

# **Open Device Lab (ODL) - collaborative movement for real devices usage on projects for the web and applications. Literature Review.**

***Open Device Lab (ODL) - movimento comunitário para o uso de dispositivos reais em projetos para web e aplicativos. Revisão da literatura.***

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## **Raquel Paiva Godinho**

Professor at Federal Institute of Education, Science and Technology IF Sul-riograndense – IFSul, Campus Pelotas, Design Departament, RS, Brazil. PhD student in Experimental Sciences and Technology Program at the University of Vic – Central University of Catalonia (UVIC-UCC). Spain.

*raquelpg@pelotas.ifsul.edu.br*

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### **Abstract**

This study presents results from a literature review regarding the worldwide collaborative movement of Open Device Labs (ODLs). This is a recent initiative, started by professionals in the field, aimed at creating and sharing laboratories with diverse mobile devices connected to the Internet. These spaces provide a greater number of designers and developers with the possibility of testing their projects in different devices in a shared and economic way. The results show the importance of the movement for tests with real devices and obtaining better results in the development of projects for web and applications in times of growing technology fragmentation.

### **Keywords**

## **Resumen**

Este estudo apresenta os resultados da revisão da literatura sobre o movimento, mundial, colaborativo dos Open Device Labs (ODLs). Uma iniciativa, recente, de profissionais da área com o objetivo de criar e compartilhar laboratórios com diferentes dispositivos móveis conectados à internet. Estes espaços proporcionam a um número maior de designers e desenvolvedores, de uma forma compartilhada e econômica, a possibilidade de testarem seus projetos em diferentes dispositivos. Os resultados apontam a importância do movimento para testes com dispositivos reais e obtenção de melhores resultados no desenvolvimento de projetos para web e aplicativos em uma época de crescente fragmentação da tecnologia.

## **Palabras clave**

Open Device Lab, Web, Aplicativos, Testes, Dispositivos reais.

## **1. INTRODUCTION**

In this literature review, we show results that organize, bring back and clarify information on the Open Device Labs (ODLs). It is a recent movement that intends to create, in a voluntary way, an open community that offers laboratories equipped with diverse devices connected to the internet for those who are interested in it, in order to perform tests in real<sup>1</sup> devices to improve web and application experience. We are aimed at answering, partially, the following questions: What are the ODLs? What are their goals? How did they appear? How are they organized? How many are them? Where are them? And how have they been growing?

The creation of projects for the Internet follows the transformation of market technology. Smartphones and especially the Iphone have modified what came to be mobile technology (Grigsby & Gardner, 2011; Knott, 2015) and consequently the projects developed after that. The same fragmentation that amplifies the diversity also makes harder the work of designers and developers that, according to Keith (2012a), must keep developing in conformity with the standards and, at the same time, deliver products that are compatible with the variety of devices, testing in diverse devices does not mean develop for many different devices.

This diversity of technological options that is present in a market with various devices, brands, models, formats, screen sizes, resolution, functionalities, operational systems and browsers increases the demand for test laboratories. It is possible to obtain a view of this scenario by observing the past years numbers. The comparison among mobile devices, desktops, tablets and consoles, considering the last twelve months (April of 2014 through April of 2015), shows that the usage of

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<sup>1</sup> The word "real" is used here to highlight that it is different from tests that simulate results, which cannot guarantee and verify the exact answers.

mobiles, in the world, has increased from 23,53% to 31,52%, the usage of desktops has decreased from 70,53% to 62,65%, the usage of tablets have not presented considerable changes, decreasing from 5,83% to 5,72% and the usage of consoles have been unaltered, remaining in 0,11% with little oscillation in the time period (StatCounter, 2015). The systems fragmentation, considering only various Android mobile devices, has increased nearly 60%. According to OpenSignal (2014), in 2013, there were 11,868 devices and, in 2014, the number was 18,796. Also in 2013, the 10 most popular devices would represent 21% of the market, in 2014, however, this number has decreased to 15% - making the practice of tests in few devices less representative. Besides that sample, we still need to consider the fragmentation of the other systems, such as Windows phone, IOS, BlackBerry and their combinations with different types of models (Knott, 2015). Last, the numbers regarding screen resolution that, currently, according to StatCounter (2015), among the 14 most used ones, the first is the 1366x768 pixels one, which corresponds to 18,27% and the second one with a much smaller representation is the 1920x1080 one with 7,31%.

It is due to this fragmentation dimension and the impossibility of performing tests in all the available devices that it is necessary, no matter what project methodology is adopted, to choose part of these market options, according to targeted clients usage preferences.

In this context, through the literature review, we present information on the movement idealized by a group of professionals from the technology field, who work in an open and collaborative way. Therefore, they have created and have been structuring, through their contact network, a community aimed at meeting the market need of improving web and application usage experience, through tests with real devices.

## **2. METHODOLOGY**

For this literature review, performed in the time period between April and May of 2015, regarding the Open Device Labs (ODLs), the selection of informational resources from available publications were: a) electronic data basis - Mendley, Scopus, Web of Science, CAPES journal portal (Brazil), Academia, Bielefeld Academic Search Engine (Base), and Safari Books Online; b) search mechanisms - refSeek, iSeek, Jurn, HighBeam research, Google Scholar and Google.

The selection was carried out through the usage of the keywords: "Open Device Lab" AND "ODL" and "Open Device Lab" OR "ODL", these results were separated in primary sources, the writings of the community and secondary sources, books that make comments about the community (Eco, 2007).

Being the study object a recent movement, we have selected as primary sources: the organization official pages, each ODL website, *blogs*, *newsletter*, discussion groups and interviews with the main people involved in the idealization, organization and current movement maintenance. Those have contributed especially with the organization of the movement history and proposal.

In the secondary sources, we have selected nine books of interest, which approach the development of digital projects and the need for real tests in the development methodology. Although we have not found studies regarding this theme in the results obtained, we identified in the selected scientific sources, books from Safari Books Online, citations to Open Device Labs. In these citations, they appear as an alternative in the testing phase with real devices, usually with brief information about their definition and goals.

Besides that, the keyword "ODL" have appeared in most of the informational resources with repetition of the results already obtained and presenting new results about studies from other seven definitions for the abbreviation and, for this reason, we are able to say that, when we mention this abbreviation, we are not talking about: Oracle Diagnostics Logging (ODL), Object Description Language (ODL), Object definition language (ODL), Open and distance learning (ODL), Optical Delay Lines (ODL), Outcome Differential Leval (ODL) or On-demand learning (ODL) we are only talking about Open Device Lab (ODL).

### **3. THE OPEN DEVICE LABS**

#### **3.1 IN THE LITERATURE**

In the literature, we have found reference to the Open Device Labs always as a usage suggestion for tests with real devices, either as a main option of doing it or as an alternative. Although there are some divergences among the concepts approached, in this references, such as responsive websites and dedicated websites, which is not our focus, the different selected authors mention the importance of performing part of the project tests with real devices. The subject matter is usually approached in the items or chapters regarding tests and suggest the usage of ODLs especially for those who do not wish or are able to invest in their own laboratories.

We have found in the theme of development for mobile web the first registers regarding the idea of creating a community for sharing mobile devices for tests. The authors' suggestions for performing tests with mobile devices are:

1. Start with valid code in a desktop browser;[...]
2. Use mobile emulators and simulators;[...]
3. Invest in a small number of devices – buying a few phones is unavoidable. [...]
4. Beg, borrow, and steal – connect with others doing mobile development and share devices. Consider creating a central wiki of device in your community so people can easily find and share devices. Better yet, go big and build a community device testing lab like the one we're building in Portland;
5. Visit your local mobile testing center – nearly every city has a mobile device testing center. You may refer to them by their more common name: carrier stores. [...]

6. Remote device testing services – sometimes you really need to test a specific scenario. [...]

7. Prioritize your testing – [...] based on the decisions you made early in the project about the devices your customers are most likely to use (Grigsby & Gardner, 2011).

What one may see in this proposal is very similar to what we will find in all the other ones selected. There is a more practical and fast phase for verifying the first possible problems, then it is important to use simulators and emulators<sup>2</sup>, because they solve another parcel of problems, however, in order to really get to know the responses of an ongoing project, one might use the real devices that are most adequate to the targeted market. Here in this proposal most important we have the item 4 that later helped us to bring back ODLs emergence history, because the authors suggest device sharing, the creation of a community, and mention the one they were developing in Portland.

Hereinafter, four authors who deal with responsive design Fielding (2014), Jehl (2015), Marcotte (2015), Peterson (2014). Ethan Marcotte is responsible for naming the term responsive design, which basically deals with flexible grids layouts, fluid images and media queries, for building projects that are adaptable to different devices. In chapter 5, *Becoming Responsive*, when dealing with iterative collaborative design, he introduces the ODLs as an alternative for tests in real devices for those who choose not to invest in their own collection. In this context, the author considers the phases that are common to the projects as: planning, design, development and delivery as phases that can be carried out, by the team, in a more individual or combined way. The phases can be performed on a sequence, with each team performing their parcels separately, or combined in a hybrid way with design and development.

Here, however, the issue is that, when following the process results, windows resizing is one of the first result tests performed, but it is not enough, it is only an intermediary step. In order to know how the pages will be executed in a certain device, it is necessary to test it in a real device.

Jehl (2015) proposes to think responsive design in a responsible way, as he names it. Result of experiences in places like Cambodia and areas in need of resources for development in the world, that cause him many problems in using the Internet. He has got to know from a close perspective an unknown part of devices fragmentation, which allowed him to increase his collection for using in tests. These tests were approached in chapter two, *Sustainable Detection*, in the item *Testing Responsibly*, in which he asserts that, in order to guarantee the website functioning, tests in real devices are necessary. In order to do that, he suggests the pursuit for an Open Device Lab, as an alternative for those who are not able to invest a considerable amount in devices. If this is not possible, performing them on emulators is an alternative, although it presents disadvantages, such as: the

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<sup>2</sup> The difference between an emulator and a simulator is that the first will show how the device would behave and the second will only show how the device screen would look like (Peterson, 2014).

browser is executed in a different hardware, the taxes updates are slow, the connection speed is usually faster than the one in the devices and a feedback of the interaction with the real device is not obtained.

Fielding (2014), in the chapter *Testing a Responsive Site*, with a proposal more focused on the process effectiveness, explains how to test a responsive website on a web browser and in a device. One may see bellow, in a succinct way, the phases developed by the author:

1. Load the responsive website URL on your browser;
2. Resize the window;
3. Use emulators;
4. Use simulators;
5. Use physical devices, as an alternative, look for an ODL;
6. Use remote access online solutions, in case of not having access to devices or laboratories.

Peterson (2014), in chapter 8, *Mobile and Beyond*, emphasizes two main issues to reflect about projects: devices and users. In her opinion, the key to the responsive design success is to test the website in various devices. The test phases suggested are the same as the ones approached before in this paper.

Until now, we have in common the responsive design, the test phases, the importance of using real devices and the ODLs recommendation as an economic alternative. Although the projects always aim at corresponding to users' expectations, it is not easy to contemplate the market fragmentation. This becomes a complex subject matter, with several other concepts to be thought about, and, for this reason, they will not be approached in this paper. We will keep the focus on devices and tests, even though they are both related to each other.

With a different proposal, Knott (2015) presents issues mentioned above, regarding the user. He deals with tests and mobile telephony market with more emphasis on the importance of acknowledging the consuming market and its expectations for tests and projects development. In his opinion, when there is an experience proposal related to the environment, besides testing the mobile applications in devices, it is also important to test them in the real environments.

For example, if you're testing an app for snowboarders and skiers that accesses slope information, one that is able to record the speed of the current downhill run and makes it possible for users to share records directly with their friends, you need to test these functions on a slope (Knott, 2015).

In chapter 3, *Challenges in Mobile Testing*, after considering information survey regarding the targeted public and thinking about fragmentation problems, the author suggests a different strategy, performing tests in groups, per device type:

1. High priority: A – new devices with powerful hardware and big screens with high resolution and pixels density. Devices belonging to this group might be totally compatible to their app in terms of functionality, design and usability.
2. Medium priority: B – medium hardware with smaller CPU, screen resolution, and size smaller than devices in group A. The project does not need to be perfect for this group, due to its smaller screens.
3. Low priority: C - small CPU and low screen resolution and density. It is still important to fully support the app in terms of functionality, the design and usability, however, may differ from the other groups, because the hardware may be too slow to provide enough response capability.

With the groups defined and going towards the tests, the same proposal as the previous one follows: use his own laboratory, invest in some devices, rent some mobile devices or seeks for an ODL.

Satrom (2014) also brings up new themes when writing about the construction of polyfills<sup>3</sup>. Approaches, in chapter 5 – Building your own polyfill part 3, various general issues of performance and JavaScript and DOM rendering and their importance for different browsers, pointing out specific considerations regarding polyfills that are meant to be used on mobile devices. The specific recommendations for these devices performance are:

- a. File size matters;
- b. Always test in devices.

That is, the file sizes for mobile devices might have more attention, because they affect the rendering time, they implicate in more information to be downloaded and consume more data and battery. Using approximated test methods, such as testing in the desktop the same browser they would use in the cellular telephone is not the same thing. There are results that can only be obtained if tested in a real device and that is why it is important to use a test laboratory (Satrom, 2014). Although the publication dates from 2014, it seems that the lack of information on ODLs is a problem, because, even though they are pointed as an alternative for performing tests, it is not explained what they are, they are not contextualized, and there is no link for those who do not know the proposal.

Ultimately, Hysolp & Castro (2013) develops issues on web development, tests, depuration and publication. They work in details with current concepts regarding HTML and CSS and in a subtle way in chapter 20, *Testing & Debugging Webpages*, after also presenting test phases already mentioned, they suggest the usage of ODLs as a free way of testing web pages.

One may note that even the authors who have different goals regarding technology follow similar recommendations about the methods. It is normal to question the

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<sup>3</sup> [...] polyfilling, which is a way to fill the holes in browser support using JavaScript (or any appropriate technology such as Flash if it makes sense) to level the playing field. (Sharp & Lawson, 2011)

need for tests with real devices, once there are emulators and simulators that solve some of the problems and remote tests that operate real devices from long distances. These are more accessible, because they do not require a device collection; they are important in certain phases and therefore regularly appear in the previous test methods. Still, they do not offer results that are only obtained with tests in real devices, such as: responses about the user's experience regarding the project namely the interaction with buttons, with touch and connection performance, for example.

We could note that the tests are a common theme in the literature presented. In general, different project methodologies foreseen interface tests before, during and after the delivery to the market. These may be development, following and/or result tests. With the cycle of devices launching and their new resources, it is fundamental to monitor the mobile devices and software market, in order to perform application functioning tests and carry out potential updates (Knott, 2015).

With this fragmentation, it is necessary to select the market targeted in the project to be developed and verify which browsers are more used, so they can be supported (Fielding, 2014). It is also necessary to select the devices to be tested, because it is impossible to test in all the models (Grigsby & Gardner, 2011; Sillars, 2015).

### **3.2. THE MOVEMENT HISTORY – FROM ITS ORIGIN THROUGH NOWADAYS**

We have identified on Grigsby and Gardner (2011), already mentioned before, what we consider the first initiatives for the idea of creating a community that can share spaces with devices for tests. When writing about the phase of tests in mobile devices, the authors suggest the investment in buying devices related to the project to be tested. After that, as an economic alternative they advice one towards sharing the devices with other developers, as in a device community, in a way that finding and sharing them becomes easier or "Better yet, go big and build a community device testing lab like the one we're building in Portland" (Grigsby & Gardner, 2011).

This laboratory idea had been cogitated for some time in Mobile Portland meetings, EUA. A non-profit organization, founded by Jason Grigsby<sup>4</sup>, dedicated to educate, promote and support the mobile technology community in the city and surround areas (J Grigsby, personal communication, June, 29<sup>th</sup>, 2015). They would get together once a month for presentations, discussion and networking since the beginning of 2008 until March of 2015, when the last meeting happened (Mobile Portland, 2015). The laboratory was more an organization action for helping local developers and bringing visibility to the city as destiny in mobile technology. Jason commented on the organization actions at some events, in which one of them, Jeremy Keith<sup>5</sup> became aware of what was being developed. After that, in April, 30<sup>th</sup>

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<sup>4</sup> Cloud Four co-founder, mobile web development company. Co-author with Lyza Gardner of the book *Head First Mobile Web* (2011).

<sup>5</sup> Irish web developer that is Internationally recognized as a conferencist, founded the Design



of 2012, Jeremy Keith wrote in his website<sup>6</sup> about the importance of performing tests in real devices, of how he had been acquiring mobile devices for his collection and, in the end of the text, invited his readers to show up and get to know the laboratory he has assembled in his company, Clearleft, Brighton, UK.

*In the meantime I've been setting up a desk at the Clearleft office for these devices so that they can stay charged up and within reach. We've always had an open-door policy here, so if you want to pop around, use our WiFi, and test on our devices, you're more than welcome. Give me some advance warning on Twitter and I can put the kettle on for a cup of tea. [...] Think of it as a quick'n'dirty, much smaller-scale version of Mobile Portland Device Lab (Keith, 2012a).*

Jeremy's differential for opening the the first laboratory to the community consisted in not to worry about bureaucratic issues and share Clearleft space through the Internet. From this moment on, on the same day, developers have started to offer their devices, on twitter and in person, in order to increase the collection. The positive and collaborative reaction from the people interested caused a series of actions in the movement organization. Josh Emerson, Clearleft front-end developer by the time, has created a page, on Clearleft website, with the list<sup>7</sup> of available devices to be constantly updated, containing the brand, the model, the system and the donator. Jeremy kept writing about the actions, stimulating Brighton residents to use the space and suggesting that residents of other locations search partnerships in their areas and start other sharing communities (Keith, 2012b). Few weeks later, in May of 2012, Jeremy Keith and Remy Sharp<sup>8</sup> presented the laboratories idea, at the *Mobilism Conference* in Amsterdam, and in a few months the movement of opening similar laboratories in England, Sweden, Holland and Germany was initiated (Salminen, 2012). With more people interested in the laboratories and with their constant advertisement on the Internet, these several laboratories have started to appear, in Europe, in London, created by Shaun Dunne at the Mozilla space, in Exeter in the United Kingdom, in Malmo in south Sweden (Keith, 2012d).

From July, 2012 on, when Andre Jay Meissner<sup>9</sup> has decided to dedicate part of his time to organize the movement and increase it, with the help of several collaborators, the community has started to perform actions in global visibility. In that moment, there were only 8 ODLs, all of them in Europe, which have been united in a list published in his website, [klick-ass.com](http://klick-ass.com), that slowly started to be

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Agency Clearleft in Brighton, England in 2005. Now he guides the company's technical direction and acts as the Research and Development wing of Clearleft investigating. Author of the blog [adactio.com](http://adactio.com) and the books, *DOM Scripting* (2005), *Bulletproof Ajax* (2007) and *HTML5 for web designers* (2010) (Clearleft, 2015).

<sup>6</sup> [adactio.com](http://adactio.com)

<sup>7</sup> <http://clearleft.com/testlab/>

<sup>8</sup> The founder of Left Logic company, co-author of the book *Introducing HTML5*, author of blog [remysharp.com](http://remysharp.com) and speaker at tech conferences.

<sup>9</sup> Mainly responsible for movement of ODLs. Entrepreneur, former CEO, speaker, with expert knowledge in SaaS, comercial web and ecommerce and broad range of experience in TI services.

updated with the opening of new laboratories, until he had his own website. (Meissner, 2012a).

In september of 2012, at first, Viljami Salminen, designer and founder do Helsinki device lab, Finland, publishes the text "*Establishing an Open Device Lab*" in Smashing Magazine, which becomes one of the most important actions that really spreads the ODLs idea around the world. Second Andre Jay Meissner creates the NPO LabUp! (*Non profit organization*), organized with Anselm Hannemann<sup>10</sup>, Christian Schaefer<sup>11</sup>, Timm Jansen<sup>12</sup>, Viljami Salminen and Bruce Bowman's<sup>13</sup> collaboration. A website to help people interested in opening their own ODL with information, papers and the opening application form (Meissner, 2012b). This action has been the most important one for increasing the movement, which until then would share information only about their local actions. With the organization, they have united interests, made contacts with device manufacturers and software companies, organized administrative meetings and invested in public relations, media, brand, website and support to the movement, speaking at conferences, writting papers and events. (A Meissner, personal communication, June, 1<sup>st</sup> of 2015).

At the same period, the laboratory in Portland resume its actions, in order to complete the bureaucratic, physical space, devices, use forms and development issues to then open the doors to the community in october of 2012 (Grigsby, 2012).

In January of 2013, Andre Jay Meissner, Christian Schaefer and Anselm Hannemann publish the ODLs directory: OpenDeviceLab.com. This website became the main mean to advertise the movement, with updates regarding scope numbers, laboratories location maps and contact information. They have also started to use Twitter, @ODL and @LabUpOrg, which later became one of the main channels with media advertising on the new openned ODLs, their assessments and events related to the movement. Mennheim ODL also publishes, in the same month, the application Open Device Lab, Android version, with functionalities similar to the website (A Meissner, personal communication, June 1st of 2015).

In october, 26th of 2013, for the first time, nine ODLs and LabUp! managers have got together in Nuremberg for a presential meeting. Until then, they would communicate through an specific group in Google groups, through low frequency reports at LabUp! or directly through Twitter, for example. The presential meeting aimed at exchanging knowledge on managing and maintaining an ODL, presenting the best judicial practices, public relations and marketing, as well as discussing how the Open Device Lab idea communication and common goals could advance with joint efforts. Some of these practices, such as the judicial ones, would apply more

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<sup>10</sup> Opendevicelab.com frontend developer. Writes on the topic of social media support and continous supporter of LabUp! since October, 2012.

<sup>11</sup> Opendevicelab.com backend and additional Frontend developer and social media support and collaborator of LabUp! from October 2012 to January 2014.

<sup>12</sup> Developer, Computer scientist, provided support for the movement.

<sup>13</sup> Product Manager of Adobe Shadow, later Adobe Edge Inspect used by some ODLs.

to Germany and Europe, and still the meeting has generated a post with several suggestions for all the already registers ODLs (Meissner, 2013d).

In november of the same year, LabUp! organizes the first dedicated Open Device Lab, specifically for the event Beyond Tellerrand , annual event of web design and development that happens in Germany, for publicizing the movement. At the site, they had assembled an ODL with borrowed devices, where they have performed several tests in projects, in order to show the importance of using the devices and to publicize the movement. The action has had a wide scope and generated a post at Meissner's website, explaining how to assemble an ODL for specific events (Meissner, 2013c).

In January of 2014, they have incorporated DYDD14 (*Donate Your Dusty Device*), as a opendevicelab.com subpage. The new page has been implemented as a global media launch with the goal of receiving devices donations and publicize the ODLs. The results of the different actions performed by LabUp! for promoting the movement have resulted in an indication for Game Changer<sup>15</sup> 2014.

### **3.3. MOVEMENT - PROPOSAL AND STRUCTURE**

The organization defines itself as a voluntary and community movement that, through laboratories, share community pools of devices connected to the Internet, allowing developers to test their projects. Thus, the purpose is to improve the experience of using the web and apps for developers, as well as for consumers. (Open Device Lab, 2015).

The OpenDeviceLab.com (Figure 1), the main channel nowadays where most of the information is concentrated, has three main goals:

- Help people to locate the right Open Device Lab for the job;
- Explain and promote the Open Device Lab movement; and,
- Attract Contributors and Sponsors to help and donate to ODLs.

The proposal is that laboratories are located in physical spaces, but that they can also be mobile between locations or for specific events. Thus, they can be of three types:

- Resident: when the ODL is hosted by a company or institution, permanently, in a permanent way, at a specific address;
- Mobile: when the ODL does not have a permanent location, it moves around - to events, co-working spaces, coffee shops and other spaces; or

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<sup>14</sup> <http://opendevicelab.com/DYDD>

<sup>15</sup> This is a Net Awards category that celebrates something that really helped the industry and the community move forward. It could be a new web design tool, a GitHub project, an outstanding article that kicked off an important discussion, and so on (The net awards, 2015).

- Virtual: in general when they are organized in a specific location, e.g. for a Meetup, conference or other event, and usually for a short duration (Open Device Lab, 2015).

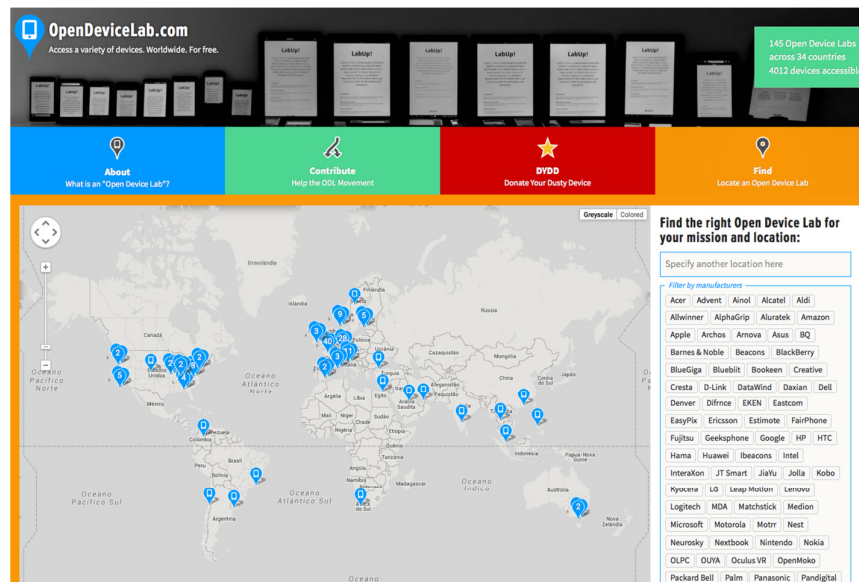


Figure 1: part of the Open Lab Device website with the general map of ODLs in the world.

Source: Opendevicelab.com

The website has been created to be the main mean to locate a laboratory and leverage the movement. It is possible to find their goals, total of opened laboratories, scope countries and number of devices available in the world. There is a global map for localizing ODLs, based on the user's location, where it is also possible to search by interest area or by specific device manufacturer. There is information from each ODL, such as: name, type, brief description, contact channels (website, facebook, twitter, among others), address, number of devices and comments with evaluation made by users who have visited the space. They also make available information on how to contribute with the movement growth either to make it visible, donating devices through DYDD, giving suggestions and evaluating the visited ODLs.

The movement, in the last April (2015) has completed three years, since the first laboratory has opened its doors to the external community. Progressively, it has finished the year of 2012 with more than 30 ODLs registered (Api Open Device Lab, 2015). By the end of 2013, they were 96, by December of 2014 they were 136, and until the present moment, July of 2015, they are 148. This total is distributed across 34 countries with 4069 devices for use and the majority is located in Europe and North America. There are 105 labs in 18 countries in Europe: 29 in Germany, 24 in United Kingdom, 12 in Norway, 9 in The Netherlands, 5 in France, 4 in Austria, 3 in Belgium, 3 in Sweden, 3 in Switzerland, 2 in Denmark, 2 in Spain, 2 in

Finland, 2 in Italy, 1 in Ireland, 1 in Jersey, 1 in Latvia, 1 in Poland and 1 in Turkey. There are 28 labs in North America, 25 in The USA and 3 in Canada. In Latin America, the total is 4, being the first one opened in December of 2012 in Santiago, Chile. The area, still with few ones nowadays, offers other three ODLs: 1 in Rio de Janeiro, Brazil, 1 in Montevideo, in Uruguay, and 1 in Bogota, in Colombia. In Africa, there is 1 in South Africa and 1 in Egypt, in Asia, there are 7: 1 in Saudi Arabia, 1 in Arabi Emirates, 1 in India, 1 in Thailand, 1 in Singapura, 1 in China and 1 in the Philipines. In Oceania there are 2, both in Australia. One can see below, in figures 2 and 3, these numbers in a comparative way, by area and country.

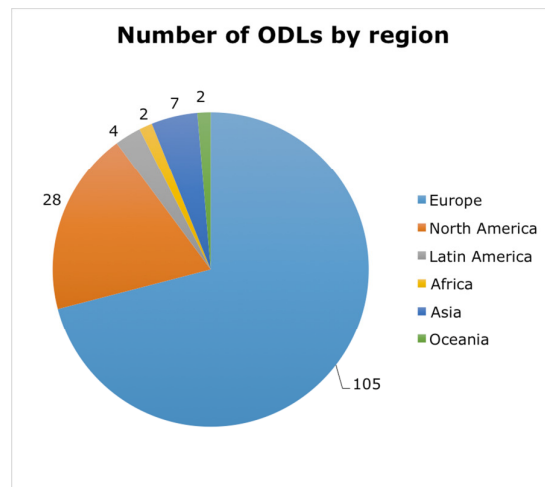


Figure 2: Chart with the number of laboratories by region, registered at OpenDeviceLab.com.

Source: Researcher, Data bases [api.opendevicelab.com](https://api.opendevicelab.com)

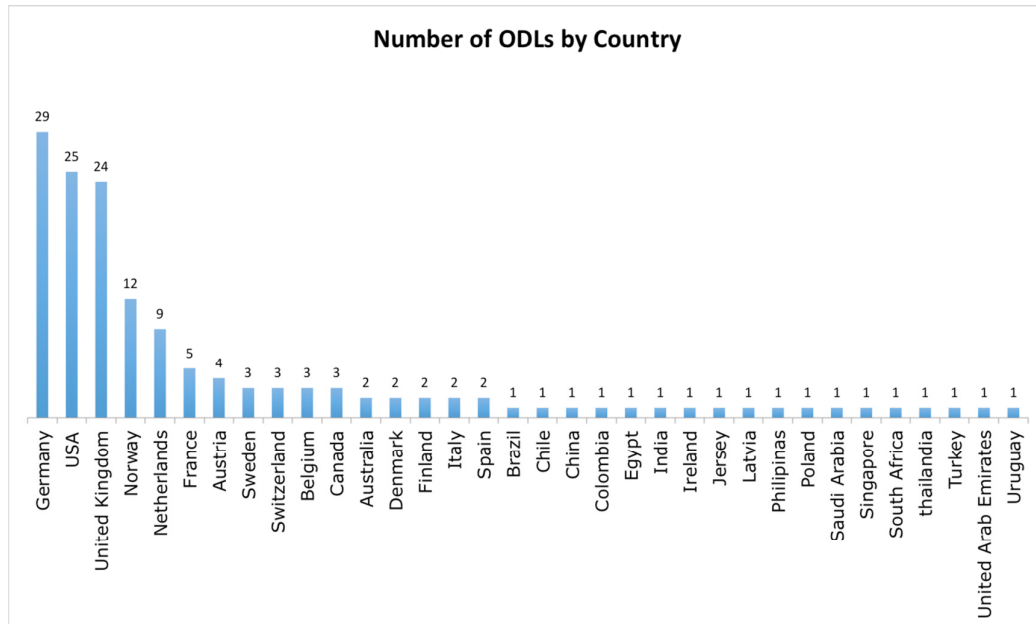


Figure 3: Chart with the number of laboratories, by country, registered at OpenDeviceLab.com.

Source: Researcher, Data basis api.opendicelab.com

The 145 ODLs existent nowadays have different settings and structures. Regarding their types, previously explained, they may be: resident, mobile or virtual. Nowadays, according to API (2015) registers, from the total, 2 are virtual, 7 are mobile and the others are resident. According to Peterson (2014), some of them are company laboratories opened to the community; others are hosted by private companies; and others are in coworkings or nonprofits. Besides these, in the researches carried out until this moment, we also found laboratories organizational settings linked to educational institutions. Based on api.opendicelab.com data, we may enumerate some laboratories registered with the mentioned features:

Co-working laboratories or linked to one of them:

1. Antwerp Open Device Lab, Antwerp, Antwerp;
2. Co.Up, Berlin, Germany;
3. Open Device Lab Düsseldorf, Düsseldorf, Germany;
4. Madworks Device Lab, Madison, USA;
5. Open Device Lab Bremen, Bremen, Germany;

Non-profit laboratories:

1. Erörer Mürcadele, Istambul, Turkey;

2. Open Device Lab Uruguay, Montevideo, Uruguay;
3. Open Ames, Ames, USA;
4. Mobile Portland, Portland, USA;

Laboratories linked to educational institutions:

1. Penn State Open Device Lab<sup>16</sup> hosted by the College of Information Sciences and Technology – Pennsylvania, USA (College of IST);
2. DevLab, located at IDEALondon, partner with UCL DECIDE<sup>17</sup> and executed by University College London (UCL)<sup>18</sup>,
3. MIGHTYminnow Web Studio & School, Okland, USA;
4. Cologne Open Device Lab, Institute of Media and Imaging Technology (IMP) - Cologne University of Applied Sciences, Cologne, Germany;
5. Open Device Lab Melbourne, The University of Melbourne, Melbourne, Australia;
6. St. Clair College Open Device Lab, St. Claire College, Windsor, Canada.

According to Knott (2015), some laboratories lend devices to the community out of the ODL space, as a library. Some of them work in a totally free way and others charge small amounts of money for using it in maintainance and collaboration (Casanovas et al., 2013). Each ODL usually has a website and some social network, such as twitter or facebook. In the website they usually make available brief information regarding the ODLs proposals and the list with the devices available for the community, like Josh Emerson has done. It is also possible to find tips, suggestions and orientations regarding mobiles, stands or other forms of exposing the devices (Figure 4). They publish tips about problems with devices recharging, maintainance, updating and other doubts that usually emerge when one thinks about openning an ODL. Also in a collaborative way, they keep information exchange groups and lists with data that may be relevant for the movement community and events in the technology field.

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<sup>16</sup> <http://odl.ist.psu.edu/>

<sup>17</sup> A user-experience and user-testing initiative by one of the world's leading universities, University College London (UCL).

<sup>18</sup> UCL center for digital innovation.



Figure 4: Shiva Device Lab in Clinchy, Ile-de-France, France

Source: Shiva Devicelab

Currently, the movement is maintained by Anselm Hannemann, who is still the frontend developer of [opendevicelab.com](http://opendevicelab.com) and continuous supporter of LabUp!, and André Jay Meisnner, since 2012, who has been investing his efforts in maintaining and increasing the movement. In order to do so, he has become the administrator and main accountable person for the organization and maintenance of the movement, as well as for the texts, newsletters to the members, social media, press, contacts with the industry, reviewing information to be published, financial investments on things that are not donated and individual support for people interested in opening an ODL or who have any problem with their ODL.

#### 4. ANALYSIS OF RESULTS

The literature review has allowed us to identify the lack of studies regarding the movement, which makes it a current phenomena not yet explored as a potentially revealing case, as well as its importance, due to the citations found in the scientific literature as the main option or alternative to the tests with real devices.

Even if the literature does not approach the laboratories as a central subject matter, we believe that would be important, for enlightening the reader, to inform what the Open Device Labs are. In the succinct way in which they are presented, one may infer that they are something of popular knowledge. If we consider the numerical data on scope in geographical areas, we may consider that these may be acknowledge in countries like Germany, in which there are 29 laboratories in nearly 357.340 km<sup>2</sup> and 80.78 millions of inhabitants, in 2014<sup>19</sup>. We cannot have the same thought about Brazil, for example, in which there is 1 laboratory in nearly 8,515,767 km<sup>2</sup><sup>20</sup> and 202.7 millions<sup>21</sup> of inhabitants. Hyslop & Castro (2013) are

<sup>19</sup> Published in the European Union website (<http://europa.eu/>)

<sup>20</sup> Published in the DOU (Country official journal) n° 16 of 01/23/2013, according to resolution N° 01, of January, 15<sup>th</sup>, 2013.



the ones that comment less on the ODLs, actually they make only one with the web page link.

Through the information found, we have identified that the ODLs have emerged from a concrete demand from mobile technology market that faces the problem of hardware and software fragmentation. The idea of sharing spaces with various devices for tests has become possible because of the network of professionals in technology area that usually works in an open and collaborative way, exchanging experiences and solutions for common problems. It has been established and has been growing due to the voluntary engagement of people interested on the movement organization with visible potential for enjoyment.

We believe that ODLs have become an important structure in the worldwide scenario of tests with real devices for the different projects developed by designers and developers, as shown in figure 5.

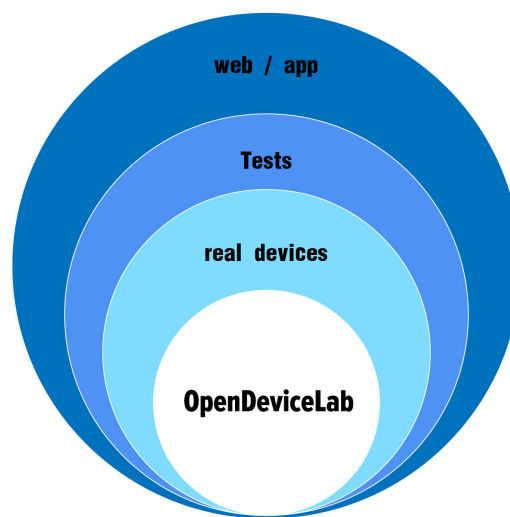


Figure 5: Open Device Lab in the context of tests for web and applications.

Source: Researcher

Besides being a case with great potential for the research continuity, it is important to highlight the usage differential in these shared spaces for those who work specially in the mobile technology area. Even if the laboratories make available equipment such as televisions and desktops, the majority of the devices are mobiles and tablets with different settings already mentioned before.

The movement centralized in the non-profit organization LabUp! <sup>22</sup> and in the website OpenDeviceLab.com has in common mainly the goals. Inside this system, we have identifies, in an initial way, that there are particularities belonging to groups or certain ODLs unities. We believe that they may be derived from the type

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<sup>21</sup> Reuters (2014).

<sup>22</sup> *Non profit organization* - lab-up.org

(resident, mobile or virtual), the culture (country where it is located) or the organizational structure to which it is linked (company, university, coworking, non-profit).

Even if it is still possible to find obstacles in accessing these laboratories concentrated in the areas that initiated its implementation, Europe and North America, due to the geographic distance or to schedule issues, there are advantages in using them. It is not necessary to assemble and structuring one's own laboratory, in which one must worry about the constant acquisition and reposition of devices, with their maintenance and recharging, with the Internet quality, with the acquisition and update of software, with financial investment for maintaining and increasing the structure. Besides that, it is still possible to find an experienced team that may help in the processes of tests and/or problems found with privacy for performing them. However, if the person interested is willing to assemble its own laboratory there will also be advantages in sharing it as an ODL and increase the network that has been growing with the intention of enlarging the offer of devices for tests.

We have found, in the researches, some limitations to answer our research questions and we believe that this difficulty is a consequence of it being a recent movement. Besides that, the work in a voluntary and non-profit way that is in fast growth, stimulated and maintained by professionals in the field with multitask limits the velocity for organizing some information, that is why there are few, limited and disperse data. The laboratories seem to open according to their possibilities and cultural needs in different parts of the world what also makes difficult to access a clear information of what is different in what each one of them particularly propose, besides the main goal of sharing mobile devices for tests. The ODLs linked to educational institutions seem to have a more academic and research focus, and the ones linked to private companies and cowering are more focused in the development of products demanded by the market.

From this literature review, part of a thesis initial investigation study, we have a greater interest in understanding the structure and system of the ODLs linked to education institutions, mainly universities. We have also realized that, in the secondary sources and just a little in the primary ones, there are no mention to the importance of tests in projects of teaching and researching in the field. There are many Design and Technology programs that develop in their courses projects in the field that would also need to be tested, in order to obtain qualification related to tests, such as function, usability, interaction, experience and performance.

We see the Open Device Lab as a community with great potential for contributing with the quality of teaching and research development in the field of Design and Technology programs. From the 148 current labs, there are only six registered as linked to teaching, for us, they seem under explored for the academic field. Thus, we intend to deepen the investigation in what regards its usage potential, through the approximation and study of what is being developed in the laboratories of universities.

## 5. CONCLUSION

In this paper, we have gathered, organized and described information regarding the Open Device Labs (ODLs) movement that point to its first steps in 2011 and initiate its local actions in April of 2012 and starts to structure itself as an organization for generating a global visibility in September of the same year. This research has allowed us to know, in an initial way, the movement and the reasons why it has been maintaining and increasing itself, in a voluntary way, through the few and recent three years. Besides that, we justify its importance by identifying the laboratories in the methodologies, as an alternative in the phases of tests with real devices.

Throughout the paper, we were able to answer the questions that we brought up regarding the Open Device Labs movement. A non-profit, open and collaborative community, which has been growing, due to its maintenance team and its ability of establishing a network of interested and voluntary people. In the end, with the results obtained, it is possible to understand that there are still many questions to be investigated, the movement is recent, it is increasing and there are a lot of professional in the field of digital interfaces involved in the maintenance and maturation of the project. One of the greatest differentials is the collaborative feature coming from the movement organization, the encouragement towards the creation of new spaces or the maintenance and improvement of the existent ones, through the donation of devices and experience sharing, as well as suggestions for advance. We understood the relevance of the movement for using real devices in performing tests and suggest to us the importance of continue the researches with the possibility of increasing the information regarding the movement and understanding its potential for collaborating with the digital community, integrating market, teaching and research. Nevertheless, there is a greater interest in the laboratories directly or indirectly linked to educational institutions for ongoing researches. It is necessary to investigate the way they are organized and how have they been acting. We understand that there is a potential for using these spaces for the educational field, either if they are linked to or hosted by a university or not. For future studies, it is necessary to extend the research corpora and follow the movement through a greater approximation with the multiplicity of the different laboratories, so we are able to understand better their research potential.

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