Open Device Lab (ODL) - a community movement for the use of real devices on web projects and applications. A 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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Abstract

This study presents results from a literature review on the worldwide collaborative movement of Open Device Labs (ODLs). This is a recent initiative, started by professionals, and 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 on different devices in a shared, economic way. The results show the importance of the movement to undertake tests with real devices and obtain better results in the development of web projects and applications at a time of growing fragmentation technology.

Keywords

Open Device Lab, Web, Applications, Test, Real devices.

Resumo

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.

Palavras-chave

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 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 different devices connected to the Internet for those who are interested in it, in order to perform tests on real[1] devices to improve web and application experience. We aimed at answering, partially, the following questions: What are ODLs? What are their goals? How did they appear? How are they organized? How many are there? Where are they? 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 on diverse devices does not mean developing for many different devices.

This diversity of technological options that is present in a market with various devices, brands, models, formats, screen sizes, resolutions, functionalities, operational systems and browsers increases the demand for test laboratories. It is possible to obtain a view of this scenario by observing the numbers in past years. The comparison among mobile devices, desktops, tablets and consoles, considering the last twelve months (April 2014 through to April 2015), shows that the usage of 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 has not presented considerable changes, decreasing from 5.83% to 5.72% and the usage of consoles has been unaltered, remaining at 0.11% with little oscillation in the time period (StatCounter, 2015). The systems fragmentation,

1 The word “real” is used here to highlight that they are different from tests that simulate results, that cannot guarantee and verify the exact answers.

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 ten most popular devices represented 21% of the market; in 2014, however, this number has decreased to 15% - making the practice of tests on a 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; currently, according to StatCounter (2015), among the 14 most used resolutions, the first is 1366x768 pixels, which corresponds to 18.27%, and the second with a much smaller representation is 1920x1080 with 7.31%.

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

In this context, through a literature review, we present information on the movement realized 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 network, a community aimed at meeting the market need of improving web and application usage experiences, through tests with real devices.

2. METHODOLOGY

For this literature review, performed in the time period between April and May of 2015, regarding Open Device Labs (ODLs), the selection of informational resources from available publications were: a) electronic databases – Mendeley, 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 into primary sources, the writings of the community, and secondary sources, books that make comments about the community (Eco, 2007).

The study object being a recent movement, we have selected as primary sources: the organization’s official pages, each ODL website, blogs, newsletters, discussion groups and interviews with the main people involved in the growth, organization and current movement maintenance. These have contributed especially with the organization of the movement, history and proposal.

From 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” has appeared in most of the informational resources with repetition of the results already obtained and presenting new results about studies from seven other 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 Level (ODL) or On-demand learning (ODL) we are only talking about Open Device Lab (ODL).

3. OPEN DEVICE LABS

3.1 IN THE LITERATURE

In the literature, the Open Device Labs are always recommended as a suggestion for tests with real devices, either as a main option or as an alternative. Although there are some divergences among the concepts approached, in these 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 they suggest the usage of ODLs especially for those who do not wish or are unable to invest in their own laboratories.

We have found in the theme of development for the 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 devices in your community so that 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 centre – nearly every city has a mobile device testing centre. 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 others selected. There is a more practical and fast phase for verifying the first possible problems, then it is important to use simulators and emulators[2] , because they solve another parcel of problems. However, in order to really get to know the responses of an ongoing project, one must use the real devices that are most adequate to the targeted market. Here in this most important proposal we have the item 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.

We now present four authors who deal with responsive design Fielding (2014), Jehl (2015), Marcotte (2015) and Peterson (2014). Ethan Marcotte is responsible for coining the term responsive design, which basically deals with flexible grid 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 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 in a sequence, with each team performing their parcels separately, or combined in a hybrid way with design and development.

Here however, when following the process results, window 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 on a real device.

Jehl (2015) proposes to think about responsive design in a responsible way, as he names it. This was a result of experiences in places like Cambodia and other areas in need of resources for development in the world that caused him many problems in using the Internet. He has got to know from a close perspective an unknown sector of device fragmentation, which allowed him to increase his collection for use 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 on real devices are necessary. In order to do that, he suggests the pursuit of 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

2 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 (Peterson, 2014).

is an alternative, although it presents disadvantages, such as: the browser is executed on a different hardware, the updates are slow, the connection speed is usually faster than the one in the emulated device and 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 below, in a succinct way, the phases developed by the author:

1. Load the responsive website URL in 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 the 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 on various devices. The test phases suggested are the same as those approached before in this paper.

Until now, we have in common responsive design, the test phases, the importance of using real devices and the recommendation of ODLs 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 considered, 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 the mobile 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 on devices, it is also important to test them in the real environment.

> *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 an 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 pixel 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 smaller size 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 seek for an ODL.

Satrom (2014) also brings up new themes when writing about the construction of polyfills[3]. He 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 on devices.

That is, the file sizes for mobile devices should have more attention, because they affect the rendering time, they imply more information to be downloaded and consume more data allowance and battery. Using approximated test methods, such as testing the same browser they would use in the mobile phone on the desktop is not the same thing. There are results that can only be obtained if testing is done on 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 out 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, Hyslop & Castro (2013) develop issues on web development, tests, depuration and publication. They work in detail with current concepts regarding HTML

3 [...] Polyfilling 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).

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 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 on 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 tests are a common theme in the literature presented. In general, different project methodologies have foreseen interface tests in different phases of the lifecycle. With the cycle of devices launching and with their new resources, it is fundamental to monitor the mobile device and software market, in order to perform application function 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 on all models (Grigsby & Gardner, 2011; Sillars, 2015).

3.2. THE MOVEMENT HISTORY – FROM ITS ORIGIN UNTIL NOW

We have identified In Grigsby and Gardner (2011), already mentioned, 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 investment in buying devices related to the project to be tested. After that, as an economic alternative they advise 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 considered for some time in Mobile Portland meetings, in the USA. A non-profit organization, founded by Jason Grigsby[4], dedicated to educate, promote and support the mobile technology community in the city and surrounding areas (J Grigsby, personal communication, June 29th, 2015). They would get together once a month for presentations, discussions and networking from the beginning of 2008 until March of 2015, when the last meeting was held (Mobile Portland, 2015). The laboratory was more an action organization for helping local

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

developers and bringing visibility to the city as a destination in mobile technology. Jason commented on the organization's actions at some events, at one of which, Jeremy Keith[5] became aware of what was being developed. After that, on April 30th, 2012, Jeremy Keith wrote on his website[6] about the importance of performing tests on real devices, of how he had been acquiring mobile devices for his collection and, at the end of the text, invited his readers to show up and get to know the laboratory he had 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 first laboratory to the community consisted in not worrying about bureaucratic issues and sharing Clearleft space via 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 frontend developer by that time, has created a page, on Clearleft's website, with the list[7] of available devices constantly updated, containing the brand, the model, the system and the donator. Jeremy kept writing about these actions, stimulating Brighton residents to use the space and suggesting that residents of other locations search for partnerships in their areas and start other sharing communities (Keith, 2012b). A few weeks later, in May 2012, Jeremy Keith and Remy Sharp[8] presented the laboratories idea, at the Mobilism Conference in Amsterdam, and in a few months the movement to open 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, and in Malmo in southern Sweden (Keith, 2012d).

From July, 2012 on, when Andre Jay Meissner[9] 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 act with global visibility. At that time, there were only eight ODLs, all of them in Europe, which had been united in a list published on his website,

5 Irish web developer who is internationally recognized as a conferencier, founded the design 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 and the books, *DOM Scripting* (2005), *Bulletproof Ajax* (2007) and *HTML5 for Web Designers* (2010) (Clearleft, 2015).

6 adactio.com

7 http://clearleft.com/testlab/

8 The founder of company Left Logic, co-author of the book *Introducing HTML5*, author of blog remysharp.com and speaker at tech conferences.

9 Mainly responsible for ODL movement. Entrepreneur, former CEO, speaker, with expert knowledge in SaaS, commercial web, ecommerce and a broad range of experience in IT services.

klick-ass.com, which slowly started to be updated with the opening of new laboratories, until the movement had its own website (Meissner, 2012a).

First, in September of 2012, Viljami Salminen, designer and founder of Helsinki Device Lab, Finland, published the text "Establishing an Open Device Lab" in Smashing Magazine, which became one of the most important actions that really spread the ODL idea around the world. Second, Andre Jay Meissner created the NPO (non-profit organization) LabUp!, organized with Anselm Hannemann[10], Christian Schaefer[11], Timm Jansen[12], Viljami Salminen and Bruce Bowman's[13] collaboration. A website was set up 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 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 for the movement, speaking at conferences, writing papers and arranging events (Meissner, personal communication, June 1st, 2015).

At the same period, the laboratory in Portland resumed its actions, in order to complete the bureaucracy, physical space, device, 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 published the ODL directory: OpenDeviceLab.com. This website became the main way 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 of media advertising for the newly opened ODLs, their assessments and events related to the movement. Mannheim ODL also published, in the same month, the application Open Device Lab, Android version, with functionalities similar to the website (Meissner, personal communication, June 1st, 2015).

On October 26th, 2013, for the first time, nine ODLs and LabUp! managers got together in Nuremberg for an in-person meeting. Until then, they would communicate through a specific group on Google groups, through low frequency reports at LabUp! or directly through Twitter, for example. The in-person 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 ideas of communication and common goals could be advanced with joint efforts. Some of these practices, such as the judicial ones, would apply more to Germany and

10 Opendevicelab.com frontend developer. Writes on the topic of social media support and continuous supporter of LabUp! since October, 2012.

11 Opendevicelab.com backend and additional frontend developer and social media supporter and collaborator of LabUp! from October 2012 to January 2014.

12 Developer, computer scientist, provided support for the movement.

13 Product Manager of Adobe Shadow, later Adobe Edge Inspect used by some ODLs.

Europe, however, the meeting has generated a post with several suggestions for all the already registered ODLs (Meissner, 2013d).

In November of the same year, LabUp! organized the first dedicated Open Device Lab, specifically for the event Beyond Tellerrand, an 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 performed several tests on 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 on Meissner's website, explaining how to assemble an ODL for specific events (Meissner, 2013c).

In January of 2014, they incorporated DYDD[14] (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 device donations and to publicize the ODLs. The results of the different actions performed by LabUp! for promoting the movement have resulted in a nomination for Game Changer 2014[15].

3.3. MOVEMENT - PROPOSAL AND STRUCTURE

The organization defines itself as a voluntary and community movement that, through laboratories, shares 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, 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

14 http://opendevicelab.com/DYDD
15 This category 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).

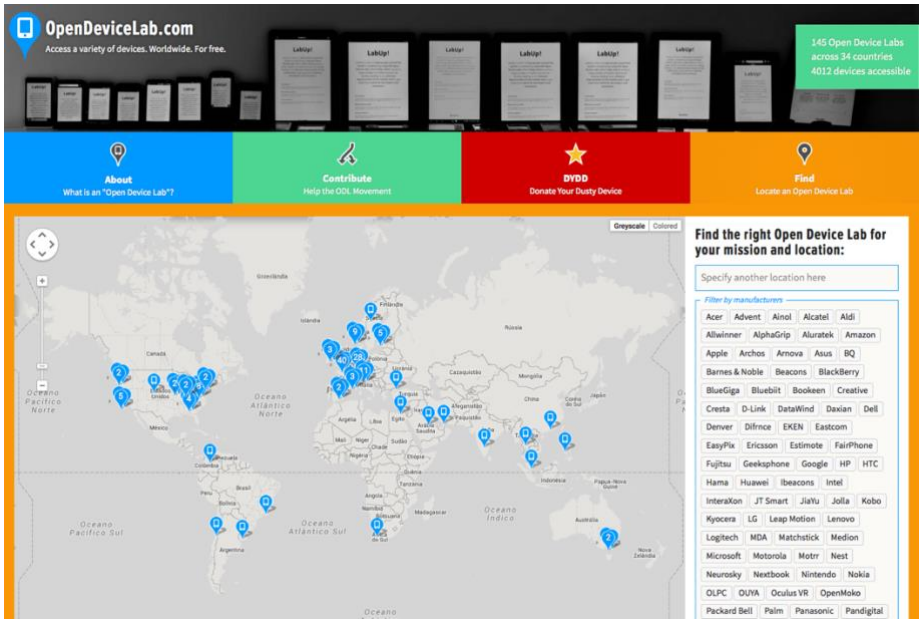

Figure 1: Part of the Open Lab Device website with the general map of ODLs in the world.

Source: Opendevicelab.com

The website has been created to be the main means to locate a laboratory and leverage the movement. It is possible to find their goals, total of opened laboratories, scope of 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 to the movement's growth, to make it visible, donate devices through DYDD, give suggestions and evaluate the visited ODLs.

The movement, until last April (2015) has completed three years, since the first laboratory opened its doors to the external community. Progressively, it finished the year of 2012 with more than 30 ODLs registered (API Open Device Lab, 2015), by the end of 2013, there were 96, by December of 2014 there were 136, and at the present moment, July of 2015, there are 148. This total is distributed across 34 countries with 4069 devices for use with the majority located in Europe and North America. There are 105 labs in 18 countries in Europe: 27 in Germany, 25 in the United Kingdom, nine in Norway, nine in The Netherlands, four in France, four in Austria, three in Belgium, four in Sweden, four in Switzerland, four in Italy, three in Denmark, two in Spain, two in Finland, one in Ireland, one in Jersey, one in Latvia, one in Poland and one in Turkey. There are 28 labs in North America, 25 in the USA and three in Canada. In Latin America, the total is four, the first one being opened in December of 2012 in Santiago,

Chile. The area, still with few presently, offers another three ODLs: one in Rio de Janeiro, Brazil, one in Montevideo, in Uruguay, and one in Bogota, in Colombia. In Africa, there is one in South Africa and one in Egypt; in Asia, there are seven: one in Saudi Arabia, one in United Arab Emirates, one in India, one in Thailand, one in Singapura, one in China and one in the Philippines. In Oceania there are two, both in Australia. One can see below, in Figures 2 and 3, these numbers in a comparative way, by area and country.

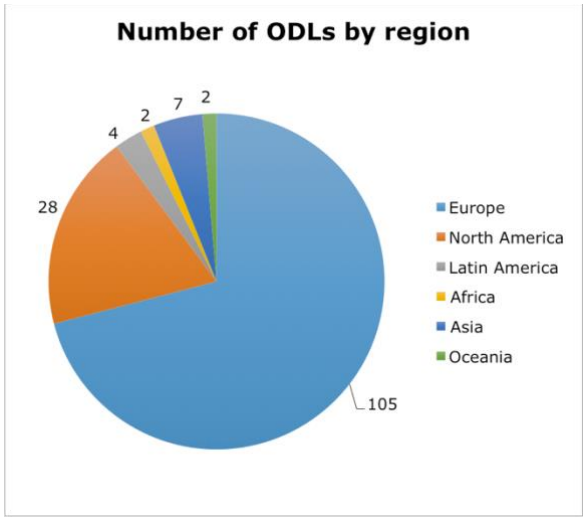

Figure 2: Chart with the number of laboratories by region, registered at OpenDeviceLab.com.

Source: Researcher, Database api.opendevicelab.com

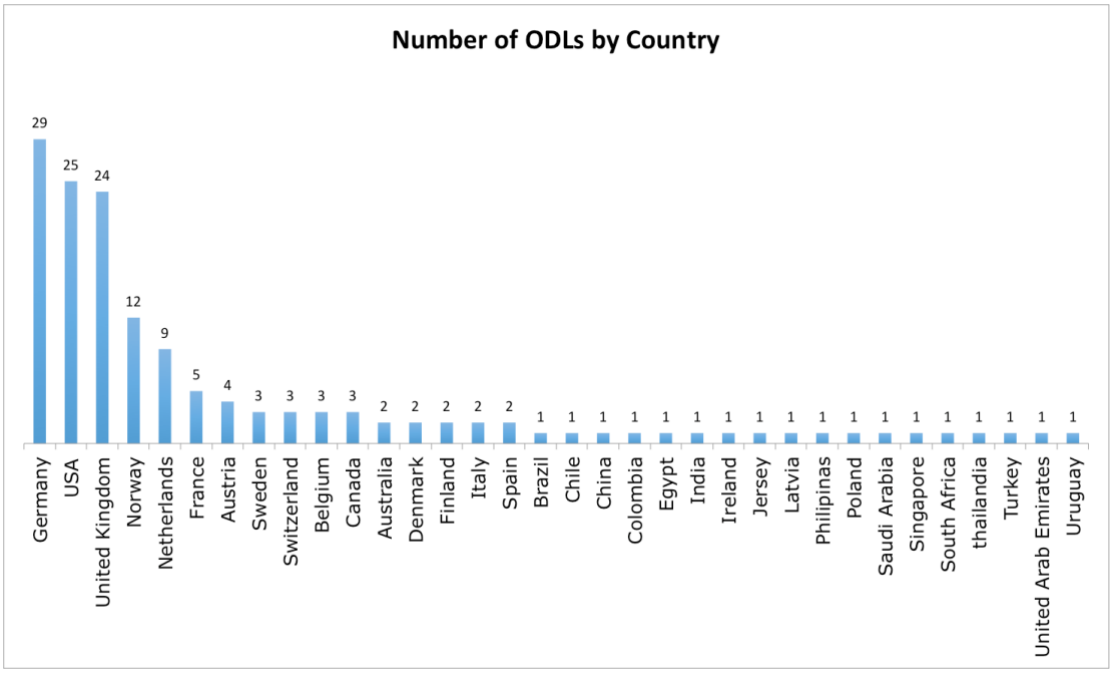

Figure 3: Chart with the number of laboratories, by country, registered at OpenDeviceLab.com.

Source: Researcher, Database api.opendevicelab.com

The 148 ODLs existent currently have different settings and structures. Regarding their types, previously explained, they may be resident, mobile or virtual. Presently, according to API (2015) registers, from the total, two are virtual, eight 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 co-workings or non-profits. Besides these, in the researches carried out until this moment, we also found laboratories organizational settings linked to educational institutions. Based on api.opendevicelab.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, Belgium;

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, Istanbul, 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[16] hosted by the College of Information Sciences and Technology – Pennsylvania, USA (College of IST);

2. DevLab, located at IDEALondon, partner with UCL DECIDE[17] and executed by University College London (UCL)[18];

3. MIGHTYminnow Web Studio & School, Oakland, 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. Clair 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 a small fee for use in maintenance and collaboration (Casanovas et al., 2013). Each ODL usually has a website and some social network, such as Twitter or Facebook. On the website they usually make available brief information regarding the ODLs proposals and the list of the devices available for the community, as 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, maintenance, updating and other issues that usually emerge when one thinks about opening an ODL. Also in a collaborative way, they maintain information exchange groups and lists with data that may be relevant for the movement community and events in the technology field.

16 http://odl.ist.psu.edu/

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

18 UCL centre for digital innovation.

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

Source: Shiva Devicelab

Currently, the movement is maintained by Anselm Hannemann, who is still the frontend developer of opendevicelab.com and continuous supporter of LabUp!, and Andre Jay Meissner, 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 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 literature, as the main option or alternative for tests with real devices.

Even if the literature does not approach the laboratories as a central subject matter, we believe that it 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 this may be acknowledged in countries like Germany, in which there are 29 laboratories in nearly 357,340 sq km[19] and 80.78 million inhabitants, in 2014[20]. We cannot have the same thought about Brazil, for example, in which there is one laboratory in nearly 8,515,767 sq km and

19 Published in the DOU (Country official journal) nº 16 of January 23rd, 2013, according to resolution Nº 01, of January 15th, 2013.
20 Published on the European Union website (http://europa.eu/)

202.7 million[21] inhabitants. Hyslop & Castro (2013) comment less on the ODLs; actually they make only one, with the web page link.

Through the information found, we have identified that ODLs have emerged from a concrete demand from the 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 the technology area who usually work 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 in the movement organization with visible potential for enjoyment.

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

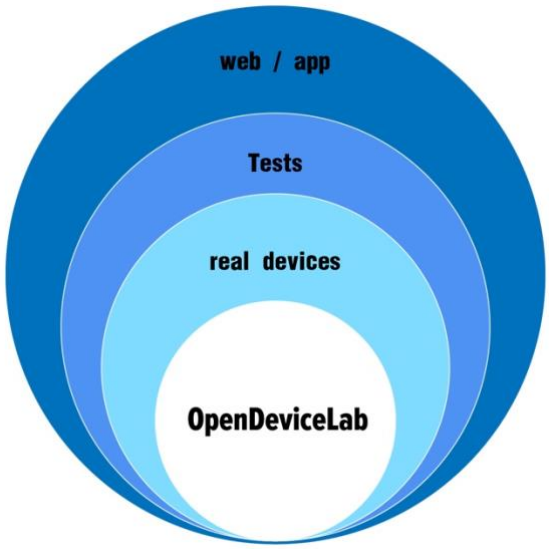

Figure 5: Open Device Lab in the context of tests for web and applications.

Source: Researcher

Besides being a case with great potential for this research, it is important to highlight the specific purpose of these shared spaces for those who work specifically 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.

The movement centralized in the non-profit organization LabUp! and in the website OpenDeviceLab.com has mainly the same goals. Inside this ecosystem, we have

21 Reuters (2014).

identified, in an initial way, that there are particularities belonging to groups or certain ODL unities. We believe that they may be derived from the type (resident, mobile or virtual), the culture (country where it is located) or the organizational structure to which it is linked (company, university, co-working, 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 structure one's own laboratory, in which one must worry about the constant acquisition and repositioning 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 their own laboratory there will also be advantages in sharing it as an ODL and increasing the network that has been growing with the intention of enlarging the offer of devices for tests.

We have found, in our researches, some limitations to answering our research questions and we believe that this difficulty is a consequence of it being a recent movement. Besides that, the work is in a voluntary and non-profit way that is in fast growth, stimulated and maintained by professionals in the multitask field that 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. In addition, it seems to be what makes it difficult to access clear information of what is different in each one of them; particularly proposes, 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 co-working are more focused on 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, there is little information in the secondary sources and less in the primary ones; there is no mention of the importance of tests in projects of teaching and researching in the field. There are many Design and Technology programmes 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 programmes. From the 148 current labs, there are only six registered as linked to teaching, and 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 initiation of its local actions in April of 2012 and to its start 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. It is a non-profit, open and collaborative community, which has been growing, due to its maintenance team and its ability to establish 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 professionals 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 continuing the research 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 research. It is necessary to investigate the way they are organized and how they have 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 corpus 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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