Ricardo Mendes Correia

TRANSDISCIPLINARY VIEW OF DIGITAL ARCHITECTURE

AUTHOR

PhD candidate, 'ISCTE - Instituto Universitário de Lisboa (ISCTE-IUL) Lisbon Portugal'
rfmcj@iscte-iul.pt

SUPERVISORS

Alexandra Paio (ISCTE - Instituto Universitário de Lisboa (ISCTE-IUL), ISTAR-IUL, Vitruvius FABLAB),
Daniel Cardoso Llach (School of Architecture at Carnegie Mellon University)

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ABSTRACT

This ongoing research outlines a historic perspective of transdisciplinary digital architecture through the work of key personalities by establishing links between them. It is important to highlight the transdisciplinarity role as a way of thinking, teaching and as a research methodology with impact on architectural practice. But considering the literature review, the relation between digital architecture and transdisciplinarity it is not usually considered relevant. After several decades, since the origins of transdisciplinary digital architecture, it is relevant to start writing about its history. In the digital era, another important idea is to use new sets of tools to deal with historiography. Those tools can give new data interpretation, based on new research sources and new ways of analyzing and visualizing collected data. This research aims to contribute to a historic perspective of transdisciplinary digital architecture with a new methodology that uses relational databases with spatial and temporal data.

INTRODUCTION

Over the past two decades, several authors started writing the digital architecture history by bringing new perspectives and visions on how digital technologies are changing architecture and design (Rocha 2004; Picon 2010; Cardoso 2012; Perry 2014; Steenson 2014). But those historic perspectives did not consider the evolution of transdisciplinary digital architecture like this ongoing research intends to make.

Although not considering a historic perspective of transdisciplinary digital architecture, the last-mentioned authors considered transdisciplinarity in architecture and design. Rocha references the use of quantitative methods in architecture, Picon considers nowadays architecture as an outcome of the information revolution, Cardoso traces the inventiveness of design across disciplines, Perry writes about the work of pioneers of digital of graphical design across disciplines of some pioneers of digital graphical design and Steenson proposes transdisciplinarity to describe the work of Christopher Alexander in his PhD dissertation (Rocha 2004; Picon 2010; Cardoso 2012; Perry 2014; Steenson 2014).

Further than being digital, nowadays architecture tend to become transdisciplinary and like other transdisciplinary practices can use science and technology, concepts from other disciplines that are not as restricted as conventional procedures. Transdiciplinarity is relatively new concept, first used by Jean Piaget and others in a 1970 congress (Jantsch, 1972; Lichnerowicz, 1972; Piaget, 1972; Nicolescu, 2003, 2006; Klein, 2013). Authors like Mark Burry, Carole Despres, Roderick Lawrence, Isabelle Doucet and ☐Nel Janssens have promoted the transdisciplinarity in architectural research, teaching and practice (Burry, 2013; Després, 2012; Doucet & Janssens, 2011; Lawrence & Després, 2004).

Therefore, transdisciplinarity can be considered a new approach in architecture, being plural, generative, formative, and interrogative (Klein in Doucet & Janssens, 2011). An architect that has a transdisciplinary approach in research, teaching or practice can be considered a transdisciplinarian. A "transdisciplinarian develops their own discipline through practice while enmeshed with others in shared design space, but they also redefine their discipline through project-based working association" (Burry, 2013, p.84).

Contemporary architecture is probably a combined version of digital architecture and transdisciplinary architecture and both concepts go somehow against the classical view of pure fine arts architecture. In both cases, transdisciplinarity and digital, architecture is involved with science and it is important to understand the change in architecture and the contributions to that change.

In fact, architecture in the last hundred years has undergone a big change

but this transformation maybe has not started with early digital computers from the sixties. Nowadays digital architecture can be tracked back to the groundbreaking work of Ivan Sutherland and to his 1963 PhD thesis Sketchpad a Man-machine Graphical Interface at MIT. This was the first interactive CAD system to be known and even contemplating other pioneer work and the fact of being developed in an engineering department, this can be considered the start of digital architecture (Sutherland, 1963).

But before the digital change of architecture, it can be considered that a transdisciplinary change came first. Even knowing that the transdisciplinarity concept was only developed in the late sixties and early seventies, a contribution to a transdisciplinary change in architecture was being developed since the twenties with new teaching methods at Bauhaus with teachers like Walter Gropius and László Moholy-Nagy who taught future architects with a new machine-based method (Moholy-Nagy, 1947; Gropius, 1965).

With Bauhaus, a change of attitude started with architecture being taught considering technology and science. That change went from Germany to the UK in the mid-thirties and from there to the USA in the last years of that decade. In those years new ways of teaching architecture and design started in the US with Gropius in Harvard Graduate School of Design's Department of Architecture and in the Chicago's New Bauhaus founded by Moholy-Nagy (Findeli, 1990, 2001; Rocha, 2004; Pearlman, 2007).

Researchers have been writing the digital architecture history and theory grounded on methods that manage limited sets of primary sources and several relationships with context and influences are lost. Following the increasing availability of digital data sources in the internet, which were not created and structured with research purposes in mind it is necessary to adopt new computational approaches that allow researchers organize complex information.

In this research, the methodology focuses on relating key figures using both traditional methods and new approaches that use the increasing availability of digital data sources in the internet. Those sources are not structured as primary sources but can be used as those to establish interactions. This new varieties of digital data sources, broadly available, can be systematized through new computational approaches like databases and methods of representing geospatial time-based data.

Therefore, is fundamental to outline a transdisciplinary view of digital architecture and to apply together with conventional historical research methods a new kind of methodology, closer to the new media and data availability to link key people. The key figures identified for this research are: Walter Gropius, László Moholy-Nagy, Serge Charmayeff, György Kepes, Leslie Martin, Steven Coons, Herbert Simon, Lionel March, Christopher Alexander, Ivan Suther-

land, Nicholas Negroponte, William Mitchell and Charles Eastman.

The research methodology can help us to understand how transdisciplinarity in the teaching of architecture can be related to Bauhaus and also be related to the development of digital architecture in the sixties. This ongoing research seeks to outline the evolution of architecture considering two important dates Moholy-Nagy arrival at Bauhaus in 1923 and Sketchpad forty years later. It is focused on relationships and interactions between people, places, and institutions, in a fifty-year period, using both conventional historical research methods and computational methods of mapping, analysis and visualization.

It is aimed to achieve the following primary research objectives:

- To verify the influence of Bauhaus and their disciples in early architectural computer users

- To establish a path of change in architectural research as well as in teaching and practice from beaux-arts to transdisciplinary digital architecture by tracking all possible links between the key figures including new approaches of representing it in space and time

- To validate the importance of early research in computer graphics to transdisciplinary digital architecture

This project main contribution is to extend the literature in three thematic areas, the use of science and technology in the teaching of architecture, the path to transdisciplinary digital architecture including links between key figures and importance of early computer graphics in transdisciplinary digital architecture.

METHODOLOGY

The overall research design is intended to address the main research questions listed above and intends to be focused on using the 21st century media possibilities mixing together text, audio, picture, video as well as alphanumerical and spatial databases to help us to trace the links between the key figures in the historic perspective of transdisciplinary digital architecture.

It is expected with this methodology to improve the possibilities over traditional historical research approaches used in this kind of study, based mainly on written text and oral interviews.

To achieve the referred objectives, the research methodology encompasses five stages:

- Literature review

- Data collection and Geospatial temporal database development

- Mapping, analyzing and visualizing

- Establishing the connections between Bauhaus teaching and com-

puter use in architecture

- Validating the importance of early research in computer graphics to transdisciplinary digital architecture

Literature review

In the literature review stage, will be assessed relevant literature, focusing transdisciplinarity in architecture and digital architecture, including key figures publications. It will be considered all the important literature to establish a historic perspective including subjects like Bauhaus, constructivism, digital art, history of computer graphics.

The literature review as well as all the research, considers two important points in time to be studied, Moholy-Nagy arrival at Bauhaus - Weimar in 1923 and Sketchpad at MIT, Cambridge, Massachusetts, USA, 1963. Starting from those dates it is expected to establish interactions that led to the development of digital architecture.

It is a fact that part of Bauhaus faculty went to the UK in the early thirties. In the UK, they took part in a British avant-garde movement that promoted a culture of scientific research that was extended to architecture. And those emigrated architects and designers carried those ideas when they re-emigrated to the USA by the time that World War II began. This made possible that those transdisciplinary ideas could flourish on both sides of the Atlantic (Whitford, 1984; Kentgens-Craig, 2001; Rocha, 2004; Finch, 2005; Picon, 2010).

Moholy-Nagy, established a school of design, the New Bauhaus in Chicago, 1937. The New Bauhaus was followed by other Moholy-Nagy established schools like the Institute of Design. Kepes and Chermayeff were teachers at the Institute and Chermayeff was also the second director. This ones were the teachers of a first generation of digital architects like Alexander, March, Negroponte and Mitchell (Chermayeff and Alexander, 1963; Alexander, 1964; Findeli and Benton, 1991; Rocha, 2004; Picon, 2010; Steenson, 2014).

That first generation of digital architects was constituted by the few that had access to computers in architectural research. Those very early architectural computer users like Alexander, March Negroponte and Mitchell were students or researchers under the guidance of Chermayeff or Kepes. Before that, in the UK, Alexander and March were also students at Cambridge, UK with Martin from the British avant-garde movement (Chermayeff and Alexander, 1963; Alexander, 1964; Rocha, 2004; Picon, 2010; Steenson, 2014).

Negroponte had three dissertation advisors, one was Kevin Lynch, urban planner and author of the influential *The Image of the City*, the other was Kepes and the third was Coons, a crucial figure in the CAD history and one of

the MIT's CAD Project directors, where Sutherland's Sketchpad was developed (Lynch, 1960; Coons, 1963, 1967; Sutherland, 1963; Cardoso, 2012; Perry, 2014; Steenson, 2014).

In the mid-sixties, Alexander became teacher in Berkeley and Eastman was his student. After graduating, Eastman went to Pittsburgh's Carnegie Mellon University (CMU) to have the future Nobel Prize laureate Herbert Simon as his PhD dissertation advisor. In nowadays digital architecture, Eastman still is a crucial figure and is best known for being one of the first and most fluent promoters of BIM (Simon, 1969; Rocha, 2004; Cardoso, 2012).

Data collection and Geospatial temporal database development

The second stage consists in bringing together information through a predefined procedure. Secondary sources cannot be used directly on research as primary sources but can be collected to be used in a geographic information system (GIS) database, creating a geospatial temporal database to establish the links between key figures.

Data collection is not restricted to a specific field or area and data can be collected in almost any research area, enabling researchers to answer questions that were not possible to answer though primary sources. In this research, that kind of data can be used in a geospatial database management system to establish the links between key figures. It can be used to illustrate geospatially and even temporally the relationships and interactions between people, places, and institutions.

In this research phase, data collection and storing accuracy is essential for the intent goals, indistinctly of being quantitative or qualitative data. Storing data through database tables structured fields considers the possibilities of executing relational or spatial queries that can be helpful to the research.

Mapping, analyzing and visualizing

This stage will be based on the previous data collection stage. It has as its main challenge, the development of a customizable tool that that helps to organize complex geospatial temporal collected data into interactive relationship maps.

At this phase, the capability to organize information with efficiency becomes the big challenge to obtain a good visualization. With the increase of digital data availability, namely internet data, the information design task is becoming more essential.

Also on this stage, will be defined the interaction map that illustrates in space and in time the key figures interactions, using the relational database.

Establishing the connections between Bauhaus teaching and computer use in architecture

The fourth stage main goal is to achieve a tool that graphically can trace all the interactions, relating not only people but spatial data like institutions and time related data through mapping, a time-line or a simple query. A tool to gather secondary sources, subsidiary information, and use it, jointly, with classical research methods.

As showed on the literature review stage, there are many connections that can be established between key figures. In this stage those links are going to be established through primary sources and through secondary sources with the help of mapping, analyzing and visualizing tools that deal with multi-dimensional data.

The use of visualization techniques gives the possibility to make the representation of data items resulting from queries. This database exploration tools are useful for table-based, cartographic displays or any other kind of visualization.

Validating the importance of early research in computer graphics to transdisciplinary digital architecture

In the fifth stage will be pondered the relevance of Sketchpad and early research in computer graphics to transdisciplinary digital architecture teaching, researching and practice.

The kind of influence that we intend to validate is related with methods and tools developed in the early days of computer graphics research. For instance, if we consider that on contemporary architecture the majority of architects use Graphical User Interfaces (GUIs) to draw and is a fact that Sketchpad was, in 1963, one of the first GUIs, this is an influence of early computer graphics on nowadays architecture (Sutherland, 1963; Cardoso, 2012; Perry, 2014).

If the above Sketchpad influence can be undoubtedly validated, others are more difficult to be traced. The data visualization tool can help us also to establish this kind of connections and validate those links that helped to change architecture into transdisciplinary digital architecture.

DISCUSSION AND PRELIMINARY FINDINGS

Based on the literature review, some preliminary findings can be disclosed. Starting with the Bauhaus, a connection is showed between a first-generation Bauhaus faculty, comprising Gropius and Moholy-Nagy, with a second generation of slightly young teachers that included Chermayeff, Kepes and Martin. Contemporary with the Sketchpad sixties era, there is a third gener-

ation with March, Alexander, Negroponte and Mitchell, some of the earliest digital architects (Rocha, 2004; Steenson, 2014).

But this is data taken from traditional historical research, the new methods and new data sources also gave us preliminary findings. The combined use of conventional historical research methods and new methods can give us new ways of analyzing links in a historical perspective. Data extracted from literature review together with publications or interviews metadata, as well as curricula or obituaries data, can be treated through databases and used in the research.

An example of data that could not be properly handled in a traditional historical research is the geographical and temporal data from the curricula. We could confirm with the use of geographical databases, that in the first years from the 1960s, most of the key figures were living and working in the Boston area.

In fact, considering that Moholy-Nagy had died in 1946, from the twelve key figures alive in the early sixties, Gropius, Chermayeff, Kepes, Coons, Sutherland, March, Alexander and Negroponte, eight of them were living, teaching researching or practicing in Cambridge, Massachusetts, USA (Chermayeff and Alexander, 1963; Sutherland, 1963; March, 2000; Rocha, 2004; Pearlman, 2007; Anderson, 2010; Steenson, 2014).

Being at a research early stage, some preliminary findings can be extracted, hence it is not possible to guarantee that the research new methods can deliver the instruments to draw all the links that are not possible to demonstrate thorough conventional historical research methods. Although it is predictable to confirm the utility of the method as a new quantitative analytical tool to analyse key figures links in a historical perspective.

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