



# ART+ MEDIA

Journal of Art and Media Studies

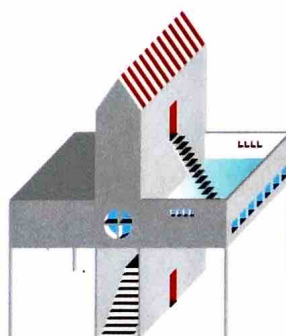
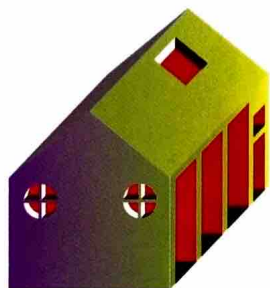
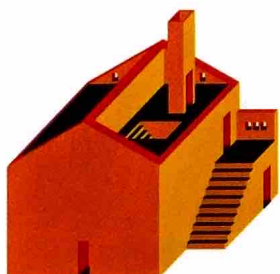
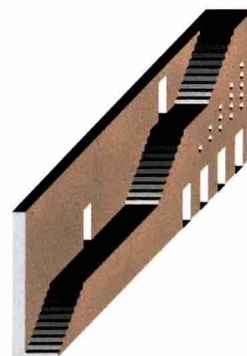
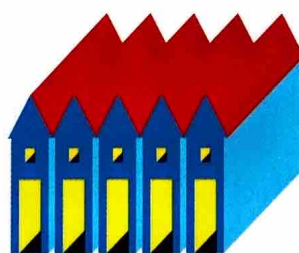
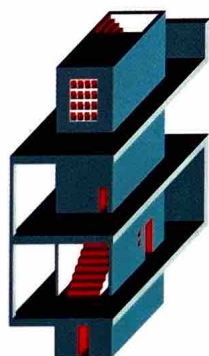
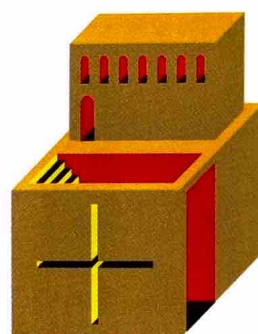
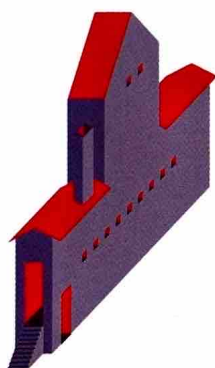
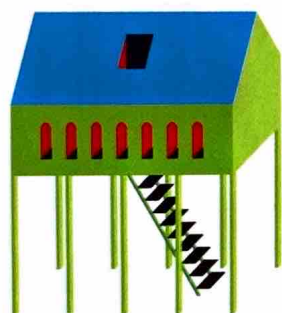
Issue No.

12 / 2017

ISSN 2217-9666

ISSN-online 2406-1654

THEME: Architecture with(in) Art and Theory



Issue No.  
**12 / 2017**



**ART+**  
**MEDIA**

Journal of Art and Media Studies

**AM**  
**Journal of Art and Media Studies**  
**Issue No. 12**  
**Belgrade, April 2017**

## **Editorial Board**

Sanela Nikolić Ph.D. (*Faculty of Music, University of Arts, Belgrade, Serbia*), Nikola Dedić Ph.D. (*Faculty of Music, University of Arts, Belgrade, Serbia*), Miško Šuvaković Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Sonja Marinković Ph.D. (*Faculty of Music, University of Arts, Belgrade, Serbia*), Vesna Mikić Ph.D. (*Faculty of Music, University of Arts, Belgrade, Serbia*), Ernest Ženko Ph.D. (*Faculty of the Humanities, Koper, Slovenia*), Polona Tratnik Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Jonathan Lahey Dronsfield Ph.D. (*University of Reading, Reading, United Kingdom*), Marta Smolińska Ph.D. (*University of Arts, Poznań, Poland*), Tomasz Załuski Ph.D. (*Department of Media and Audiovisual Culture, University of Łódź, Poland*), Veronika Darian Ph.D. (*Institute for Theatre Studies, Leipzig University, Germany*), Nataša Šegota Lah Ph.D. (*Faculty of Philosophy, Rijeka, Croatia*), Dragana Stojanović Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Vladimir Stevanović Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Aneta Stojnić Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Žarko Cvejić Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Ana Petrov Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Andrija Filipović Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Nataša Teofilović Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Bojana Matejić Ph.D. (*Faculty of Fine Arts, University of Arts, Belgrade, Serbia*)

## **Advisory Board**

Tyrus Miller Ph.D. (*University of California, Santa Cruz, USA*), Sven Spieker Ph.D. (*University of California Santa Barbara, USA*), Aleš Erjavec Ph.D. (*Institute of Philosophy, Ljubljana, Slovenia*), Lev Kreft Ph.D. (*Faculty of Philosophy, Ljubljana, Slovenia*), Blanka Brzozowska Ph.D. (*Institute for Contemporary Culture, University of Lodz, Poland*), Nicole Haitzinger Ph.D. (*Universität Salzburg, Austria*), Mirjana Veselinović-Hofman Ph.D. (*Faculty of Music, University of Arts, Belgrade, Serbia*), Milanka Todić Ph.D. (*Faculty of Applied Arts, University of Arts, Belgrade, Serbia*), Jelena Todorović Ph.D. (*Faculty of Fine Arts, University of Arts, Belgrade, Serbia*), Ješa Denegri Biljana Dojčinović Ph.D. (*Faculty of Philosophy, University of Belgrade, Serbia*), Nada Popović Perišić Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*)

*AM Journal of Art and Media Studies* was founded by Dr. Miodrag Šuvaković and Dragorad Kovačević in Belgrade, 2011.

## **Editorial Team**

Miodrag Šuvaković Ph.D., **Editor-in-Chief**  
Sanela Nikolić Ph.D., **Managing Editor**  
Nikola Dedić Ph.D., **Supervising Editor**

## **Focus Issue Editor**

Vladimir Stevanović Ph.D.

## **Secretary**

Marija Maglov MA

## **Proofreading**

d.phil. Gregory de Cuir, Jr

## **On the cover:**

Irena Gajić, *Paper Architecture*

**Design and Layout**  
Aleksa Milanović MA

**Reviewers**

Dubravka Đurić Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Amra Latifić Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Oleg Jeknić Ph.D. (*Faculty of Media and Communications, Singidunum University, Belgrade, Serbia*), Mariela Cvetić Ph.D. (*Faculty of Architecture, University of Belgrade, Serbia*), Biljana Leković Ph.D. (*Faculty of Music, University of Arts, Belgrade, Serbia*), Sanja Petrović Todosijević Ph.D. (*Institute for Recent History of Serbia, Belgrade, Serbia*), dr Bojan Blagojević Ph.D. (*Department for Philosophy, Faculty of Philosophy, Niš, Serbia*), Tatjana Vulić Ph.D. (*Department of Journalism, Faculty of Philosophy, Niš, Serbia*), Iva Simčić Ph.D. (*Academy of Fine Arts, Sarajevo, Bosnia and Hercegovina*), Elizabeta Šeleva Ph.D. (*Faculty of Philology, Saints Cyril and Methodius University, Skopje, Macedonia*), Darja Pavlič Ph.D. (*Faculty of Philosophy, University of Maribor, Maribor, Slovenia*), Darko Štrajn Ph.D. (*Institutum Studiorum Humanitatis, Ljubljana, Slovenia*), Iztok Osojnik Ph.D. (*Ljubljana, Slovenia*), Jelena Guga Ph.D. (*University of West Bohemia, Pilsen, Czech Republic*), Izabela Kowalczyk Ph.D. (*Faculty of Artistic Education, University of Arts, Poznań, Poland*), Ewa Wojtowicz Ph.D. (*Faculty of Artistic Education, University of Arts, Poznań, Poland*), Kurt Ozment Ph.D. (*Bilkent University, Ankara, Turkey*), Micha Braun Ph.D. (*Theatre Studies at Leipzig University, Germany*), Melentije Pandilovski Ph.D. (*Video Pool Media Arts Centre, Winnipeg, Manitoba, Canada*)

**Publisher**

Faculty of Media and Communications  
Karadorđeva 65, Belgrade, Serbia  
+381 11 26 26 474

**As Publisher**

Nada Popović Perišić Ph.D.



**Press Artprint, Novi Sad**  
**Print Run 100**

AM Journal of Art and Media Studies is issued three times per year.

The Journal is classified in ERIH PLUS – European Reference Index for the Humanities and in the List of Scientific Journals Categorization of Ministry of Education, Science and Technological Development of Republic of Serbia

**Mariela Cvetić\***

*Faculty of Architecture, University in Belgrade, Serbia*

and

**Slađana Marković\*\***

*Professional architectural practice, Belgrade, Serbia*

## **Experience and Theory in Architectural Design: Digital Chain Case**

**Abstract:** The aim of this paper is to research the impact to emerging theory based on the relation between the architect and his work in a digital approach to the process of design and realization by the principle of *Digital Chain*. *Digital Chain* is an uninterrupted digital process consisting of design (idea, coding, geometrics), through construction (structure, junction, prototyping) to production (fabrication) with every step as a programmed entity connected by CAAD/CAM technology universal interfaces. The term *Digital Chain* is defined and researched (theoretically, experimentally and practically) by the CAAD Chair at ETHZ within the research projects of this institute. *Digital Chain* is not continuous without the role and position of the architect as the fluid energy and expert that investigates how digital technology is changing, i.e. the entire process of the chain, simultaneously adapting to it.

In that sense architecture appears as an open work (Umberto Eco) without final definitions and in a constant process of information motion as the main component of the architectural product caused by the demands of context, function, form and user input. Testing design code through changes of parameters in iterations, as well as checks in prototype on the next level, makes the theoretical playground between experiment and experience, through education and expertise. It is exemplary that interest in the process (performance) was larger than the representation (appearance), what Deleuze and Guattari call supremacy of the Gothic spirit over the spirit of Romanesque or classical spirit, where Gothic deals with the generation of Gothic architecture by understanding the forces, trends and behavior of the material from the bottom to the top, contrary to the classic generation that deals with the imposition of visual aspects such as the proportion of top-down. This paper considers experience or posteriori knowledge as the main driver of the emerging theory of the *Digital Chain*.

**Keywords:** *Digital Chain*, design process, realization process, experience, experiment, emerging architecture, theory

\* Author contact information: marielacvetic@yahoo.com

\*\* Author contact information: marsladjana@gmail.com

## The Relation between the *Digital Chain* Approach in Architecture and Existing Theory

In recent decades digital technology has significantly pushed the boundaries of the process of design and realization in architecture. Complex requirements and conditions create a perfect environment for the use of effective tools.

Digital technology has primarily affected architectural presentation, and eventually began to represent a design tool directly connected with realization, which was, through various digital techniques, establishing the continuity of a 'digital gap' between design and architectural realisation. With the characteristics of continuous connection, this relation design – realization is increasingly manifested as a CAAD/CAM technology<sup>1</sup> – is most commonly researched as a *Digital Chain* principle. Primarily, the term *Digital Chain* is defined and investigated (theoretically, experimentally and practically) by the CAAD Chair at ETHZ within the research projects of this institute.

Digital technology simultaneously sets a new creative context in terms of the use of digital tools and the processes of appearance of artistic and architectural works. Characteristics of materials and machines as the tools of the digital process are included into the initial parameters of the concept.

*Digital Chain* is a continuous process where the architectural intention is directly materialized by using digital tools. It is a metaphor for an uninterrupted digital process, consisting of the design (idea, coding, geometrics), construction (structure, junction, prototyping) and production (fabrication or manufacture) with every step as a programmed entity, connected to others by the universal interfaces of CAAD/CAM technology.

*Digital Chain* is not continuous without the role and position of the architect as the fluid energy and expert that investigates how digital technology is changing, i.e. the entire process of the chain, simultaneously adapting to it.

In that sense architecture appears as an open work (Umberto Eco) without final definitions and is in a constant process of information motion as the main component of the architectural product caused by the demands of context, function, form and user input. Testing design code through changes of parameters in iterations, as well as checks in prototype on the next level, makes the theoretical playground between experiment and experience, through education and expertise.

---

<sup>1</sup> Index of signs, shortcuts and symbols:

CAAD	Computer-Aided Architectural Design
ETHZ	Die Eidgenössische Technische Hochschule Zürich
CNC	Computer Numerical Control
CAM	Computer-Aided Manufacturing
3D	three-dimensional

Prototype is an early sample, model or release of a product built for the testing of the concept or process or to act as a thing that is replicated or through which the basis is taught.

Interface is a distributed environment in which two components of a computer system exchange information

Mass customization is the mass production process of a limited series with specific user requirements.

It is exemplary that interest for the process (performance) was larger than for the representation (appearance), what Deleuze and Guattari call supremacy of the Gothic spirit over the spirit of Romanesque or classical spirit, where Gothic deals with the generation of Gothic architecture by understanding the forces, trends and behavior of the material from bottom to top, contrary to the classical generation that deals with the imposition of visual aspects such as the proportion of top-down.

Digital CAAD/CAM technology is already largely represented in world architecture. Leading architects<sup>2</sup> are using it in various aspects of their work, whether whole or in part. Architectural works in Beijing such as the CCTV headquarters building designed by OMA, the Bird's Nest Olympic stadium by Herzog & de Meuron, and the Water Cube Olympic Aquatics Centre by PTW Architects show a turn to postmodern architecture and a new approach to design in terms of process and structure that is no longer subordinate to ornament and form, in other words theoretical statements from *Learning from Las Vegas* by Venturi and Scott Brown are no longer valid. The leading structural engineers – Cecil Balmond, for example – are, in the words of Manuel DeLanda, “materialist philosophers”.<sup>3</sup> The link between theory and architecture, with examples such as Bernard Tschumi, Jean Nouvel and Marc Augé, clearly indicates that architecture is inseparable from theory and that theory is always already at work in any type of design. Theory is a conceptual framework that conditions design, and architecture cannot exist without a set of theoretical assumptions. In answering the question “What would you like the best about architecture and/or being an architect” Sarah Whiting said: “Architecture is a generalist, synthetic discipline and practice. That means that everything affects and is affected by architecture.”<sup>4</sup>

However, architectural theory, as claimed by Michael Speaks, architect and theorist, is definitely dead nowadays; he refers to “philosophy-lite” – the text based on deconstructivist preoccupations that came to saturate architectural academia in the eighties and nineties.<sup>5</sup> This is actually another ‘theory of anti-theory’. It could be the truth that certain theories – for example Derrida’s work, who once inspired the architectural imagination – have disappeared; though this does not mean that theory is dead. Instead, there are now different theories, such as, e. new materialism.<sup>6</sup> The new materialism as a new theoretical discourse is a theoretical direction that is less concerned with philosophy and the question of meaning and more concerned with material behavior and technology. There is a growing interest in structural performance

<sup>2</sup> Herzog & de Meuron, UN Studio Amsterdam, Frank O. Gehry, PTW Architects, Renzo Piano, Nicholas Grimshaw, Future Systems, Norman Foster, Coop Himmelb(l)au, Massiliano Fuksas, MVRDV, OMA, Diller&Scofield, Toyo Ito...

<sup>3</sup> Neil Leach, “Od anestezije arhitekture do fašizma,” *Tvrđa. Časopis za teoriju, kulturu i vizuelne umjetnosti* 1–2 (2007): 381.

<sup>4</sup> Mariela Cvetić, “Interview with Sarah Whiting,” in Vladan Đokić, Petar Bojanić, ed., *Interviews Issues. Concerning the Project of Peter Eisenman. On Architectural Education* (Belgrade: University of Belgrade, Faculty of Architecture, 2015), 41.

<sup>5</sup> Michael Speaks, “Which Way Avant-Garde?” *Assemblage* 41 (Apr. 2000): 78.

<sup>6</sup> Neil Leach, “Od anestezije arhitekture do fašizma,” 381.

and the performance of environment, environmental-efficiency of materials and energy; also, there are the appearances of materials and the more intelligent use of old materials. All of this happens through 'immaterial' processes like programming and parametric programming. It is the architecture which is confirmed through its performance, not quite appearing as visual effect.

Structural, economic, and environmental have become the primary parameters, and architecture is no longer preoccupied with style and appearances. The situation is similar in architectural theory: if in the 1980s to the 1990s architectural theory was dominated by interest in literary theory and continental philosophy, from structuralism, post-structuralism, and post-modern (Charles Jencks and Robert Venturi) to Jacques Derrida (Peter Eisenman and Bernard Tschumi), in the first decade of the 21<sup>st</sup> century this interest vanishes, which does not mean that this is a time of the "death of theory" (Michael Speaks).

Any form of practice has a theoretical impulse: this new branch of theory is linked to science, technology and materiality. The technology is the use of knowledge regarding tools or skills and has an impact on the ability to control and customize the environment. It is mainly a consequence of science and engineering, but some technologies advanced earlier.

Deleuze and Guattari analyzed the difference between Romanesque, the classical and the Gothic spirit as a qualitative difference, as static and dynamic understanding of architecture, as different sciences, not styles. One is scientific opinion that sees the world in terms of laws, fixity, representation, and the other in terms of the sense of flow, fluxes, process. Deleuze and Guattari describe the difference between these two as the difference between the nomadic war machine and the royal government – fixed rules and given forms, a hierarchical system that is placed from the top. This is in contrast to the royal, nomadic war machine going 'from below'. The difference is not only quantitative but also qualitative: the essential are dynamic relations of force. "Architecture, as Deleuze would say, is made up of reciprocal oppositions of Gothic and classical. At certain moments, it would make sense to give priority to one of those two. But there are both existing."<sup>7</sup>

Deleuze and Guattari analyze architecture – through the most advanced technology on construction, and the importance of building performance over form and appearance. Deleuze sees creation as movement. According to this, architecture is an arranged transition from one form to another, i.e. an order of poses or specific moments, as in dance.<sup>8</sup> We make a distinction between feelings and actions that Deleuze refers to as the 'primary' and 'secondary', and he adds a third type of image which he calls 'mental' or 'triad'.

Heidegger dealt with the understanding of *technics* in terms of the house as a machine for living and introducing *technicism* in terms of architectonic. His capital work *Bauen, whonen, denken* brings us back to the question of who is thinking, when and how. Linking the terms of house for living and thinking, we come to the

<sup>7</sup> Ibid.

<sup>8</sup> Žil Delez, *Pokretne slike* (Sremski Karlovci, Novi Sad: Izdavačka knjižarnica Zorana Stojanovića, 1988), 10.



conclusion that the architectural product is a machine of thinking, not vice versa. The connection to architectural experience is clear.<sup>9</sup>

Foucault as a philosopher of technology is relevant to new media as a tool in terms of power of knowledge, by disciplined mechanisms and desire for control, which can be transferred to architectural guidelines. This applies in particular to changes in dealing with information about architectural work.

This discussion is also based on an approach of Bryan Lawson in terms of the development and explanation of architecture as a design science and in order to demystify the role and importance of the architect for the process, the process itself and the influence of the process. It is the layered complexity of the emerging architecture crossed with new design activity, as Ludwig Wittgenstein claims, as “the most complex activity that people perform”<sup>10</sup>.

### **Exprience of Digital Chain Approach in Architecture through Education, Experiment and Expertise**

Related to Richard Maccormac, the design process is a journey, “en episodic journey towards a destination which you don’t know about, which is what life is and what writing and all arts are like.”<sup>11</sup> The same statement today related to the development process of creating emerging architecture influenced by technology should always be reviewed and redefined.

Emerging architecture sets a large number of requirements for architects. These digital requirements are interrelated and conditioned by varying, more or less acceptable results. As a science and art of design architecture is set on the usual starting points and is determined by the context and space; architectural context is, basically, the connection of thoughts and different levels of communication. Urban and environmental conditions include the communication of architecture with regulatory norms, standards and planning solutions, represented also on a global level of digital system. The new context is the communication of programming parameters, i.e. coding. “Emerging architecture is an overlapping product of technological tools and context with their connections to various complex requirements, approaches and action by the expert, who has the skills of a meaningful connection to the product, i.e. space. The spaciousness of the architecture is defined by functionality and form. The design is the process of harmonization of context and function as 3D geometric results – architecture, which passes all aesthetic criteria.”<sup>12</sup>

---

<sup>9</sup> Cf. Martin Heidegger, *Vortraege und Aufsaeetze – Was heist denken* (Tübingen: Neske, 1954).

<sup>10</sup> Bryan Lawson and Kees Dorst, *Design Expertise* (New York: Routledge, 2009), 24.

<sup>11</sup> *Ibid.*, 11.

<sup>12</sup> Slađana Marković, “Positioning of and architect in the process of design and realization of architecture based on a principle of a ‘digital chain’” (PhD diss. in Serbian, University in Belgrade, 2016), 28.

If we consider the context in digital architectural terms, it represents an artificial environment, i.e. environment of digital design – coding, where the selected parameters have the role of factors and are determined in the form of an artificial environment.<sup>13</sup>

The emerging architecture of today's architectural reality includes a wide range of different types of architectural products and is created in parallel processes of design and realization of conventional, digital or combined tools. The response to a complex context and requirements of emerging architecture itself is an experimental process, based on a digital approach to constant rehearsals and changes, which is a necessary passing phase of the prototype, but in most cases also testing the process of design and realization, materials and machines.

Harmonization of art in technology and *vice versa* is primarily based on creative thinking and constant learning. The creativity of architects and artists in the digital process relates to the combination of parameters necessary for coding, as well functional, aesthetic design, and parameters of machines and materials. The architect is no longer just a designer of a product, but also the designer of the process in terms of direct impact on the design and improvement of machines and materials, as well as working tools. These statements are based on Heidegger's *house as machine for living* related to the *bottom-up gothic spirit* of Deleuze and Guattari.

*Digital Chain* allows a continuous digital approach in architecture, and so it changed the attitude of the architect towards the tool and the material, bringing it closer to the artistic relationship. Digital tools and techniques are now set in the artistic experience of the architect through the product – architecture, that which is confirmed in the words “art is skill, that is the first meaning of the word”<sup>14</sup>.

The pursuit of a new creative process is continuity without the ‘gap’ between idea and realization. *Digital Chain* is not a continuous one without architects that change digital technology, i.e. the entire process of the chain, simultaneously adapting to it. The characteristic of the current connectivity positioning architects and principles in *Digital Chain* is in parallel with what Keshavan Nair claims: “Change cannot be avoided. Change provides the opportunity for innovation.”<sup>15</sup>

Artistic feeling or instinct is the power of the architect, which further develops the experience. It is the possibility of the human, and the inability of the machine. Freedom of the process is prescribed by the architect, and thus the freedom to create, as well as the necessary framework for this freedom. Architecture, after all, is creating by the experience of architects based on cognitive experiments, which in emerging architecture are closely connected to experiences from the process that is changing.

---

<sup>13</sup> Slađana Marković, *The Guide through the Process of “Digital Chain” in Architecture* (Belgrade: Endowment Andrejević, 2013), 14.

<sup>14</sup> Steven Hackbarth, *The Educational Technology Handbook: A Comprehensive Guide – Process and product for learning* (Englewood Cliffs, New Jersey: The Educational Technology Publications, 1996), 91.

<sup>15</sup> Peter Marinelli, “What is the Difference between Change Management and Innovation?,” accessed December 29, 2006, [http://www.innovation.cc/discussion-papers/change-management\\_v4i1a2.htm](http://www.innovation.cc/discussion-papers/change-management_v4i1a2.htm)

“Anyone who devises courses for acting of action in order to change the existing situation to desirable is designing.”<sup>16</sup> What is inevitable with all the critics of Simon’s science of design is the answer to the question – who determines courses of action and whose desirable situation we are projecting? It adds the question of what are all the decisions of the architect in current architecture and what else, besides a wide and multidisciplinary knowledge, he must know.

The base of the *Digital Chain* experience is 3xE – education, experiment and expertise.

### **Education – Principles of Learning *Digital Chain* (Experience in Learning *Digital Chain*)**

A key factor in the process of development and improvement of the position of the architect is the education of architects. The CAAD ETHZ course<sup>17</sup> consists of modules based on theory, which constitutes an introduction to the practical part – design and realization. It is an introduction to digital tools for architects. Training begins by introducing programming with the concept of requirements and expectations of machinery and materials in the realization of the product.

Receiving this model of education leads to architects that know the system and know the process, who have passed tests in programming languages (though not all of them have to write script). The task of the architect is to establish a system of work through the organization of the *Digital Chain*.

Teaching modules consist of presentations by lecturers with experience in digital design, whether experienced architects or older colleagues or participants of the course in previous years. The model of learning the *Digital Chain* is a parallel way to encounter something new, also learning from the mistakes of the whole team, as well as the participants of the course in previous years. These two sources of knowledge are combined into one at the end of the process.

The module for scripting is based on the idea that “most of the architects who built the building don’t make the building, but they make information for making the building”<sup>18</sup>. This module introduces the concept of programming. The starting point is to find a graphic template, pattern or patterns that you need to analyze and define the specific rules of composition, and then describe the parts of which it is composed and what was the concept of the algorithm, which generally corresponds to the description for the solution of a problem. These are the basics of parameter design, which means a connection to one or more changing parameters with different

---

<sup>16</sup> Herbert Simon, *The Science of Artificial* (Cambridge: MIT Press, 1996), 130.

<sup>17</sup> MAS ETH ARCH/CAAD – 2005–06, accessed May 6, 2006, <http://wiki.arch.ethz.ch/twiki/bin/view/MAS0506.html>

<sup>18</sup> Bob Sheil, Inaugural lecture Bartlett 2012/2013 titled “Design through Production,” accessed December 29, 2016, <https://vimeo.com/50819078>

solutions, which is based on the idea of requirements or user input into script, i.e. code.

The realization modules of *Digital Chain*, the practical part, are connecting two steps between digital design and realization: 1. transfer of design code to the CNC machines for prototyping; and, 2. transfer to the CNC machine for realization of products. All steps are fully automatic and require the inevitable presence of responsibilities and solutions in accordance with starting an idea through the comprehensiveness of the education of the architect who leads the process. The uncertain characteristics of digital production are primarily a connection between the design code and the code for the CNC machine. The result is the product of a large number of iterations through the choice of an architect in accordance with the concept based on prototype solutions. The module for rapid fabrication deals with the resulting change in the architecture that substantially relates to the CAM environment that allows architects and ordering to be included in the production. In this course we learned that there are a large number of machines that operate in 2D CNC technology with two basic processes in 3D fabrication: additive and reductive. The idea of this module was a standard mini *Digital Chain* as an introduction to the course and duration of the process: different programs, machines and an overview of the possibilities and limits of a machine, such as 3D printer, laser cutter machine, milling machine, bending machine, pipe, etc.

Generations born in the age of information culture have an approach to architecture based on digital technology and on technological media that produce architecture. These generations require a design education about architecture from digital resources, from laboratories, as for them the digital paradigm is the default tool.

### **Experiment – Principles of Testing *Digital Chain* (Experience in Testing *Digital Chain*)**

Re-definition of *Digital Chain* architecture through the discourse of mixed architectural education – a conventional and digital approach provides the basis for the development of architectural knowledge based on experiments. The phenomenological approach of self-realization, i.e. the presence of the author in his work, is what Schumacher was also talking about.<sup>19</sup> As with each experiment, this one aims at setting a specific subject in a specific environment and monitoring behavior in relation to the environmental conditions in which it is placed. It represents the description of the inside, i.e. experience and explanation of the process and product from the process of knowledge of the subject.

The presence of the personal characteristics of the computer generation of optimization produced creation which is naturally linked to infinity. Within the theme

---

<sup>19</sup> Cf. Patrik Schumacher, *The Autopoiesis of Architecture* (Chichester: Wiley, 2011).

of design coding Fabian Scheurer<sup>20</sup> discusses the establishment and cause of the first reaction, which is the first question in the guide for the development of a computer program. Tools define the problem and must correspond to the problems and permitted resources:

- Computers determine and are not creative;
- Simulations are never live as a real thing;
- Computers will never be fast enough.

“Those points I find pretty reassuring, because they leave the creative designer in the centre of the picture. When we move on from designing buildings to designing algorithms that design buildings, we are just changing the level of abstraction, but not the level of responsibility.”<sup>21</sup> The synthesis of architecture encompasses the philosophy of building and creativity as human capital. It is only with the comprehensive architect who overviews it, measures and prejudices, and carries the passion, emotion, and knowledge of the time, a willingness to learn and the experience of the profession and ethics. Today’s architecture is based on the networking of architects and tools.

The architect who will design and create the future must, more than ever before, be the type of architect by Vitruvius: a mixture of theoreticians non-alienated from the present and from life; an artist open to technological developments and engineers integrated with other disciplines and with nature.

The idea of mass production in terms of a changeable finished product (Le Courbisier) is set to the interactive design principles and realization and their mutual interdependence. The base is a concept, the characteristics of material and machine, and the challenges returned to the creation of design as well as bases of development and subsequent theoretical settings.

The complexity of digital design includes the design requirement conditions and coding and implementation, but does not exclude organized simple processes and simplicity of the product. An essential feature of present and future architects is a willingness to experiment and test processes and products through the prototype, as well as training in the field of digital education in parallel with conventional architectural processes as a basis for further technological development in the design and realization of the architecture.

The architect is also the creator of the process, of processing and manufacturing resources and products. Key points of the ideas and of *control* (Foucault), as well as the determination of parameters of coding and the entire process, are the architect’s responsibility.

The whole process of the *Digital Chain*, on the principles of *open work* developed from inside to outside, contains characteristics of an experiment – learning by doing and testing the parameters that are set in an artificial context. An environment

---

<sup>20</sup> Fabio Gramazio, Matthias Kohler and Silke Langenberg, ed., *Fabrica. Negotiating Design and Making*. (ETH Zürich, 2014), 53–59.

<sup>21</sup> Brady Peters and Terry Petres, *Inside Smart Geometry – Expanding the Architectural Possibilities of Computational Design* (Chichester: Wiley, 2013), 195.

is chosen by creating more solutions, checking the prototype, and if necessary, requiring a return to the beginning, changing and re-testing it in the new environment.

Some final thoughts on *Digital Chain* use are that the research includes parts of large scale or the realization of experimental work with certain materials and machinery. This area is an overview of the idea that the process is as important as the product, since the architect becomes the designer of the process directly connected to tool production. Mandatory innovation in technology is an integral part of design and realization as part of an existing project or the design improvement of applications or machines, which is necessary for the realization of the idea.

### **Expertise – Principles of Practicing *Digital Chain* (Experience in Practicing *Digital Chain*)**

The new generation of architects must be intellectually agile and at the same time sensitive in their interactions with other disciplines. This leads to a better understanding of their language and literacy existence in divided processes, such as computing. There are other important aspects in the analysis of multidisciplinary work. First, in an interdisciplinary setting everyone must have specific competence in the context of discipline, since engineers, architects, designers and mathematicians are working together integrated. In the context of multidisciplinary there must be a pre-concept disciplinary challenge for a fruitful dialogue. It also raises the question of whether the attitude of the participants toward the project is based on the specifics of the discipline or pedagogical challenge which leads to the productivity of the multidisciplinary environment as well to Foucault's *power of knowledge*.

According to Lawson,<sup>22</sup> learning design is possible but depends on the architects as to what will be accepted, adopted and applied in practice. This applies particularly to philosophy and history, with the justification that they do not surrender so that they are applicable in design projects, so they are *designerly*, as Nigel said. However, all the tools of digital architecture are learned because of the specific application, so these are also conceived in this way. From this point of view, episodic and experiential knowledge are easily stored, bound and used in practice.

Improvement and expert knowledge are constantly attached to formal education limited by practical training. The progress of architects is the most important push against boundaries, which is compared with the words of Jan Lucassen,<sup>23</sup> where the development of the architect is similar to results in sports. If an athlete does not increase the target they will not progress.

As we mentioned, the architect is an expert – someone who has specific knowledge or learning skills related to some topic. *Digital Chain* functions as a chain of team of experts. Different positions require different skills and knowledge of the

---

<sup>22</sup> Bryan Lawson, *What Designers Know* (New York: Routledge, 2004), 104.

<sup>23</sup> *Ibid.*, 161.

entire process. Specialization within the position is below the standard specialization. Digital architecture is a necessary trend in computer education – programming, with practical education in an architectural studio. It requires trained designers who work faster, more accurately and more reliable than non-experts. They work in a different way, which depends on finding alternative methods of work to transform the way in which the work was done until then. They are, primarily, thinking connective; as Gilbert Rule said, *thought is a matter of training and skills*.<sup>24</sup>

Architects have to learn constantly, with the constant belief that the manner of learning is changing, as well as the manner of drawing, designing and making models.

The main task is to educate architects and monitor technologies in terms not only of personal education, but also as a task of architects in terms of improving the architectural process. Current and future architectural processes are unthinkable without technology, including software applications and machine tools. The permanent training and improving of architects is required.

Projects driven by realization have a great impact in the construction industry, or indirectly in the education and training of architects. Architecture is the only engineering discipline in which the solution of the problem is located between the orientation toward the problem and orientation to the solution. In general, architecture is the building and development of passions and pleasure, a discipline that operates in both intellectual and physical practice.

### **Digital Chain Approach in Architecture Challenges Emerging Theory**

This paper considers experience, i.e. posteriori knowledge, as the main driver of the emerging theory of the *Digital Chain*.

Architects claim that new techniques themselves solve problems, and they do not perceive the necessity of adapting changes of their behavior or their role. An architect, to be a real leader of digital processes in architecture, has to monitor, check and process all information received.

By combining knowledge of the subject with the possibilities of tools and materials in relation to the requirements of design, experience is acquired as the base of the formation of generalized postulates. There are necessary steps such as links and connectors of operation, time and place, and automation with control of choice and flexibility in terms of the process by the subject.

In that way technology at the present moment, the era of digital Darwinism,<sup>25</sup> affects humanity together with society much faster. This sets a new era of authorship, as the supreme role of the architect, the subject, the actor and the holder of the

<sup>24</sup> Bryan Lawson and Kees Dorst, *Design Expertise* (New York: Routledge, 2009), 88.

<sup>25</sup> Brian Solis, "Digital Darwinism: How Disruptive Technology Is Changing Business for Good," accessed April 1, 2016, <http://www.wired.com/2014/04/digital-darwinism-disruptive-technology-changing-business-good/>

architectural process. Digital transformation is guided by technology and the behavior of actors in all processes, including architecture. From this position we approach the topic and one issue of digital maturity, which refers to technology as part of the solution and part of the problem.

It is important to mention that the theoretical postulates regarding no border between art and architecture as a combination of aesthetics, form and function, which date from the time of Adolf Loos, are transferred to contemporary architects and constantly appear in some form in architectural practice. However, the current state of technology in architecture is based on the existence and personal recognition of the architect in his work; in the opinion of the Spanish civil engineer Eduardo Torroja, it causes the appearance of the contemporary theoretician, among whom Patrik Schumacher stands out with the term *The Autopoiesis*<sup>26</sup>, meaning the choice to approach is inherent, not the formation of the style of the epoch based on digital tools.

The architect is the creator of ideas. Digital phenomenology is a driver of the idea of a digital approach in architecture; these are not just organized processes, but also an effective way of solving the problem of the separation between design realization. The process of creating digital architecture and tools, based on the principle of the *Digital Chain*, is outperforming the 'digital gap'.

The aim of this study is to establish an efficient, complex, specific and defined design based on the characteristics of different materials, which continuously leads to a series with limited automated realization in architecture, with a creative and controlled contribution of the architectural profession in every part of the architectural chain, as well as in emerging theoretical settings of this approach.

Architecture is constantly looking for effective solutions to a wide range of complex issues according to its interdisciplinary nature and for which there are developed technological tools, as well as parallel theoretical models with an emerging, variable character.

The supremacy of the Gothic spirit in Deleuze's and Guattari's theory from *bottom to top* combined with Foucault's *power of knowledge and control* reflects in architecture of digital parameters, as Heidegger's *machine* in correlation with self-design and the expert power of architects.

*Understanding the Digital Culture* by Miller<sup>27</sup> includes information and communication technologies so that new technology provides the transformation of society, the setting of the conditions for social change and progress, and therefore technological innovation based on experience as drivers of progress. Technology is the active agent that drives culture and society after the causal principle.

The findings of this research indicate the presence and expansion discourse of architects in the *Digital Chain* through the proper definition of the activities and areas in which they necessarily occur, based on digital techniques and tools in the digital process through education and the proven experience of architects in the existing

<sup>26</sup> Patrik Schumacher, *The Autopoiesis of Architecture*.

<sup>27</sup> Vincent Miller, *Understanding Digital Culture* (London: Sage Publications, 2011).



digital scene, testing the subject in various roles and positions of the chain. It is the process of positioning architects that contributes to the feasibility of continuity of the *Digital Chain* as an approach to a direct overview process for problems analyzing and receiving creative solutions. This characteristic thinking and orientation of the architect lies between an engineering and artistic approach.

## References:

- Delez, Žil. *Pokretne slike*. Sremski Karlovci, Novi Sad: Izdavačka knjižarnica Zorana Stojanovića, 1988.
- Đokić, Vladan, and Petar Bojanić, ed. *Interviews Issues. Concerning the Project of Peter Eisenman. On Architectural Education*. Belgrade: University of Belgrade, Faculty of Architecture, 2015.
- Frichot, Hélène. "On the Death of Architectural Theory and Other Spectres." Accessed January 5, 2017. [https://www.academia.edu/3593335/On\\_the\\_death\\_of\\_architectural\\_theory\\_and\\_other\\_spectres](https://www.academia.edu/3593335/On_the_death_of_architectural_theory_and_other_spectres)
- Gramatio, Fabio, Mathias Kohler, and Silke Langenberg, eds., *Fabricate. Negotiating Design and Making*. ETH Zürich, 2014.
- Heidegger, Martin. *Vortraege und Aufsaeetze – Was heist denken*. Tübingen: Neske, 1954.
- Hovestadt, Ludger. "Strategies for raster' overcoming." *Archithese* 4 (2006): 76–85.
- Lawson, Bryan. *How Designer Think*. New York: Routledge, 2005.
- Lawson, Bryan. *What Designers Know*. Oxford: Architectural Press, 2004.
- Lawson, Bryan, and Kees Dorst. *Design Expertise*. New York: Routledge, 2009.
- Leach, Neil. "Od anestezije arhitekture do fašizma." *Tvrđa. Časopis za teoriju, kulturu i vizuelne umjetnosti* 1–2 (2007): 377–82.
- MAS ETH ARCH/CAAD – 2005/06. Accessed May 6, 2006. <http://wiki.arch.ethz.ch/twiki/bin/view/MAS0506.html>.
- Marković, Slađana. *The Guide through the Process of "Digital Chain" in Architecture*. Belgrade: Endowment Andrejević, 2013.
- Marković, Slađana. "Positioning of architect in the process of design and realization of architecture based on a principle of a 'digital chain'", PhD diss., University in Belgrade, 2016.
- Marković, Slađana. "Proces 'digitalnog lanca' u projektovanju i realizaciji arhitekture.", MSc diss., University in Belgrade, 2009.
- Miller, Vincent. *Understanding Digital Culture*. London: Sage Publications, 2011.
- Peters, Bradym, and Terry Peters. *Inside Smart Geometry – Expanding the Architectural Possibilities of Computational Design*. Chichester: Wiley, 2013.
- Shodek, Daniel, Martin Betchthold, Kimo Griggs, Kenneth M. Kao., and Marco Steinber. *Digital Design and Manufacturing*. Hoboken: Wiley, 2005.

Schumacher, Patrik. *The Autopoiesis of Architecture*. Chichester: Wiley, 2011.

Simon, Herbert. *The Science of Artificial*. Cambridge: MIT Press, 1996.

Speaks, Michael. "Which Way Avant-Garde??" *Assemblage* 41 (Apr. 2000): 78. doi:10.2307/3171338.

Solis, Brian. "Digital Darwinism: How Disruptive Technology Is Changing Business for Good." Accessed April 1, 2016. <http://www.wired.com/2014/04/digital-darwinism-disruptive-technology-changing-business-good/>

**Acknowledgement:**

The authors would like to thank Professor Ludger Hovestadt, PhD, the CAAD Chair at ETH Zurich, for support in this research.

Article received: December 26, 2016

Article accepted: January 23, 2017

Original scholarly paper

CIP - Каталогизacija y publikaciji  
Народна библиотека Србије, Београд

7.01:316.774

AM : Art + Media : journal of Art and Media studies /  
editor-in-chief Miodrag Šuvaković. - 2012, br. 1- . -  
Belgrade : Faculty of Media and Communications,  
2012- (Novi Sad : Artprint). - 24 cm

Tri puta godišnje. - Tekst na engl. jeziku. - Drugo  
izdanje na drugom medijumu: AM. Art + Media  
(Online) = ISSN 2406-1654  
ISSN 2217-9666 = AM. Art + Media  
COBISS.SR-ID 192045324