# 2015 ICAR

International Conference on Architectural Research

Ion Mincu University of
Architecture & Urbanism
Bucharest, Romania

re[search] through architecture

http://icar2015.uauim.ro/ Bucharest, March 26-29, 2015

# Keynote Speakers
## Presentations

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# Introduction

Two years ago, on the occasion of the 120th Anniversary of the Romanian School of Architecture we organized the first edition of ICAR (International Conference on Architectural Research). After being a highly prestigious academic event where knowledge and culture in architecture and its related fields were shared with more than 130 participants from 20 countries, we are launching now the second edition of this conference.

Under the title theme Re[Search] through Architecture, ICAR 2015 proposes a debate of the subject defining some new principles of nowadays architectural design. In the XXI-st century, in searching of a "style", after Postmodernism, it is considered that new architecture based on algorithms and parameters may offer new senses of space continuity and legibility. In opposite, the contextualist and phenomenologist movements consider this approach as a formal and fragile tendency, culturally unsustained and which won't prove its consistence in time as utopist and futurist did.

Topics like new avant-garde movement, stylistic searching, anachronistically architecture, space continuities and correspondences, lived architecture or experimental manifesto projects, the evolving of geometries, urban continuities or classical defragmentation, functional zoning, social impact scenarios, space formalization, aesthetic and symbolic design values, authentically or new built archaeology, sustainable design etc. will be presented and debated under three main sections: Traditional versus Computational, Innovation and Experiment, Archive – Utopia – Events. Built / Unbuilt.

*Assoc.Prof. Beatrice-Gabriela JÖGER, Arch, PhD, UAUIM, Bucharest, Romania*

# Contents





# re[search] through architecture

**KEYNOTE SPEAKERS**

Juan P. HINESTROZA, Assoc.Prof., Director of The Textiles Nanotechnology Laboratory, College of Human Ecology of Cornell University, USA.

Karin HOFERT FEIX, Arch., Profesor Titular E.U., Department of Architectural Design, Barcelona School of Architecture ETSAB, Politechnical University of Catalunya UPC, Spain

Romolo MARTEMUCCI, Arch., PhD, Professor of Architecture, Pennsylvania State University, USA; Director of Pennsylvania State University - Sede di Roma; President of Pantheon Institute, Rome; President of Accademia Adrianea di Architettura e Archeologia, Rome, Italy

João MENEZES DE SEQUEIRA, Arch, PhD, MsC, Assoc.Prof., Head of Architectural Department, Universidade Lusófona, Lisbon, Portugal

Zuhal ULUSOY, Arch., PhD, Professor, Dean of Faculty of Art and Design, Kadir Has University, Istanbul, Turkey

Maria VOYATZAKI, Arch, PhD, Assoc.Prof., School of Architecture of Aristotle University of Thessaloniki, Greece

## Juan P. HINESTROZA

**Assoc.Prof., Director of The Textiles Nanotechnology Laboratory, College of Human Ecology of Cornell University, USA**

Juan P. Hinestroza is a tenured Associate Professor of Fiber Science and directs The Textiles Nanotechnology Laboratory at the College of Human Ecology of Cornell University in Ithaca, NY. Professor Hinestroza obtained a Ph.D. from the Department of Chemical and Biomolecular Engineering at Tulane University and B.Sc. in Chemical Engineering from Universidad Industrial de Santander. Prior to pursuing doctoral studies, Professor Hinestroza worked as a process control engineer for The Dow Chemical Company.

Professor Hinestroza works on understanding fundamental phenomena at the nanoscale that are of relevance to Fiber and Polymer Science. Hinestroza has received over 5.3 MM USD in research funding (Federal and State agencies as well as Industrial Consortiums) for his pioneering work in exploring new pathways for creating multifunctional fibers via manipulation of nanoscale phenomena.

Professor Hinestroza, a US Fulbright Scholar, has been the recipient of a myriad of awards including the National Science Foundation CAREER Award, the J.D. Watson Young Investigator Award from NYSTAR and the Educator of the Year Award from the Society of Professional Hispanic Engineers. Professor Hinestroza has delivered invited lectures worldwide at Universities and Research Centers in Italy, Korea, China, Japan, Taiwan, Mexico, Spain, Brazil, The Netherlands, Colombia, Argentina, Hungary, Czech Republic, Vietnam, Switzerland, Finland, Austria, France, Singapore, Thailand, Chile, Turkey and Germany. In addition, Professor Hinestroza has received visiting scientist fellowships from The Chubu Foundation for Science and Technology of Japan, The National Council for Scientific and Technological Development in Brazil and The Swiss National Science Foundation.

Professor Hinestroza's scientific work has been featured in Nature Nanotechnology, MRS Bulletin, Materials Today, C&E News, National Geographic, ASEE Prism as well as mainstream media outlets such as CNN, Wired, TechReview, The Guardian, Popular Science, ABC News, NYTimes, Reuters, PBS, NPR and BBC. In addition to his scientific endeavors, Professor Hinestroza and his research group are actively involved in community outreach activities aimed at increasing the number of members from underrepresented minority groups in Science, Technology, Engineering and Mathematics as well as engaging senior citizens in collaborative and inter-generational learning experiences.

**Current Professional Activities:**
Professor Hinestroza is a member of the Division of Cellulose and Renewable Materials of the American Chemical Society. Hinestroza is also a member of the Society of Materials Research MRS, The American Institute of Chemical Engineers AICHE, The Fiber Society and The Society of Hispanic Professional Engineers SHPE.

**Current Research Activities:**
The main focus of the Hinestroza Research Group is to explore the interface between the technologically established and mature field of textile science with the emerging and revolutionary field of nanoscale science. The field of textiles was the first beneficiary of the scientific developments from the 18th century's industrial revolution while the nanotechnology revolution emerged the end of the 20th century. Our research group aims at merging two hundred years of innovation history.

We believe that this unusual combination, between an established and an emerging scientific field, can provide unique scientific platforms that take advantage of the ability of nanoscale science of controlling the synthesis of materials and probing unusual phenomena at the nanoscale with the time-tested capabilities of textile and fiber manufacturing.

In order to explore and understand nanoscale phenomena of relevance to fiber science we decided to pursue a three-pronged approach as follows: The first branch is aimed at modifying the properties of existing textile products, specifically natural fibers, using nanomaterials. The second approach is aimed at creating novel nanofiber based materials by taking advantage of unique self and directed assembly phenomena. The third effort is aimed at developing metrology and computer simulation tools to better understand traditional issues in textile processing such as friction and electrostatic charging whose influence is magnified at the nanoscale.

These three efforts are highly complementary and when combined they are expected to provide a more comprehensive understanding of nanoscale phenomena relevant fiber science.

Detailed information about Professor Hinestroza and his research group is available at: http://nanotextiles.human.cornell.edu/

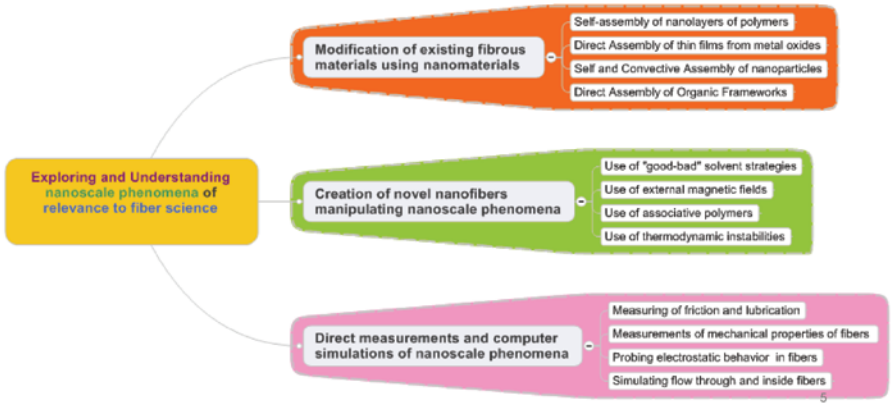




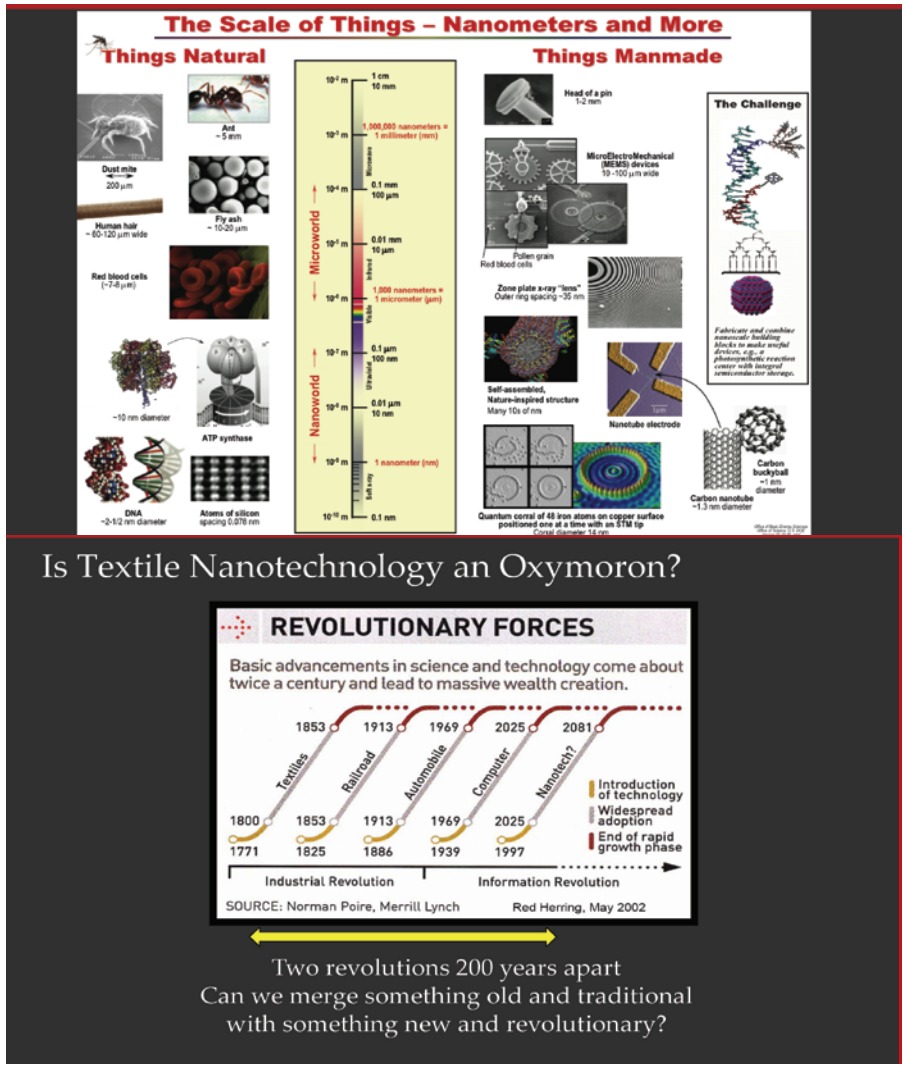
# Multifunctional Fibers via manipulation of Nanoscale Phenomena. Can Nanotechnology be Fashionable?

**Juan P. Hinestroza**

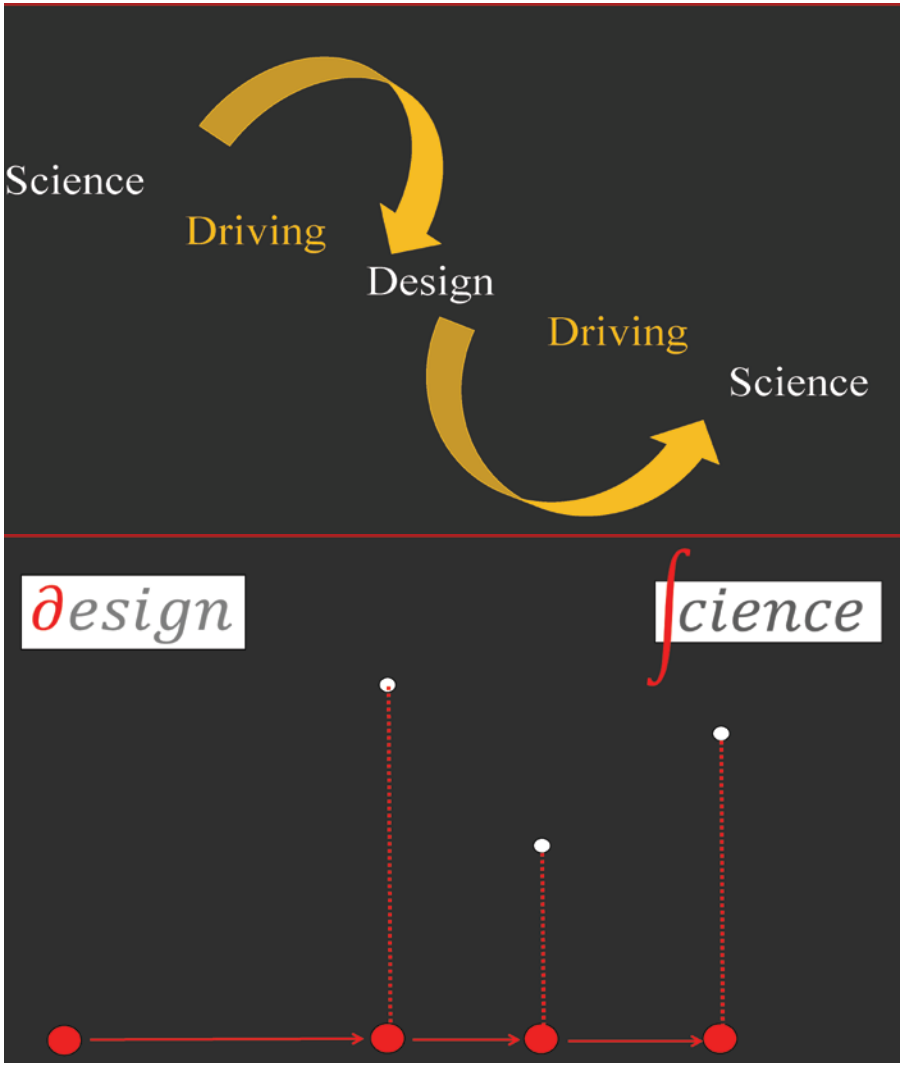
## Exploring and Understanding Nanoscale Phenomena of Fundamental Relevance to Fiber and Polymer Science

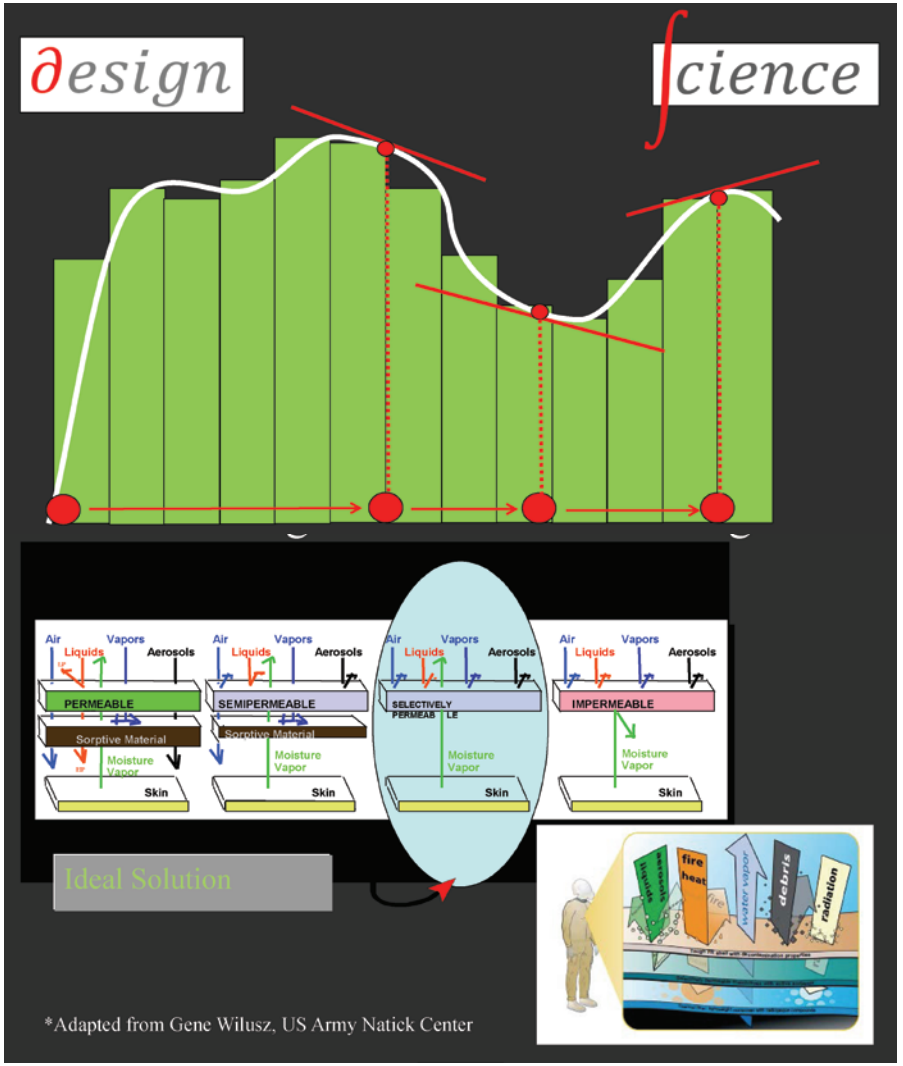


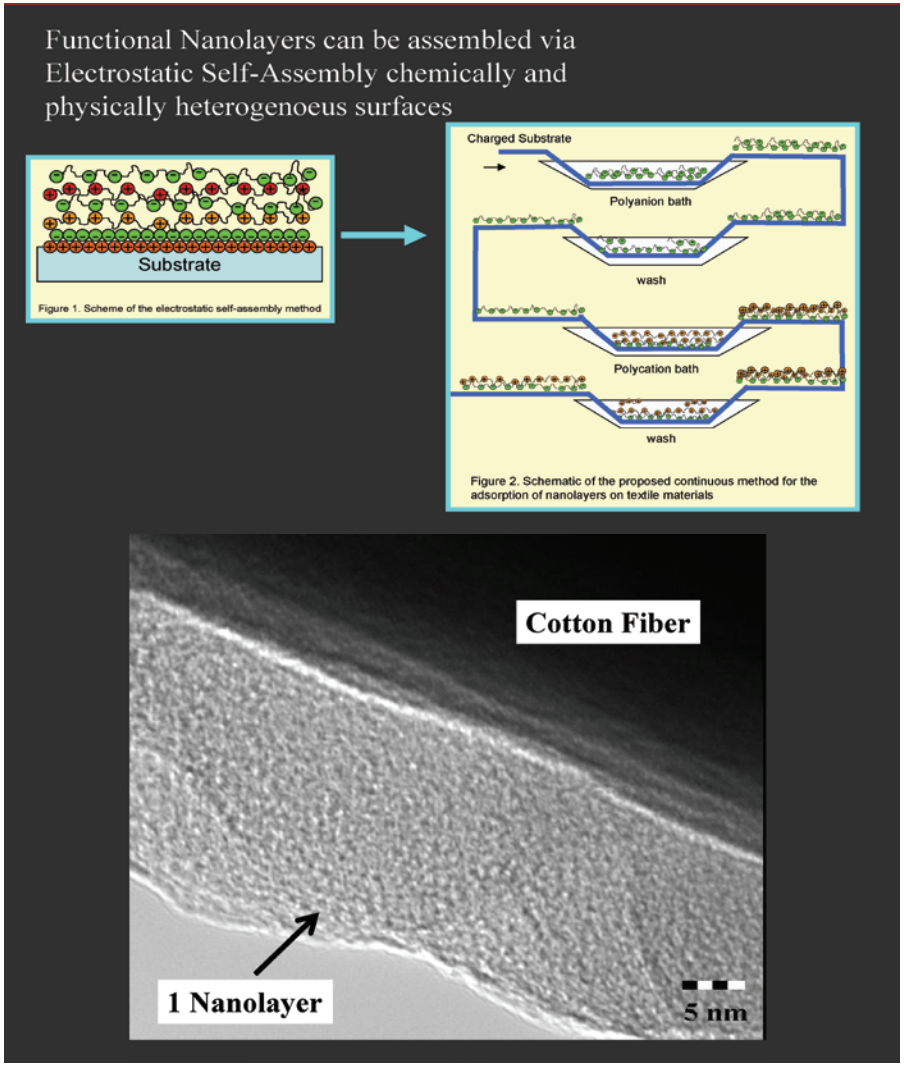


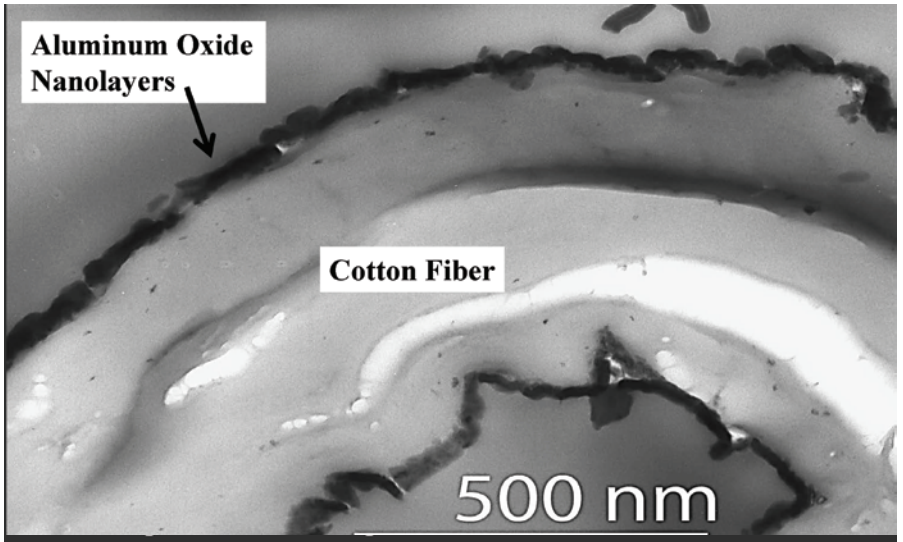


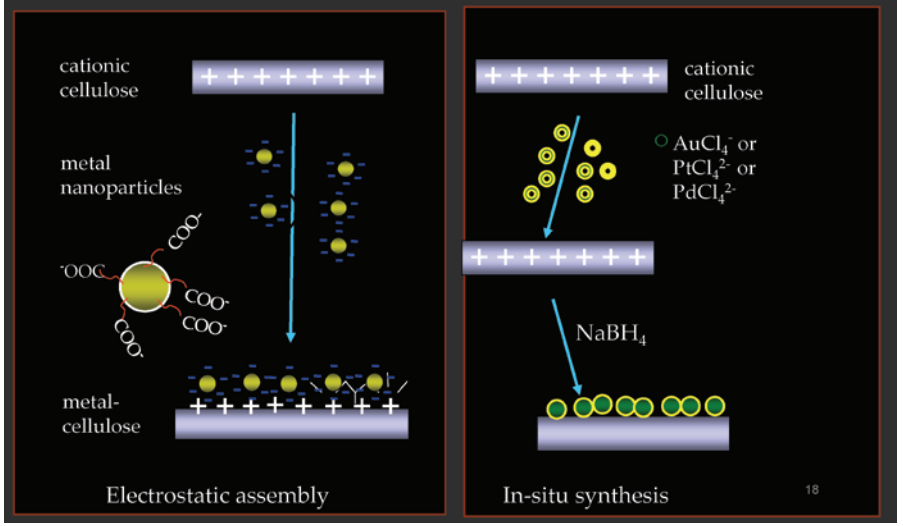

COTTON
The Biography of a Revolutionary Fiber
STEPHEN YAFA
SO WAS FORMED THE JUSTICE LEAGUE OF AMERICA, SEVEN OF EARTH'S GREATEST HEROES JOINED IN A COMMON CAUSE; LO, THESE MANY YEARS GONE...
Circa 1940

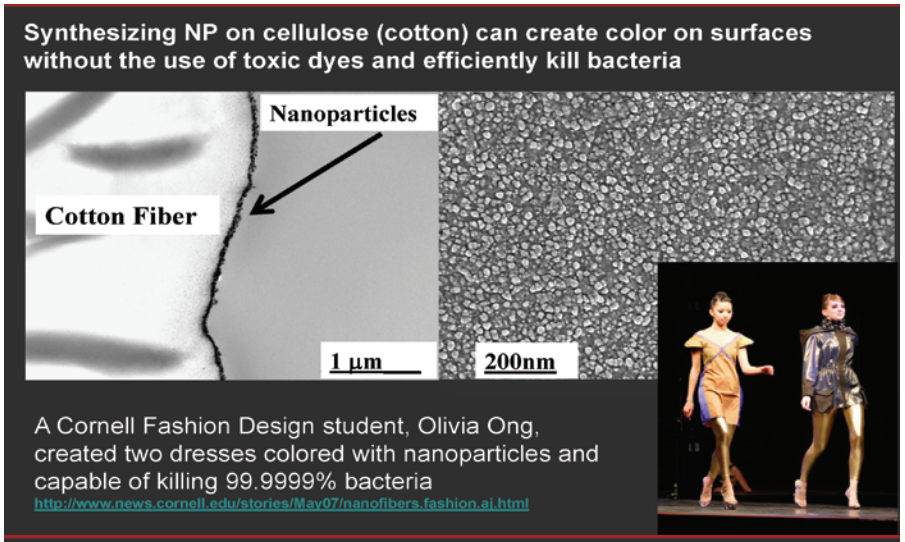

Science
Driving
Design
Driving
Science
∂esign
ſcience

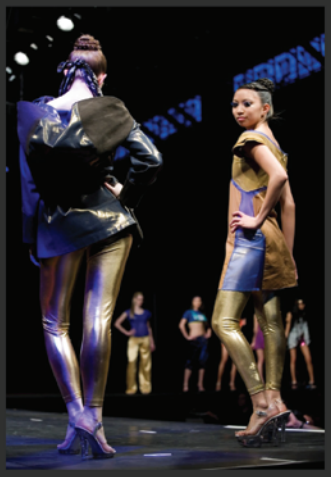

∂esign
∫cience
Air
Liquids
Vapors
Aerosols
PERMEABLE
SEMIPERMEABLE
SELECTIVELY PERMEABLE
IMPERMEABLE
Sorptive Material
Moisture Vapor
Skin
Ideal Solution
fire
heat
debris
radiation
*Adapted from Gene Wilusz, US Army Natick Center


Functional Nanolayers can be assembled via Electrostatic Self-Assembly chemically and physically heterogeneous surfaces
Substrate
Figure 1. Scheme of the electrostatic self-assembly method
Charged Substrate
Polyanion bath
wash
Polycation bath
wash
Figure 2. Schematic of the proposed continuous method for the adsorption of nanolayers on textile materials
Cotton Fiber
1 Nanolayer
5 nm

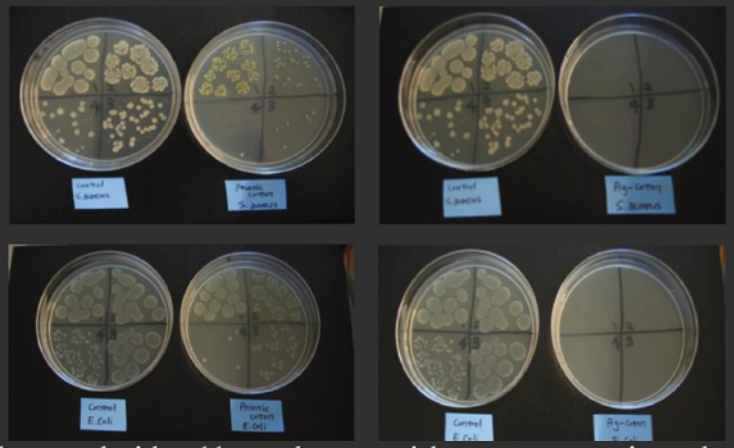

Aluminum Oxide Nanolayers
Cotton Fiber
500 nm


cationic cellulose
metal nanoparticles
metal-cellulose
Electrostatic assembly
cationic cellulose
$AuCl_4^-$ or $PtCl_4^{2-}$ or $PdCl_4^{2-}$
$NaBH_4$
In-situ synthesis
18


Synthesizing NP on cellulose (cotton) can create color on surfaces without the use of toxic dyes and efficiently kill bacteria
Nanoparticles
Cotton Fiber
1 µm
200nm
A Cornell Fashion Design student, Olivia Ong, created two dresses colored with nanoparticles and capable of killing 99.9999% bacteria
http://www.news.cornell.edu/stories/May07/nanofibers.fashion.aj.html



## Antibacterial Performance of Ag coated cotton fabrics Against *E-coli* and *S. aureus* **Killing ratios of $10^7$**



**Textiles coated with *noble* metal nanoparticles represent a unique platform for surface-enhanced Raman scattering (SERS) detection**

The Raman effect can be significantly enhanced by localizing molecules close to nanostructured noble metal surfaces.

**Typical enhancement factors are on the order of $10^6$, and under appropriate conditions single molecule detection has been achieved**

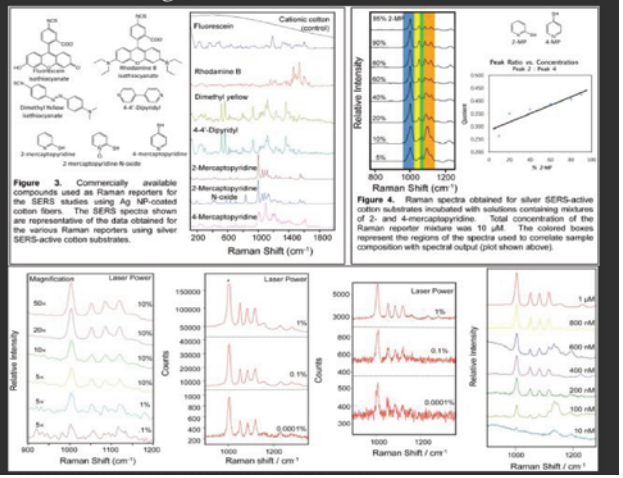
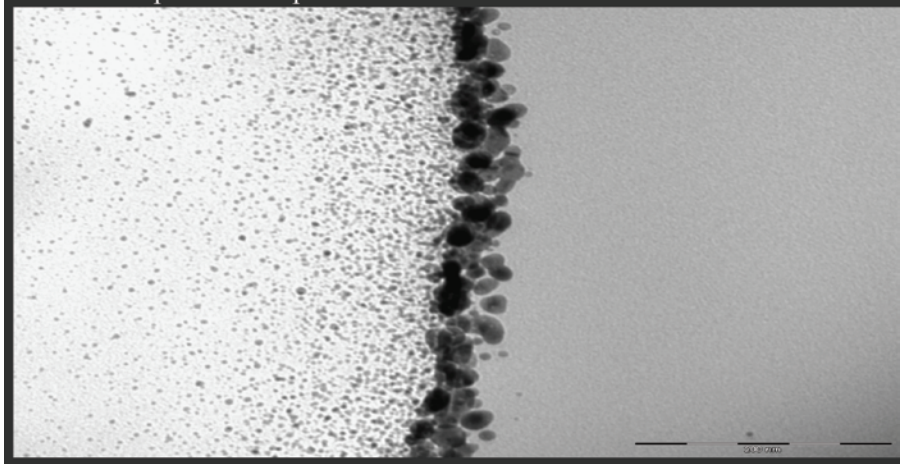



Figure 3. Commercially available compounds used as Raman reporters for the SERS studies using Ag NP-coated cotton fibers. The SERS spectra shown are representative of the data obtained for the various Raman reporters using silver SERS-active cotton substrates.

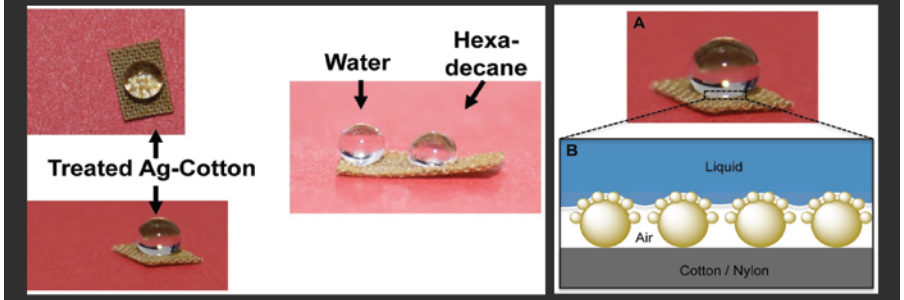
Figure 4. Raman spectra obtained for silver SERS-active cotton substrates incubated with solutions containing mixtures of 2- and 4-mercaptopyridine. Total concentration of the Raman reporter mixture was 10 μM. The colored boxes represent the regions of the spectra used to correlate sample composition with spectral output (plot shown above).

Strickland, A. Batt, C., **Hinestroza, J.** Conformal particle coatings on fiber materials for use in spectroscopy methods for detecting targets of interest and methods based thereon PCT/US2010//29438

## Can we deposit nanoparticles inside fibers?

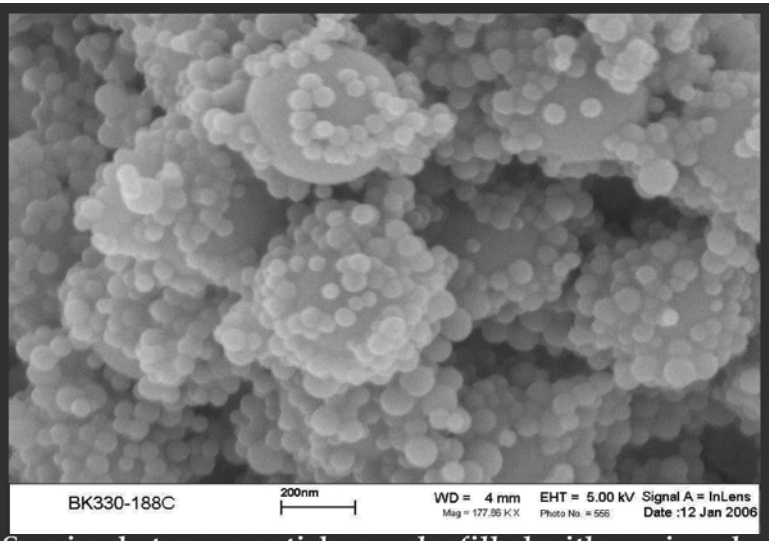


**Controlling the space allows for repelling water and oil simultaneously**

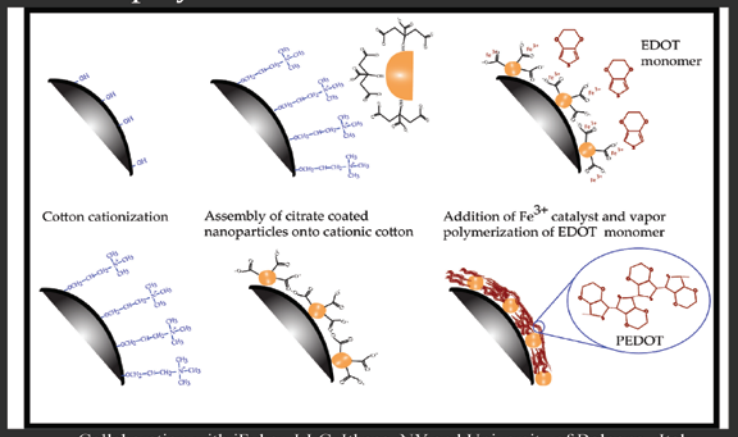



Courtesy of Dr. Aaron Strickland from iFyber, LLC Ithaca, NY

Avila, A.G., **Hinestroza, J.P.** Tough Cotton (2008), *Nature Nanotechnology*, 3, 458-459

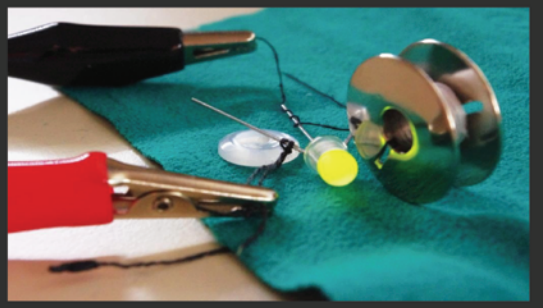


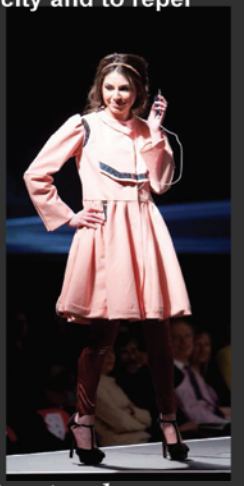

Spacing between particles can be filled with semiconductor polymers to create conductive cotton




Collaboration with iFyber, LLC Ithaca, NY and University of Bologna , Italy

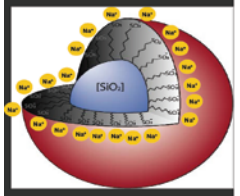
Controlling the space between nanoparticles and creating conductive polymer interconnects allow cotton to conduct electricity and to repel oils and water

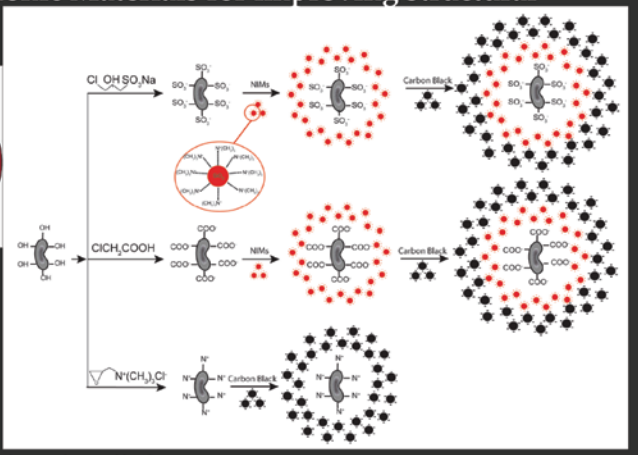




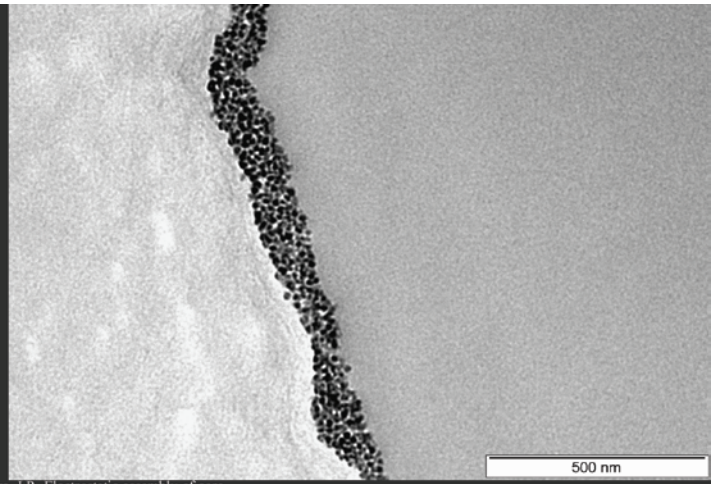
A Cornell Design student, Abbey Liebman, created a dress, using the conductive cotton, capable of charging an i-phone using solar panels.
http://www.news.cornell.edu/stories/March10/SolarCoat.html

Nanoparticle Ionic Materials for improving structural Coloration

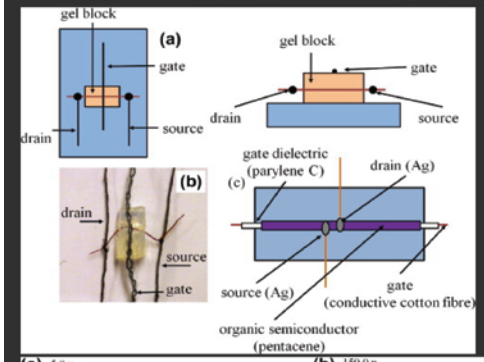



Song, J., Wang, C., Hinestroza, J.P., Electrostatic assembly of core-corona silica nanoparticles onto cotton fibers, *Cellulose*, 2013, 20,4, pp 1727-1736

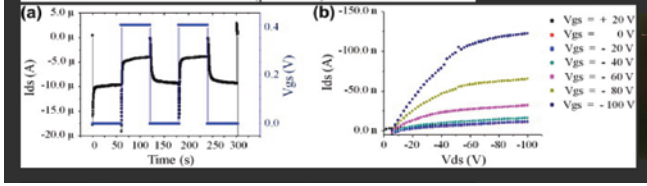


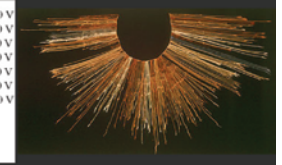

Song, J., Wang, C., Hinestroza, J.P., Electrostatic assembly of core-corona silica nanoparticles onto cotton fibers, *Cellulose*, 2013, 20,4, pp 1727-1736



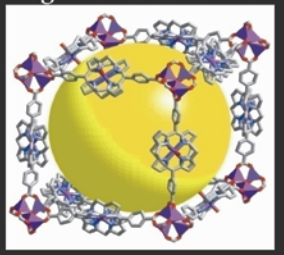

## What about Cotton Transistors?

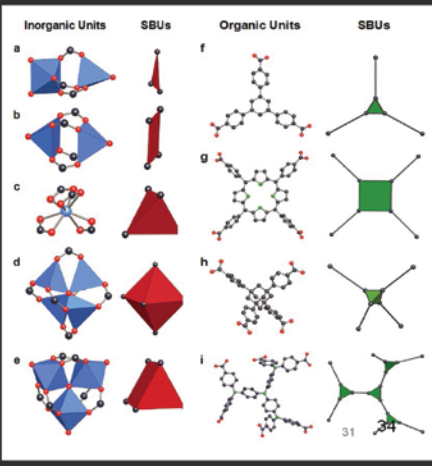

Mattana, G., Cosseddu, P., Fraboni, B., Malliaras, G., **Hinestroza, JP.** Bonfiglio, A., Organic electronics on natural cotton fibres, *Organic Electronics* (2011) 12, 2033-2029



## Using Fibers to assemble Metal Organic Frameworks for capturing gases



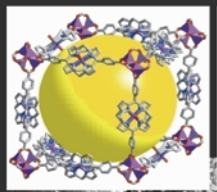


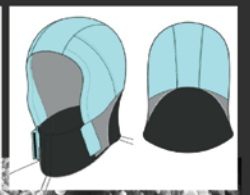

Design of composition (metal centers and organic links). Synthesis and structural characterization is well worked out.

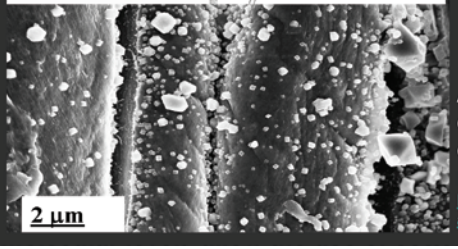
Control of structure, topology, interpenetration and porosity.

Isoreticular functionalization and metallation are possible.

**Controlling the functional groups on the surface of cellulose at the molecular level, allow the use of cotton as a scaffold for the synthesis of novel molecules such as Metal Organic Frameworks**

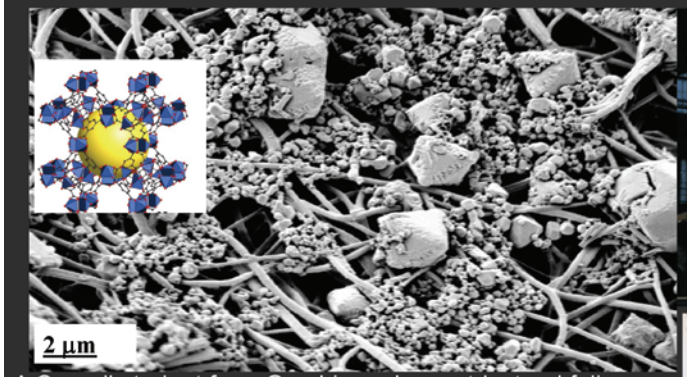


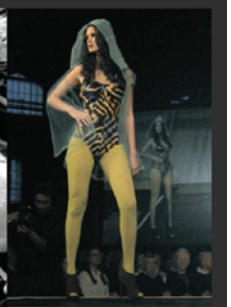





A Cornell student, Jen Keane, designed a mask and a hood capable of trapping toxic gases in a selective manner.
http://www.news.cornell.edu/stories/April11/GasGarments.html

amounts of active molecules such as insecticides

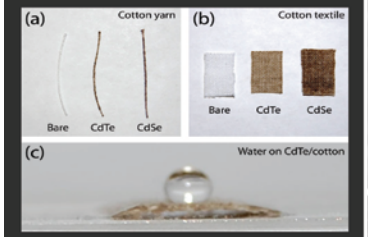


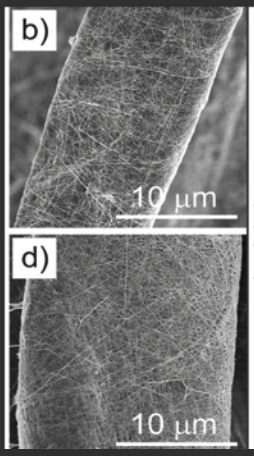



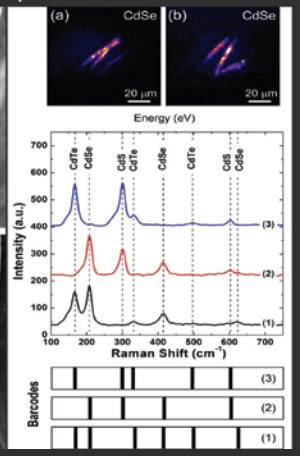
A Cornell student from Gambia and a postdoctoral fellow from Kenya created a prototype of an anti-malaria mosquito net with 3 times the capacity for storing and releasing insecticides

http://www.news.cornell.edu/stories/April12/RepellantSuit.html

Coating cotton with quantum wires can provide unique identifiers for anti counterfeiting purposes and make modified cotton emit light (Collaboration with Prof. Kuno at Notre Dame)

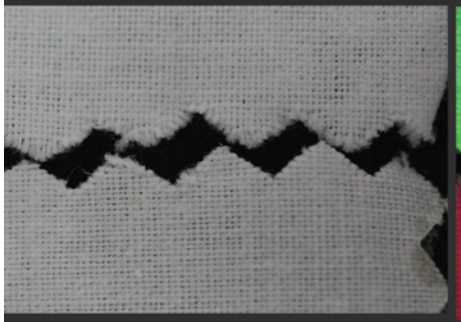


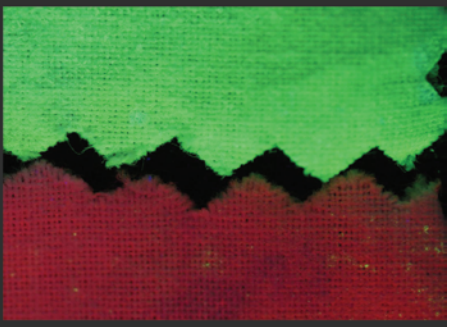




Unique raman signatures as well as alternative ways to create color and responsive materials

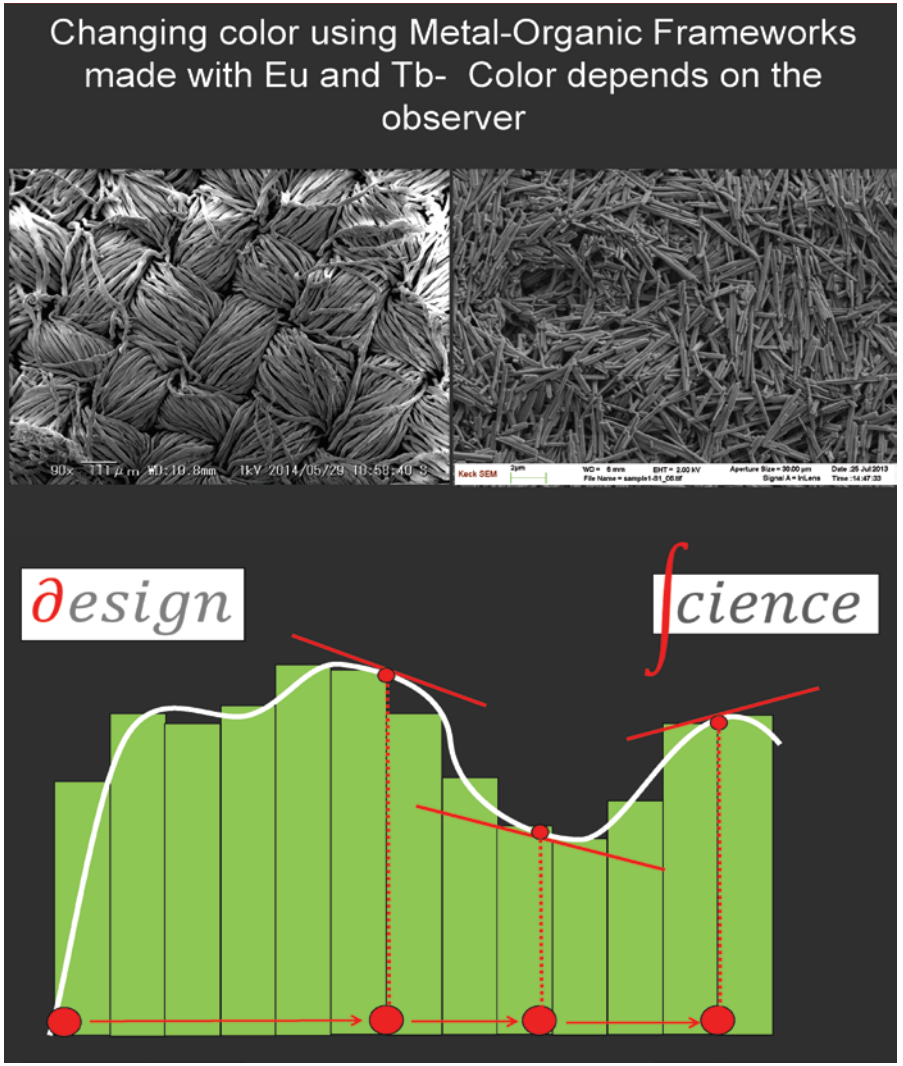
Changing color using Metal-Organic Frameworks made with Eu and Tb- Color depends on the observer





Under normal light conditions

Under UV at 254nm


Changing color using Metal-Organic Frameworks made with Eu and Tb- Color depends on the observer
∂esign
∫cience


Scie^rnce^r
Driving
De^rsign
Driving
Scie^rnce^r
Can Nanotechnology be fashionable: Merging Fiber Science and Apparel Design
Juan Paulo Hinestroza, Ph.D
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Fiber Science & Apparel Design
http://nanotextiles.human.cornell.edu

# Karin HOFERT FEIX

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Karin HOFERT graduated in Architecture in the Barcelona School of Architecture ETSAB in 1986 and since 1987 teaches Architectural Design in this School. Currently she teaches first and second year. She complements the regular course with elective monographic courses, and is member of a Master thesis jury. From 2004 to 2009 she was co-director and teacher of a UPC postgraduate course on Interior Design. From 2008 until 2014 she has been Vice-Dean in charge of the International Relations at ETSAB. She has been invited as visiting lecturer to several universities in Europe, South America and Asia, lecturing in four languages.

Besides regular teaching her main activity in ETSAB from 1995 onwards has been the organization and direction of a good number of international workshops and seminars, and of an international conference commissioned by the International Forum on Urbanism IFoU. She also has taught and has been jury member at the own and a large row of foreign workshops. Her main study fields are: Relation between structural type and resultant space; basic space forms; building enclosure in relation to structural type. Due to her professional work and the postgraduate course she has a founded experience in interior architectural design. As extension she is also concerned with interior urban design.

Research in progress focuses on the streetscape of modern Barcelona, by analysing the facades of a series of residential buildings of the 50-60, both from a technical and formal viewpoint. Her professional activity in the last years has focused the refurbishment of private housing. In former times she got awards in several design competitions, such as: third Prize / building commission of a square in Badalona; first prize for the town hall of Lugo (not built), second prize for the rehabilitation of Sant Pau al Camp Monastery in Barcelona.

# Representation as tool or as goal? Some general reflections on computer drawing versus hand drawing.

**Karin HOFERT FEIX**

## Common language

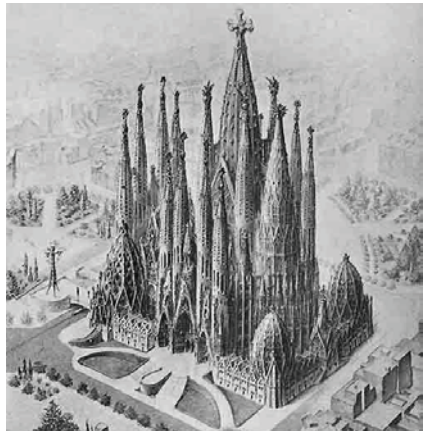
We architects share a professional peculiarity: we have an own language. It is not a letter-based language. Like the ancient Asian pictograms, it does not have a direct translation to sounds; to sounds that become words and subsequently meanings. It is a sign-based language that goes straight from the eyes to the brain and therefore is understandable for everybody who has been trained in it; part of this language even is understandable by the not trained. Like Chinese, Koreans and Japanese, who (to a certain degree) are able to communicate by the written word –or let us better say the drawn word- while their spoken languages are totally different, architects, planners and engineers can transmit and understand through drawings.

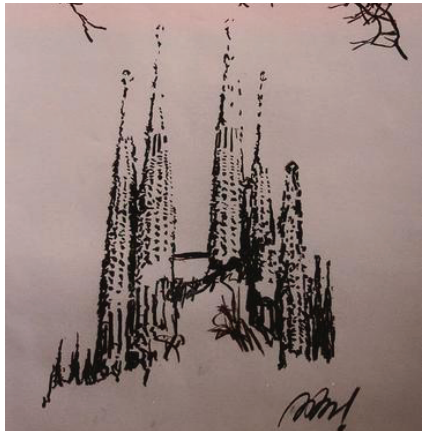

## Representing and projecting

The instrumental character and value of representation is out of doubt. By drawings we are able to register and at the same time pass information: information about the existing reality and about future realities, but also about feelings, ideas or visions. In any of these cases representation is working as vehicle, as connector or as catalyser. It re-presents or stays-for, making things be present.

If we think at representation as a means to achieve the future, by pre-visualizing future situations or objects, we enter directly the realm of architecture. Drawing enables us to fore-see, to pro-ject, what literally means to drive-out, to drive forward something. Drawing becomes the tool to think. That widens the instrumental nature of representation and makes it more subtile: representation is extending from recording to proposing; proposing in our field actually only is possible through representation. Representation becomes the clue to future, as pre-figuration of the future in our profession hardly can't be done in another way.

Thus pictures describe -or better depict- something that does not exist in reality. But this something exists in the picture. Hence representation can be understood as a reality in itself. Without loosing its vehicular quality representation becomes self-referring. It does not longer represent a reality; it is a reality.



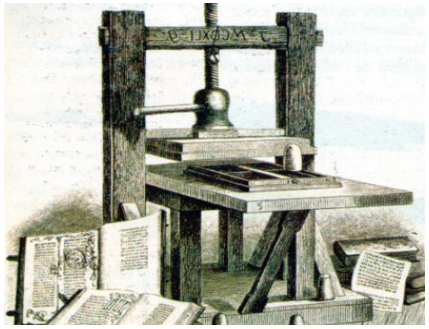


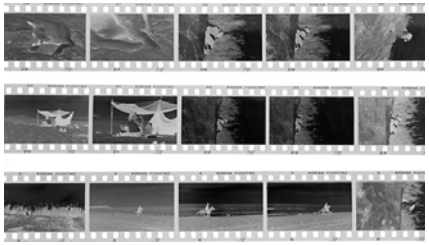
**Drawing, printing, disseminating, editing**

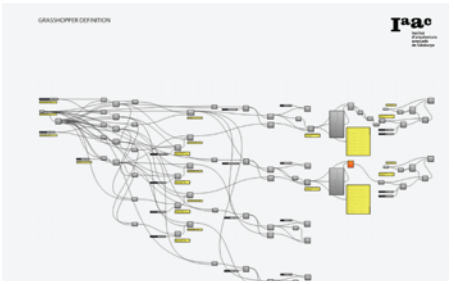
Since ancient times representation has physically been done scratching a tool, that usually is impregnated with colour, on a surface: a stone on a rock, a piece of burnt wood or charcoal on a wall, a paintbrush on a canvas, a pencil on a paper. The hand holds a stick moving it over a plane.

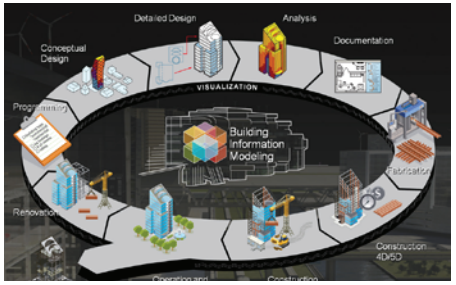
If the movement of the hand is done rhythmically provoking repetition of figures, we speak about printing. Since Gutenberg this action can be done mechanically with the help of a machine. It permits not only to serialize the contents of a picture, obtaining patterns and other systems based on repetition, but also to serialize the picture itself reproducing it many times.

A specific way of printing is photography. At the analogical photography the light acts on a film. The developed film becomes the stamp that allows copying the image again and again.









From the fifties of last century onwards, a new printing machine also based on the effects of photoconductivity, the photocopier, makes its entrance. Reproduction becomes more and more easy and accessible.

The most recent "revolution" in architectural representation/reproduction occurred only about 30 years ago. Computer assisted design entered our life with important consequences.

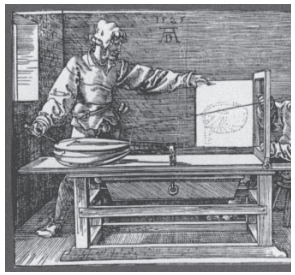
The first change does not have directly to do with drawing or drawing software. It has to do with reproducibility, immediacy and dissemination: in shortest time people have individual access to reproduction. Without middleman they can freely communicate whatever they want, directly, without filters, from any place. PC stays for Personal computer. From now onwards the machine is exclusively working for me. I don't depend on the work of others. The control of contents, but also of time is now on my side. I can spread anything worldwide by a simple click.

The second big change the computer age brought to architects (and the community of professionals dealing with representation) was the possibility to draw with a machine. In a relatively short time quite a lot of representation programs were launched. At the beginning the programs for architects mainly focused the technical representation in two dimensions. Soon the programs permitted to draw in three dimensions. The possibility to emulate free hand drawing appeared. And the last generation of software allows directly relating and converting data into shapes, figures into forms. Parametric design enables us to dominate the most complex spaces, while BIM information technology, by relating any kind of information to a concrete physical place, opens new ways of handling and organizing the building process.

In parallel an important number of programs dealing with text and graphic composition have been developed. Everyone can be his own editor. Definitely a message gains reliability and veracity if its presentation is carefully designed. A proper display/staging apparently guaranties the quality of the contents.

**From 2D to 3D by stacking layers**

The figurative drawing fixes something that in space has three dimensions on a two-dimensional surface. This happens in various ways that can be gathered in two main fields: only 2 dimensions of the object are represented; or all 3 dimensions of the object are represented, loosing one or more of them their metric scale.





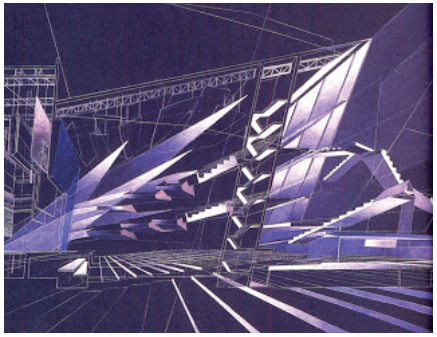
When we show an object in 2 dimensions, we use to look upon it perpendicular to a determinate plane. The "perpendicular dimension" disappears, while the object is explained by the "parallel to the plane" dimensions. Thinking on architecture we can do that from outside, obtaining elevations and roof plans, or from inside, obtaining sections and ground plans.

This leads us directly to the concept of scanning: by cutting an object in parallel slices, and sticking these slices together, we can rebuild the third dimension. 3-D modelling is based upon this. What traditionally has been used to build topographies nowadays is used for any object built with a 3-D printer. Our data, codified by computer-programs that are trained in working with and by layers, can be translated not only into drawings on a screen but also into real materiality.

And here we are again: at what point does representation "become" reality in itself? When it is converted in a touchable body? Or when -without moving from the screen- it can be seen in any position, for instance?

**From tool to subject**

The slight shifting of architectural representation from tool to subject is relatively recent. Architects often have drawn buildings that never were built. But the drawings were done with the intention to become a building. Or they were done to figure out a theory, often based on potential/expected social changes.



In recent times, very much in parallel to the appearance and development of mechanical drawing, more and more architectural representation is realized to be seen, shown, published, disseminated. If the representation later on will enable the construction of an object often is not priority.

**Why is this happening?**

For sure we can find several reasons. The following are some of them.

Technology has produced the so-called information society; most of the information is pretended to circulate fluently and open; so information has become mostly visual. As information is so available, we tend to become dulled. Therefore it is important that the visual representation strikes the observer, remains in his mind detached from the rest of information that is bombing him constantly. In that sense architectural representation –the promise of a better future- shows similarities to advertising. It can or not be the representation of tomorrow, but it must be appealing today.

At the same time (and only in apparent contradiction to the previous) information nowadays is an important exchange value. We handle with information, and information has a price. Even if at the end it does not serve for or does not lead us to anything, it has a value in itself. If we understand architectural representation in these terms we understand the shifting role of representation.

With the help of fluid information occident has started to delocalize production. We are changing from being industrial countries to service countries. We are not the ones that use their hands in combination with a machine to build the final product, but the ones who do the rest: decide the product, design the product, wrap the product, transport the product, sell (and mostly buy) the product. This is also permeating our realm: the vehicle is the added value.



If we are going to offer services we have to be trained: higher education offers us the chance to enter the market. In the developed countries higher education is available for everybody. The result is that we produce more academics than we need. More and more academics have to share job opportunities. In Europe we can already speak about an inflation of certain professions; one of them is being an architect. So the newer generation, very skilled in drawing with the machine, but not requested to intervene at the building process, focuses drawing as aim and not as means.

Drawing with the machine in certain way reminds playing. The step from playing a game in the computer to playing with the computer –using it for my own game- is small. Also this contributes to confound and mix the tool and the objective.

3-D computational representations –renders- nowadays are so close to camera pictures that they can be taken as representation of an existing reality. Often it is hard to distinguish if we are in front of a drawing with purposeful character or in front of a picture with testimonial character. Where is the reality? It ends up that the only thing that we know is really real is the drawing itself.

**Conclusion**

So we come to the conclusion that computational drawing has done an important contribution to the shifting of architectural representation from instrument to subject. It seems contradictory that this happens with an apparently "neutral" drawing, where the author hardly will be identified, while the personalized hand drawing in architecture has mainly been used as a mere vehicle.

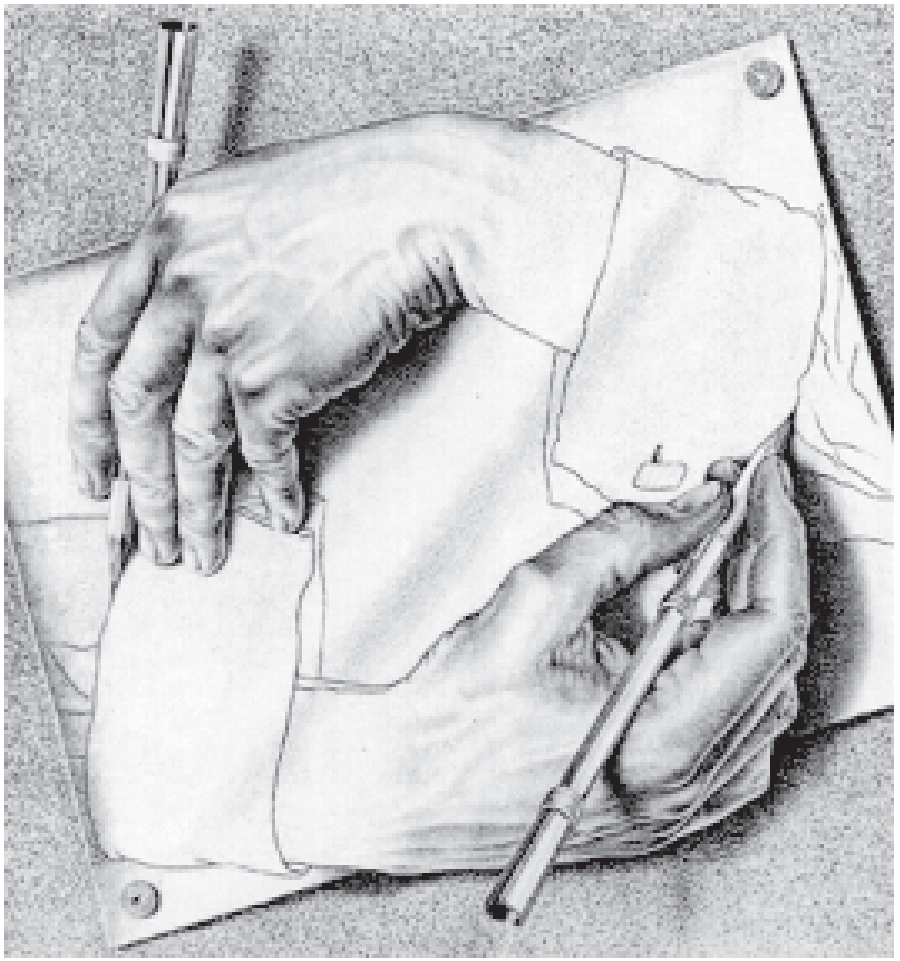
In my opinion this opens a new door to the classical patterns of representation. Personally I still believe in representation as a previous stage of reality, but according to the new scenario why shouldn't we take advantage of the situation "rescuing" ways of doing that are running the risk to be relegated? If representation becomes the aim in itself, shouldn't it be specific, personal, un-exchangeable, and highly subjective? Drawing never is neutral; it always includes the drawer's interpretation. The machine drawing tries to hide away this fact; actually it is misleading. Hand drawing clearly assumes its analytic and even critic dimension, its interpretation of an existing or a future reality.

By contrast hand drawing is not influenced by the facilities of the machine, at most by the abilities of the drawer. If we come back to the classical role of representation as "forecast", we realize that the drawing mechanics of the computer program often influence the project. The tool (partially) determines the product. Shouldn't it be the other way around? Shouldn't the object provoke a specific way of being represented?

These reflections are not pretending to establish any comparison of digital and hand drawing and by no means want to issue any judgement.

All existing representation tools, included the ones not referred to in this essay, have to coexist. There value lies in their complementary.

But the main value of any means of display and representation, independently form their vehicular or objective character, lies in being our specific way of thinking and (re) searching.



# Romolo MARTEMUCCI

**Director of Pantheon institute, Rome, Italy**

**President of Accademia Adrianes di Architettura e Archeologia, Tivoli, Italy**

**M.A. Architectural Theory, University of Pennsylvania, 1994**

**M.S. Urban Design, Pratt Institute, 1976**

**B.A. Architecture, Pratt Institute, 1975**

**AIA (American Institute of Architects)**

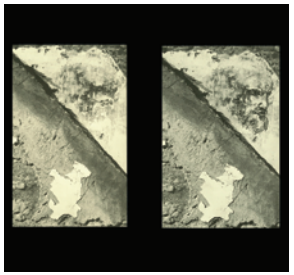
Romolo Martemucci was Professor of Architecture at the Penn State University and Director of their Sede di Roma from 1990-2009 as well as the interim department head of Architecture at Penn State University from 1995-1997. Prior to becoming the co-founder and Director of the Pantheon Institute, he was also the creator of the La Magia Institute in Rome that offered special courses in architecture and landscape architecture, and co-founder and Director of the Accademia Adrianea, which currently offers a unique Italian-accredited Masters degree in Museography, Architecture and Archaeology.

Professor Martemucci has presented numerous papers, and his articles have been published in Urban Design Magazine and in the Association of Collegiate Schools of Archtecture publications. He has lectured and/or taught at University of Pennsylvania, Temple University, University of Minnesota, Rensselaer Polytechnic Institute, Pratt Institute, Iowa State, Ohio State, Notre Dame University, and North Dakota State Universities along with University of Puerto Rico, Università “La Sapienza” and “Roma Tre” in Rome, and the University of Monterrey, in Monterrey, Mexico.

Mr. Martemucci has professional interests in urban design, institutional architecture, and the architecture of the public realm. Teaching since 1977, his academic and research interests include architectural theory, representation and meaning in architecture, urban design, materials and materiality, the human body as paradigm, Renaissance planning and town design, the work of Biagio Rossetti and the city of Ferrara, Italy.

# Architectural Representation in the Paperless Office – Drawing Research

**Romolo MARTEMUCCI**



Architectural research is not easily defined because the object of the search is unknown. Unlike our related fields of engineering that are more easily associated with the empirical sciences, architects often do not know a priori the direction of inquiry their research should take. They research to find the object of their study. Often enough, the evaluative measures and criteria of value lie outside the field itself.

In addition, the design business is firstly a business. The collaborations required to take concept to completion are governed by contract administration. The goal in this arrangement is to achieve confident investment. While the pursuit of an ethical or cultural goal may be elusive, it is what academic critics stress and is the currency of our debate and often the aim of stated research. The academy is quite literally out of step with the practice of architecture.

Technological knowledge and its pursuit is more easily measured. Often quantitative in dimension, it allows one to do again what has been done before often without regard to context. Nothing in the realm of technological work acknowledges a territorial obligation. Perhaps because of this the technical object enjoys world-wide distribution.



I would like to suggest that the hand drawing is an emblem of the ethical pursuit in architecture. It completes the technical dimension and is its opposite. Hand drawing embodies the translation necessary from, and of, concept to completion and that as such, it is place-bound, situational, body centered and physical, and representational in the materials medium of architecture.

Here in Frascari's Synopsis, is how it works:

Architecture is a virtue by which humans interact spatially, tectonically and culturally with a region that they modify to their advantage as a proper expression of their humanity. Drawing is the fundative act of architecture. Drawing and architecture were there before building took place. Architectural drawing commenced when humans found a support and began to trace lines to figure out, or better, to build their cosmologies by making visible what is invisible in theoretical thinking. An architectural drawing is first and foremost something which stands for something else. It is a formal system for making explicit certain entities and specifications regarding construction of buildings and architectural construing. The result is that architectural drawings are the results of four interlacing cosmospoiesis.

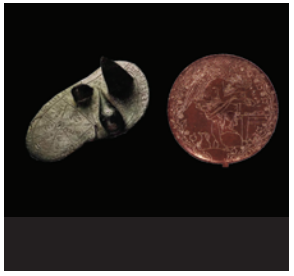
» The world of the represented

» The world of the representation

» The world of who has created the representation

» The world of who is reading the representation

Marco Frascari (Frascari, 2004)






**Drawing a situation:**

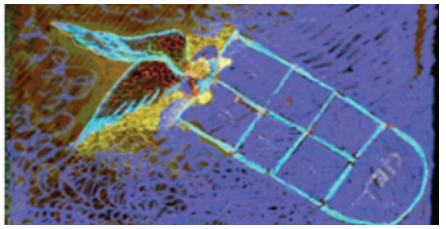
Drawing by hand is a synesthetic act. All Children are synesthetic, as they assimilate human experience in a disordered and random sequence of learning where senses overlap. Children have the capacity to align separate dimensions of human experience to each other in a personal, concrete, and material manner. We learn to dissociate tastes from tactility from vision and sounds only as we grow older.

Drawing replicates in its inchoate references the act of scribing or inscribing by cutting into an object. The flat stone of Dibutades, or the sheet of paper are cut by the action of the writing instrument. Not unlike the cut skin of Vessalius' anatomical drawings or the open entrails of the sacrificial animals of foundation rites, each opening reveals. In each case the opening reveals knowledge. The knowledge of the anatomical self in the former case, and an important message from the higher order of things, in the latter.

Design in Italian is Disegnare and comes from a non-Latin Designare referring to the indication of where things go (to designate). The original designare was a placement issue and a craft, ongoing and circular, like construction tasks. Mario Ridolfi called his drawings literally "a building on paper." In fact, one can usually see within the traces of an architectural drawing the first gestures of its concept.

Historically, pre Renaissance drawings were not of finished buildings but of construction directives and process (designo).

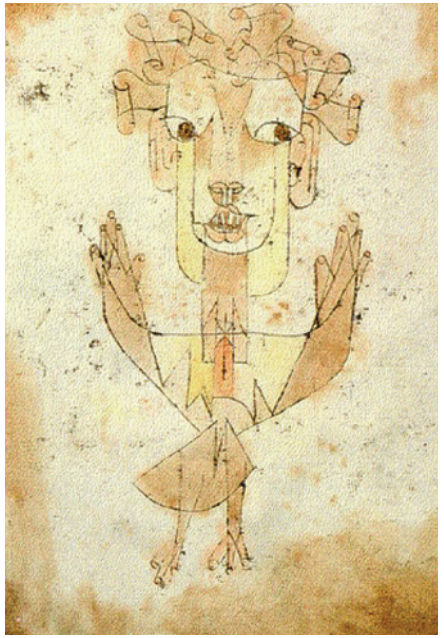




The physical work of hand drawings is also messy and often stains the author. It is a dirty manipulation. Compare the graphite or ink stained hands and architects drafting apron to the white-clad human forms in "clean rooms" where computer components are assembled.

A hand drawing is done at a specific time and in a specific place. It often remembers both. The computer generated image is nowhere and everywhere and is only circumstantially associated with time. An architectural hand drawing is thus always a situation.

**Drawing is drawing the body:**



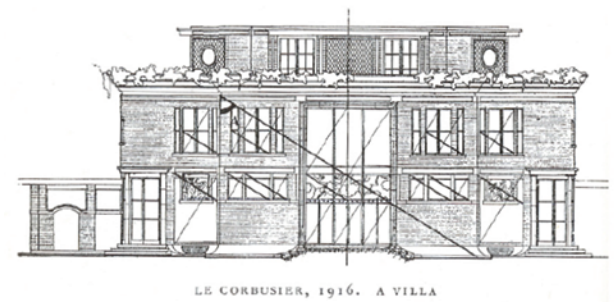
The body is the object and subject of a drawn work. We think in terms of bodies in space, and bodies moving through architectural spatial patterns. Our concepts are defined by these event specific moving parts. They are the objects of our concerns, but also our best instruments of measure.

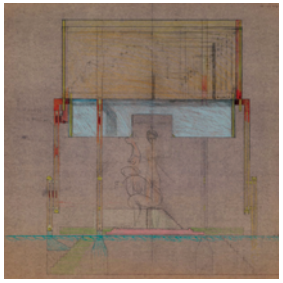
All knowledge is anatomical since we understand all we know through this body filter. Thus we only know our anatomy.

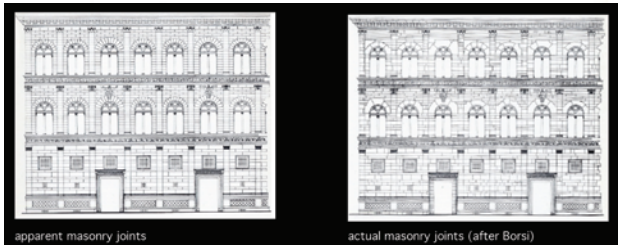
But we also principally represent our bodies. Our concepts and composition are often and more than usually, body mimetic. The drawings of Francesco di Giorgio are only one early set of examples.

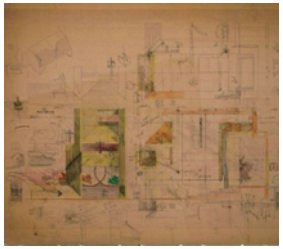
Our bodies also produce the drawings and add an endemic idiosyncratic dimension to the process. In the Name of the Three, Edgar Wind tells of a 19th C medical doctor, Giovanni Morelli, who could attribute authorship of important works of art by studying the inconsequential details of the work.

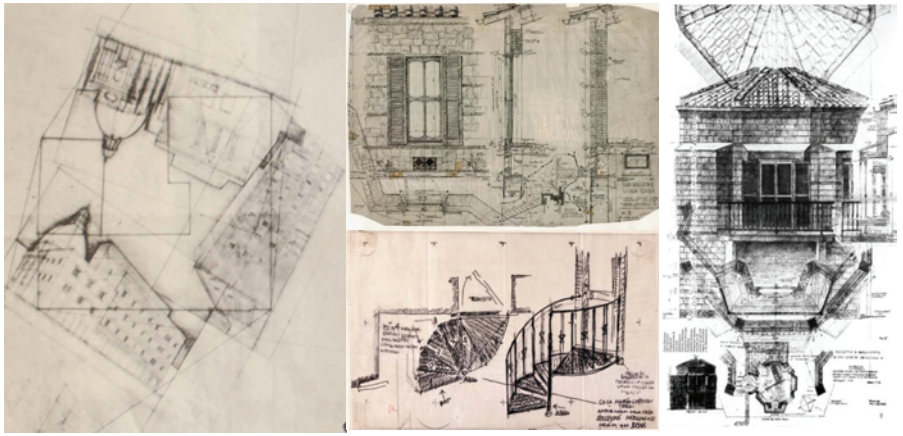
> *Giovanni Morelli's (1816 –1891) capacity to identify the authors of paintings relied entirely on the work's inconsequential details. (Wind, 1985) Morelli's insight was that painting is a human operation, a performance, which by virtue of the performer's actions, will include things that are identifyingly personal. The less important the item, the less conscious control is exerted and the more person-ality becomes evident. Mental and physical retracing of the detail becomes habitual, but none the less subjective and thus character-revealing. The notion that insignificant gestures betray personality traits is now a standard axiom in psychoanalysis where the insignificant is often the most significant. (Ginsburg, 1983)*







Drawings hold these clues to the identity and disinterest of its author. They are like tell-tale fingerprints attesting to the presence of a specific individual in a specific place.

The human body is the subject and object of architectural thought and maintains this position in drawing.

**Drawing the Joints in the Medium of Architecture:**

Each line drawn represents a joint, a seem in, and an edge of, something physical. The material components of a project are the thought medium of the concept and the true content of the drawing. If we consider building materials as the medium of architecture, then all concepts must begin and end there.

One of the most distinguishing features of computer generated renderings and drawings are their difficulty to represent materials. That is because their task is different. They aspire to present materials and forms, while the truer task of the work of drawing is to re-present these.

Translation going in and interpretation coming out is a requirement of drawings in this and other stages of the making of architecture. Materials are representationally assembled on the drawing through a construing and constructing process. Materials are productively metaphorically present and unite the theoretic and practic dimensions of what we do.

In conclusion, situations, bodies, and materials in architecture are the proof that drawings represent: That representation is a necessity in architectural research, and that the pronouncement of the death of architectural drawing is a bit premature.

**Endnotes:**

Frascari, Marco 2004 Grimoire of Architecture

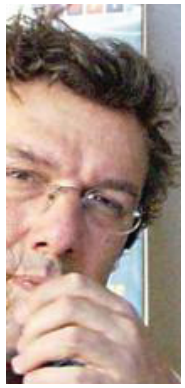
Symposium on the work of Marco Frascari Complementing the Adelaide Festival of Arts 2004 Architecture Symposium which featured Professor Frascari as an international keynote speaker - Abstract

Ginzburg, Carlo 1983

"Morelli, Freud and Sherlock Holmes, Clues and Scientific Method" in

Eco, U. & Sebeok, T.

The Sign of the Three Bloomington 1983



# João Manuel Barbosa Menezes de Sequeira

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**Associate Professor and Head of Architecture Department DARQ/ECATI - Lusófona University**

**Scientific Coordinator of the Architectural Lab. Research centre (LabART) - Lusófona University**

**Research Collaborator - Architecture Research Line at CHAIA – Évora University**

Manuel Barbosa Menezes de Sequeira graduated in Architecture in Lisbon University in 1990, the M.Arch degree on Urban Design in 2000 at Lisbon University Institute and the PhD in Urban Design at Lusófona University where he teaches Urbanism, Design and Architecture since 1993. He is since 2010 Associate Professor and the Head of the Architectural Department of Lusófona University, the Scientific Coordinator of Architectural Lab. - Research Center (LabART) and the Director of Lusófona Journal of Architecture and Education (AE). Since 1995 João is CEO of A2S - architects office (ex AJLS) were he continues to work with Arch. Luisa Paiva and various collaborators in architecture, planing and design. He has two international prizes one in 2007 by UIA (International Union of Architects) and another in 2008 by the OEM New York City.

He has published eight books and book chapters, thirteen scientific papers with scientific refereeing, six papers in conference proceedings and twenty nine articles in magazines and journals. He is the coordinator of the Research Group "Studies on Architecture and Media" (SAM), of the research line "Advanced Architectural Technologies" (AVATECH) and since 2013 he is member of the scientific committee of the european research project DR_SOM Design Research Series on Methods. He participated as a member in the research group of EAAE in the creation of the European Charter for Architectural Research (approved in 2012). And since 2013 one of the founding members of the "Architectural Research in Europe Network Association" (ARENA). His main research interests are in the areas of Architecture and Urban Design with emphasis on communication (cognitive, semiotic and perceptive) and in the areas of research by design.

# "New approaches between academia and professional practice through research by design"

**João Manuel Barbosa Menezes de Sequeira**

**ABSTRACT**

This paper will try to stress that a new approximation between academia and professional practice has its roots on the revolution that occurred in the schools of architecture in the middle of the XX century. We think this process has different phases: first with the idea of connecting arts and crafts, leading to a new kind of schools the "design schools"; second, the idea of bringing practitioners into the academia and liberating the concept of academic curriculum. Today we have a crisis in our hands that is mainly due to, both, the last liberalizing process of the curricula and the revolution of the digital mediums. This reflection must be accompanied by the reemergence of new concepts of representation in architectural practice and in the arts and by a small excursus on the history of the relation between academia and society.

We stress that, today, the only disciplinary response of architecture is the development of the concept of architectural research by design as the main core of the discipline identity and at, the same time, the reification of different curricula's according to different schools and/or departments.

The crises situation that we all live in our universities is different from country to country, so it's difficult to identify precisely what will happen in the future, but we can say that the solution is not a conservative reaction of returning to the past of the beaux-arts curriculums, nor a multidisciplinary dispersion in other disciplines, more connected to arts, to technologies or to social sciences. The path cannot be defined by ideology, theory or history; instead it must be walkable by all of us in a rediscover of new and old forms of architectural knowledge in design.

**Keywords**: research, education, architectural practice.

### 1. Figures - non gestalt impressions


AVATAR 1

Today and for us, both as teachers of Architecture and Urban Designers, as for researchers and practicing architects, to speak about new approaches in education, is to speak about the way research has introduced itself in the academia and in practice as an unifying path.

What we mean is that, we believe architectural research and especially research by design is the main way to approach academia and the architectural practice today.

This approximation is possible if we start with design-oriented approaches and try to clarify some of those concepts.

Research in architecture is a very fuzzy and complex issue especially due to the hemorrhagic literature that has spread in the world, with many disciplines and many different points of view using the same words to refer to very different realities. According to some authors, like Nigel Cross (2001, 45) the discussion starts in the 60's with the design methods' conference organized by John Christopher Jones and D. G. Thornley. Unfortunately we are not so positivists and we think, like Jonathan Hill (2013), that the origin of this idea is much older and is more complex than we can expect.

However we can, in a simplifying manner, try to organize some concepts of design research that can help us to understand research by design. We will use two different approaches, of two different generations, one from the brothers Faste, Trygve and Haakon (2012), which identify at least four concepts and other, from Christopher Frayling (1993) that proposes three concepts in art research.

| Trygve Faste and Haakon | Faste kinds of research | Christopher Frayling |
|---|---|---|
| (2012) | | (1993-94) |
| Conceptual Categories | General Categories | Pragmatic Categories |
| Design **through** Research | Traditional Research | - |
| Design **of** Research | Tradicional Research | - |
| Research **on** Design | Traditional/ Designerly Research | Research **into** art and Design |
| Research **through** Design | Designerly Research | Research **through** art and design |
| - | Designerly Research | Research **for** Art and Design |

Table 1: comparative table between the different approaches of the Faste brothers and Frayling

The approach made by Trygve and Haakon is different from the one used by Chistopher Frayling, because the first ones appear to make the approach under the point of view of the designer, and the approach from Frayling appears to be done from the researcher point of view. We will see that both are different and at the same time similar.

The Faste (2012, 7) brothers identify at least four "categories" of relations between design and research that stress different "intents and objectives of designers". 1. Design through Research identifies the activities of design that conventionally can be considered research; 2. Design of research identifies the activities that are made by researchers to plan and evaluate their experimental designs; 3. Research on design, also named as design-led research, or practice-led research, identifies the activities that are made by designers about their practice or work, to improve the design practice; 4. Research through design or research by design identifies the activities made by designers when they acquire new knowledge through their practice, outcomes or about their practice. Based in these four concepts we can consider two kinds of research categories: the traditional, that includes the two categories of "design through research" and "design of research"; and the "creative" or the acceptable "designerly ethos" of design by Nigel Cross (2007), that

embraces the other two categories of "research on design" and "research through design".

On the opposite side of table 1 we can see that Frayling identifies only three categories of research design: 1. Research into art and Design, identifies the HTC paradigm of research and the most common work that we make in the academia. We can see it in the preparation of classes and even in the classroom, and for that reason is the well known type of research in the academia. As we point out earlier it is also connected with the paradigmatic H.T.C. which means history, theory and critics. It is historical research, aesthetic or perceptual research, research on social, economic, political, ethical, cultural, iconographic, technical, material and structural perspectives, etc. In a word, is research that is fundamental for the teaching of architecture and urban design planning; 2. Research through art and design, identifies all the research that has to be done for the good performance of art, architectural and urban design, like materials research, building temperature behavior, development work of customizing constructive technologies, etc. and action research where we can see much of the digital research, characterized by a step by step experimentation in studio or in lab environment with the communication of results gathered in the daily reports; 3. Research for Art and Design is, according to Frayling, the most controversial kind of research because there is a thin line between this research and the actual work of professional practice and, between this type and the platonic idea of being inside the design process and outside with a consciousness of being the "object that produces itself".

As we can see, the two first and traditional categories mentioned by the Faste brothers, are not mentioned by Frayling, which is justifiable because of the target of art and design research approach of this last one. The category of "Research **on** design" is very similar to "Research **into** art and Design" but "Research **through** design" of the Faste brothers has much more amplitude and gathers Frayling's, "Research **through** art and design" and "Research **for** Art and Design" categories. The differentiation that Frayling creates has much to do with the pragmatic aspect of the outcomes that they must present, having, the first, a traditional verbal outcome and, the second, an artefact where the knowledge is embodied in the artefact and the goal is communicable by a visual, an iconic or an imagistic object or process. A problem related to the "cognitive tradition" that is concerned with the problem of being "outside the artefact at the same time as standing within it" (Frayling, 1993, 5).

This is very interesting because is a clear statement about what we call the "mirror problem" and we will make a small excursus in order to clarify the concept and to connect it with the contemporaneous practice architecture.

## 2. Parallels – the mirror problem


AVATAR 2

The mirror of action and its conscience is the other side of the observation of an object, assuming a relation of both, independence and distance. Relation that modern and post modern movements have been working both, in transparency and communication.

Bernard Tschumi also approached this last problematic in his architectural theory, especially in "Architecture and Disjunction" (1994) where the paradigm of architecture stands between the labyrinth and the pyramid[1] . For Bernard Tschumi the connection of the metaphysical state of being inside and outside is the proper nature of architecture, since "architecture involves the materialization of concepts or ideas" (Tschumi, 2014).

Categories like, space - event - movement, or program (juxtaposition/superimposition) or vectors & envelopes, or concept - context - content and concept-form, constitutes his last book called Red is Not a Color (2012), where the architect exposes his theoretical work over the years and where architectural practice is seen as a way of generating ideas and concepts about the world we live in, allowing us to apprehend that world and, in other words, apprehend a genuine "form of knowledge".

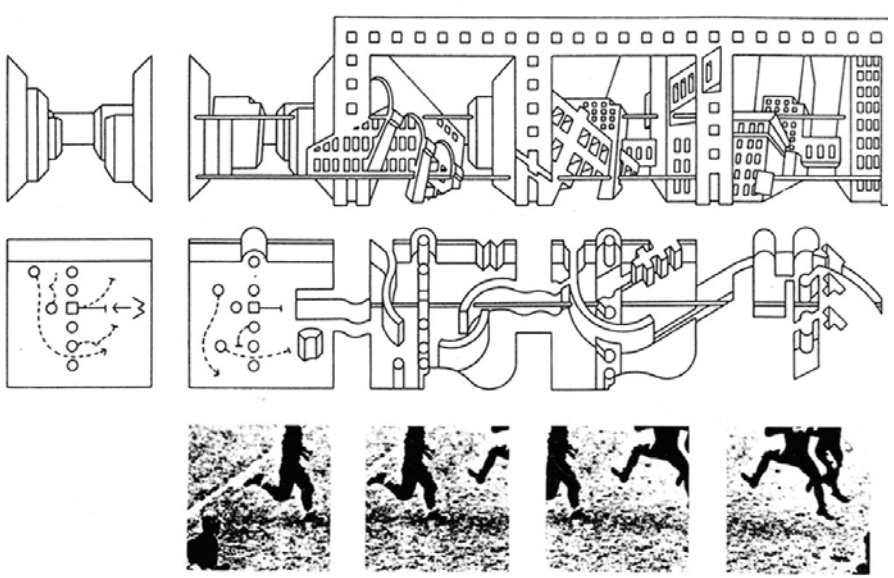


Fig.1 Bernard Tschumi, composition made for the Manhattan Transcripts p.48

The important question is that, despite the metaphysical theoretical impasse of the mentioned paradigm, empirical necessities of practice and the experience of architectural practice have been working on it since the beginnings of the 20th century, because in some issues, like architecture and urban design, our verbal thought is much slower than our imaginative hands-on.

As we want to stress in this paper, by this verbal mean, research is the way we can connect academia and practice, and this is easily observed in the way some contemporary architects communicate their own research work.





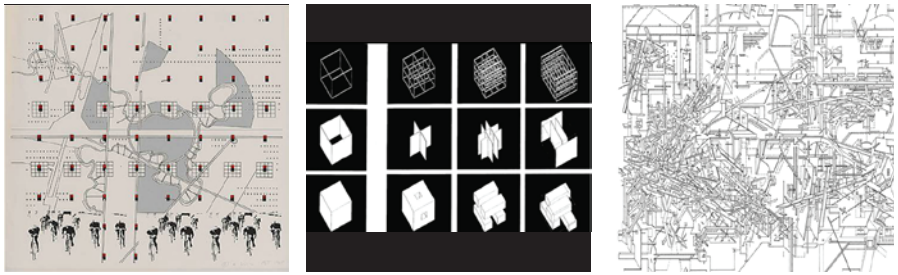


Fig. 2. From left to right: Tschumi studies for the project of the Parc de La Villette in Paris (1998); Peter Eisenman house studies (1969-1978); Daniel Libeskind's "Micromegas" Dance Sounds Drawings (1979)

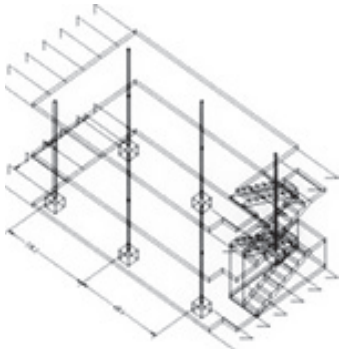
The preponderant idea of communication, as we all know, is mainly started in the postmodern architecture, but transparency (that's another concept) has started long before, in modernism. The crisis of transparency of the Modernist buildings has two causes, one from modernist itself (Sequeira, 2014) expressed by the post-modern movement, and the other from the today complex infrastructure of build-ings (De Mouron, 2005).

The appearing of postmodernism and the development of the substitute idea of communication is, as we will see, in a profound crisis. Today the idea of communi-cation and transparency has been transformed in a transparency of communica-tion, introducing architecture as a media device (Sequeira, 2014).

In a devious way and with enormous consequences in contemporary architecture, architects are compelled to communicate and, in doing it, they bring new insights to architectural research. Nevertheless these insights are coming from a specific type of research and become increasingly more important in architectural education.

### 3. Wireframes - The transparency of design.

We think that there is a connection between the two revolutionary transformations done in the schools of architecture, one at the beginnings of the 20th Century, in the Deutscher Werkbund, the Staatliches Bauhaus and the Vkhutemas school, and the other in the second half of this same century, in the reform of the Architectural Association School in the UK by Alvin Boyarsky with the new categories of architecture research, and the emergence of architectural communication of the design object.



AVATAR 3

The modern idea of the transparency of the object as an objective for education, started between the two World Wars with the three mentioned schools.

In the German school, the Deutscher Werkbund (1907-38), founded by Herman Muthesius, students already in 1914, study mass production way of design; and subsequently contradictions between the individual expression and mass-production techniques or between beauty and usefulness become the core of students discussions.

Fig.3. The Weißenhofsiedlung Settlement built for the exhibition of the Deutscher Werkbund in Stuttgart in 1927 by the government under the direction of Mies van der Rohe.

Fig.4. Classes in the Bauhaus School.

The Staatliches Bauhaus (1919 to 1933), continuing the work of the Deutscher Werkbund, was the second emergence of the idea of a school where design must show the inner genesis of the objects produced. The system of education was profoundly marked by the idea of a study of the design processes as a way to conciliate individual expression with mass-production objects, with the assimilation of filtered and pertinent knowledge from other disciplines – technical knowledge. Originality, like any consumer product, must be intimately mixed with the simplicity of the production methods to be used. Simplicity is another side of transparency.

The same, but not so concerned with mass production and more with disciplinary and interdisciplinary knowledge's, was happening in Russia with the School of Higher Art and Technical Studios (Vkhutemas) founded in 1920 and a direct heiress of the Obmokhu Society of Young Artists (1919)[2] , where the connections between scientific and artistic studies were at the core of the school pedagogy.

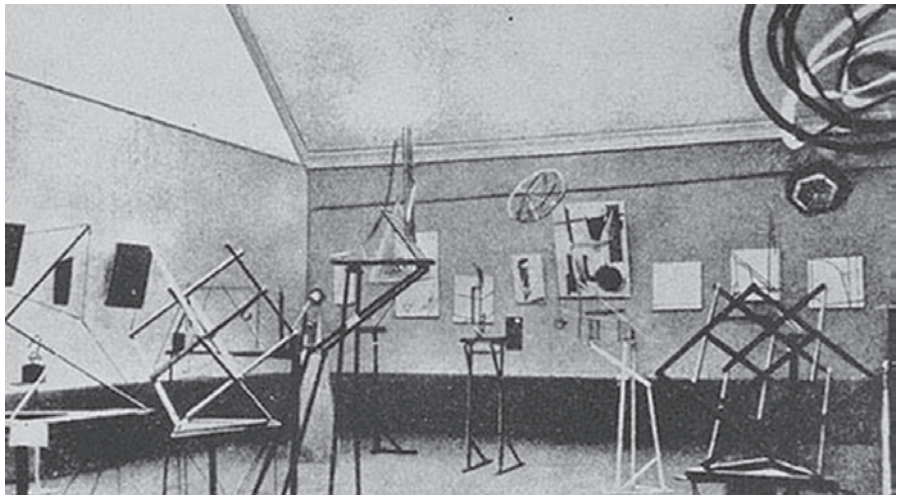


Fig.5. The exhibition hall of the Society of Young Artists, 1921 with A.Rodchenko, K.Iogansson, K.Medunetzky and V.&G.Stenberg.

Fig.6. Exhibitions of students' works on The Revelation and Expression of Three-Dimensional form, late 1920's

In both schools, Bauhaus and Vkhutemas, students should apply for aesthetics at the same time as science, economic production, higher mathematics, physics, theoretical mechanics, descriptive geometry, history of art and architecture, theory of color, construction, ergonomics, and so on. And all this experiences didn't have scientific prejudices over artistic ones.

A few years later, some non architectural researchers started to use de word design in other fields, such as research brought by radar air-defense studies, synchronization systems for fire-control - air gun and propeller – and automatic piloting with the investigation on curvilinear prediction of flight, and introduced words like feedback and pattern analysis in design research. The article by Rosenblueth, A., N. Wiener, and J. Bigelow (1943) about Behavior, Purpose, and Teleology in the Philosophy of Sciences Journal n.10 was one of the firsts to introduce the idea of programming loop control, based on neurophysiology and voluntary activity and to start a larger interdisciplinary research that was coined "Cybernetics" by Norbert Wiener and A. Rosenblueth in 1947[3] . As Bayazit (2004, 22) puts it: "the scientific developments during World War II made great contributions to the solutions of design problems, especially in the engineering disciplines." And, when Horst Rittel (1972) says that: "the reasons for the emergence of design methods in the late 50's and early 60's was the idea that the ways in which the large-scale NASA and military-type technological problems had been approached might profitably be transferred into civilian or other design areas" he is confirming that most of the studies in design have their origin in the political availability of funds and in the progressive fascination for the materialization of the patterns of though.

Fig.7. Radar air-defense in the 2nd World War 1944 (Wiki)

The advances on automation design and especially in cybernetics connection with brain operations lead to the fascinating idea that human thought and even creative thought can be designed in

explicit ways and, may be, materialized in automatic machines, under an idea of total transparency of the creative mind and in the objectiveness of anything that can be called design process.

Formally the design methods movement appears in the 60's, after all those experiences, and focuses its attention especially in design methods as a subject field of inquiry. It looks, not at the objects produced, but both, to the way they have been engineering and the way they perform and seek to get formalized by diagrams, patterns and schematics. Academics, especially from the UK, Germany (Hochschule für Gestaltung de Ulm[4] ) and the US (MIT, Berkeley) sought to rationalize, systematize and even codify the design process and present it as a scientific method.

So, the history of Design Methods has already started when John Crhistopher Jones wrote "Systematic Design Methods" on the Internal Paper of the Associated Electrical Industries (first in 1961 and then in 1962) and organized, with D. G. Thornley, in the same year, the Conference on Design Methods: papers presented at the Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications, in London. Maybe looking only to the social and intellectual manifestation of the studies, Nigel Cross (2001, 45), referring to this Conference said that it was "generally regarded as the event which marked the launch of design methodology as a subject or field of inquiry", and pointed those as "the first generation of design methods".

We all know how this faith on machines and on transparency finished in the 70's in the cultural disciplines. When Christopher Alexander said: "I've disassociated myself from the field... There is so little in what is called design methods that have anything useful to say about how to design buildings that I never even read the literature anymore... I would say forget it, forget the whole thing" (Alexander, 1971, 5). Was something like saying "the queen is dead".

In architectural practice the concept of transparency of the object and its structure has much to do with the Chicago School (or the Commercial Style) in the turn of the century and with the necessity to produce constructive technological systems for a rapid construction after the famous Chicago fire of 1871[5] . Names like William Le Baron Jenney, Daniel Burnham, Louis Sullivan and Dankmar Adler

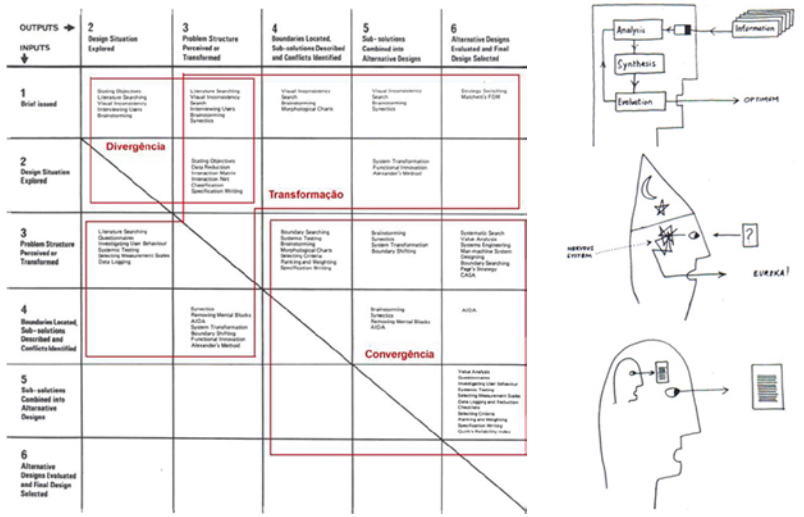



Fig.8. Input/Output – Matrix John Chris Jones, design methods (1970)

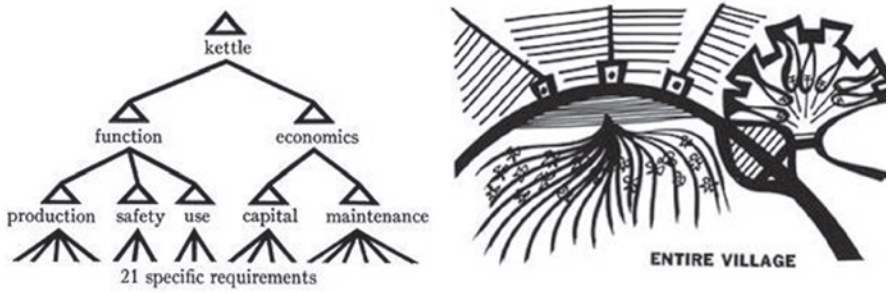


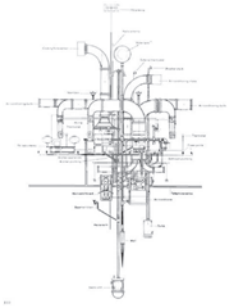

Fig.9. Christopher Alexander: A basic tree of possible requirement sets for a kettle (left). Diagram sketches from the book's appendix, depicting an optimal layout for a rural Indian village (right)

and their influence in the European modern movement are well known. We don't have time to develop this specific issue, but the important thing is to establish the connection of the second Chicago School with the Illinois Institute of Technology founded by Ludwig Mies van der Rohe based on the ideal of the Bauhaus education spirit.

**4. Solids and meshes - From transparency to communication**

The idea of communication as a fundamental issue in architecture and art, seems to have their roots on the Pop Art movement of the 50's first with Reyner Banham, with the British Independent Group and then with the seminar book "Complexity and Contradiction in Architecture" (1966) by Robert Venturi and Denise Scott Brown.

AVATAR 4



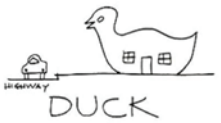




Fig. 10. (Left) The Anatomy of a Dwelling. Reyner Banham + François Dallegret in "A Home is not a House" (Art in America #2, 1965); (Right) Robert Venturi, Denise Scott Brown, and Steven Izenour – The Duck and the Decorated shed in "Learning from Las Vegas" (1977).

The differences between these two moments of this same movement can be demonstrated, on the one hand, by Reyner Banham admiration for technology and expressionism and, on the other, by Venturi and Brown refusal for technology as an end and the ideological preference for iconography instead of expressionism. Both, resuming an old classical paradigm of structure vs. ornament.

For Venturi architecture has disconnected itself from society and from history precisely because it insisted on structure transparency, which is abstract and amnesic by nature and by the same principal lacks "inclusion" in popular taste and "allusion" to the traditional architectural values. According to these authors those "faults" are the result of rejection, by the modern movement, of ornamental iconography in favor of a formal abstract expressionism.

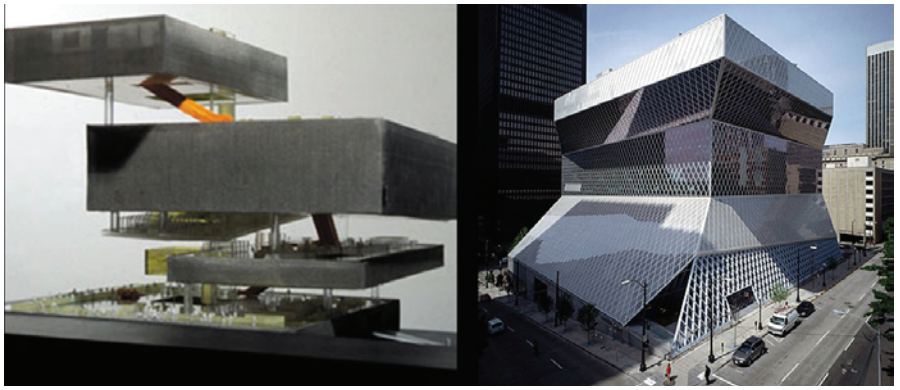


Fig.11. Rem Koolhaas & Ole Scheeren (top left) (2004) Seattle Public Library structural program; (top right) Seatle Public Library skin; (botoom left) OMA (1999 a 2005House of Música, Porto. Perspective view; (bottom right) OMA (2009) China Central Television Headquarters.

Venturi, Brown and Izenour developed a very interesting metaphor on their book "Learning from Las Vegas: the Forgotten Symbolism of Architectural Form" (1977), the idea that architecture seems to present a dichotomy between the "The Duck and the Decorated Shed". For them the "duck" is the modern paradigm, of a design that is an abstract and free structure only subject to an expressionist sculpture that is a sign. And they believe on a postmodern model of an "ornamented box", a building with communicative and decorated elevations and a vernacular interior space. This means that architects should apply ornaments despite space and structure, because space and structure are designed to serve the program as vivid space. Nowadays this dual inheritance between Venturi and Banham has different answers, either in the works of Rem Koolhaas or Frank Gehry.

In the first we find strong influences, both from the images of Archigram and the New Brutalism, somehow in both, the House of Music, or the China Central Television Headquarters CCTH we witness technological innovations which, by themselves, create snapshots of urban icons. In other words, liberation of structure by modern movement has allowed these structures to become Architectural and urban icons. In the Seattle Public Library, Koolhaas doesn't change the premises of the Venturi argument and assumes the differentiation between structure, now seen as

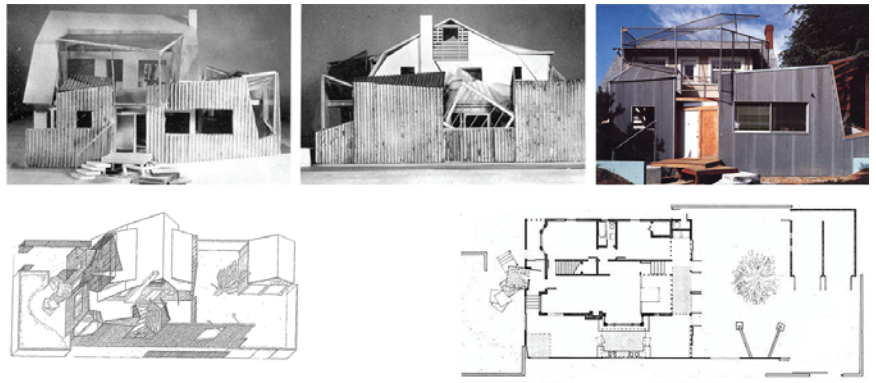


Fig. 12. Frank Gehry: (1978) House in Santa Monica, elevations and plan

the result of the program, and surface as a skin that uncover and reveal parts of the structure. But, this veil pretends to hide the structure appealing to a more attentive look, because it reveals and covers, and by doing so, it presents itself as a production of an architectural icon, in much the same way of the House of Music.

Frank Gehry started his work with an uncommon inventive exploration of materials in a composition that became almost a ready-made object, as it is the case of the almost venturian intervention in Santa Monica. But quickly it moves to the manipulation of structural signs as it happens in the Aerospace Hall (1982-84), the building Chiat / Day and in the Fish Hotel d'Arts (1988-92).

Since the 80's this architect seems to have repositioned the Venturi opposition between modern structure (architecture as monument or Duck) and the postmodern ornament (the sign or decorated shed), as we can see in the Fish Hotel d'Arts in Barcelona, where the ornamented box/shed takes again a structural scale of an icon. In subsequent approach the Guggenheim in Bilbao assumes completely the undervaluation of the structure by the surface or, if we reformulate the phrase, assimilates the structure on the surface.

Fig. 13. Frank Gehry: (1988-92) Fish Hotel d'Arts, Barcelona. View of the surface structure;

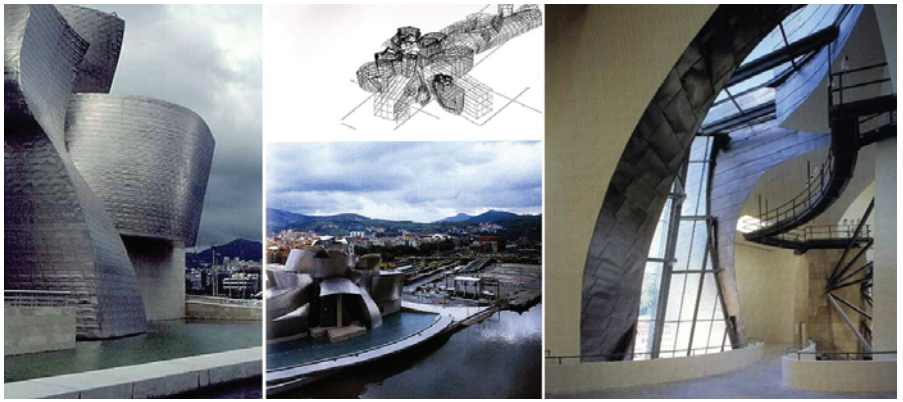


Fig. 14. Frank Gehry: (1991-97) Bilbao Guggenheim exterior (left) and interior (right) view (bottom).

**5. First Parametric - Back to School, now "liberate"**

After the discontinuity of the Bauhaus and Vkhutemas schools, the progressive implementation of this new educational systems in parallel with the ancient Beaux-Arts training system[6], and the end of the "design methods" study in the 70's, a big crisis got installed in Academia and in Universities. If until 1968 the Beaux-Arts training, emphasizes the competition and the image, throughout the production of quick conceptual sketches, beautiful perspectives and drawings; the technological and artistic schools derived from the the Bauhaus and Vkhutemas spread in the universities, especially after the AA revolution by Boyarsky. The studies based in workshops and studios implemented in the majority of contemporary Universities follows the progressive growth of the liberal capitalist society.

AVATAR 5

In the beginning of the 70's the Architectural Association School was the school that has the better conditions for a change[7] . Since the rejection of the Baux-Arts system to the "flirty with the pop culture" by Cedric Price and the strongest influence of Archigram, with Peter Cook, this was the only School that could have gone out of the system. And with the end of the process of conformity to the official system of RIBA and the subsequent financial problems, students, once again, took the school in their own hands and elected Alvin Boyarsky to assume the direction, in 1971 until his death in 1990.

Boyarsky has taken careful attention to the dissemination of the internal works of students with the annual Projects Review and with the Prospectus book/journal, raising the school profile and projecting the students work on an International scale.

He abandons the idea of a unique academic curriculum - that was a hybrid one between the beaux-arts and the remains of Bauhaus structure – and gives total freedom to tutors in order to set their own agendas and programs and to follow their own interests and manifestoes, implementing a structure similar to the workshops, but applied as a studio model. Besides, he specially chooses tutors by their creative ideas and by their media projection, regardless their academic curriculum. For the first time in the academia history, inexperience tutors have the power to conduct their studios using their own practice experience and their own ideas. The list of staff attracted to this brainstorming atmosphere was quite extraordinary; there were unit studio tutors like Elia Zenghelis, Bernard Tschumi, Peter Cook, Dalibor Vesely, Joseph Rykwert, Daniel Libeskind and, latter Rem Koolhaas starting in 1975, and Zaha Hadid joining the staff in 1978, etc.

From now on tutors had to teach and evaluate students work in a different way, not only they had to bring their one professional method to the academia, but also they had to adapt them in order to communicate with the audience.

Instead of only evaluating results they started to evaluate the creative processes and the way concepts are presented in the architectural design project. The research methodology becomes the main part of design project to be communicated.

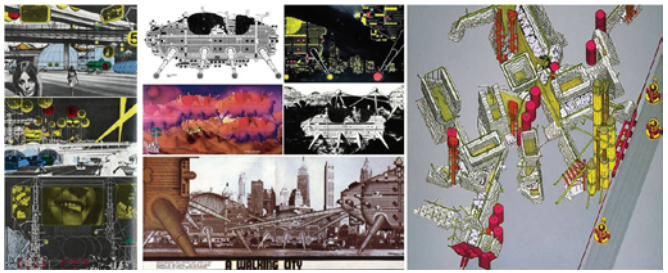


Fig.15 Archigram influence on AA: (left) Jhoana Mayer "The Instant City", 1951; (middle) Ron Herron, "Walking City", 1964; (right) Peter Cook, "The Plug-in City", 1964

Fig.16 AA School: (left) Exodus or the Voluntary Prisoners of Architecture is the final AA thesis of Rem Koolhaas, Madelon Vreisendorp, Elia Zenghelis, and Zoe Zenghelis 1972

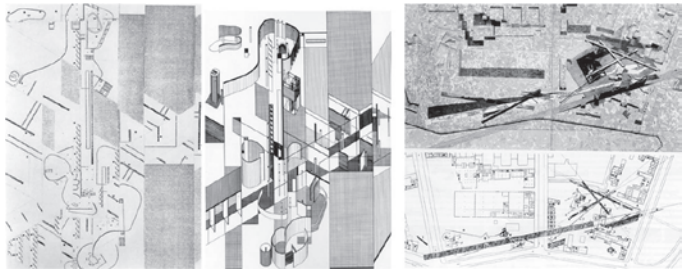


Fig.17 AA School: (left) Daniel Libeskind Collages, 1967 "Education of an Architect 1961-1974"; (right) Daniel Libeskind. Edge City, 1987

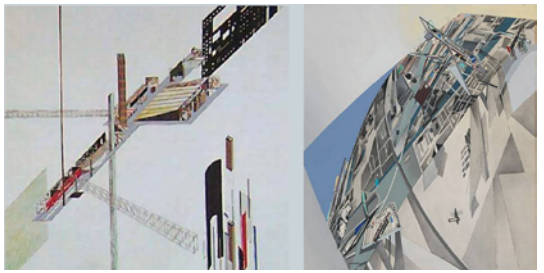


Fig.18 AA School: (left) Competition for the Dutch Parliament Extension, OMA (Koolhaas, Zenghelis, Zaha Hadid) – 1978 "The Ambulatory and its Connections" Zaha Hadid; (right) Zaha Hadid (British, b. Iraq 1950), "The World (89 Degrees)," 1984. Aerial view.

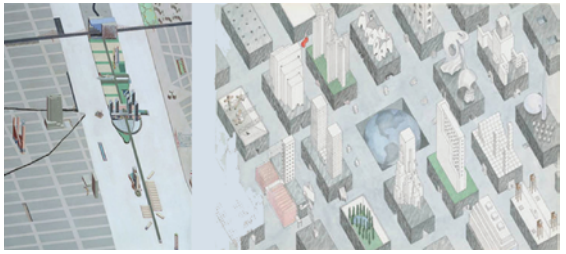


Fig.19 AA School: (left) Rem Koolhaas and Elia Zenghelis, Roosevelt Island Redevelopment Project, New York City, Axonometric, 1975; (right) Rem Koolhaas The City of the Captive Globe Project, New York, Axonometric, 1972

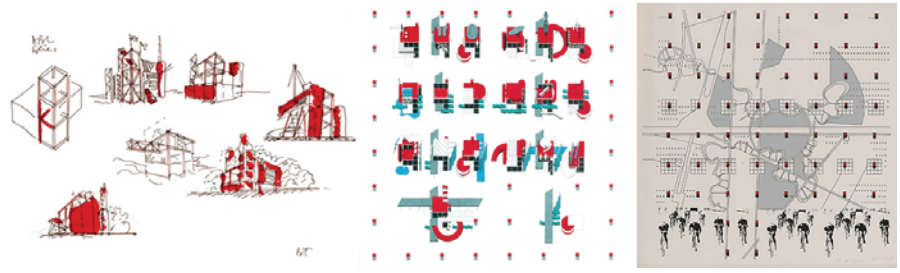


Fig.20. AA School: Bernard Tschumi, Parc de la Villette, Paris, first sketches 1983; "#4 K Series," Study for "La Case Vide: La Villette," Folio VIII, 1985.

**6. Second Parametric - In the official circles of education**

As we all know the "Modern University" was born with the education reforms of Napoleon in France and by Humboldt in Prussia. These reforms were parallel to the creation of the modern concept of "State Nation" and had, for the first time, introduced the idea of research in education. The intention was to renovate and qualify the state staff, constructing the "state-nation" under a bureaucratic system for democratic guaranties and political defenses against the "old regime".

AVATAR 5

Today the university works in the same way; but instead of producing staff for the state, it produces workers for the private enterprises of the liberal capitalist society. And, has we saw previously, the University continues to be a past image of society, only in very special moments the gap between society transformations and university transformations got smaller. Nevertheless, even in this punctual moments of history, university is only a mirror of society and has little responsibility in its developments. In other words, University not only, doesn't participate in the creation of a new society, as should be expected, as merely reiterates the existing state of affairs, appearing always with a delay, more or less long, between real society evolution and University own programs.

In the Nation-State period, but also in modernist Fordism age, Universities are controlled by the State, and education is part of a mass-production system where transparency of curricula and production must be equal, because the need is to supply persons with technological skills and knowledge to respond to the state necessities, or to what the state thinks are its needs. In this period Universities use more or less the same curricular structure, generally more focused on the final results (Beaux-Arts).

The technological development is different from any other developmental area. Technology, having its roots in science, has also more autonomy, and this autonomy was one of the characteristics that allowed the implementation of a more liberal curriculum in the University. In Architecture the model of studio was progressively implemented as a response to postmodern ideology and to liberal society.

But even in this model the control of the state was, and still is in some countries, the one of a supervisor, using accreditation agencies, in an attempt to control, not only the research and the knowledge creation, but also the curricular structures. With a university trailed by the liberal society marked, and with an European Union that limits itself to direct funds for research, research in itself cannot present other solutions and other insights than the ones for old problems, and by doing so loses the natural leadership that should have by its own nature. Even using some principles of autonomy and self regulation, as was implemented in the policy document HOAK (Higher Education: Autonomy and Quality) by the Dutch government, the "Saint Ann Plan" in Belgium, the "Ley de University Reform" in Spain or the Autonomy Law (Law 108/88) in Portugal, and many other countries, research and university management are still grabbed by an inertia principle connected with prejudices from the old era.

Instead of the centralized state we now have a mystified market that controls universities and its objectives. The principles of economy, student costs, efficiency and self sustainability management are now the goals for the university governance. The values of competition and entrepreneurial attitudes are imposed on academics, forcing them, departments and faculties, to get involved in a competitive behavior similar to that prevailing in the markets, in order to grant, funding, contracts, protocols, etc. Students became clients and Universities enterprises. So, new forms of regulation become the new regulators.

Since the market doesn't know where it goes, research is scattered ill-founded and anxiety is spreading all over researchers, which no longer seek to investigate what they believe is worthy, but instead seek to investigate on areas where the European and national funds are placed. So, without the independence and transformation of the research centers and projects, universities will continue to be the trailers of the markets, or the tools of centralized political power, instead of being the transformation principles of society. We think that, the role of the University is

to propose insights and knowledge to construct a new society, trying to anticipate and find solutions for future problems. In other to accomplish such a goal, the first step is to reform the way we practice research.

## 7. Renderings - CONCLUSION

The emancipation of Universities must be founded in the way research should assume the core path of the curricular structure. Today we have this structure only in some of the best doctorate programs, but it's necessary to spread this same method to the 2nd cycle and, at least, the end of the 1st cycle. Curricula should stop going after the market and its fluctuations, always an impossible task to carry out, given the excessive training time in comparison with the speed of the current market swings.

But, for this research endeavors been capable of becoming the essence of the curricula, research in itself must change, and we must be able of dropping many of the academia prejudices against the designerly type of research, especially in architecture and in the units directly connected with architectural design.

Let us now return to our initial, but now altered table, where conceptual and pragmatic categories can become one:

| |
|---|
| **Research on or about architecture (type 1)** |
| design through research is the possibility of structure and framing research as design; |
| design of research is the intention of structure and framing research as a design process; |
| research into design is the more classical research about architecture. |
| **Research in or by architecture (type 2)** |
| research through or for design is design-based research |
| research on design is design-led research |

Table 2: Synthesis between conceptual and pragmatic categories, and proposal of a simpler view of architectural research

Our hypothesis is to discuss the structure of architectural research into two main types, research **on** or **about** architecture and research **in** or **by** architecture.

Departing from two different assumptions: one that assumes, in the name of transparency, that architecture is not a natural production, but an artificial production (Simon, 1996) where the object in itself will always reveal his genetic imprint and the diverse processes used to achieve the final building: and the other assuming that the researcher has not an independent point of view, as we have learned in Baroque architecture (long before the epistemological and phenomenological studies)[8] .

In this sense, research in or by architecture, means research in or by design. The same must be said about the research studies that will have an apparently more distance approach to architecture; they should not be seen as objective studies, even when they use digital mediation tools to measure or simulate building performances, material quantities, budgets, pert chart, etc. because research about architecture is not only research about methodologies used to study architectural performance.

Type 1 of table 2 can be research about the architectural product. By product we only mean a finished part of the process, since buildings are not death after construction. It is the research that is concerned with the building as it is in a special period of time, present and past, or present and future behavior, performance, reception, etc. This kind of studies normally, if they are architectural inquiries, structure its research trough architecture and not by history, sociology, or any other disciplinary knowledge. This kind of studies discriminate the subjects of inquiry, according to the dynamic object that is the architecture building.

Type 2, concerning research in or by architecture, is a kind of research that can be based in architectural design methodologies (design-based research) or can be research about the processes of architectural design (design-led research). In other words, this second type of research can be, in a fine and careful mode, separated into: a design-based research which is research that is based in architectural design methodologies to study a specific subject treated in an architectural project searching the insights and knowledge that emerges in the outcomes of this archi-

tectural project; and research about those processes and methods used during the designing, to seek the improvement of individual or group performance of design processes.

For design-based research the process of design is the pattern used as a research methodology and it seeks to gain new knowledge, partly by the creative means and the outcomes of the artifact created. For design–led research the object of inquiry is design and can be seen also in practice when we are concern with the nature of practice and we want to gain operational knowledge about our own practice. In a certain way, it's what we are constantly teaching to our students, to reflect in their own design process.

These two kinds of research are normally complementary methodologies of research, because the study of the architectural design processes and methodologies helps to develop the understanding of insights and knowledge embodied in the outcomes of architectural design, and vice-versa. But also those two are more connected with architectural practice and can be made in architectural studios and architectural offices.

The implementation in the academia and research centers of these two types of architectural research, that are not new to architecture, will have big repercussions if they can become the core of the curriculum of architectural programs in Universities, and at the same time we believe that they allow us a more direct connection with the society at large, the marked but also, and mainly, the social and cultural agents that are the main core of society. In traditional research the knowledge is something that expresses itself mainly by verbal means and in a different way designerly research knowledge should express itself by all means that are at the disposal of architecture, opening the creative process to society.



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## ENDNOTES

1. Problematic taken from Jacques Derrida's (1979) deconstruction on Hegel philosophy.

2. OBMOKhU or OBMOLDUKh known as the Society of Young Artists was created by the students of the State Free Art Workshops (GSKhM), in Moscow in the Autumn of 1919. This workshop society has presented several exhibitions, one of which gave born to the constructivist movement with works by A.Rodchenko, K.Iogansson, K.Medunetzky and V.&G. Stenberg (fig.4)

3. According to these authors the study of J. C. Maxwell (1868) "On Governors" in Proceedings of the Royal Society, No.100 was the first cybernetic study.

4. This school was cofounded by Max Bill in 1953 and had interesting curricular areas and, despite of the closing of the school in 1968 it was here that started some of the most critical positions towards the modern movement.

5. From the records we know that 17.500 buildings were destroyed in this fire.

6. Is important to note that the Beaux-Arts system, that we are spoken, is the ones that were created by the big reforms at the end of the XVIII century with Napolean and von Humbold.

7. Remember that Peter Cook was the senior graduate of the AA and the school has been influenced by Archigram.

8. We assume of course a phenomenological approach.

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Zuhal Ulusoy graduated with B.Arch and M.Arch. degrees from the Middle East Technical University, Ankara, Turkey. Receiving a Fulbright scholarship, she continued her graduate studies in the School of Architecture at Carnegie Mellon University (Pittsburgh, PA, USA), where she completed her M.Sc. and Ph.D. degrees in architecture and urban regeneration. In 1992, Dr. Ulusoy joined Bilkent University (Ankara, Turkey) as the Founding Chairperson of the Landscape Architecture and Urban Design Department. She was a visiting professor at Carnegie Mellon University's School of Architecture in 2003-2004, where she taught senior level design studio and a course on housing. In 2005 she joined the newly founded Architecture Department of Izmir University of Economics.

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# Architecture as a Practice of Inquiry

**Zuhal Ulusoy**

*Why this topic, why this title? Is architecture an 'inquisitive' practice?*

*Ideas expressed in this essay are not totally new. Here, they may only be said in a different way, from a different angle. It is rather an attempt like connecting some dots, which may appear to be unrelated. Furthermore, there are people most probably among the readers who are a lot more knowledgeable on the topics that are touched upon in the paper.*

*Throughout the paper, the word 'design' is used interchangeably with 'architecture', because the points raised here are about the essential cognitive processes involved in the process of design. So, whether what we talk about is architecture or some other design profession is irrelevant.*

Why the word 'inquiry' is used instead of 'research'? Are they different, or do they refer to the same concept? If they differ, how do we tell the difference?

A quick search about their dictionary definitions will be helpful. Webster dictionary defines 'inquiry' (noun) as such:

: a request for information

: an official effort to collect and examine information about something

: the act of asking questions in order to gather or collect information

: a careful or diligent search

: a studious inquiry or examination; an investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws

: the collecting of information about a particular subject

The definition of 'research' (noun) in the Webster Dictionary is like this:

: careful study that is done to find and report new knowledge about something

: the activity of getting information about a subject

: a careful or diligent search

: a studious inquiry or examination; an investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws

: the collecting of information about a particular subject

They appear to be synonymous, and in some sources they are used interchangeably. Still, for the sake of the argument made in this paper, these two words are treated differently.

By using 'inquiry' I would like to emphasize the open-endedness of a process, where the method is not strictly set, more akin to a process where even the objective of the search is a conceptual endeavor that is open to redefinition. 'Research', on the other hand, resonates with a search process where there is an already defined problem; the goal is clear, method is set and probable results are more or less defined.

This choice of words, 'inquiry' instead of 'research', implies the first point I want to make: to emphasize the distinction between different types of thinking that 'designing' and 'problem solving' entail, and these words are helpful in expressing that distinction.

Thus, my first point is that the kind of difference I pointed above between 'inquiry' and 'research' is similar to the difference between 'design thinking' and 'analytical thinking'. Let me try to clarify what I mean by this.

Research as a process to find a solution to a given problem entails 'analytical thinking' as its major characteristics. Thus, the search is a rational process towards a more or less defined target, incorporating the method(s) that seem to fit the case at hand. 'Design thinking', however, entails the process of redefining the problem itself where the target is not known, neither is the path to reach there. Hence, even the preliminary stages involve a degree of inquiry, where the problem definition and the procedure of addressing it unfold in an iterative manner as the cognitive act of design thinking progresses. It is a particular kind of process where there is no single answer, and the search is infinite.

The notion of design as a 'way of thinking' can be traced to Herbert Simon's 1969 book The Sciences of the Artificial. His thought provoking ideas and insights about the relationships between thinking, computing and human behavior expressed in this ground-breaking book, have been very influential in design and other fields, and are still relevant. As one of the most influential social scientists of the twentieth century, Herb Simon's research ranged across the fields of cognitive psychology, cognitive science, computer science, public administration, economics, management, philosophy of science, sociology, and political science, all unified by studies of decision-making.

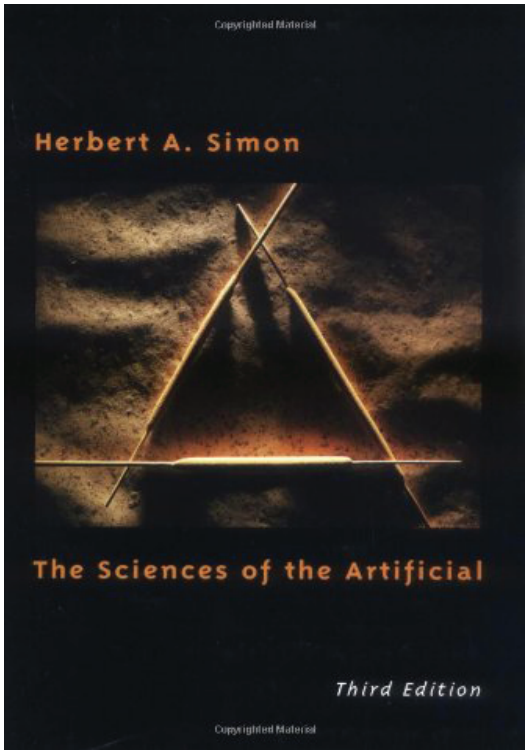
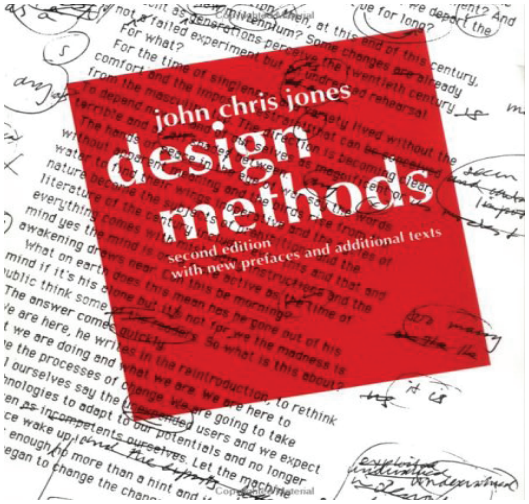
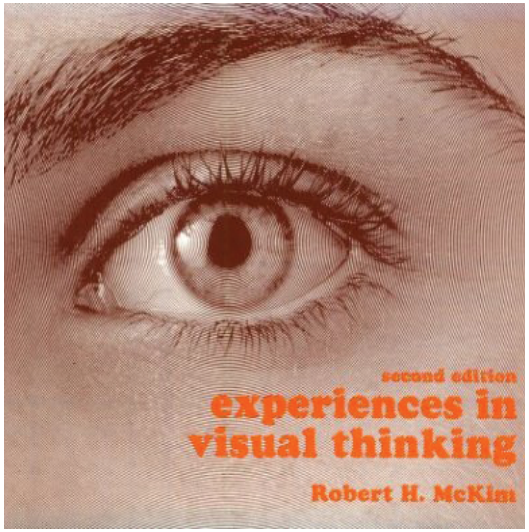



Figure 1 – Herbert Simon, The Sciences of the Artificial



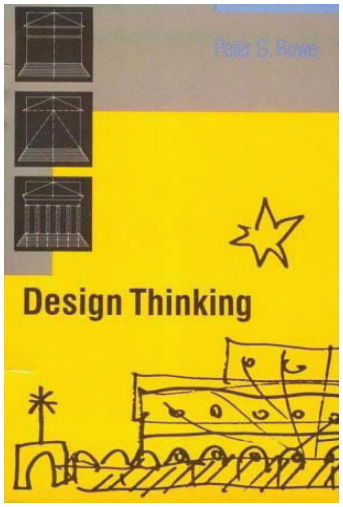

In Design Methods: Seeds of Human Futures, by John Christopher Jones, the integration of creative and rational skills was emphasized, moving further away from areas of specialization to a broader view of design. Published in 1970, with its focus on design as a decision-making process, the book was ne of the major readings of architecture and design students at the time.

Figure 2 – John Christopher Jones, Design Methods: Seeds of Human Futures




Following that, the reflections of 'design thinking' can be found in various other studies, such as 'design engineering' in Robert McKim's 1973 book Experiences in Visual Thinking. Here the emphasis is on visual thinking, pointing to the significant impact of all senses and providing insight for creativity. The book offers a broad understanding of brain functioning, which is based on innovative ways to look at the processes of design problem solving.

Figure 3 – Robert McKim, Experiences in Visual Thinking




Emphasis on 'design thinking' was expanded in the 1980's and 1990's in the form of teaching it as a method of creative action. Again, Peter Rowe's 1987 book Design Thinking, described methods and approaches used by architects and urban planners with a systematic approach. The book introduces a scientific analysis of human problem solving skills, based the study of various instances to point to the underlying structure of design inquiry that is common to all.

Figure 4 – Peter Rowe, Design Thinking


The 1986 book by Omer Akin, Psychology of Architectural Design, was a well-received contribution to the track of scientific studies on the process of architectural/design thinking and has been frequently cited by those who are conducting research on the topic. The fact that the book was published in a series titled "Architecture and Design Science" (Pion Publishers) is meaningful, drawing our attention to the prominence of scholarly studies on the subject.

Figure 5 – Omer Akin, Psychology of Architectural Design

David M. Kelley, founder of IDEO, an international design and consulting firm, adapted 'design thinking' ideas for business purposes. Active since 1991, the firm states that they use design thinking methodology to design products, services, environments, and digital experiences, and that their involvements include management consulting and organizational design.

In his 1992 article "Wicked Problems in Design Thinking" Richard Buchanan, with a broader view, addresses intractable human concerns through design. Drawing on the concept of 'wicked problems' coined by Horst Rittel in the 1960s, the article emphasizes the relation between the determinacy and indeterminacy in design thinking.

Here I would like go back to John Christopher Jones' seminal book Design Methods: Seeds of Human Futures. Published in 1970, exactly 45 years ago, it still sheds light on to today's discussions on design as a process. Those of us who had studied architecture during 1970s and have started teaching right after, would remember how influential this book was in our architectural pedagogy. Thus, this will be, in a sense, commemorating the book, and through that, all the intellectual energy that went into design thinking studies around that time.

To reiterate the points made by John Christopher Jones, design or the act of design were identified in the book with the following qualifiers:

- the process of devising not individual products but whole systems or environments;
- act of participation, the involvement of the public in the decision–making process;
- creative skills, which is supposed to be potentially present in everyone;
- an educational discipline that unites arts and science and perhaps can go further than either;
- a process or way of living in itself.

New methods that were developed in the book to enhance the designers' and planners' sensitivity to user needs actually are more related with the thought that precedes the end result. The book dwells on the integration of creative and rational skills, moving further away from areas of specialization towards a broader view of design. Furthermore, the categorization of various methods, such as systematic search, literature survey, questionnaires, participant observations, etc., provides clues to figure out the one(s) that would better suit to respond to a particular design problem.

Christopher Jones further argues that there are some stereotypes in terms of designers' behaviors and their decision-making processes. He identifies them as:

- Designers as black-boxes – This approach sees the act of design as a magical process. In this model, design relies heavily on intuition and cannot be strictly scrutinized.
- Designers as glass boxes – Contrary to the previous one, here design is considered to be a completely rational act which can be fully analyzed and is monitored/moderated.
- Designers as self-organizing systems – In this approach design is considered as a cognitive process, which has both creative and critical components. Entailing a more complex view of design process here the strengths of the former two come together, attaining a level which is more comprehensive than their combination.

Design Methods: Seeds of Human Futures has been an important source for professionals and academicians in numerous fields, particularly in design related areas. Thus, it is not only widely welcome and accepted by architects, planners, engineers, interior architects, graphic designers, and industrial product designers, but also provides new insights to people outside these professions, to those who are involved in any kind of creative process. A quick search in the Internet shows how influential these studies have been. When you enter 'design thinking' you come across with numerous sources from a variety of disciplines that hardly cross our minds when we think about design, such as innovation, business, management, education, etc. and to activities such as designing products, services, environments and experiences.

Coming to my second point that was mentioned above, I argue that the thrust of 'design methods' or 'design thinking' as an emerging field in the 1970s and

1980s, and all the rigorous research and heavy theorizing behind it, all the literature that was produced mainly at that time all constitute the foundation and source of inspiration for today's algorithmic/parametric design practices. It is worth acknowledging that such inquiry on design combined with the so-called digital revolution has been at the root of many innovations that followed.

Thus, ground-breaking studies on decision-making, problem-solving, organization theory, artificial intelligence, information processing, complex systems, all have constituted the contemporary architectural practices that celebrate unprecedented formal gestures as expressions of a future world. Yet, this significant linkage is not much recognized or expressed, focusing on the formal qualities of such 'architectural wonders', without acknowledging the decades of scientific inquiry and commitment on the rigorous research that enabled advanced technologies that lie beneath them.

My point is that current innovations in parametric design derive upon systems thinking, similar to programming languages, working with complex data sets and parameters, developing algorithms. We are mostly fascinated by the architectural expressions that go much beyond what can be achieved through the so-called 'analogue' -- as opposed to 'digital' -- tools and means. We all recognize that these formal qualities utilize huge data sets, ranging from the particularities of new materials all the way to behavioral studies, environmental concerns including the ecological footprints, and negotiations within budgeting constraints. As such, architectural expressions that amaze the viewers owe a great deal to a strenuous juggling with complex parameters and incorporation of very intricate systems that can only be performed by digital means. It should be pointed that the capacity of such systems certainly is not limited to creating formal gestures. These systems open the door to environmentally sustainable buildings and building complexes, to responsive environments, designs that respond to the needs of their users, buildings that have the capacity to adapt to a variety of changes in the conditions for which they are initially built.

To reiterate my second point, all the technology that makes today's architectural practice possible is tightly and inextricably linked to the ground breaking innovations and theorizing on design thinking and methods of the past four or five decades. We shouldn't dismiss the other developments which went hand in hand with the scholarship on design research; rather, their synchronization enhanced the capacity of both.

Here I would like to draw your attention to the convergence of the two points I have made: Essentially, designing and thinking about designing are two sides of the same coin, mutually affecting each other, bringing together of the materiality of the product and the elusiveness of the process. Such a convergence is the essence of creativity.

The argument I make may also be seen as a position against the idea that academic research or scholarly inquiry in the schools of architecture diverge more and more from the business or practice of architecture. I suggest that not recognizing these linkages reflects quite a narrow perspective of what scholarly research entail and how the accumulation of their outcomes impacts practice in a multitude of ways and means.

In this essay I wanted to reflect upon the emergence and development scholarship on design thinking and design methods as processes of inquiry. Going back to early 1970s to search for clues to tie them to the current conceptualizations about architecture; to remind that the state-of-the-art architectural practices connect those times, which I find to be at its foundation. Nothing new, as I said in the beginning, simply connecting the dots in a different way, with the hope it makes sense and touches upon meaningful points.

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She has taught for over 11 years in the United Kingdom and for a semester in Denmark (Aarhus School of Architecture) between 1989 and 1991 she worked in the research team of Bath University, UK on projects between the University of Bath led by Ted Happold, Buro Happold and Frei Otto. She works as a freelance architect in Greece. She has organized and participated in numerous international student workshops and international conferences for architecture educators. She is the coordinator of the European Network of Construction teachers since 2001. She is also the coordinator of a number of European funded programs on architectural education, with the most recent one being the two-year funded Life-Long Learning Multilateral Project, Continuum from the school lab to the factory workshop that investigates new pedagogic protocols for teaching students on a file- to-factory logic. She has been a Council Member of European Association for Architectural Education (2000-2007) and has been editor, together with Constantin Spiridonidis, of several numbers of "Transactions on Architectural Education", the official paper of the AEEA.
She has lectured abroad and has been a memmer design juries around the world. She is a chartered architect and member of the Royal Institute of British Architects.

# (Re)thinking Architectural Education for a non-standard Architecture

**Maria Voyatzaki**

The way we teach architecture depends upon the way we think about and practise architecture, and changes in this perceptual domain, as reflected in its history, are naturally accompanied by changes in the way architecture is taught. This is due to the fact that architecture is based upon a system of values principally related to the conception of the human being as individual or social entity, to which architecture is addressed, and to the worldview according to which architecture is produced. Therefore, it follows that architectural education is based upon the same set of values. The process of creating architectural forms and the architectural education process are fundamentally expressions, representations or manifestations of the same set of values dominating in a certain period of time. Thus, the development and transformation of values in time are accompanied not only by transformations in architecture itself, but consequently, by transformations in the way architecture is taught.

In transitional periods from one value system to another, architectural production has oscillated between two coexisting systems, yielding architectural products that belong to one or to the other system, experiencing this way the coexistence of completely different perceptions, contemplations and practices of architecture. The same process is also valid for architectural education. As a result, it is not a rare occurrence to note that in the same institution, new ideas are usually adopted by a small number of teachers, thus leading to the coexistence of more than one set of architectural values, which may not always be advantageous to the education of students.

In this particular overlapping condition, the new, labeled as avant-garde, promotes a critical and even polemic attitude to the old, labeled as established. Moreover, an emerging architectural literature encourages this debate, which, in most cases, focuses on some particular aspects of architectural creation, stress-

ing their significance and implicitly introducing a partial view or understanding of architectural creation. This is the reason why the new, in most cases, appears to overemphasise its principles in order to surmount the resistance of the established. This stance, as a consequence, renders those that favor the new vulnerable and exposed to criticism on the grounds of partiality and fragmentation. Thus, teachers introducing new ideas very often emphasize the dominant characteristics of the new, promoting this way a fragmented and narrow understanding of architecture. More specifically, in design education, teachers are sometimes attached to innovative ideas primarily focusing on the formal expression of the values these ideas are founded upon, consequently marginalizing the teaching of architectural creation that derives from more profound theoretical premises or from an aspect of materiality and its construction which are both dependent upon the same context and founded upon the same set of values.

**The old and the new in a continuum**

Contemporary society is distinguished by speedy changes. Structured upon an increasingly globalised knowledge-based economy, facilitated by the already powerful media and the extended applications of digital technology in all sectors of production, administration, education and consumption, the contemporary world is conditioned to rapidly transform. The mental and operational landscape of our life is affected on a day-to-day basis by unexpected modifications of possibilities, capacities and conditions directly influencing our social, financial, cultural and built environment as well as our conceptions about human beings and the world. All our activities are profoundly influenced by this new condition of instability, fluidity and interdependency of various, unpredictable parameters and factors, which rapidly transform our vision, introducing us progressively to a parametric understanding of the world and our position in it.

The project of Modernism was to create a world of stabilized parameters defined on the basis of rationality and scientific knowledge. All its cultural and technological production was based upon predefined norms, axioms, standards, models, rules, benchmarks, patterns, measures or exemplars. Modernism spent all its energy and resources in order to define and institutionalize constants in all levels of our everyday life, believing that this would assure for human beings a better and more secure, predictable life. Nowadays, we increasingly accept the existence of unstable parameters, and this attitude transforms our worldview by introducing a conception of the standard as just a version of the parametric, not necessarily the most appropriate or the most valuable one. Our project is now to administrate and manage complex parameters and in this project information technology sets the conditions for assuring such complex management in which the unconventional and the fluid often obtain the status of a value.

In this unconventional and fluid environment of globalised economy and information society architecture, as a cultural statement and manifestation of our life in space, seeks new considerations. It is constantly elaborating, redefining or restructuring a new framework of values and principles, knowledge, skills and competences, tools and means, as well as priorities and preferences, as a new paradigm. New terms, notions and concepts are constantly appearing in the architectural vocabulary. Liquid, hybrid, virtual, trans, fluid, emergent, animated, seamless, interactive, parametric, machinic, self-generating, are all new terms introducing a new culture where change is replacing stability and solidity and complexity are replacing simplicity and clarity –terms and values that have nourished architecture for centuries.

Although society is more apt to embrace changes, schools of architecture interestingly enough remain somewhat resistant to the avant-garde. The speedier the diffusion of the new in the academic environment the more fragmented and partial the education. The emerging architectural paradigm is based upon the extended use of digital technology through which forms are generated as the digital representation of a script articulating modifiable parameters depended upon predefined relations. In this reality, the teaching of architectural design is often dominated by the technical aspect of the use of software or the creation-modification of this software. This fragmented approach to the new, encouraged by the fascination for the forms created by digital means as expressions of an 'other' promising world, turns students towards a formalistic aspect of architecture, disconnected from a theoretical discourse and a consistent content of their design proposals.

From the above-mentioned conditions and accepting the premise that architects-

to-be, as well as architects, as Rahim puts it, have to realize their role as agents in the loop between technology and culture1, a fundamental question emerges: How can we, the teachers, teach our students to translate the new set of values of our society into architectural principles and then into architectural designs without being 'imprisoned' in the technicalities of scripting or software application?

**The design and the materialization in a continuum**

Despite the conscious efforts to embrace the issue of materiality in architectural curricula, in most cases graduates lack the necessary skills and competences that could enable them to turn their ideas into buildings. Compromising the continuity between idea and building has always been a common struggle and challenge for architects of all times. Nowadays, the central role of IT in both generating a form and turning it into a building seamlessly, the complexity of a world informing design and construction, the galloping technological advances in building techniques and the emergence of new materials and components render this issue more acute. Even in the most renowned schools of architecture, where the necessary infrastructure is at the disposal of all students, and the courses are tailored to explore and achieve this aim, continuity is only achieved at a level of simulation and rarely at 1:1 scale. Even when the operational scale is 1:1 the outcome is rarely tested to real conditions of loading, weatherproofing, sustainability, material properties and the respective failures etc. Moreover, new non-isotropic materials, the materials that open up to new possibilities to structure complex non-linear forms are hardly ever explored.

There is a new element that further contributes to the difficulty for educators to teach this continuity and for the students to grasp it. Admittedly, every masterpiece in the history of architecture has been distinguished as such for the consistency with which it managed to transform a set of values of a given intellectual system into the built form.

The emerging paradigm of parametric architecture has brought about a radical change to what we have been accustomed to until it turned up2; that is, the transformation of values such as mutability, 'adaptivity', transformation, flexibility, affordance, individualization, personalization, customization, intelligence and ecology into built form. A new perception of materiality is therefore called in to accommodate the transformation of the unstable into a new perception of construction, detailing, and nodal points and to redefine established perceptions of the building as a whole.

The above-mentioned change is accompanied by another one, which concerns the non-Euclidean geometry and topology, the rules of which are followed by the emerging architectural forms. The proposed forms, in their majority, cannot be materialized with the existing building industry equipment and infrastructure. The products of these traditional building industries have constituted for years the content of construction courses in schools of architecture, and they have been explicitly described in the relevant bibliography or presented as construction technical libraries in the schools' construction workshops, testing structures and conventional materials and techniques.

The non-standard forms generated in the new architectural paradigm presuppose a customized production of components, rendering the existing knowledge on traditional materials and techniques practically irrelevant. In this context the emerging necessity is for architectural education to incorporate knowledge and experiences, unattainable from the digital simulation, infrastructure schools often have at their disposal. Such necessity can be accomplished through the collaboration between schools and technologically-advanced building industries. Nowadays, in the world of contemporary construction there are industries and enterprises that come into the design and construction teams to act as agents or transformers offering their expertise and functioning as mediators that can rapidly make a prototype to test and eventually customize the entire construction of a building3.

From the above-described conditions another fundamental question emerges: How can we teach the materiality and the construction of the architectural forms of the new paradigm? It becomes apparent that there is a need for a new teaching protocol to be defined in which direct contact with the real production process of customized components is necessary; a new relationship between schools and building industries has to be established.

**Why "CONTINUUM"**

Continuum was a programme funded by the EU that was put forward to address the above issues. Even though at first glance Continuum appears to be an educational project, it is, in fact, a programme where schools of architecture get together with the building industry to work on the ultimate case of achieving continuity between idea and materiality: the file-to-factory seamless process. The original premise was that education and the building industry share the same frustration deriving from different starting points: the former from the fact that even centers of excellence in architectural education cannot test their ideas in a real context and the latter from the fact that even well-known building industries have not developed and established digital manufacturing techniques.

The objectives of continuum were to:

1. establish exchange among educators, researchers and industries of experiences and information related to the knowledge of contemporary trends and the special needs of architectural creation,
2. enrich the educational material offered in design and construction courses and to re-design new courses capable of accommodating and projecting the new conditions in the production of the built environment through new design vehicles, new teaching methods and peda-gogic protocols, new teaching techniques and new educational strategies.
3. bring students closer to the real world of building production and to familiarise them with the idea and logic of designing materials, components and the construction itself as an inseparable and indistinguishable part of the design of architectural form.
4. facilitate the access of students to the real world of building production, stimulating their interest in experimentation and scientific research in the area of new material generation and the implementation of new techniques entailed.
5. open up avenues towards research subjects that will support the development of new research programmes among the partner schools.
6. establish among enterprises and universities the exchange of research results, new ideas and queries on the contemporary discussion about the tendencies of avant-garde architecture.
7. bring students close to building production aiming at effective cooperation in their professional life.
8. develop a dialogue among partners on design pedagogy in the new context of architectural creation and to form a pedagogic protocol with new values and strategies compatible with the contemporary attestations of architecture.

Alongside the above, by gathering seven schools of architecture from six European countries to work with twenty industries from France, Spain and Greece according to the European conference4 on innovation, the multicultural and multidisciplinary character of the group enhances innovation.

The present volume is an account of this two-year experiment that was informed and enriched by the lectures of internationally renowned specialists that teach and practice in the area and with researchers coming from universities around the world that work in this area.

**(Re)thinking Continuum**

The Continuum project was an experiment: An opportunity to investigate possibilities, to develop experimentations and to collaborate in a multicultural, multidimensional and multidisciplinary environment of architectural creation. As all the activities of this project were presented in detail in an exhibition, this text focuses on a number of remarks that could be made as an epilogue and, at the same time, as a possible opening to new possibilities and debate. These remarks mainly concern issues raised by the partners at the meetings and the workshops of the project, and to a certain extent, by the works presented in the Conference, which appear in this volume.

**Does f2f initiate a new design process?**

The file-to-factory process is part of a new conception of creation and materialization of spatial forms corresponding, as was already mentioned, to a new set of values, terms and priorities. Does it also correspond to a new concept of the design process as such? This issue was broadly discussed between the partners from the very first meetings and it reappeared in the works that students presented in the workshops. Do we have to think and develop the act of designing as a process in which the whole defines the part or as one in which the parts are responsible for the form of the whole? Is this process top down or bottom up?

It is common knowledge that the 20th century introduced an approach to architectural design where the whole was defined as the regulator of the part. Consequent to its broader conception of the world, in which the elements of a system are depended upon the system itself, the architecture of this century defined the part as the result of a certain fragmentation of the whole. This fragmentation was based upon a broad spectrum of logics and views, from a scientifically oriented de-composition to a more subjective, intuitive de-construction. In all these cases the part was conceived as the component which could properly represent, portray and assure the idea of the whole as it was condensed in terms such as concept/ conception, 'parti', dominant or general idea, etc.

Nowadays, we are moving towards an increasingly individualized society, where individuals are progressively losing their collective consciousness. We are experiencing an individualization of our social behaviors, preferences, choices, and expectations. The more we individualize our social presence and escape from the formerly established norms by personalizing our everyday objects, the more the customization of industrial production of these objects becomes the prevalent strategy of the industry. In this context, the individualized-customized part tends to become an autonomous component of an unpredictable whole, dependent upon the emerging dynamics of unstable and variable parameters. The more obscure the whole, the clearer the part; the more we can contemplate and formulate the part, the better we can conceive the whole.

In contemporary architectural creation the detail becomes a crucial issue of architectural quality5. Building components are very often designed autonomously, regardless of the final form of the building. Architects organize the design proposals on the basis of the adaptability, transformability and flexibility of the building components. In this case the design of the building starts from the design of these components and not vice versa. The generic design of a component parametrically allows the manufacturing of unique elements that follow the same logic and structure but possess different positions in a complex, multidimensional form.

If the file-to-factory process introduces a new way of making and materializing buildings, does this way introduce a different process of designing forms? Partner schools in this project appeared to implement both approaches at the two workshops of the project. Could they be both equally efficient in this new mode of production? This question was left unanswered allowing, in turn, space for further reflection and investigation in the future.

**Can we teach the seamless in a fragmented curriculum?**

In principle the file-to-factory processes are the ultimate and closest means to a seamless and continuous connection between design and manufacturing. They are the direct and uninterrupted diffusion of an idea that encapsulates the values of an intellectual system vis-à-vis materiality, or the translation of values into built form. However, the Continuum experiment revealed how difficult it is to teach the seamless in an extremely fragmented educational system.

The infinite know-how of the new field of digital design and manufacturing appears to form a decisive factor that can easily alienate both educators and students to be consciously or unconsciously detached from this seamless connection. It also seems that the demand for continuity can be easily turned into an exercise where manufacturing non-standard forms is an end in itself. Contemporary architectural education in the area has not as yet identified how this new conception of creation and materialization of architectural forms can be positioned in the existing school curricula.

In fact, our educational system is constructed on the basis of a top-down process, where architectural knowledge as a whole is split into smaller subject areas, which are further split into smaller courses and modules, thus creating parts which have to be taught in order to reconstruct the fragmented whole of the architectural knowl-

edge. In this educational environment, the conception of continuity, articulation of knowledge and experiences, are absent. Schools in this system have difficulties controlling how the synthesis of students' knowledge could be achieved most appropriately and systematically. The system can only evaluate a result of articulated ar-chitectural knowledge which has built up in students' minds and consciousness, but which has never been systematically taught or strategically organized.

Under the above conditions, fragmentation is a fact not only in the form of organization of studies but also as a kind of viewpoint in educators' consciousness and, to a certain degree, in the students' perceptions. A direct consequence of this perception is to consider this continuum as fragmented or as a unification of fragments and not as a unique, seamless process. The fact that different professional bodies and specializations are involved in this process makes it more difficult to overcome the handicap of fragmentation.

Do we have to radically transform our educational system in order to be able to teach the new paradigm properly? How easy is it, and to what extent is such a project feasible? Should we wait for such a reform or is the ground already prepared for action and initiative for an operational teaching of f2f processes? These are questions, which have to be further investigated by all the partners of this project in the near future.

**Can existing materials materialize non-standard forms?**

The file-to-factory process is a mode of production. As such, it is already implemented in many sectors of industrial production using materials that belong to the traditional palette of materials familiar in the building sector. Therefore, our educational system, which founds its teaching on existing materials, can rather easily incorporate f2f practices and familiarize future architects with this mode of production. This was the basis on which Continuum project developed. During the two workshops of the program conventional building materials were mostly used with the only exception being the use of high-density micro-fibrous concrete and the use of cardboard tubes, which could be characterized as non-building materials6. The prototypes of the presentations at the conference at Chania were mostly made of conventional building materials.

Even if f2f has a significant efficiency with the existing materials, its operational value is mainly based upon the enormous possibilities it can develop through new and non-standard materials. By incorporating in its capacity both standard and non-standard materials, f2f appears to represent a mode of production which, supported by the advanced technological develop-ments of our times, broadens the spectrum of production possibilities and, in this broadened spectrum, the standardized is just a small and less significant part. We can easily recognize the accordance of this condition with the above mentioned parametric worldview according to which, the standard is just one version of the parametric and not necessarily the most appropriate or the most valuable one.

This worldview affects also the conception of the relationship between matter and form. Any material is conceived now as having endogenous tendencies and capacities (affects). Simple materials have inevitably simple capacities and tendencies, which restrict what DeLanda7 defines as 'self-organizing capabilities of matter', but complex materials are those in which many things are left 'active and affective', non-linear and closer to form the topological rather than the geometric representing what Deleuze8 defines as "hylomorphic model". The latter have complex and variable behavior raising their morphogenetic potential. This potential is a core concept in the way that the new paradigm perceives materiality since it manifests the continuously variable behavior of the matter as a value, assuring the continuum between form and its generation through the exploration of its materiality. Form is conceived now as teased out of an active material and part of its design is to define the properties of continuous variation of its materiality9.

This new conception on materiality opens the way toward the use of new materials and, more often, composite ones with specifically designed properties, accompanied with a strong tendency for experimentation and innovation. Many educational environments have already absorbed this tendency by declaring the experimentation on forms and new materials as one of their educational priorities, and defining innovative and creative thinking as the most significant competences of future architects.

**Is non-standard architecture sustainable?**

Even if this question was not raised either during the work conducted in the Continuum Project or by the presentations in the closing conference, it appears to be crucial and burning. Is the new paradigm environmentally sensitive and friendly or will it collapse under the pressure of the demanded environmental consciousness? Can f2f processes assure a more environmentally friendly strategy related to the use of materials in the building sector, which makes the most significant contribution to the pollution of the environment? Is the customized building inexpensive or elitist10?

It is difficult to make a general statement about the environmental quality of non-standard architecture as the variety of used materials does not allow safe generalizations. On the contrary, what we can certainly admit is that new technology can easily contribute, if not assure, a measurable economy of means to achieve a certain outcome11. Even if little research has been devoted to this issue, in fact, f2f processes can be considered sustainable financially as well as ecologically or environmentally; more specifically, file-to-factory processes are potentially sustainable in terms of:

1. The performance of the materials used by the technologies of f2f construction.

   The customization / optimization of structures assured by this approach, the accurate cutting patterns of material and the techniques of maximum use of the available material result in using less material more effectively.

2. The procurement and production performance of the environmentally-sensitive technologies of f2f construction. Procurement and production are achieved by customizing building components locally so they do not have to be shipped (i.e. sending virtual data rather than materials). Moreover, production can be used strategically, generating a great deal with limited resources.

3. The environmental sensitivity of the emerging technologies of f2f construction.



Environmentally sensitive building components are achieved by changing geometries, forms and positions in order to adapt to specific environmental conditions e.g. optimized solar shading panels etc. This way the non-standard forms can become more environmentally efficient and be more tailored to the particularities of the climate.

Finally, all the above issues require further investigation in order to make an exact claim on the environmental aspects of the new approach to architecture and materialization of the designed forms.

**Does experimentation on non-standard architecture nurture architectural thinking?**

With the infinite possibilities offered by contemporary construction technology the constraints of materializing a form are no longer part of making a concept stronger12. Given the eternal loop and vicious circle where technological advances have cultural effects and that societal needs push for technological innovation, the emerging question is: how can we not lose track of the real cultural content of architecture 'seduced' by the power of CNC machines to manufacture anything conceivable? How can architects translate technological advances into innovative designs that produce lasting and significant cultural effects?13 How will students or rather future architects not become the (neo-)Arts and (Digi-)Crafts14 people of contemporary times?

In the history of architecture the relationship between thinking and making has been challenged between extremities of total isolation to total integration. There have often been conflicts between thinking and making architecture to the extreme of one overshadowing to invalidating the other. On the one hand, the 19th century Arts and Crafts Movement was primarily focused on the tangible qualities of craftsmanship. On the other hand, new ideas on architecture that were never built were dismissively15 characterized as 'paper architecture' (Utopia16).

The industrialized economy in the Modern movement introduced an interesting articulation of these extremities. Industrial production, according to Le Corbusier is not the production of objects but a world of intellectual constructions, of for-

mal languages and information17. This new relationship between materiality and the intellect, between craftsmanship and thinking processes, seems to be under redefinition in the non-standard architecture and, at this crucial moment, it is imperative to support, enhance and sustain the thinking process as the necessary regulating factor in the loop between technology and culture. The emerging question is: how can we teach our students to become agents of the loop between technology and culture?

Nowadays, we can observe a progressive impoverishment of the humanities in architectural curricula, which, in most of the cases, are replaced by modules related to more technical development of IT applications to architectural design and construction. The humanities have significantly lost their role in the design decisions. Cultural sensitivity and particularity, which dominated architectural design in the seventies and the eighties, have disappeared from architectural discourse, legitimizing designed buildings. In most publications the contents focus on the process of generating non-standard forms and marginally refer to the social and cultural impact of the outcome of this process. If our educational system is becoming more technical, procedural and intuitive how can we then efficiently cultivate and develop creativity and innovation?

Can innovation stem from a technical thinking alone? Can competences that encourage innovation be assured in an educational system with the humanities marginalized? Established educators such as Ken Robinson18 agree with a recent survey by Newsweek19 that the association of ranking mathematics and sciences as the top subjects in the education of future innovators is wrong20. In acknowledging the inherent complexity of our times and, without undermining the invaluable contributions made by distinguished scientists and engineers, Alan Brinkley remarks that this world would be unimaginable without the great works that have defined culture and values. In his article "Half a Mind is a Terrible Thing to Waste"21 his suggestion to all educators, clearly architecture educators included, is the balance between equally cultivating the sciences and humanities that put the world together:

Along the same line Alan Nevins asserts that for him, "the humanities are not simply vehicles of aesthetic reward and intellectual inspiration, as valuable as those purposes are. Science and technology aspire to clean, clear answers to problems (as elusive as those answers might be). The humanities address ambiguity, doubt, and skepticism -essential underpinnings in a complex and diverse society and a turbulent world…..it is almost impossible to imagine our society without thinking of the extraordinary achievements of scientists in building our complicated world. But try to imagine our world as well without the remarkable works that have defined our culture and values. We have always needed, and we will need, both."

**Do schools disposing advanced IT infrastructure produce better architects?**

Would schools of architecture that possess the most advanced CNC machinery and offer their students possibilities to even construct their own machines for a given, unique design question, put forward better architecture than schools that do not?

The creation of prototypes and models for testing of design proposals was always a significant part of the educational process in all schools of architecture. 1:1 prototypes, no matter how timely and crude, have always been a means for this testing22. Architecture in its attempt to strive for innovation has always proposed unprecedented ideas that only if not failing in their testing could be established as good and genuine. Rapid prototyping has certainly the merits of speed and accuracy but its high cost does not allow for repetitive testing. On the other hand the number of students in schools of architecture in most cases does not permit them to have access to this infrastructure due to the time and cost limits imposed by the time schedule and the poor finances of schools, at least at undergraduate level.

Contemporary machines can certainly produce complex forms in prototypes for testing. However, what differs in the non-standard architectural forms is that for each building there is one parametric detail which Oosterhuis, defines as 'universal' 23. Testing an idea through testing its unique parametric nodal point is a new and interesting concept of turning construction of elements into the manufacturing of parametric components to be assembled. It becomes evident that for schools of architecture there is a broad spectrum of possible experimentations with the new technologies. What our education system must certainly avoid is to

dissolve the use of IT technologies and testing as an end-in-itself exercise, depriving students of the final outcome of the content and association with its original theoretical premises and architectural ideas.

**Towards parametric architectural curricula**

From all the above remarks that emerged from the Continuum experiment, it becomes evident that, as teachers we are all confronted with the challenge to reshape our educational environments in order to meet the demands of a fast-changing world. Even though we all recognize the need for change, in our everyday educational experiences, the key word is not so much the change itself, which in any case has framed all the recent developments of our educational system, but the speed of this change. The speed of change appears to be the central issue of our educational environment, which profoundly affects our teaching strategies and pedagogical approaches.

How can we adapt the architectural education we are offering in order for our students to be responsive to this fast changing world? Can the forms of education offered till now cope with the new demands of practice, the fast growth of the variety of building materials, the implementation of new construction methods and techniques, the variable expectations of the clients, the liquidity in the financial and political dynamics in the globalised economy? Is it still possible to teach the same way we have been taught? Can we structure curricula for an unpredictable profile of the graduate architect? Can we envisage the context in which our graduates will operate? Can we apply the same educational and pedagogical strategies to students who are nowadays exposed to unpredictable, multiple stimuli, knowledge and images reaching them through the digital infrastructure available? Can an architectural design course be taught in the same way when it takes place in a room called atelier, laboratory, design studio or lab? Can we teach the same way we used to people who have no free-hand sketching skills but have incredible dexterity in texting? Can we develop the same pedagogical approaches for our students who read and write less but see and hear more?

We are becoming more and more conscious that we have to proceed to radical reforms in our educational system in order to update the impact of the education we are offering to the needs and the conditions of our globalised world. In this new challenge we must rethink the modularized system we apply in order to structure a new one which will incorporate a parametric view on architectural education that will be easily responsive to the dynamics of an unstable, broader social and economic environment. The design and implementation of a new parametric architectural curriculum is for an already significant number of schools of architecture one of the most significant projects to be accomplished. The Continuum project offered us extremely useful stimuli, opportunities to think and to rethink our educational practices and to investigate new needs, objectives and means towards a more challenging education of future architects.

**Notes**

1 Ali Rahim, Catalytic Formations, (N.Y.: Taylor & Francis, 2006), pp.10-14

2 In the Modern paradigm the clear-cut distinction of the parts of a building associated materiality with the idea on the unique resolution of nodal points that connected the parts, all assembled producing the overall building. The transformation of the values of the given intellectual and cultural context of democritisation, internationalization, and the perception of the human being as a regular modular but central in world was achieved with the use of standardized components made of not so traditional or local to the building site materials. The process itself was a top-down approach to design where the conceived form, in most cases, was resolved through the resolution of its distinct parts. For further reading see: Edward Ford, The Details of Modern Architecture, (Cambridge: MIT Press, 1990)

3 Known for their crucial role in contemporary constructions are companies such as Gehry Technologies (http://www.gehrytechnologies.com/) and Materialise (http://www.materialise.com/)

4 2009 was the European Year of Creativity and Innovation, http://www.create2009.europa.eu/, celebrated with a Conference entitled "Imagine-Create-Innovate".

5 Kas, Oosterhuis, Hyperbodies: Toward an E-motive Architecture, (Basel: Birkhaeuser, 2003)

6 Singeru Ban would certainly not have agreed with characterising cardboard tubes as non-building materials.

7 Manuel DeLanda, Material Complexity, eds. Neil Leach, David Turnbull & Chris Williams, in Digital Tectonics (London, Willey Academy, 2004), pp. 14-21

8 Gilles Deleuze and Felix Guattari, A Thousand Plateaus (Minneapolis: University of Minnesota Press, 2002), p. 408

9 James Edward Gordon, The Science of Structures and Materials, (Scientific American Library, 1988), p. 135

10 For further reading on the economies of the digital paradigm read:, "The Economies of Elegance" by Ali Rahim and Hina Jamelle, in Elegance, Architectural Design, Helen Castle ed. (London: Wiley Academy, 2007) pp 66-75 The essay is also included with no illustrations in the present volume (pp 101-104 as Ali Rahim's contribution to the closing conference of Continuum, Chania September 2009.

11 See Manuel DeLanda, "Material Elegance:, in Elegance, Architectural Design, Helen Castle, London: Wiley Academy, 2007) p 18

> It is worth following DeLanda's argument against optimisation of the familiar versus the 'irreducible complexity' of forms that display an elegance of their own, p 21

12 Jean Baudrilliard and Jean Nouvel, Les Objects Singuliers, (Paris: Calmann-Levy, 2000), p 16

13 Ali Rahim, Catalytic Formations, (N.Y.: Taylor & Francis, 2006), p 11

14 Unlike Bonwetsch, Gramazio and Kohler us of the term 'digital craft' the term here is used for its derogatory implications and connotations to thoughtful architecture, see Tobias Bonwetsch, Fabio Gramazio & Matthias Kohler, Digitales Handwerk, in Nonstandard structures, GAN, Architecture Magazine 06, (Wien, N.Y.: Springer, 2009) pp 172-179

15 In her course "Archigram and its Legacies: London, A Technotopia", Annette Fierro discusses the preoccupation of Archigram with technology: "Coming into the present day, Archigram prophesied, to an uncanny degree, the extensive use of technologies that are environmental, or based in information and communication, and mass fabrication in new materials of organic or plastic characteristics"

16 Manfredo Tafuri, Architecture and Utopia. Design and Capitalist Development, (MIT Press, 1979)

17 Le Corbusier, Towards a New Architecture, (New York: Dover Publications, 1931)

18 http://www.ted.com/talks/lang/eng/ken_robinson_says_schools_kill_creativity.html. Sir Ken Robinson in his lecture at TED (February 2006) explains that intelligence is diverse, dynamic, interactive and distinct while creativity is the process of having original ideas that have value. He stresses that only the acquisition of skills in maths and sciences is a hindrance to creativity as their prioritasation in the education globally is artificial and derives from the needs for highly numerical scientists to be employed since 19th century Industrialism and has not been re-considered since.

19 The survey indicated that the Americans are losing ground in their ability to innovate, as opposed to the Chinese. The possible explanation is that the former place the emphasis of their education on maths and computer sciences (52%) and undermine the creative approaches to problem solving (18%). The Chinese believe that in order for their children to drive innovation they need to cultivate their skills on creative approaches to problem solving (45%) and less on maths and computer sciences (9%). Daniel McGinn, The Decline of American Innovation, in Newsweek, November 21, 2009, pp 32-37

20 That has been a hot topic for a long time: Cyril Stanley ('Matter Versus Materials: A Historical View', in A Search for Structure, Cambridge, Mass: MIT Press, 1992), a historian of materials describes in his book the erroneous clear-cut distinction between craftsmen and philosophers from ancient Greece that was soon dissolved when science was more keen on looking into the 'problematic' topological

versus the 'axiomatic" structures as described by Gilles Deleuze and Felix Guattari in A Thousand Plateaus (Minneapolis: University of Minnesota Press, 1980) p 411.

21 Alan Brinkley, Half a Mind is a Terrible Thing to Waste, in Newsweek, November 21, 2009, p 45

22 Brett Steele, Prototyping Architecture's Future, Again, in Manufacturing Material Effects Rethinking Design and making in Architecture, eds. Branko Kolarevic & Kevin Klinger, (N.Y.: Routledge, 2008) pp1-4

23 Kas, Oosterhuis, Hyperbodies: Toward an E-motive Architecture, (Basel: Birkhaeuser, 2003)