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# Science and the City

**CONFERENCE PROCEEDINGS**

**TDW2020 International Scientific Conference**

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# Science and the City

## In the Era of Paradigm Shifts

### TAW2020 International Scientific Conference

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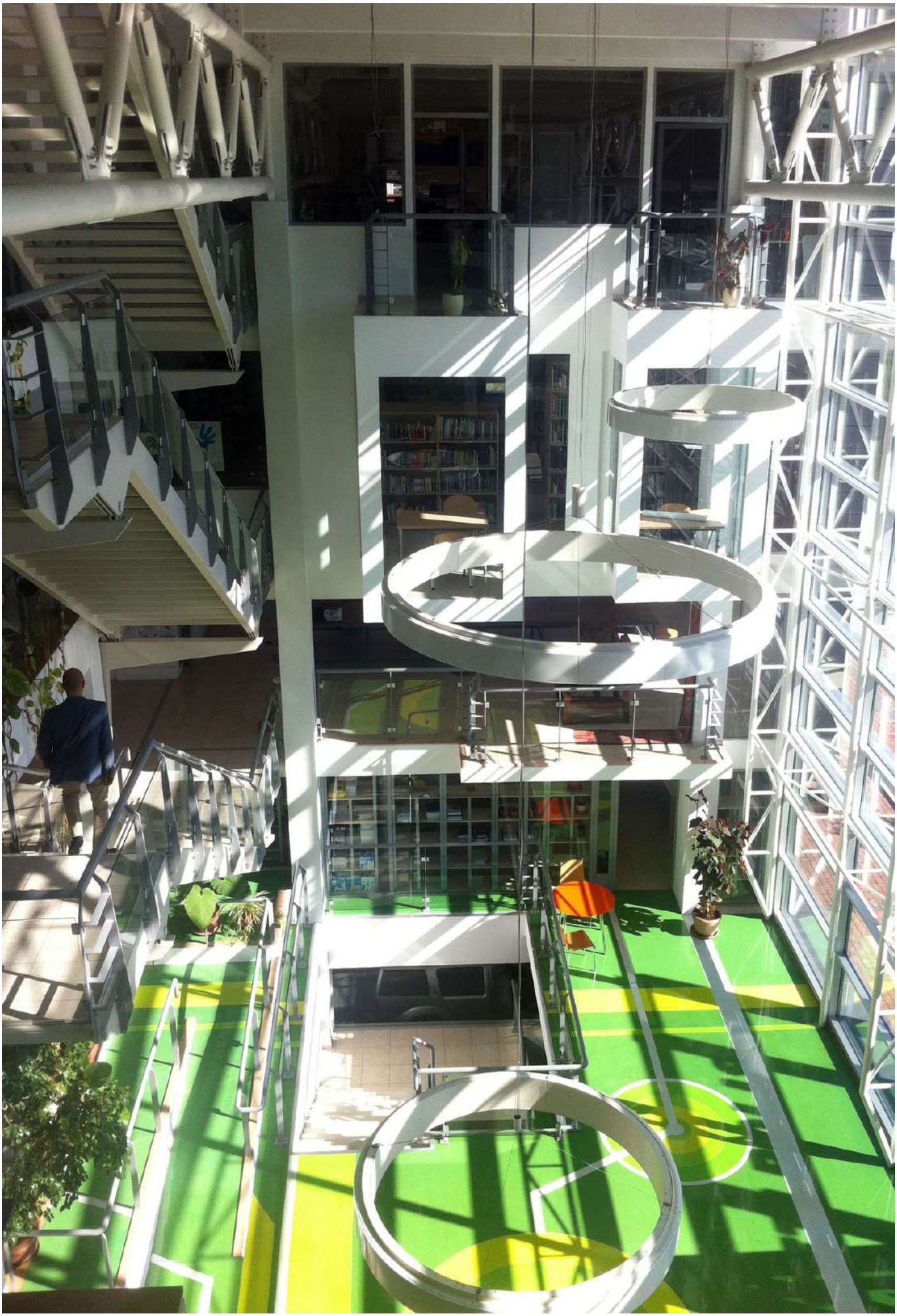

Dear participant of Tirana Architecture Week,

Thank you for joining us in TAW 2020. I stronlgy believe that all together we are making an historic step directly or indirectly related to Tirana's and Albanian's architecture, city and landscape. In addition, this is also a contribution for the region and wider on. At present time Europe is struggling with the instability of one of the worst recessions of its own history. Europeans are tired of the lack of flexibility and rigidity of overregulated societies where nothing happens. But here in Balkans and specifically in Albania, despite similar symptoms, things are still evolving, not because of delayed projections but because people here are very active, entrepreneurial spirit survivals, and the creativity of society is in a never-ending process. In Tirana, Albania or anywhere – as they say – in Western Balkans, we are still doing fine, so we might have to learn but also to offer something to the rest of the continent, despite our endless effort to join EU. This is a land of creativity where all architects and city experts feel just great: amazed, shocked, revolted, confused, enthusiastic, inspired, etc. This is due to the fact that there are layers of a real self-generative city.
Let's not forget that Tirana is an example of creativity. So, let's use such energy in a positive way and let's open a debate that might be useful for everyone. TAW is an academic event which gives you the opportunity to come and share your professional passion or nightmare. Enjoy time with us. There is not a clear recipe but there is always a solution out there to be discovered with passion and commitment. Join POLIS University, Co-PLAN Institute and our network of creative partners. I believe we all have something in common that can help to educate the new generation of architects who can re-appropriate the city and its needs, including those of real dignitary architecture. This is the point where the architect rediscovers its own place, space and meaning within society.

Enjoy TAW 2020! Enjoy U_POLIS and Tirana!

**Prof PhD Besnik Aliaj**
*Rector of POLIS University*

Dear participant of Tirana Architecture Week,

In his famous book 'The Structure of Scientific Revolutions' (1962), the American physicist and philosopher Thomas Kuhn, coined the notion of 'paradigm shift', intended as a fundamental change in the basic concepts and experimental practices of a scientific discipline. In opposition to the activity of 'normal science', a 'shift' occurs when the current predominant paradigm, under which scientific activities are conducted becomes incompatible due to new phenomena, facilitating the research – and adoption – of a new theory or paradigm.

We can also assume that, such a critical change is often driven by a 'crisis', a transitional moment where the appearance of new technologies, environmental conditions (ex. climate change), or political situations (ex. migration phenomena), requires the a drastic rift from the past and opens the way to a reformulation of the notion of the so-called 'Modernity'. Indeed, according to the words of the French philosopher Jean Baudrillard: «Modernity ... is what transforms crisis into a value, a contradictory moral, says Baudrillard, for it gives rise to an aesthetics of rupture».

The history of Architecture and Design itself, can be also interpreted as a consequential stream of changes following the research of a new paradigm. The Industrial Revolution deeply influenced the work of professionals during the whole XX Century, leading to the appearance of an architecture that could be a response to the industry preferring a free and functional arrangement of bodies rather than typological preset; transparency rather than opaqueness, points structures rather than tectonic configurations.

In the last thirty years, with the development of computers and ICT technologies, another paradigm has raised and changed these disciplines from their inner structures. The IT Revolution has imposed itself as the central element for a new phase in all of architecture, and information has become the essential component of a new way of designing and a new urban environment. A whole generation of architects has been dealing with the purpose of transferring the dynamic interconnection at the heart of IT from the digital world to a new reality of reactive, sensitive, interactive architectures. The aim of Tirana Architecture Week 2020 is to draw current research and design practices, as well as theoretical speculations on the relationship between the paradigm shifts in science and urbanism; in other words about the science and the city. Such mandate will be addressed in multiple scales and contexts, and from different perspectives within different fields of interest, directly or indirectly related to design, architecture, urban studies, sociology, environmental research, engineering, education and pedagogy.

**PhD Skënder Luarasi, PhD Valerio Perna**
*TDW2020 Curators / Scientific Coordinators and Editors of TDW2020 ISC*

**Skënder Luarasi** is an architect and writer. His research investigates the relationship between architecture and geometry. His PhD dissertation, received at the Yale School of Architecture on 2018, focuses on how design processes end, and how the question of finitude intersects with style, geometry and parametricism in history.
Luarasi has presented his research in numerous ACSA conferences, and has published in Haecceity, A+P Forum, and other Journals. In collaboration with Adil Mansure is currently working on the book Finding San Carlino: Collected Perspectives on Geometry and the Baroque, to be published by Routledge in Fall 2019. Skender Luarasi also holds a Master of Architecture from Massachusetts Institute of Technology, and a Bachelor Degree in Architecture from Wentworth Institute of Technology. He is currently the Dean of the Faculty of Research and Development at Polis University in Tirana, Albania.
He has previously taught at the Yale School of Architecture, the Department of Interior Architecture at Rhode Island School of Design, Wentworth Institute of Technology, Boston Architectural College, the Architecture + Design Program at University of Massachusetts Amherst, the School of Architecture at Washington State University, and Massachusetts Institute of Technology. He has worked as a designer for dEcoi architects/MIT Digital Design Group, Kennedy & Violich Architects Ltd and Finegold + Alexander Associates Inc.

**Valerio Perna** (Rome, 1988) (Rome, 1988) is an architect and PhD in "Architecture - Theory and Design" at Sapienza - Università di Roma. During his studies, he was a Visiting Scholar at AUAS Amsterdam and lectured and taught at several universities in Iran, Sweden, Albania, and Kosovo. He is currently employed at Universiteti Polis, where he is Coordinator of the INNOVATION_Factory (IF), Head of the Research Center in Architecture, Engineering and Design, and Coordinator of the Professional Master in Digital Architecture. His research agenda explores the role of games and game-based processes in contemporary architectural practice to address the complexity and behavioral phenomena in the urban fabric. Valerio has published in several international journals and has been invited as a speaker in European and Asian countries. He is a member of the Editorial Boards of architectural magazines and series such as archiDOCT, FORUM A+P, OMB series, Gli Strumenti series, etc... In 2020 he published his first monograph L'attività ludica come strategia progettuale. Regole e libertà per una grammatica del gioco in architettura (Quodlibet).

***International Speakers***

*POLIS University,28th September 2020*

**Alessandro Melis**, RIBA ARB AOU, is a professor of architecture innovation at the University of Portsmouth and the Director of the Cluster for Sustainable Cities in the UK. In 2019, he was appointed by the Italian Minister of Cultural Heritage (MIBAC) as the curator of the Italian Pavilion at the 17th International Biennale of Architecture in Venice 2020.
Previously, at the University of Auckland, he was the head of the technology area and director of postgraduate engagement at the School of Architecture and Planning. In the period 2010-2013 he has been the Director of Urban City Lab at the Institute of Architecture of the university of Applied Arts Vienna (Die Angewandte, Vienna) and visiting professor in Germany (Anhalt University, Dessau).
He holds a PhD in architecture design from the University of Florence. He has been an honorary fellow at the Edinburgh School of Architecture. He has also been invited as a keynote speaker at the China Academy of Art, the MoMA New York, the University of Cambridge, TED, the Italian Institute of Culture in London, and the UNESCO Headquarters in Paris.

*POLIS University,01th October 2020*

**Matias del Campo** is a registered architect, designer and educator. Founded together with Sandra Manninger in Vienna 2003, SPAN is a globally acting practice best known for their application of contemporary technologies in architectural production. Their award-winning architectural designs are informed by advanced geometry, computational methodologies, and philosophical inquiry. This frame of considerations is described by SPAN as a design ecology. Most recently Matias del Campo was awarded the Accelerate@CERN fellowship, the AIA Studio Prize and was elected into the boards of directors of ACADIA. SPAN's work is in the permanent collection of the FRAC, the MAK in Vienna, the Benetton Collection, and the Albertina. He is Associate Professor at Taubman College for Architecture and Urban Planning, University of Michigan.
SPAN gained wide recognition for its winning competition entry for the Austrian Pavilion of the 2010 Shanghai World Expo, as well as the new Brancusi Museum in Paris, France.
The practice's work was featured at the 2012 Venice Architecture Biennale, at ArchiLab 2013 at the FRAC Centre, Orléans, France, the 2008 and 2010 Architecture Biennale in Beijing, and in the solo shows 'Formations' at the Museum of Applied Arts (MAK, 2011) in Vienna and 'Sublime Bodies' at the Arch Union Gallery in Shanghai (2018).

*POLIS University,02th September 2020*

**Farshid Moussavi** OBE RA is an internationally acclaimed architect and Professor in Practice of Architecture at Harvard University Graduate School of Design. Moussavi's approach is characterised by an openness to change and a commitment to the intellectual and cultural life of architecture. Alongside leading an award-winning architectural practice, Farshid Moussavi Architecture (FMA), she lectures regularly at arts institutions and schools of architecture worldwide and is a published author. Moussavi was appointed Officer of the Order of the British Empire (OBE) in the 2018 Queen's Birthday Honours for services to architecture. She was elected a Royal Academician in 2015 and Professor of Architecture at the RA Schools in 2017.
At FMA, Moussavi's completed projects include the acclaimed Museum of Contemporary Art in Cleveland, USA; La Folie Divine, a residential complex in Montpellier; a multi-tenure residential complex in the La Défense district of Paris, and flagship stores for Victoria Beckham in London and Hong Kong. Current projects include an Ismaili Center for the city of Houston in the Unites States, and, a new residential complex for the the city of Montpellier. .

**Antonino Saggio** (Italy) is an Architect and Full Professor of Architecture Theory and Design at 'Sapienza – Università di Roma.' He has been for several years coordinator of the Ph.D. School in 'Theory and Design' and director of the International book series 'The It Revolution In Architecture.' He has written several books among which one of the most important ones - 'Architecture and Modernity: from Bauhaus to the IT Revolution' - has also been edited in Albanian by POLIS University.

Three main guidelines distinguish his work: first, the confidence in the concrete possibility of teaching architectural design through making its methods evident and transmissible. This approach has been tested with many students and graduands, with the members of nITro (New Information Technology Research Office), and with many assistants and collaborators that are currently teaching in foreign institutions such as POLIS University.

The second fundamental aspect of Saggio's work is the continuous interrelation between the critical historian moment and the concrete design phase.

Particularly, this research path permeated his intense critical historian activity and led to the birth of books regarding Giuseppe Terragni (published by Laterza), Giuseppe Pagano (published by Dedalo), Louis Sauer (published by Officina Edizioni), Peter Eisenman and Frank O. Gehry (published by Testo&Immagine).

The third peculiarity of his work concern the belief of today's catalyzing role of IT in the definition of a proper 'IT Revolution in Architecture.'

This topic has been part of his early teaching years at Carnegie Mellon-Pittsburgh and has continued at ETH Zürich and is currently part of his commitment at the Faculty of Architecture at 'Sapienza – University of Rome.'

The book series 'The IT Revolution In Architecture,' founded by Saggio in 1998 and also edited in English by Birkhäuser, has been a focal point for the deepening of this topic and contributed to influence a whole generation of architects that are currently at the forefront of the international debate.

Furthermore, the presence of IT also characterized critical urban projects for the city of Rome (Urban voids, Urban Green Line, Tevere Cavo, UNLost Territories) that link together the different historical and landscape peculiarities of the city that urgently needs for the development of new infrastructures within the urban fabric that can treasure the impact of the new IT possibilities.

## Notes

All papers presented at this conference have undergone a process of **double blind review** by the members of the international scientific committee. The quotation system adopted is the **Harvard Referecing System**.

As stated in the call for papers, **all copyright responsability is fully and solely on the author(s) of the text**. The coordinators, organizers and scientific committee are not legally responsible for any claims for compensation if the author(s) have included figures, tables or text which have already been published.

## Index

# Towards a More-than-digital architecture

**Bianca Andaloro**
*Università degli Studi di Palermo, Italy*

*The transition from the Age of Information to the Digital Era has been a shifting paradigm from the anonymous mass consumption to the individual customization, that has today become the most common model in the society (Negroponte, 1995). Because of its attitude of translating the values that each society exploits with a time-and-space specific point of view, architecture has incorporated the digital transition, or the so-called Second Digital turn, trying to adapt its methodology to an exclusively-technologically-driven approach. The old dichotomies 'architecture-science' and 'man-machine' have become in the last decades more profound, especially with the introduction of AI and Generative Adversarial Network processes. The use of Big Data, together with these two semi-automatic approaches, has stressed the point of the influence of form-finding process -instead of the 'problem-understanding' and 'question-asking'- in the com-position of the architectural design. The evolution of digital technologies seems to be going faster every day, whilst architecture has often passively absorbed the results carried out by the digital world (Carpo, 2017). Our homes are becoming so increasingly embedded and filled with Iot devices and elements that, architectural design may incorporate not just the technologies brought up by these devices, but the broader sense of a digital diffuse networks that allows defining a relationship with them (Ratti, 2016). From the micro-scale of the technological components to the macro-level of the city (or the infrastructure), passing by the scale of the building, a project that is able to adapt to the needs of its users and that can collaborate with them, will explore the potentiality of a newer way to conceive the mingling of architecture and techno-science in the whole design com-position process.*

**keywords** digital composition, adaptive architecture, interactive architecture, Kas Oosterhuis, Theodore Spyropoulos

## 1. Introduction

In the contemporary age, where the digital element has influenced many aspects of our common lives and professions and quickly grows empowering its features and devices, it is necessary to understand not just the technicality of this process, but its proper aim. Considering architecture as a broad domain that involves several aspects of the society in which it's produced and designed, The question is not whether this digital influence is beneficial or not, but which direction it is currently hearing and how can it benefit the world of tomorrow. Starting with the importance given to the individual, since the introduction of the so-called Digital Era at the end of the XX century, architecture has followed many different paths, absorbing different aspects of the powerful digital revolution and incorporating them in different ways. Although lots of new technologies allow exploring new fields of form-finding and uncommon geometries, it is important to put this technological empowering in strict relation with the environment we live in, in order to guarantee the social and cultural attitude of architecture. In order to achieve this goal, architecture should refer to a Techno-science field with a More-than-digital approach, able to link the outside and the inside into a more efficient way. This approach will be better expressed through the works Kas Oosterhuis and Theodore Spyropoulos, that show with a different approach this desire to link man, architecture, and the environment throughout technology.

## 2. The Age of Digital

The profound change brought by the introduction of digital approaches in the definition of design processes roots in the concept of the Society of Information, between the Nineteenth and Twentieth centuries, usually referred to as the Second Industrial Revolution. In fact, all the technological solutions, elaborated in this period to empower the efficiency of the industries, were mainly tested in an attempt to resolve what J. Beniger has defined the "crisis of control" (Benigner, 2009) or the need to manage an exponentially large and complex amount of data. But as A. Picon stated in his Digital Culture in Architecture, «information has no social relevance unless circulated and shared» (Picon, 2010, 19): the real shift in architectural paradigm was

on the following turn of the century, when new tools and new approaches were developed and spread. The initial effort to pass from an encoded kind of information to a direct vision led firstly on the necessity to manage a large amount of military data, whilst researches on the field of cybernetic encouraged new introduction in architecture. The introduction of the Digital Era brought with it also a new idea of the human, previously considered just an anonymous element in the mass and later as an individual entity (Negroponte, 1995). This tendency, aiming to a customization process, has defined a new condition not just in the human subject, but in all the fields that interfered with him, including architecture, thought-out the management of information.

The development of digital culture, therefore, understood not only as a capillary diffusion of computerization but also as a transposition of computational processes in different fields, is nowadays a remarkable moment in the development of technologies due to the introduction, on a hand, of new tools (hardware and software, as well as devices) and on the other of a new approach. Whereas the first Personal Computers were quickly developed, in the Eighties a new strand of thought was being elaborated between the USA and the UK. From the researches of Wiener on cybernetics as a new science between mathematics and computer science, the figures of G.Pask, C.Price, and J.Frazer worked together on the definition of the architectural cybernetic approach. In this way, they re-shaped some human faculties in order to re-propose them in the architectural field: language, command, control, and, above all, the -active and passive- capacity of learning. Such a visionary approach, close to the contemporary Avant-garde group of Archigram[1], allowed to define an element nowadays fundamental in the understanding of contemporary digital architecture: the bi-lateral communication (the interaction) between man and machine, where the machine could be a computer as well as a simple device able to respond to programmed parameters. Already in 1976, the idea of a broad collection of data available for a single machine that can communicate with human was set in place through the Generator Project or the so-called *First Intelligent building*, (elaborated in 1976-1980) by C.Price, J., and J.Frazer. What was physically (or, better, virtually) missing was the capacity of sharing information through a network accessible at the same time by different devices sharing (Figure 1). The Frazer mechanism worked for the complex project of the Generator, but they should have waited some decades more to see how powerful the idea of form-definition through interaction would have been. The mathematical root of cybernetics, in fact, implied the possibility to establish a correspondence between neuroscience and computer science, between the brain and the computer and therefore between neurons and bits of information.

*Fig. 1 View of working electronic model of the Generator project_Image source: CCA Canadian Centre for Architecture, Montreal, 'Cedric Price fonds – 1903:2006, predominant 1953:2000', DR1995: 0280: 108*

## 3. Toward New Horizons

As architecture has incorporated the digital transition, or the so-called Second Digital turn, trying to adapt its methodology to an exclusively-technologically-driven approach, it has shown its attitude of reflecting the cultural values of its time, space, and society. What, however, can be noticed is that the new tools that have been introduced to facilitate and empower architecture, have replaced not just the making-process but also the thinking-process, so that it may seem that architecture has passively absorbed the outcomes of the digital revolution (Carpo, 2017). Along with this idea, the increasing use of computational software, based on an algorithmic process of data elaboration, may have given more relief to the actions of computation and visualization, rather than computation and realization (M. Burry in Spyropoulos, 2013), resulting in a less validity of the architectural profile. What needs to be noticed, however, is the fact that, despite an initial enthusiastic moment in which the form-finding process was the unique beneficiary of this technological innovation, nowadays, the empowering of a diffuse network of information, is creating a tangible digital infrastructure able to spread also into the architecture field. The idea of the society of bits, that refers to a society in which the immaterial good prevails on the industry[2], is now introducing the virtual element of data as a real design matter. It is therefore possible to indicate as architectural matters a triad usually referred to Media Architecture composed by 'physical, experiential and communicative dimension'. The experiential dimension can be easily associated with the process of data transmission, especially if it concerns the environment that hosts the built element or also the human emotions; furthermore, the communicative dimension refers to the approach

*1. C. Price and the Archigram group were close friends, as much that Price was called a 'fellow traveler of Archigram') and they both took part in a very fertile moment of the design production at the AA school were they studied and Price later taught.*

*2. The pillars of the Information society are information technology and telematics networks, elements at the basis of the transition from mechanical and analog to the digital technology of the digital revolutions that have affected our society since the 1950s.*

shown before about the interaction needed between the man and the machine. In order to system these three elements with the built environment, it is necessary to configure a broad digital infrastructure, a vehicle that allows us to share information in space and time. What the digital technology has brought also into architecture, in fact, is a changing in the idea of space and time, that can be widely separated or easily unified thanks to the ease of use of new technologies and in the data managing process. These elements also constitute the paradigm of what was initially called the Smart city and now is turning into a more sensitive approach: it is the case of the Intelligent or Sensing or Senseable cities[3]. These different paradigms show an interest in equipping the city with devices and software: an input device to sense the environmental changings (both physics or human), a software to understand the data and program an answer, and an output device to actuate the answer elaborated. This scheme is proper of every changing architecture, both responsive, or cybernetic (and kinetic) or adaptive and encloses the elements of control, language and learning.

## 4. The Research

The work presented is part of initial doctoral research at the Università degli Studi di Palermo (Italy) at the Department of Progettazione Architettonica, Teoria e Tecnologia, about the way resilient architecture can receive benefits from the paradigm of adaptive and digital architecture. With this scope, it is important to underline and identify which characters this type of architecture, that is not just adapting but primarily evolving, should introduce and adopt. The strict relation between architecture and the digital world has produced in the years several works entirely based on the potentiality of the digital machines as a powerful tool at the service of a new human-centered design[4], where, indeed, the presence of man has always been put at the center of the design process. What M.Fox and G.A.Carldweel have pointed out is that, in such a global condition characterized by pollution, climate-changing and consequent loss of biodiversity, it is necessary to reverse the « human exceptionalism and anthropocentrism» (Foth, M., Caldwell, G. A., 2018) in order to conceive a kind of architecture that could give a practical answer to the environmental issue, collaborating with the digital tools. For this reason, it is a belief that an adaptive approach, that implies a different kind of architecture, from the responsive to the adaptive to the cybernetic, can define a new resilient approach. The title given to this paper, Towards a More-than-digital architecture, makes reference to a methodology brought up especially in media architecture, i.e. the More-than-human approach, in which the design process is based on the aim of going beyond the needs of human by casting in the project itself elements from the natural environment, such as plants or animals. What a More-than-digital approach would introduce, instead, is the intention of considering the technological innovation of the digital devices, and especially the information infrastructure of big data, as an equal part of the design process, in order to establish a mutual relationship and an interaction between the immaterial elements, the physical world and the human being that live in it.

## 5. E-motive and Behavioural

The elements that constitute the dichotomies 'architecture-science' and 'man-machine' that have crossed the history of architecture, can nowadays merge thanks to the introduction of digital technologies. The broad use of data has allowed the development of systems as Artificial Intelligence or even the Generative Adversarial Network, that are able to link the physic reality to the virtual world. However, in order not to over-empowering the technological aspect of the design conception, but still to assure architecture its cultural role, designers have stressed the point on the interactive feature. This allows a project to be a linking element between, for example, humans and nature, still remaining the central focus of the adaptiveness itself.
The methodology presented here is based on the comparison of two different approaches brought up by K. Oosterhuis at the T/u in Delft and T. Spyropoulos at AA School in London. They both believe in the necessity of the introduction of what we can call a More-than-digital element in the process of conceiving architecture with adaptive elements. The first case is related to human emotions, that can be traced by and expressed within the architecture itself, whilst the latter focuses on the adaptivity as a systemic form of interaction that engages behavioral (human or natural) features.
The theory brought by both these architects implies the necessity of the conceived architecture to adapt itself: in this way, the informational background, that drives both these approaches, is not entirely aimed towards the form-finding process. Instead, it is focused on the 'problem-understanding' and 'question-asking' method, which allows a project to understand the reality that surrounds it and to elaborate the adequate response. Again, the themes of control and learning (passive in the sense of understanding and active in the sense of computing) are a main feature of adaptive architecture.

## 6. E-motive Interaction

Head of the Hyperbody center and the Protospace laboratory at the Faculty of Architecture of Delft, the Dutch architect Kas Oosterhuis has dedicated his academic and professional career to the development of non-standard architecture (NSA) and Interactive architecture (iA). He refers to his work as "e-motive", meaning an architecture that feeds on information, processes information, and transmits information in different forms (Oosterhuis, 2003). In this idea, all the components of these continuous processing buildings behave like birds in a swarm, transposing in the design process a natural behavior that allows adaptivity to be real. Therefore, the building itself is a sensor-adaptor system as it is conceived as a living body, capable of changing form and content in real-time and at the same time it is itself part of a network where information (data) is continuously shared. This feature defines the building as

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*3. The smart city paradigm, an innovation of the XXI century, brought with it the idea of a city as a computer, capable of interactions, connection and communication in real-time. The introduction of external devices in the real-life (such as smartphones, tablet, ...) has empowered the idea of a city that can be sense its inhabitants and their needs, as well as its infrastructures and building. For this reason we refer to the idea of Intelligent cities (Gausa, 2017) with digital communication networks, the ability to process data and the presence of sensors and design application software; as well, also the sensing cities or the so-called Senseable city, a city able to sense, sensitive and sensible (Ratti, 2017).*
*4. The interaction that the digital technologies have brought into architecture has covered in the years many fields of research and has produced several different branches, named in different ways, depending on the single and particular point of view of its designers. For example, we can refer to HCI, Human-Computer Interaction, which deals with interactions between humans and machines, HBI, Human-Building Interaction, that transposes the previous approach to the relations between humans and the built environment. Finally, the More-than-human approach is recently emerging in the Interaction design field as a post-anthropocentric way to conceive the city. (Foth, M., Caldwell, G. A., 2018)*

a flexible networked information processor in a continuous process of a self-learning . Furthermore, the capacity of self-learning and, at the same time, the ability to be adjustable in changing, defines the distinction between reactive and interactive, meaning for the latter a circular system of answer-response-answer that can be articulated in direct manipulation (deliberate control), automation (reflexive control) and hybridized model between the user and the technologies (Sterk, 2006; Kolarevic, 2009). The idea of a circular system, therefore, is easily connected with the possibility to have a built structure in a continuous state of calculation, adapting its structure and envelopes, its colors and patterns: an Hyperbody that changes in real-time. The first speculation of his «concrete science fiction» (Oosterhuis, 2002, 17) is the Saltwater Pavillion, designed and built in 1997 in Neeltje Jans, five years before the Blur Building by Diller & Scofidio + Renfro. This parallel with the Swiss pavilion is interesting because it shows a common interest of the time in building with the environment, aiming at a strict interaction between the building, the environment, and the users. The Dutch pavilion, conceived as a Hydra following the visitor in the form of a structural element or as an interface, is directly connected to a weather station positioned on a buoy in the North Sea (Fig. 2). The information captured in the natural outside environment were sent to a computer that elaborated this data to produce real-time effects trough fiberoptic lights and sounds effect inside the building. At the same time, with a sensor board, the users of the pavilion could interact with space itself by acting on some lights and sound (Oosterhuis, K., & Biloria, N. M., 2008) (Figg. 3-4).

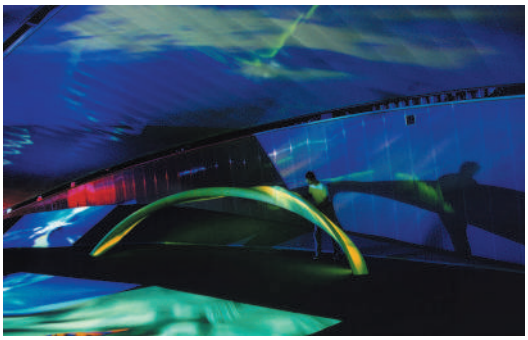
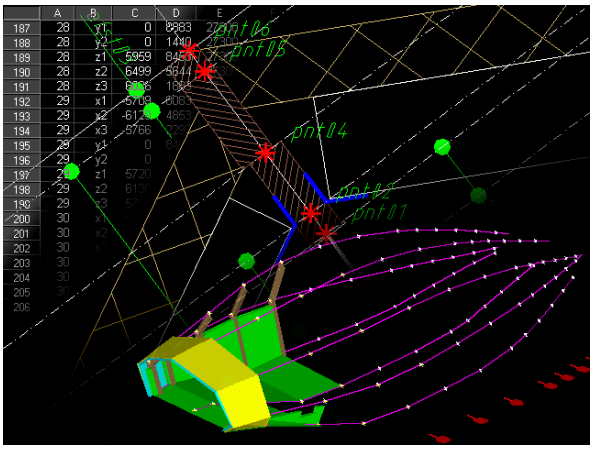


*Fig. 2: The Saltwater Pavillion, K. Oosterhuis, Neeltje Jans, 1997; Image source: http://www.oosterhuis.nl/?page_id=412*
*Fig. 3: The Saltwater Pavillion, K. Oosterhuis, Neeltje Jans, 1997; Image source: Oosterhuis, K., & Biloria, N. M. (2008). Interactions with Proactive Architectural Spaces: The Muscle Projects*
*Fig. 4: The Saltwater Pavillion, K. Oosterhuis, Neeltje Jans, 1997; Image source: http://www.oosterhuis.nl/?page_id=412*

The result is a place shown always in different ways, depending on the visitor behavior but especially on the external condition. This attempt of creating a real interactive building works in pairs with the application of the swarm paradigm, here applied for the first time by the ONL studio. As seen before, the swarm paradigm refers to the building as an ensemble of several different elements, all different, that work autonomously (each one of them has its own shape, position, color and code) but that are strictly connected in order to work simultaneously. Like a bird in a swarm, they adapt their characteristic once that one has changes its own. Therefore, the swarm architecture is visible not just in the initial moment of project conception (when, thus, the building is com-posed or synthesized by parametric software) but also in the realization that allows a system to continuously evolve. «The essence is in the genetic code. The genetic code of a building body is a set of rules and algorithms, animated by the circumstantial parametric values placed into the formula's making up the genetic code. The visual appearance is the outcome of the process running the genetic script in a site-specific and time-specific environment.» (Oosterhuis, 2003, 38-39) Space and time have become effective architectural matters, they contribute to the definition of the building due to their continuous evolving feature, in a dynamic conception of architecture that considers the user as central in the understanding of itself and at the same time, as an entity to feed with information. Finally, the conception of the building itself deals with, on a side, an only 3D modeled project, designed through the relation between points on a control curve and the production machine (Figg. 5-6); on the other, it required (like all the cybernetic projects have shown before) a flowchart to program the behavioral system to control the intriguing relations between input sensors or devices, interfaces, receivers and outputs (Oosterhuis, 2002).



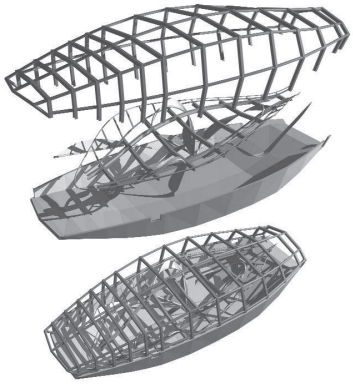



*Fig. 5: The Saltwater Pavillion, K. Oosterhuis, Neeltje Jans, 1997; Image source: http://www.oosterhuis.nl/?p=184*
*Fig. 6: The Saltwater Pavillion, K. Oosterhuis, Neeltje Jans, 1997; Image source: Oosterhuis, K., & Engeli, M. (2002). Architecture Goes Wild: 010 Publishers.*

## 7. Behavoural Ecologies

Director of the AA's Design Research Lab (AADRL) in London and co-founder with his brother Stephen of the architecture studio Minimaforms, Theodore Spyropoulos works on the attitude of architecture to produce a new form of communication through a generative and behavioral approach. In 2013 he published a book that collects years of research at the AADRL on the theme of Adaptive Ecologies, remarking an idea of architecture in continuous evolution with a constantly adapting behavior. His experience at the AA in London is undoubtedly linked to the long traditions of architects that have studied and taught there since the Seventies and that composed that ambient in which digital technologies begun to develop and merge into architecture. For this reason, in the book, a chapter is dedicated to the direct experience of John Frazer at the AA starting from the Seventies, showing his first attempts to develop a self-organizing architecture, during his thesis (Fig 7) .
The approach developed by Spyropoulos is, however, emphasizes the primacy of time over space in the design process, as it is the main feature that defines

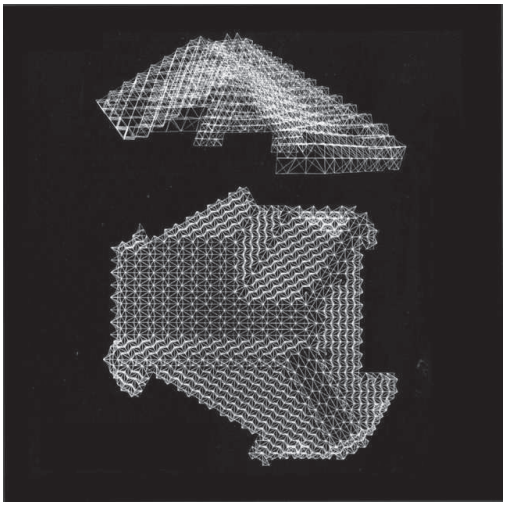
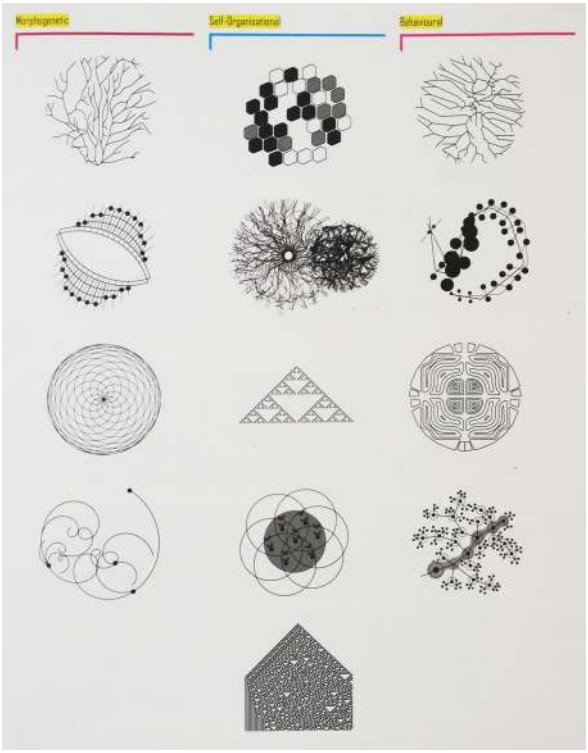


*Fig. 7: Reptile, J. Frazer, Thesis Project, 1970; Image source: Spyropoulos, T., & Schumacher, P. (2013). Adaptive Ecologies: Correlated Systems of Living. Architectural Association.*

the adaptation and, therefore, the change. The concept of changing, indeed, implies a continuous ability to trans-form, producing a time-based architecture that shows a complex revolution in form, meaning by it, the design process played out in time over the life of a project and not its external appearance (Steele in Spyropoulos, 2013). "Living systems are units of interaction: they exist in ambiance", quotes Spyropoulos in his volume (Spyropoulos, 2013, 10), so the architecture has to be considered with a living environment that changes over time. Due to this inevitable condition, architecture should be part of this system by using similar behavioral approaches in order to allow a biodiverse network to deal with urban contexts, buildings and materials. He recognize to the adaptivity he claims the character of multi-scalarity (or polyscalarity as he says) defined by the capacity of interaction. From the definition of these systems, it follows the triad of information, life and matter, from the interaction of which it is possible to define that complex reality where is possible to make a new synthesis. The term synthesis, as Schumacher points out in his essay, replaces the idea of architectural com-position, from a parametrical point of view, transmuting this action in three types of correlations: functional, formal-spatial and for-function. Here he shows as not only the time is a parametric value in conceiving adaptive architecture: also the concept of space can be considered parametrically variable, determining dynamic event scenarios. With this idea in mind of designing adaptivity seeking the best behavioral parameter for the ecologies involved, Spyropoulos presents a methodology based on three different scales and three different behavior. To the categories of unit (house), cluster (building) and collective (territory), he associates three frameworks referring to behavioral, self-organizational and morphogenetic approaches. Furthermore, the research shows an attempt to address the complexity of the multi-scalarity the diversity of these behavioral approaches, defining thirteen types of systemic forms of interaction. The

thirteen patterns reveal the basis of the research due to their direct relation to the animal and natural environment and, through academic projects, they show the theorized behavior-based model of living (Figg. 8, 9). In the morphogenetic category, four patterns are showing a method for creating forms and adapting to the external environment without an explicit definition: Mangrove, Polyp Growth, Phyllotaxis and Seeding. In the self-organizational category, four patterns are showing a chain of elements communicating to better define how to adapt: Stigmergy, Hair, Cellular Automata and Swarm. Finally, in the behavioral category, four patterns are showing a complex system that allows adaptation: Surface tension, Siphonophora, Cymatics, Soft-Cast.



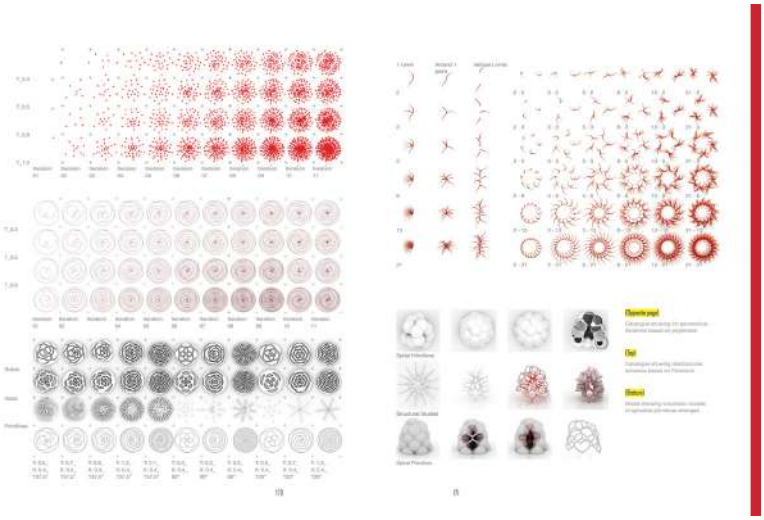



*Fig. 8: Morphogenetic, Self-organizational and Behavioral; Image source: Spyropoulos, T., & Schumacher, P. (2013). Adaptive Ecologies: Correlated Systems of Living. Architectural Association.*
*Fig. 9: Mangrove:Mangal – AADRL 2007-2008/ Chimera; Image source: Spyropoulos, T., & Schumacher, P. (2013). Adaptive Ecologies: Correlated Systems of Living. Architectural Association.*

## 8. Conclusions

The two approaches shown, different in the process but close in the aim they propose, reveal a contemporary interest in the definition of an architecture that collaborates with and within the space it's built in. The experiences of data-driven technology in the form-finding process have given way to a more engages and conscious approach aimed at the environment and human well-being. Conceiving architecture as a living body or as a living ecology allows designers to take into consideration a lot of features proper of different fields, like science or biology, that can improve its matters. Furthermore, including the digital elements not just as an external device, but as a matter that implies new features, shows how it is possible to design projects every day multi-scalar and multi-temporal. Time and space themselves, that in the past have been just constraints of the static design process, can constitute an active part of the process as parameters in continuous change. An architecture that is at the same time digital and human, in the sense that includes digital process with a human (or natural) behavior is not anymore impossible or far from reality. On the contrary, it can be part of a resilient approach that is now what our environment requires. Due to the recent natural catastrophes, architects must implement and empower their way to conceive architecture, with a digital and together adaptive approach that makes possible a newer way to conceive the mingling of architecture and techno-science in the whole design com-position process.

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