração no programa fab lab livre SP

popularization of technology and collaboration in the fab lab livre SP program

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Abstract:

Social participation and collaborative practices were the basis for the development of the public policy Fab Lab Livre SP of the City Hall of Sao Paulo, aiming to bring the ideals of the hacker and maker cultures to the peripheral areas of the city, offering access to cutting-edge technology. In order to evaluate this policy, this article utilizes the methodology of institutional arrangements for public policy, that allows to observe the dimensions of horizontal integration (intersectoriality), vertical integration (federative subsidiary), territorial and social participation, considering three stages of the cycle of public policies: designing, implementation and monitoring. The article describes the form of operation of the city network of laboratories of digital fabrication and its relationship with public administration and civil society. It shows how the articulation between actors allowed to implement the program and how the direction of the public policy could affect and be affected by disputes on assumptions around the debate of the "collaborative and solidarity practice" versus the market logic of "individual entrepreneurship".

Keywords: Digital fabrication, Public policies, Technopolitics

1 Introduction

To promote the participation and technological collaboration among the people who live in the city of Sao Paulo was one of the main goals that took the City Hall to create a program to disseminate and facilitate the access to the maker culture. This article describes how the implementation of the *Fab Lab Livre SP* program was, its main collaborative institutions, and how the project was shaped in practice. The methodology of the institutional arrangements (Lotta and Favareto, 2014) will be utilized to analyze this public policy. There are four considered variables for the understanding of public policy: first, the *intersectoriality* or *horizontal articulation* (it takes place when different sectors operate together in order to solve social problems by reaching synergy in an integrated way, and it works in the formulation, implementation and monitoring stages); second, the dimension of the *verticality* regarding the federative levels (Federal Government, States and municipalities); third, the reading of the territorial dimension; fourth, the dimension of social participation

(observing the articulations and local structural competencies, considering those who are involved in the deliberative process).

2 Digital fabrication

The concept of *digital fabrication* is utilized in processes that use computerized machines to produce designs modeled through software, often in CAD file types. In the industrial production field, digital fabrication is already a reality, mainly utilized for prototyping and elaboration of personalized parts. It can be applied into a great variety of enterprises such as architecture, industrial design, marketing, education and arts. Along with robotics, artificial intelligence, Internet of things and cloud computing, digital fabrication is one of the pillars of what has been called Industry 4.0. Digital fabrication is, therefore, the ensemble of techniques that enable the concretization of the maker culture, based on the principle that anyone can create, produce, fix and modify any object ("do-it-yourself"). For Gabriel Menotti (2017) the maker culture is marked by the combination between craftsmen and hackers.

The name *Fab Lab* (from the English *fabrication laboratory*) was created in the interdisciplinary laboratory named *Center for Bits and Atoms* (CBA) of the *Massachusetts Institute of Technology* (MIT), USA. It inspired activists (makers) around the world and currently operates as an independent international network. *Fab lab* is not a trademark, but it is a concept that advocates for innovation and collaborative production. As Silveira (2017, s.p., our translation) states: "the internet [...] is a network of sharing information, either it is signals or non-material products. The possibilities of creating and sharing are used by individuals and collectives that, intentionally or not, also practice a gift and exchange economies without economic purpose". This approach is completely applied to the concept of the fabs labs. In order to protect the idea of what these laboratories are, the CBA-MIT produced a document called *Fab Charter*, which details guidelines that should be adopted by those who want to name their laboratories as "Fab Labs".

Fab Lab Livre SP is a network of laboratories for public and free digital fabrication, integrally supported by the Sao Paulo City Hall. The main data presented here is based on the report "*Conectividade e Inclusão Digital na Prefeitura de São Paulo* (2013-2016)" (Cassino, 2016)[1]; the book "*Inovação nos Serviços Públicos na Cidade de São Paulo* (2013-2016)" (Chiovetti, 2017); the São Paulo City Hall website (www.capital.sp.gov.br) and the *webpage* www.fablablivresp.art.br.

The program subscribed to all the *Fab Charter* guidelines, however it decided not to formally associate to the CBA-MIT laboratories' network, understanding that the executive power of the largest city of Brazil could not be subordinated to any international institution. It considered the risk of alterations in the philosophy or possible changes in the running of the international network, which could turn its public policy incompatible to the principles of the City Hall. The chosen name of the program was *Fab Lab Livre SP*, meaning that there was an assignment to all the good practice of an international fab lab, nonetheless the city network is free to decide its own paths. The name was also adopted to keep a branding with another City Hall program named *WiFi Livre SP*, which brought free wireless internet to parks and squares in the city. For a fab lab to take place it needs machines, equipments, accessories, consumables, human resources, place of operation, electricity and logical network. The team has to be well equipped and qualified, and should motivate the students to learn, to create and to produce.

Based on Lowi's conceptualization (1963), the *Fab Lab Livre SP* can be categorized as a distributive public policy. If there were resources, this policy could be universalized. As there are no funds to cover 100% of the city area, the dispute over the resources occurs on the place of installation of its units. There was no opposition in the City Council concerning to the program.

Between 2015 and 2016, 12 units were opened and distributed in all regions of the city, becoming the largest network of fab labs worldwide. The City Hall coordination that led the design, implementation and monitoring of the public policy was the Coordination of Connectivity and Digital Convergence (*Coordenadoria de Conectividade e Convergência Digital* (CCCD)), subordinated to the City Secretary of Public Services (*Secretaria Municipal de Serviços* (SES))[2]. The costs with human resource and consumable, including the inputs for the working of the machinery is approximately R$ 3 million reais per year. The total investment for 12 units for 24 months was R$ 4,69 million reais. Divided per month and per laboratory, the cost is approximately R$ 16.300,00 reais per month for each laboratory, which can be considered low for a city with a budget over R$ 50 billion reais.

The main equipment of the *Fab Lab Livre SP* are: 3D printers, that produces objects with tridimensional printing technology using plastic resin; a large CNC (Computer Numeric Control) milling machine and precision CNC milling machine, which generates pieces by shaping materials; laser cutters, to cut with millimeter precision using laser ray through optical path; cutting plotter, that uses a blade to cut various materials. Other equipments are: computers, welding stations, bench drills, function generator, digital oscilloscope, screwdrivers, saws, serigraph equipment, instruction manual, scanners 3D, sanders, micro rectifies, sewing machines, photographic cameras, vacuum cleaners, vacuum forming and joinery workbench.

The São Paulo City Hall made a strategic option for open source softwares. All the softwares used in the courses and workshops are open source. The first advantage of this decision was regarding to the budget: there were no expenses for licenses. There was no need of public bidding for computer systems, which also contributed for the laboratories to be opened on time. To opt for the use of open source technologies had the objective to promote the *Fab Lab Livre SP* as a gateway for the Free Software community, motivating its users to participate in the collaborative network development. For the student, there were other gains: the student can attend a course and, when arriving home, install the software used in the classroom on their computers for free, without the need of a license or digital piracy; to continue to practice the content, to plan the digital designs and to return to the laboratory only to print them. With open source software, the Sao Paulo City Hall ensured that the fab labs would not be dependent on computer systems' suppliers. If the licenses were bought from software companies, each time there was new version it would be needed to acquire the update (which it cannot always be possible). The main open source softwares used by *Fab Lab Livre SP* are: Blender for 3D modeling, *Inkscape* – for digital design, *GIMP* – for treatment and manipulation of images, *Scratch* – to teach kids computer programming, and *GNU/Linux* – operating system.

In order to present an example (other examples will be discussed in the article), the combination of hardware and software used in fab labs allowed the emergence of the case study of the Arthur George, a cinema producer, that acquired a 16 mm film recorder manufactured in the 1960s. Since he bought it, the equipment never worked, as one of its pieces was broken and it was impossible to find this part of the equipment in the market, as its industrial production was ceased long ago. Together with the *designer* Erik Savini, George used 3D modeling techniques to design the gear teeth. There were many attempts until it fit perfectly, as the machine demands perfect synchronicity. "The film recorder is now used for cinema courses", Arthur George tells (interview to Cordeiro, 2017, our translation).

3 Analysis of institutional arrangements of the *Fab Lab Livre SP* public policy

3.1 Horizontal integration (intersectoriality)

The idea to implement the fab labs came from a visit of the Mayor of Sao Paulo to Colombia in 2014, moment when he got to know a fab lab (Chiovetti, 2017, p.116). At the same time, the team of Coordination of Connectivity and Digital Convergence (*Coordenadoria de Conectividade e Convergência Digital*) was studying how to develop a program for digital inclusion, born with the former *Telecentros* in 2001. As Kingdon (2006, p.219) states in "*Como chega a hora de uma ideia*?*",* the *decision-maker* (the Mayor) had his attention captured (by the travel) and included the theme in the public administration agenda, opening space for the makers.

A number of cases were studied: the Fab Lab Barcelona, the fab lab of the Faculty of Architecture and Urbanism at the University of Sao Paulo (FAU-USP), the *Garagem Fab Lab* (a non-governmental organization), a mini fab lab in the Memorial da América Latina, the laboratory of technological structure of digital fabrication of the Information Technology Center Renato Archer (a Ministry of Science, Technology, Innovation and Communication's research centre) and public bidding produced by the Industry Federation of the State of Rio de Janeiro(Firjan). The intersectoriality of the designing was given, therefore, by the cooperation between the Mayor's office (Gabinete do Prefeito), the City Secretary of International and Federative Relations (*Secretaria Municipal de Relações Internacionais e Federativas*) and the City Secretary of Public Services (*Secretaria Municipal de Serviços*), public university and civil society. At the stage of its implementation, three other secretaries were involved: City Boroughs, Culture and Education. The reason was that the laboratories were installed in spaces (public buildings) that belong to those secretaries. The integration was important to decrease the time of installation and maintenance expenses, since the fab labs could share the previous infrastructure, such as water, electricity, internet, security and cleaning. To support the borough management, to hire professionals and training, the City Hall of Sao Paulo opened a public bidding call for a partnership with a third sector organization, won by the Institute of Social Technology (*Instituto de Tecnologia Social – ITS Brasil*).

Regarding monitoring and evaluation of the public policy, the role was attributed to the Coordination of Connectivity and Digital Convergence (*Coordenadoria de Conectividade e Convergência Digital*), which has, by legal ground, the right to enforce the fulfillment of the goals of the partnership with the institute. All expenses were supervised by the Office of the Municipal Comptroller General (*Controladoria Geral do Município)*, The Municipal Court of Accounts (*Tribunal de Contas do Munícipio)* and the City Council (*Câmara dos Vereadores)*.

The Coordination of Connectivity and Digital Convergence (*Coordenadoria de Conectividade e Convergência Digital*) has undertaken a research in July/August 2016 aiming to monitor and generate data on participation in courses offered by *Fab Lab Livre SP*, published in Cassino's report (2016). One hundred people were interviewed and they could choose between the options: "Excellent, good, average, bad, terrible". The first result regarding gender attendance shows that 57% were women. This result is calls the attention here because female participation is often smaller than male in the technology field. This result can be explained

due to a series of special initiatives, such as the "Women FABricate" week ("*Mulheres FABricam*") in 2016. For the question "how have the project and the workshop met your expectations?", the answers reached 87,6% for excellent or good; the question: "how do you evaluate the equipments that were used?" 92,4% approved; for the question: "how do you evaluate the instructor's qualification and motivation in the interaction and support of participants?" 88,5% answered positively; the question: "how do you evaluate the time duration of the workshop?" 20,7% of the students stated they wished more time in the classroom; the "punctuality of the workshops" was approved by 77,3% of the participants; "cleanliness and organization" was seen as positively performed for 92,8% of the participants.

The achievement of the contractual goals, which follows up is done monthly by the City Hall, the quantitative results (attendance of approximately 40 thousand people per year, almost the total capacity of the installed network) and the qualitative results (based on the research conducted in July/August 2016 on the acceptance of the program and in the interviews) allowed the coordinators to conclude that the program was successful.

3.2 Vertical integration (federal subsidiary)

Vertical collaboration was done in an informal way, with the support of the Faculty of Architecture and Urbanism at the University of Sao Paulo (FAU-USP) and the Memorial da América Latina (both from the Government of the State of Sao Paulo), and the Information Technology Center Renato Archer (Federal Government). These institutions provided data for the research of the Coordination of Connectivity and Digital Convergence (*Coordenadoria de Conectividade e Convergência Digital* (CCCD)), which aimed to find the best model to be implemented.

3.3 Territorial dimension

All the digital fabrication laboratories of the Sao Paulo City Hall are located in public spaces of the city. The first unit was opened on the 17th of December of 2015, in the Centre of Cultural Formation (*Centro de Formação Cultural*) of Cidade Tiradentes (east area of the city). The place was symbolically chosen, as in 2001 the neighborhood received the first *Telecentro* from the City Hall. The neighborhood has the major ensemble of public housing of Latin America, with around 40 thousand housing units; it also has slums (*favelas*) and irregular allotments. The choice of this region to receive the first *Fab Lab Livre SP* in 2015, and the first *Telecentro* in 2001, aimed to provide a strong message to the population: the most modern technologies are available to the excluded people.

The option for the poorest regions of the city was kept in the choice for the location of the other units. Also in the East region of the city, there is the Casa da Memória da Itaquera, a building from the 1930's, which was for years the old train station. In the Centro Cultural da Penha, the fab lab was installed to make visible the cultural and artistic activities developed there. Three Unified Educational Centres (*Centros Educacionais Unificados* (CEUs)) received the fab labs: CEU Três Pontes, CEU Heliópolis, and CEU Parque Anhanguera, aiming to be fab labs for public schools. In the city centre, the Fab Lab Olido Cibernarium was installed in the historical building of the old Olido Cinema, a symbol of the 1950's, and in Vila Itororó, in which the fab lab had the role to collaborate for the restoration of a architectural setting of 1922. The third unit in the central area is in the Cultural Centre of Sao Paulo (*Centro Cultural São Paulo*), one of the most important cultural spaces of Latin America. In the North area of the city, there is a laboratory in the Youth Cultural Centre (*Centro Cultural da Juventude*) for young people and teenagers. In Jardim São Luís, the fab lab is together with a *Telecentro*. Finally, there is a unit in the Chácara do Jockey Park, opened in 2016.

The goal was that the territorial dimension would be one of the requirements for the staff selection of the *Fab Livre SP*. The focus of the administration was to hire people who lived near the laboratories, who were integrated to the local communities and acted and talked to their users. The selection process was rigorous in order to choose people based on their proficiency to perform the required complex tasks. Up to now, however, it was not possible to tabulate this data and to verify whether the goals were achieved.

The dissemination of technological appropriation among the poorest can be easily verified in cases studies such as that of Amélia de Sousa, who suffers from monoplegia (paralysis of the left side of the arm), and is a CEU Três Pontes' fab lab user since its opening. Amélia de Sousa describes she has always had difficulties for everyday tasks such as cooking, for example. It was difficult to bake cake, as she had limitations to hold the bowl. It was hard also to cut food. In the program of the digital fabrication laboratories, she decided to attend all available courses, and was especially interested in 3D printing. She started to think on projects that could help her in everyday life. "One of the pieces I have done was a stand for the cake bowl", she tells. This is a plastic rod in an inverted "L" shape, which holds the bowl of the mixer and allows to pour the dough onto a pastry board that goes into the oven. "It made it much easier, I don't waste time, the material is very resistant, I use it at home and helped me a lot", she states. Another object developed by her, with the help of the fab lab technicians, was a plastic board to cut meat with a perfect fit in relation to the measure of the sink of the kitchen in her house. It works not only to cut meat, but also vegetables such as onions, carrots and others. "This is the cool part of the project: even if you don't have a broad technological knowledge, here you

learn", she states. In the last part of the interview, Amélia makes explicit why the program works to share knowledge: "we live in a poor community and the people do not have access to technology; when they have access, they don't have money, and the Fab Lab is good because of this, I am very happy, feeling much better, I see that I can help people who have the same problem that I have and even other ones" (interview to Cordeiro, 2017, s.p., our translation).

3.4 Social Participation Dimension

As previously discussed, the design, implementation and permanent evaluation of the public policy was much centered in the City Hall, despite the participation of the tertiary sector. In the everyday of the *Fab Lab Livre SP* there was an attempt to encourage the participation of the users and of the maker movement. The coordinator of the program from the City Secretary of Public Services (*Secretaria Municipal de Serviços* (SES)), Juliana Pessoa da Silva, presented in a conference at the Fab Lab *Maker* week of the Faculty of Engineering of Sorocaba (*Faculdade de Engenharia de Sorocaba* (Facens)) in 2016, that each public laboratory had its own characteristics and specific population. She says that many think of fab lab as a place to attend courses. In fact, it is hard to explain what a fab lab is: the courses serve as gateway for people to understand that "here it is a space to meet people, to materialize your ideas, to develop projects" (Silva, 2016, s.p., our translation).

A relevant question to be highlighted is that, alongside encouragement for social participation, the Sao Paulo City Hall cannot neglect to fulfill the contractual obligations, strongly based on goals to be achieved. As Barrett (2004, p.258) explains, after the pro-market changes that happened in the 1990s, the public sector turned to use formal contract not to leave any doubts regarding what can be accepted as satisfactory performance.

4 Entrepreneurship versus Collaboration

Almost three years after the opening of the first *Fab Lab Livre SP*, the impact triggered by the introduction of the digital technologies of manufacturing in the context of peripheral countries was the theme of the article "A insustentável neutralidade da tecnologia: o dilema do Movimento Maker e dos Fab Labs"(Fonseca de Campos and Dias, 2018), which analyses the complexity of the challenges and opportunities to be faced by the so called makers. The authors debate whether this movement actually assures the critical appropriation of digital technologies or it maintains the logics of alienation and labour exploitation of the current economic model. A good example of knowledge appropriation is the case of the service user Alexandre Alves, who declared in an interview for the TV Câmara São Paulo in 2016, that he brought a broken door to the laboratory and he fixed it himself in the carpentry class. "I won't need to waste money, I did it myself, I've learnt how to do it, by the way, this is what is more important. It is not only the "to do", but "to know how to do" for when the next time something similar happens, I will deal with it", he asserted. (interview to Chaves, 2016, s.p., our translation).

The conflict of the maker movement is: does it needs to place itself as a source of sharing of knowledge and technological empowerment, or should it promote the "individualistic entrepreneurship" as a basis for the neoliberal economy? Social emancipation cannot be a nice mask for the deregulation of the labour market. There is a fundamental contradiction: 1- to increase the cognitive autonomy and solidarity production, or 2- to teach techniques for the citizen to open their own business (many times to escape from unemployment). Fonseca de Campos and Dias (2018, p.44, our translation) cites the *Fab Lab Livre SP* as a real alternative for the promotion of appropriation of technologies in a free and public manner:

> [...] the experience of these fab labs, as public equipment, has been shown to be the most coherent and effective in relation to the issue presented here. It is interesting to note how the democratization of access to advanced technologies present in these laboratories came to be seen as an acquired social right.

A good example of entrepreneurship is that of Rafael D'Arco, musician and manufacturer of the *Handpan*, a percussion instrument, whose appearance reminds a "flying saucer". According to him, the object was not produced in Brazil and imports could take up to three years. In the *Fab Lab Livre SP* he saw an opportunity to manufacture the instrument. Using a 3D printer and a CNC milling machine, he assembled the pieces for the definition and tuning of the musical notes. Made of metal, the *Handpan* has cavities in specific formats, molded with digital fabrication technology. "It changed my career; I do this for a living. I have stopped teaching and playing, now I am much more focused on this", he tells. In March of 2017, he had already produced and sold 17 *Handpans* (Interview to Cordeiro, 2017, s.p., our translation). We can note that the case of this musician is very different from those who open a business solely to provide invoice for the employer and then escape the labour legislation.

For Luiz Otávio de Alencar, coordinator of the fab labs from the ITS Brazil, the important aspect is not only the courses offered, but the life experience people can have in this place. "Someone who has a tendency to create a business, here they will find complete support: from technical support to marketing support, to be able to

place the product "in a box" and offer it to the market" interview for Rede TVT, in 2016 (interview to Junior, 2016, s.p., our translation).

The entrepreneurship theme is being valued by governments, business and society as a vehicle of innovation and economic and individual growth. In Brazilian education, it has been incorporated in higher education curriculum of diverse courses, and universities encourage their students to open their own business, to generate intellectual property and to register copyrights. As Costa, Barros and Martins (2008, p.996, our translation) describe:

> [...] the common sense, media and business literature propagate professional models as heroic and idealized, presenting the ideal type of the entrepreneur as that emblematic hero who dares to open new paths, incorporates risk in their actions, breaks the rules and recognizes opportunities where no one else could see.

The sociologist Sérgio Amadeu da Silveira (2010, p.28-39, our translation) explains that the hacker culture (from where the maker culture is derived) was born in a time of North-American counterculture, when the World Wide Web development began. "The social movement inspired by the counterculture that idealized to distribute power and emancipate people through access to information, has in the hackers their main representation". The basis for the hacker standpoint is that information and knowledge cannot be anyone's propriety.

5 Conclusion

The article aimed to present how the Sao Paulo City Hall implemented a program that, in practice, encourages the people to participate and collaborate in network through digital fabrication technologies, having as basis the *Fab Lab Livre SP*. The laboratories find what perhaps is the major conflict of the maker movement: "entrepreneurship" versus "solidarity and collaborative practice". While the former seeks the integration of the professional to the business profit logic, that in the time of cognitive capitalism is based on the closing of codes, of information, of agreement and confidentiality, of corporate opacity, or – worse- it can serve as instrument to fraud the Consolidation of Labour Laws (*Consolidação das Leis do Trabalho*); the latter is based on a sharing logics, the non-material information is never scarce, which free circulation does not cause harm to anybody (or it should not cause), since the data can be infinitely copied, being an important mechanism of educational and cultural popularization.

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1 The author of this article was a Coordinator of the Connectivity and Digital Convergence (Conectividade e Convergência Digital (CCCD)) of the City Hall of São Paulo between 2014 and 2016, and also produced the managerial report at the end of the City administration, that due to the municipal electoral process, resulted in an change of government. However, the author utilized the method of Participant Observation for the case studies, as described by Robert Yin (2001).

2 After 2017, the CCCD was transferred to the City Secretary of Innovation and Technology (Secretaria Municipal de Inovações e Tecnologia – SMIT).