OPEN SOURCE IN URBAN PLANNING AND ARCHITECTURE: EXPERIENCES AND GUIDELINES FROM TRADITIONAL CULTURES, PARTICIPATORY PROCESSES AND COMPUTER SCIENCE

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Keywords

open source; architecture theory; traditional cultures; participatory processes

Abstract

Open Source (OS) philosophy can cause important effects both in the design processes and in the professional role of designers. It started as a computer science phenomenon and has rapidly spread to other fields, such as architecture and urban planning. However, there are few studies reflecting about its impact, and there are not guidelines for managing its possible consequences. This article offers some insights considering three main sources: (1) current OS experiences in architecture and urban planning, (2) past traditional and participatory design strategies, and (3) works in computer science about OS. These three topics are conceptually linked using as an index some OS attributes expressed in the OS initiative definition. With that background, guidelines are finally proposed. The article demonstrates that current OS initiatives in architecture and urbanism have many similarities with past design processes and recent computer science experiences. Both subjects can be used as precedents in order to adequately incorporate and adapt OS thinking, a revolution that, depending on the managing skills, could improve the quality of the design and the designer’s profession, or provoke a crisis in the current professional model.

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INTRODUCTION

Open Source (OS) concept is having a great influence in many fields of culture (Goyal, 2013). It has also reached architecture and urban planning, where its principles, combined with other trends such as Do It Yourself (DIY) movements and increasing popularity of 3D printers, can have important effects in the current common design strategies and the role of the designers themselves. How can we manage the influence of OS? Which references can architectural and urban designers follow in order to appropriately adapt to this revolution? These are the main questions addressed in this article.

OS tendencies started in the field of computer science some decades ago. In order to understand the concept, it is important to know that most computer programs are basically made from a set of instructions, commonly written in a human understandable language (i.e. high level languages). To be executed by a computer, these instructions (called “source code”) need to be translated into a machine-understandable “low level” language, a process which is done with two tools named compiler and assembler (Stallman, 2002).

Since the 1980s, the most frequent mode for distributing software is called “proprietary” (Weber, 2004). In this modality, a company writes the source code for its programs, compiling it later and selling licenses for using the compiled code. This system protects the source code for the company through intellectual rights laws, increasing its profits, and making it impossible for the user to understand what is happening below the execution of the software they have bought, or modify the program.

Simultaneously, and starting from some pioneering experiences in the 1970s, another distribution mode has been consolidating. In this second method, programmers freely share the source code, which they improve in a progressive collaboration process. This source code (or a compiled version) is made available for anyone, usually free of cost, and can be downloaded by computer users without any proprietary license. For that reason, this tendency has been called OS movement, which has produced an increasing number of applications. In fact, today OS “is already a major part of the mainstream information technology economy” (Weber, 2004, p. 5).

As OS can be understood as a general “way of organizing production, of making things jointly” (Weber, 2004, p. 224), this approach has spread from Information and Communications Technology (ICT) to many other disciplines and daily life, especially boosted by the notable progress in communications which makes it possible to increase the amount of information exchanged. In that sense, OS is highly related with public participatory and collaborative processes, dependent of recent interactive tools such as social networks, which in some cases are replacing the past role of public spaces (Gardner, 2009). Some of its applications comprise the writing of a public global encyclopedia such as “Wikipedia”, the development of “crowdsourcing” initiatives in order to retrieve information from many participants (Howe, 2006) or the discovering of new drugs (Årdal et al., 2011). OS has also produced a revolution in intellectual rights management, with the emergence of new type of permissions which widen the traditional “copyright” concept, for example in the form of the increasingly popular “Creative Commons” licenses (Creative Commons, n.d.).

Following the logics of dissemination to other fields, OS principles have reached architecture and urbanism, where they are inciting changes both in the design processes (Sprecher, 2012; Vardouli and Buechley, 2014) and the figure of the professional designer (Parvin, 2013). Interestingly enough, in 1999 American software developer Eric Raymond wrote an
article about OS development, which he entitled “The Cathedral and the Bazaar”, where he associated proprietary and OS production models respectively with the architectural concepts of the cathedral and the bazaar. In opposition to the reverent cathedral-building of the proprietary software, the OS movement was described as a “great babbling bazaar of differing agendas and approaches” (Raymond, 1999). Following that opposition, it is possible to identify certain common characteristics shared by OS and traditional cultures or user participation approaches developed in the 1960s (Goyal, 2013). This parallelism is interesting because some studies about those previous design systems can be useful as references for the development and integration of OS tendencies.

Considering these facts, this paper claims that we need references and guidelines for adequately managing future changes linked to OS concept in architecture and urbanism, especially in a global context of limited resources (Bardi, 2011). However, there has not been enough reflection about OS implications for architecture (Fok, 2014). As the original and main area of development of OS is computer science, and it has similarities with the aforementioned traditional and participatory processes, insights for that management can be found in studies about both topics. Bearing that in mind, the article has two main aims: (1) Classify and analyze current OS initiatives in architecture and urban planning, using the OS definition (Open Source Initiative, n.d.) as a base for identifying common characteristics with traditional building systems and some previous user participation approaches; and (2) provide some basic lines for the future management of OS tendencies.

The main results of the study are three. Firstly, it proposes a systematic classification of current OS tendencies, not present in previous studies, which can be useful for the study of a spreading phenomenon. In second place, using the characteristics enumerated in OS definition, it establishes the relationship between OS attributes, current experiences in Architecture and Urban Planning, and past facets of traditional cultures and participatory processes. Finally, the article provides guidance for the study and the management of OS tendencies, based on the previous analysis.

BACKGROUND

Previous studies about OS in Architecture and Urbanism

Kaspori (2003) was one of the first authors who reflected about OS in architecture. He used the aforementioned Raymond’s metaphor of the cathedral and the bazaar, and wrote that OS “provides an organization model for the collective development of solutions for spatial issues involving housing, mobility, greenspace, urban renewal and so on”. He also pointed out the necessity of understanding architecture not just as the process of designing aesthetic objects, but also as a learning and discussion process linked with OS philosophy. The specific term “Open-source architecture” (OSArc) was initially coined in the number 948 of Domus Journal (2011), and is in continuous revision in its Wikipedia page. This concept refers to the development of “spatial design towards a collaborative use of design and design tools by professionals and ordinary citizen users”.

In recent years, more studies about this topic have appeared. Sprecher (2012) has reflected about the changing object of study of the architecture, from a static element to an “organism shaped by intensive computational operations”. This author has also written about the design process, which in OS is in continuous evolution, in opposition to the conventional structure of cause and effect. Parvin (2013) has worked about these subjects, addressing the possible
consideration of OS as a threat to the existing profession, and concluding that, if correctly done, it can be a “good business”. The question of the intellectual property in architecture has been studied by Fok (2014).

Finally, Vardouli and Buechley (2014) explore how the OS metaphor has been applied to architecture, reviewing critically its meaning, and concluding that it ideally would require providing access and empowerment to users (proposing Building Information Model – BIM, as an interesting platform for it). Consequently, an OS architecture would not just require “openly publishing architectural designs”, but also “a rethinking of the discipline’s theory and practice”, including changes in the roles of the people involved, what connects to the statements of some previous scholars.

Study of design-build processes in traditional cultures and participatory processes

Goyal (2013) developed a similar approach to the one proposed in the current work, comparing OS philosophy in design with “the pre-Renaissance building methodologies and also to the user participation approaches of the 1960s”. As he has studied the second ones, the present article will focus specifically in the “pre-Renaissance” methodologies.

Turning back to Raymond’s metaphor, the development of OS (bazaar strategies) can be understood as a crisis of the “cathedral” system. Linking this with the history of Architecture, it is important to remember that the building process of cathedrals has been frequently associated with the emergence of the modern figure of the professional architect from the master builder. This role appeared as the result of a specialization trajectory in medieval guilds (which are actually very related with bazaar schemes). In fact, Castex (1994) writes about the final stage of that evolution in the construction of the dome of the Cathedral of Florence (Italy), started by Brunelleschi in 1418. Therefore, a transition from a “cathedral” model to a “bazaar” system, as the one that OS could represent, may lead to a crisis in the design processes and the figure of the contemporary professional architect.

This opposition between professional-creation methods and “bottom-up” traditional strategies has been studied by several authors. A complete and interesting portrait of the situation was presented by Alexander in his book “Notes on the Synthesis of the Form” (1964). In that work, he addressed the differences between the design techniques of “unselfconscious” and “self-conscious” cultures. In the first ones, there are trial-and-error collaborative strategies, which allow builders to improve their constructions over time, without the necessity of prominent figures or academies. The second one corresponds to our current model, where design processes are professionalized. In later works, Alexander developed a “pattern language” in order to allow the contemporary designer to use bottom-up strategies, and developed a systematized multi-scale design system (Alexander et al., 1977).

A similar distinction was made by Rudofsky (1964) in a famous book and exhibition, where he explored the values of the “architecture without architects”, or “non-pedigreed architecture”. Rudofsky studied the creations of traditional cultures, concluding that many of those vernacular or spontaneous works had very interesting spatial characteristics. Recently, Berque (2013) has explored the differences between old cultures with landscaping thought (or without a stable concept of landscape) and current societies with landscape thinking (or with a complex analytic system about landscape). Considering these and other examples, it is possible to state, as Pak (2016) does, that nowadays “bottom-up participatory architectural
practices can hardly be considered as novel” (p. 26). Table 1 shows some of the terms used in the last decades, referring to the opposition between a traditional bottom-up model and the contemporary culture (see table 1).

Table 1: Different studies about the opposition between traditional and contemporary strategies of design/building. (Source: The Author).

<table>
<thead>
<tr>
<th>Traditional model</th>
<th>Contemporary model</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unselfconscious cultures</td>
<td>Self-conscious cultures</td>
<td>Alexander (1964)</td>
</tr>
<tr>
<td>Architecture without architects (Non-pedigreed architecture)</td>
<td>Architecture by architects (pedigreed architecture)</td>
<td>Rudofsky (1964)</td>
</tr>
<tr>
<td>Spontaneous architecture / urbanism (spontaneous design)</td>
<td>Technical/modern architecture (voluntary design)</td>
<td>Quaroni (1967)</td>
</tr>
<tr>
<td>Vernacular / folk / popular architecture</td>
<td>High-style and modern</td>
<td>Rapoport (1969)</td>
</tr>
<tr>
<td>Popular architecture</td>
<td>Professional architecture</td>
<td>Flores (1978)</td>
</tr>
<tr>
<td>Spontaneous organization</td>
<td>Systematic production</td>
<td>Sorre (1962)</td>
</tr>
<tr>
<td>Unplanned city</td>
<td>Planned city</td>
<td>Kostof (1991)</td>
</tr>
<tr>
<td>Landscaping thought</td>
<td>Landscape thinking</td>
<td>Berque (2013)</td>
</tr>
</tbody>
</table>

**METHODS**

The methodology used for this study is divided into four stages. The first one corresponds to the phase of detecting and identifying current applications of OS in Architecture and Planning. To do that, several searches were performed using the terms “open source architecture” and “open source urban planning” in common academic databases, namely Web of Science and Scopus. In both cases, research areas were limited to “Architecture” or “Urban planning”, as OS term is very common in other fields such as engineering. Taking into account that OS is an emergent field and it tends to use informal diffusion structures, other searches were conducted using Google general search and Google Scholar. A selection of the most interesting cases was extracted from the outcome of these searches, containing both publications about OS concept and lists of examples.

Second stage refers to the classification of examples. The proposed taxonomy was defined considering the available cases of study, establishing fields with relative autonomy. Nevertheless, it is important to remember that most of the experiences show attributes corresponding to different classification groups, but for the ease of presentation, each one was assigned to a main category.

The next stage develops a study of similitudes between them and past design and participatory strategies, using OS definition provided by OS initiative (n.d.) as a base for indexing. In that way, each attribute of OS contained in the definition was linked with different types of experiences, and with specific characteristics of the mentioned strategies. Finally, the fourth phase addressed the redaction of guidelines for future study and management of OS influence, inspired in the analysis of both computer science studies and works about traditional or participatory design processes.
RESULTS AND DISCUSSION

Classification of main OS processes and experiences in architecture and urban planning

Attending to the common characteristics of different OS experiences in Architecture and Urban Planning, it is possible to classify them into five groups:

1. OS Software Availability

The most immediate outcome of OS movement affects directly to the software tools commonly used for architecture and urban planning. In past years, many alternatives to proprietary software have appeared, and today it is possible to develop building or planning projects with OS tools (most of them at no cost). The main progress in that area corresponds to Computer Aided Design (CAD) programs, Geographical Information Systems (GIS), 3D modelers (Dounas and Sigalas, 2009), vector graphics edition and image manipulation tools. The availability of OS BIM software is limited, but some teams are developing solutions in this line (OpenBIM, n.d.).

Apart from making it possible to work with free or low cost design tools, which is interesting for new teams in periods of economic difficulties, this affects the design process in the sense that it can foster architects and urbanists to think in a more scientific way. OS software is very widely used in the scientific community, and one of its main features is the ability to share data between different types of applications, as well as encouraging users to explore and understand the mechanisms which underlies the programs, which is positive for developing abstraction skills.

2. Consolidation of Collaborative Networks

In addition to the obvious incidence in the architectural software, OS concept is having an important effect in design processes. Regarding the collaborative way of working, it is possible to find initiatives such as “Open Architecture Network” (Parvin, 2013), defined as a “community dedicated to improving global living conditions through innovative and sustainable design”. Crowdsourcing strategies have also been used in order to retrieve information to study urban form and function (Crooks et al., 2015). Other examples are the creation of 3D city models (Roupé and Johansson, 2010) and the developing of collaborative cartography (with “openlayers” as main example).

Progress in this field is very relevant for designers, because it allows them to share ideas and resources in a flexible way, including real-time collaboration processes and the possibility of collecting information from citizens. But we need new tools for manage information flows, and projects as softGIS deserve special mention: it is a framework for enhancing “participation by allowing the residents the possibility of sharing their knowledge of their living environment with urban planners and researchers” (Kahila & Kyttä, 2009). Crowdfunding strategies, which make it possible to gather economic resources, are also growing, and its impact for bottom-up design strategies has been addressed by Pak (2016), who points out its wide possibilities for supporting collaborative design processes.
3. New Conditions for Projects Access and Distribution

In the field of intellectual property changes, some initiatives have appeared in recent years for the free diffusion and reutilization of architectural projects. For example, the “PFCcommons project” publishes Final Degree Projects under a Creative Commons License, which permits studying and re-using them by other students and professionals. In another significant case, 2016 Pritzer prize Alejandro Aravena has published in his team webpage (Elementalchile.cl) some projects under open source license, for its free distribution and reutilization.

This fact can have an important impact, mainly in the fields of learning and education. In a similar way as the transformation happened in the editorial market, which is changing the manners of gathering information, freely distributed projects can make design innovations more accessible for students. It is a process running in parallel with the apparition of scientific open access journals, which makes knowledge freely available through the internet. Nevertheless, as will be discussed later, the unlimited use of free models or its repeated application to different places can be a problem if we are not capable of developing context-adaptation mechanisms.

4. Appearance of Full Design and Construction Frameworks

Full design and construction processes inspired in OS philosophy can be found in the “Open Structures” or the “WikiHouse” projects. The aim of the first one is the development of “a modular construction model where everyone designs for everyone on the basis of one shared geometrical grid” (OpenStructures, n.d.). The second was started in 2005 by Architecture 00 studio, and it is defined as “an open source building system”, developed by “many designers, collaborating to make it simple for everyone to design, print and assemble beautiful, low-energy homes, customized to their needs” (Parvin, 2013). There is also the “Open Source Ecology” project (Open Source Ecology, n.d.), an organization founded in 2003, whose main members are farmers and engineers. They are developing the so-called “Global Village construction set”, which will make possible “the easy fabrication of the 50 different Industrial Machines that it takes to build a small, sustainable civilization with modern comforts”, and includes a “microhouse” between its components.

These initiatives are commonly linked with Do It Yourself (DIY) processes (Doane and Rumbo, 2015), as well as with the recent availability of 3D printers or Computerized Numerical Control (CNC) machines, which may allow building those sets in an automatized way. Parvin (2013) mentioned other initiatives related to this topic, such as the “Segal self-build method”, developed by German Architect Walter Segal (Lee, 2006). In addition to these architectural examples, it is worth to mention that other branches of industrial production are exploring these type of strategies, e.g. using “cloud manufacturing” structures (Tao et al., 2011). It is also interesting the proposition of Stoutjesdijk (2013), for an open-source building system “with digitally fabricated components”. There has been studies about mass-customized designs (Celento, 2010), and it has been considered that OS designs can solve demands for high-density housing in rapidly growing countries (Gao et al., 2015), and crises (Sinclair, 2006). What is clear, from this number of examples, is that OS is affecting building processes, and that it may change our way of understanding design in the following decades.
5. Collaborative Management of Public Spaces

Urbanism has also received the powerful influence of OS thinking. Processes for the collaborative management of public spaces appears worldwide, frequently developed in the context of urban agriculture, as Pudup (2008) studies, analyzing the evolution of “community gardens”. Collective neighborhood networks and public appropriation of vacant spaces are also relevant examples, and a list of these type of projects has been provided by Arredondo-Garrido (2014), who mentions many of them, such as “estonoesunsolar” in Zaragoza and “Campo de Cebada” in Madrid (Spain), Moritz Plazt in Berlin (Germany), or San Francisco Victory Garden (USA). According to this author, these are representative examples of a growing tendency in 21st century: the production of fresh food inside cities, which may be a key concept for the future development and planning of metropolitan areas. Another interesting case, focused in the local participation for designing public spaces, is the “Dreamhammar project” in Norway, headed by the “ecosistema urbano” team (Senciuc and Leco, 2013), an initiative which makes it possible for citizens to take part in a “collective brainstorming” for defining their new square.

6. Emergence of Full Urban Planning Strategies

Apart from those strategies mainly oriented to specific public spaces, OS principles can be used for the whole city design and transformation. Notable is the pioneer approach to this subject by Austrian architect Christopher Alexander, described in his book “The Oregon Experiment” (1975). In that project, an experimental approach to collaborative planning for a new campus for the University of Oregon (USA) is fully documented, based in some principles that inspired posterior works of that author. As well as in exceptional new-plan projects like this, some teams are also applying participatory strategies to urban renewal. As Mayer et al. (2005) state, it is necessary to develop tools in order to make it possible for stakeholders to share knowledge for decision-making. In this sense, collaborative frameworks, such as the aforementioned softGIS (Kahila & Kyttä, 2009) and others, have being developed in recent years.

Regarding this line, it is also interesting to consider the UK Conservative Party (2010) proposal of a green paper about “open source planning”. In that document, a radical reform of the UK planning system was suggested, using OS principles with three main objectives: “restore democratic and local control over the planning system, rebalance the system in favor of sustainable development, and produce a simpler, quicker, cheaper and less bureaucratic planning system”. That proposition received several critics, including a response from the Royal Institute of British Architects (2010). Subsequent implementation of that planning framework was also negatively received by academic and professionals, like Raco (2013), who stances that the proposal “will not devolve power to local communities and citizens but create new forms of distancing and disempowerment.” This debate is representative of the difficulties that some OS ideas, which work well for software development, find when switching them to other fields.

OS characteristics, traditional and participatory creation processes

The mentioned group of experiences can be linked with different characteristics of OS, as well as with several attributes of traditional or participatory processes. I describe these relationships below, using some principles of the OS definition provided by Open Source Initiative (n.d.) as an index:
1. Free Redistribution

This OS attribute is specially linked to the new conditions for projects access and distribution (3rd group of experiences). Likewise, it is worth to note that in unselfconscious cultures, there are construction rules linked to a complex tradition (Alexander, 1964), that generally is not controlled by any institution: new designer-builders can learn from others, for example by oral transmission modes. Those vernacular processes can today be used as models for “sustainable design and deeply respond to the economic and environmental requirements” (Yousuf, 2011, p. 117).

In those pre-Renaissance models, there was no necessity of paying a professional for taking advantage of his knowledge, as the know-how was shared in open communities. Changes in this sense could have important effects in contemporary designer's role and earnings.

2. Source code must be included with the program

As in OS not just the result (compilation), but also the original code is distributed, in OS architecture the important point would be the plans and instructions for building, more than the conventional processes which finishes with a construction. The changes in this line are appreciable again in the experiences of the 3rd group, but also in the appearance of full design and construction processes (4th group). It is interesting to note that, in traditional processes, the building processes were linked to myths, ritual or taboos (Rykwert, 1985). The builder did not only know how to construct, but usually also a mythological story with a set of stages and instructions, which can be assimilated to a “source code”.

3. Derived works from the original work must be allowed

New full design strategies based in OS (4th and 6th of the aforementioned groups of experiences) allow the community members to freely modify structures or plans. This may open a fierce debate about intellectual rights management (Fok, 2014). Interestingly, in spontaneous processes continuous flows of failure and correction can be found (Quaroni, 1967), which makes it possible to improve progressively and collectively the results from the original stage.

4. No Discrimination Against Persons or Groups

According to OS definition, anyone can collaborate in improving the source code, independently of its position, profession or academic grade. This would be an interesting opportunity for effective integration of user's view, which may affect specially the examples organized in groups 2nd, 4th and 5th. This fact can create some conflicts and dilute the importance of the "first" or "main" designer, and empower the collaborative work of organized communities (Goyal, 2013). In traditional cultures, as the owner is often also the builder/designer (Flores, 1978), people from many groups can develop the construction model and enhance it. Nowadays, this characteristic is linked with the aforementioned DIY processes and the emergence of technologies as 3D printers.

5. License Must Not Restrict Other Software distributed along with the licensed software

This attribute is interesting for managing possible changes for the current role of architects and urbanists, because in spite of new conditions for projects access and distribution pointed out in the experiences of the third group, conventional closed intellectual rights can be kept in parallel with OS strategies. In the case of traditional processes, the existence of a popular
set of rules for building, developed and improved over the time, did not prevent from the apparition of specific groups specialized in some relevant buildings. These groups were progressively consolidating, and finally developed professional roles.

6. License Must Be Technology-Neutral

This last selected characteristic of OS definition affects to the technical capabilities and the distribution modes of OS software, and it is specifically relevant for the examples of the 4th group and the management of resources. In architecture and urbanism, it would imply that OS strategies must be realizable using both technologically advanced systems and traditional modes. The development of this attribute can be seen, in some examples, in the adoption of easy building strategies, affordable for anyone, sometimes into a DIY framework. In traditional cultures, spontaneous building processes generally remained elementary and associated with low-technology construction systems, so the delivered set of instructions were applicable to many situations.

GUIDELINES FOR THE FUTURE

In order to manage changes in architecture and urbanism due to OS philosophy spreading, and considering the aforementioned examples and relationships, two sources may be used as references: strategies in traditional cultures / participative processes (often a “bazaar” system), and experiences in fields with a broader trajectory in OS applications (mainly computer science). Some possible guidelines taken from these fields are listed below.

1. The designer's role as a head of communities and manager of control mechanisms

In many cases, in an OS architecture the designer may act not as a prominent figure who develops and finishes a project (alone or into a limited team). This would change the professional role of designers, and especially of the so-called “anti-Vitruvian” architects: those who use the act of building “for personal exploration and expression” (Salama, 2007, p. 118).

But the OS architect could develop organizational skills in order to head a community of developers and establish control systems over the work done by open source peers. In this sense, it would be useful to consider the structure of three concentric circles described by Årdal et al. (2011): an inner core team responsible for most of the design; a middle circle of developers who collaborate in design, mainly performing “peer review and fix bugs”; and a third circle of individuals “who report bugs”, but do not design. A good example of participative system, with the designer as “moderator”, can be found in the mentioned plan for the University of Oregon (Alexander, 1975). Sometimes, the designer’s role can be important for attracting participation, as sometimes it is difficult for newcomers to start OS software projects (Steinmacher et al., 2015).

2. Maintaining isolated projects would be also possible

Many OS software projects are not really developed by wide communities, but by reduced teams (Årdal et al., 2011), and it has been argued that “the size of the development team negatively affects software development productivity” (Scholtes et al., 2016). Therefore, it would be possible to maintain the coexistence of small specific design teams with big open communities. But the first ones must decide whether they integrate in OS models, or...
continue working exclusively in proprietary mode (as described earlier, OS definition considers the possibility of including licensed software). Current scenario tends to maintain the second modality, but OS tendencies can progress a lot in future years, especially in response to a negative economic context and resources limitations. In traditional cultures, spontaneous architecture coexisted with emerging masters who devoted to certain type of works (as the public infrastructures or main buildings), so it would be interesting to explore thoroughly those relationships.

3. Working in a shared source code, more than in final architectonic or urban results

According to Vardouli and Buechley (2014, p. 53) OS architecture must imply "open sharing of the digital files that encode information on built artifacts", and Building Information Models (BIM) is the more adequate platform for it. In this sense, OS supposes a paradigmatic change which can be seen in the examples of the aforementioned 3rd and 4th group: the production could be focused in generating adaptive structures and strategies, progressively improved, which final designers, builders or users can freely adapt to their necessities. This model seems similar to the progressive strategy described by Alexander (1964), so his study of the design processes of “self-conscious” creators is of full interest for analyzing OS changes. Working in that line could also be useful for providing solutions for humanitarian problems (Sinclair, 2006).

In this point, a possible disadvantage of OS Architecture can be pointed out: if the “source code” is directly applied to different places with unique characteristics, it will not answer the questions of adaptation to each context: local climate, culture, heritage, etc. If we do not want to create such uniformity, it is important to stress the role of one of the most important processes in OS in computer science field: the compilation. Compilation is the stage that allows creating, from the universal source code, the specific program which will be run in each computer.

Applying OS concepts to architecture and urban planning, the creation of source codes would be the definition of certain general structures of patterns. It is very important not to describe or apply them directly to each place, but to adapt and generate a final form in a process of “compilation” for each place. As will be explained in Guideline 5, this is similar to the way in which traditional cultures share knowledge between them, applying learnt techniques to their own contexts.

4. Need of changing and developing new scientific design strategies

In response to this profound change, new strategies for thinking architecture/urbanism responses and collaborative design must emerge, as it has also been pointed out by Vardouli and Buechley (2014, p. 55), with reference to the necessity of "re-diagramming" discipline’s processes, “and the roles of the subjects involved in them”. However, Fok (2014) notes that there has not been enough reflection about the influence of OS in architecture and its creative methods.

In general, this issue may require a different consideration of architecture and urbanism that the currently most common one. Thinking about a collaborative development of “open source” code and its “compilation” for different places, needs a more scientific method for addressing those disciplines, like the approach proposed by the mathematician Salingaros (2000). Another scientific perspective about design has been developed by Alexander in the last decades (Kalb, 2014), and his well-known strategy described in “pattern language”
(Alexander et al., 1977) could be really useful for OS Architecture. In fact, the work of Alexander has had an important influence in Computer Science, for example in the development of learning web based applications (Avgeriou et al., 2003), which shows its possibilities for different designing strategies. OS ecology project is another interesting reference, as it defines guidelines, workflows and specific strategies for developing the main objects needed to build the “Global Village” (Open Source Ecology, n.d.).

In OS processes, expert and peer review processes should be integrated, as long as a management structure is defined in order to support the stages of design and compilation. It is also important to create tools which, using for example GIS or web frameworks, allow sharing information between designers, stakeholders and citizens.

5. Adaptive strategies to local peculiarities

Considering the specific characteristics of Architectural and Urban Design, it seems that one possible strategy for OS development could be related to the improvement of general models, and different adaptations to local characteristics. As I previously mentioned, this would rely on BIM systems, in order to efficiently share information. In this scheme, a group of main designers would develop a general prototype of building or urban plan, which could be adapted by others, using for example rules or parametric systems, as the ones shown in ESRI's City Engine proprietary software (ESRI, n.d.). This kind of adaptive process was common in traditional cultures, where general building models, which can be found in different regions and countries, were constantly adapted to specific features and requirements (Rudofsky, 1964), resulting in adequate responses to environmental and economical requirements (Yousuf, 2011).

6. Less powerful formal institutions; emerging informal organizations

Due to the freely shared knowledge and architectonic/urban “source code”, it is possible to predict the emergence of informal educational organizations, as well as the weakening of conventional academic or professional institution (Universities, Institutes of Architects, etc.). This type of phenomenon is currently quite visible with the increasing popularity of “Massive Open Online Courses” (MOOCs) and, especially in ICT, with the appearance of different formative websites (such as Codeacademy, Code School or TreeHouse). The certification control processes, as well as the relationships between formal institutions and informal emerging initiatives, are some subjects which should be discussed in the future.

7. A new economic model for architecture and urbanism?

According to Parvin (2013), OS architecture, more than a threat to the existing profession, must be considered as a “good business”. This seems to be an interesting point for the debate and would require a detailed discussion, as many questions have been laid out about “OS economics” (Lerner and Tirole, 2002), but an obvious fact is that economic viability of designers in the future could depend on their ability to change the offered services, and adequately redefine their roles.
CONCLUSIONS AND IMPLICATIONS FOR PRACTICE AND ADVANCEMENT OF RESEARCH

The progress of OS philosophy seems unstoppable, considering factors as the power of social networks, their advantages to solve problems and promote new research (Von Krogh and Spaeth, 2007), and the low-cost and efficient strategies they can spread in a decreasing resources context. It is having an important influence in architecture and urbanism, which requires a thorough reflection (Fok, 2014). Considering the links between OS (“bazaar” strategies) and traditional cultures, it is expectable to see significant changes in current design processes, as well as in the figure of the professional architects and urban planners.

The future challenge will be how to adapt to these tendencies and reformulate the role of many designers. Although some may argue in favor of maintaining the current model (Parvin, 2013), competence, resource limitations and negative economic context (Tverberg, 2012), will add difficulties to its continuity. So the appropriate strategy would not be to fight against new tendencies trying to defend the established design system (a “cathedral” mode, according to Raymond), but to adapt smartly to the changes, as well as integrating the excellent possibilities that OS thinking offers. In order to do that, it is quite useful to look at previous experiences in computer science, as well as to traditional or participative models developed for architecture and urban management, which can offer valuable insights and guidelines like the ones presented in this work.

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