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INTRODUCTION

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Foreword: Connecting the dots

As a prelude to this EPFL diploma thesis project, I would like to take time to explain my subject choice and to contextualise it. The EPFL diploma (PDM) has the particularity to be a free-subject diploma where the students can choose a personal subject on what they will spent most of their time on their final year. A final academic project that should help them better understand the posture they want to develop towards architecture. It is also a tool that students can use strategically in order to find particular paths to the professional world.

I took around four months during the last year in order to find my PDM subject. I considered this as a self-awareness period to understand particularities of my current profile. Remembering one Steve Jobs quote¹ about connecting the dots, I did the exercise to list the subjects that interested me in architecture since I started my studies in 2008 in ENSA-LYON. Recurrent themes that appeared since the first years was an attraction to experimental, non-conventional architectures. Research and criticism are for me as much important as design. I was at the beginning very interested by minimalist aesthetics and Japanese contemporary architecture. A major obsession emerged from these previous interests: **"Invisible environments"** meteorological architecture, mediatic and climatic design, that came from my work with Philippe Rahm in 2010-2011. A recurrent pattern also appeared: **"core architecture"** doesn't interest me that much. I enjoy more to explore the boundaries of the architectural practice, and I find great value to transpose knowledge from other disciplines to the architectural field. I don't consider architecture as a very independent practice, because I truly believe it absorbs the socio-technological society in which it evolves.

Aside my architectural interests, I was early fascinated by **the potential of the Internet**, by the speed in which the digital

1 "You can't connect the dots looking forward; you can only connect them looking backwards"—Steve Jobs Stanford Commencement address, 2005.

technologies we use are evolving, and how they can quickly change our everyday habits. In the eight year time frame in between the beginning of my studies and today, so many things happened ! The birth of smartphones was a shock, a computer in your pocket. I realised somehow that digital technologies can change architecture “directly” with design tools like Rhino, but also “indirectly” because it change the configuration of the world itself. I was at 16-17, an early adopter of Facebook in France, and I paid a lot of attention to my digital-self that I understood not as separate from the physical world, but complementary. Exploring the **digital territories** changed the geographies of my life and brought me some physical advantages. I travelled and learned languages for free, or even found internships or jobs because of them. I asked online friendship with random people sharing common interests, and some of them became good friends of mine that I actually met “IRL²” some years after.

I was never interested in digital architecture³ as a style, that I personally found superficial and too self-centred. However, my observations on the impact of the Internet and digital technologies in life motivated me to start investigating the relationships between this other part of “the digital” and architecture. I dismissed the other options of my PDM shortlist with the vision that this subject is the most likely to bring meaningful insights in a long term vision—as much for me, as for its potential readers. This investigation is rooted on an overall feeling: **the digital technologies and culture will change architecture more disruptively than it already changed it during the two last decades, and architects need to be prepared.**

A first research led me to the (re)discovery of a large set of emerging concepts or phenomena like infosphere, crowdfunding, big-data, Internet of Things, digital privacy, personal fabrication, redistributed manufacturing—and **the idea of postdigital**. I observed that many of this phenomena are already starting to be tested on experimental architectural projects since few years.

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“In Real Life” (In opposition of the online life)

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Here, in the sense of formal, complex architectures represented by architects, like Zaha Hadid or Frank Gehry. We talk about “parametricism” as an architectural movement.

“This research is as much about a potential future than a very tangible present.”

—makecollaborate.net, 2016

“At the right time, at the right place”

This preliminary research comforted the initial intuition that something very important is currently happening in architecture. The use of digital technologies in architecture is not a new phenomenon anymore, but the deep integration of digital culture as a dominant paradigm is now almost achieved in our global civilisation. That makes a big difference.

This research is, in 2015, more relevant than ever. It is no coincidence that a series of influential architects are starting to investigate since the early 2010s, a “**digital shift**” going beyond digital design. As example of this focus change, we can notice the publication in April 2015 of a short but significant essay by Rem Koolhaas on Artforum, The Smart Landscape⁴. Here is an extract of the text:

“After a decade and a half, the twenty-first century is beginning to reveal some of its likely essences. Architecture has entered into a new engagement with digital culture and capital—which amounts to the most radical change within the discipline since the confluence of modernism and industrial production in the early twentieth century. Yet this shift has gone largely unnoticed, because it has not taken the form of a visible upheaval or wholesale transformation. To the contrary: It is a stealthy

infiltration of architecture via its constituent elements. [...] Now digital technology is no longer restricted to merely enabling design; it is rapidly integrating with architecture's essential physical [...] For thousands of years, the elements of architecture were deaf and mute—They could be trusted. Now, many of them are listening, thinking, and talking back, collecting information and performing accordingly. The door has become automated, transformed into an extension of the smartphone, with each opening and closure logged; elevators predict your intended destination by listening to your conversations and tracking your routines; toilets diagnose potential illness, building a catalogue of the user's most intimate medical data; windows tell you when they should be opened and closed for maximum environmental efficiency. Your house may soon insist on an early bedtime to stop irresponsible consumption of energy. A Faraday cage will be a necessary component of any home—an electromagnetic shield offering a retreat from digital surveillance and preemption.”

It is important to note that Koolhaas didn't wrote this essay ten or five years ago, even if OMA is extensively using digital technologies in architecture since the early nineties⁵. The relevance of Koolhaas's essay is related to the context in which it has been produced: **the emergence of a very actual paradigm shift**. In 2005, smartphones and social medias were anecdotal, tablets and smart

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The "Tres Grande Bibliothèque" competition in 1989 is one of the first OMA projects showcasing volumetric CAD and digital representation.

wearables were just at a concept stage. The majority of the digital services we use now, like Google Maps, Airbnb, Uber, Spotify, were not existing yet. The list of examples that Koolhaas highlights, related to domestic intelligence and the Internet of Things, are virtually not existing today but will certainly become a reality before the 2020s.

Koolhaas describes furthermore a *“most radical change within the discipline [...] since the early twentieth century”* that is happening yet without the awareness of architects on the question. It happens precisely through a *“stealthy infiltration of architecture via its constituent elements”*. While architects are focusing on direct explorations of the digital tools, the architecture was already changing subversively, without them, by the **infiltration of digital** products and systems developed by external protagonists such as information technology companies. This context leads to a variety of technical, aesthetic and ethical problems to solve. This essay is then a call for the architectural profession to take a critical and technical control of this emerging changes.

As Koolhaas pointed it out, **it is therefore strategical to investigate this shift** in order to forecast more accurately the evolving position of architects in society—The emerging opportunities and challenges that architectural practices will face in the next decades. **If the architectural profession needs to adapt or reinvent itself, it should be a proactive process, not something unknown to us.**

Why makecollaborate.net ?

I was recently asked if the New Aesthetic would coalesce into “something more serious”: a book, collection of essays, or a manifesto. While I would like to, and probably should, produce a book or

book-like object at some point, it itself would not be “the New Aesthetic”, but a commentary upon some of the issues it raises. I strongly reject the notion that a manifesto is an appropriate or “more serious” (and thus worthy) way to address the issues under discussion here, as it would represent precisely the kind of premature codification of the subject that the New Aesthetic explicitly sets out to avoid. (While admitting, with respect to that statement, all the contradictions presented by this piece of writing: where the two accounts differ, trust the network and not this document.)

—James Bridle⁶

Project Formatting

This present publication investigates the emergence of a “postdigital architecture”. It is a very timely project. A fast-evolving research focussed on experimental phenomena that are not defined or well recognized yet. It possesses a strong forecasting dimension. For obvious reasons, one of the first decision was to design it as an evolutive and flexible platform where the first version to be published for EPFL diploma thesis in January 2016 will have the ambition to act as the kernel of a larger, open-sourced project going beyond diploma context.

A theoretical and applied research project where the content will be illustrated and supported by the format of the research itself. I decided to develop first an internet platform : makecollaborate.net that have the flexible advantage of the digital world, leading to regular printed outputs acting as a “screenshots” of an online process. The printed publications are named makecollaboate.ink and

will exist not as issues, but as **sucessive versions of an ongoing project**. The overall research formatting of makecollaboate.net was influenced by two main books : Postdigital print⁷ and Open Source Architecture⁸ and the research project of Silvio Lorusso, Post-digital Publishing Archives. The overall project is accompanied by an evolving series of digital discussions remotely done with the help of online collaborative tools such as google docs called **#conversations** in reference to The conversation series project⁹ from Hans-Ulrich Obrist.

Project Naming

So... why “makecollaborate” ? One’s might ask himself.

We are living in a world where everything is constantly overbranded: your breakfast meal is on instagram, your holidays on youtube, your afterwork with friends on snapchat, etc.—Welcome in the world of ubiquitous digital marketing. The resarch project was lunched with its own online platform in order to “officially exist”.

As the digital entrepreneur Gary Vaynerchuk claims: *“Content is King, but marketing is Queen and the Queen runs the household.”* I chose to baptise it straightforwardly with the name of the internet platform hosting it. This name rather be catchy in order to survive in this world wild web. A simple and graphic title to associate with a more complex palette of this borad exploration about architecture, culture and digital technologies. The motto **“Beyond digital : make, collaborate”... “Architecture for the next decades”** was coined in the early phases of this present project, after the preliminary research. The association of two meaningful actions “to make” and “to collaborate”, as significant of the important paradigm shift we are currently witnessing.

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LUDOVICO, Alessandro, *Post-Digital Print, The Mutation of Publishing since 1894*. 2012
RATTI, C. & CLAUDEL, M., *Open Source Architecture*, 2015
<http://www.artbook.com/huocnv.html>

- **To Make** because the digital technologies are currently strongly impacting our relationship with materiality, and fabrication processes. The rise of advanced robotics, automation, digital fabrication as many factors to deeply influence architectural production. Because, also we are witnessing the rise of new phenomena such as the fab-labs, the maker culture, and a certain regain of interest for personal making rather mass-consumerism.
- **To Collaborate** because the Internet is completely transforming our relationship towards each other and towards our planet. Digital technologies are providing the infrastructure for new forms of collaboration at a geographical and complexity scale that was even impossible to imagine few decades ago: welcome to the collaborative age.

The online platform of **makecollaborate** uses the domain name **.net** for network : a “soft”; flexible and evolutive, rhizomatic organisation with a distributed knowledge form. The printed version will act as archive and will integrate the domain name **.ink** for obvious reasons. The paper version is available, and ready to print on pre-formatted **.pdf** files for personal publishing. A collector version in collaboration with artists and colour print will be regularly published in small batches and numeroted.

@EPFL	#EPFL
@steevejobs	#architecture
@philipperahm	#masterdiploma
@remkoolhaas	#freethesis
@OMA	#subjectchoice
@jamesbridle	#connectdots
@opensourcearchitec-	#invisibleenvironments
ture	#experimentalarchitec-
@postdigitalprint	ture
@silviolorusso	#internetculture
@hansulrichobrist	#digitalterritories
@garywaynerchuk	#investigation
@makecollaborate	#intuition
	#disruption
	#digitalshift
	#phenomenons
	#postdigital
	#thesmartlandscape
	#now
	#elements
	#digitalinfiltration
	#makecollaborate
	#openresearch
	#onlineplatform
	#evolutive
	#postdigitalpublishing
	#conversations
	#make
	#collaborate
	#paperoutput
	#nonlinear
	#versionone

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PROLOG

The discovery of “postdigital”

Postdigital 101: a definition and an introduction

A peer-reviewed definition
Complementary notions

A historical timeline of the use of “post-digital”

The three “digital revolutions”

Technological maturation and diffusion of innovation

The maturation of the three digital revolutions

The second “talking dog phase”

What is Postdigital architecture ?

Postdigital architecture ?
The postdigital age ?
Postdigital architecture is not necessary digital

The **Prolog** is to be considered as an extended introduction and as a reference tool for a good understanding of makecollaborate project. The prolog sets the historical context of the present research. It provides core-principles and the needed definitions for the following essays composing the project.

The Discovery of “Postdigital”

A preliminary research was deployed with the objective to discover and assimilate some digitally related phenomena at the origin of important changes in the western society today. It was constituted by a series of book readings related to this subject. Books about diverse disciplines such as information technologies, economy, engineering, publishing, politics... with a relatively a small part of architecture. It can be considered as an accelerated update on “what’s going on now” done with a constant attitude of transposing the ideas in an architectural context.

An important part of this research output is a **historical re-contextualisation** over the two last centuries, of the situation we are now. Something interesting happened, and can be understood as a key-element of this present research: a large amount of observations done in different books, treating different subjects with different attitudes are actually converging quite precisely. The notions of **industrial revolution**, **paradigm shift**, **technological penetration** are for example present in different “core books”. In the comparative history of western electrification and current cloud computation by technologist Nicholas Carr, in the observations on digital culture in architecture from the architect and historian Antoine Picon, or in the studies of economist and social theorist Jeremy Rifkin. We find similar observations in the publications of MIT Media Lab former director Neil Gershenfeld, a specialist on interdisciplinary studies and digital research.

These notions are important to understand the origins and the process of the changes currently starting to happen in our society, and will be developed later. Not directly present on these men-

tioned “core books”, the concept of “post-digital” is mentioned in a book from editor and media critic Alessandro Ludovico. The adjective “**postdigital**” appears yet to become a central term for the further development of the overall research.

“**Postdigital**” seems to a good tool to represent the situation we are currently living, and seems to be in adequation with the previous observations made in the core books. In that context, the objective of the research was set “to define and explore the *“emergence of postdigital in architecture”*”

Postdigital 101: a definition and an introduction

“**Postdigital**” is a concept still partially defined yet. The term was first coined only two decades ago in 2000 by a Kim Cascone, a musician, in a specific context. The understanding of “postdigital” is then necessary in order to create a solid reference for the next steps the research. After a chaotic first decade where the term was defined in many contradictory ways, a peer-reviewed definition was developed under the leadership of the applied researcher and theorist Florian Cramer. However, this reviewed definition has been done in regard to contemporary art and medias disciplines. We will need to understand if this definition can also be accepted in design and architectural practices.

The peer-reviewed definition is as follows:

“Post-digital” once understood as a critical reflection of “digital” aesthetic immaterialism, now describes the messy and paradoxical condition of art and media after the digital technologies

revolution. “post-digital neither recognises the distinction between “old” and “new” media, nor ideological affirmation of the one or of the other. It merges “old” and “new” often applying network cultural experimentation of analog technologies which it re-investigates and re-uses. It trend to focus on the experimental rather than on the conceptual. It looks for the DIY agency outside totalitarian innovation ideology, and for networking off the big-data capitalism. At the same time, it already has become commercialised.” (2013)

Complementary notions

In 2013, in the published article **“What is post-digital?”** Florian Cramer also exposed a series of complementary reflections about the notion of Postdigital. It is interesting to note that many of these ideas are somehow present in the core-books from preliminary research.

Here is the resume of few points that can be interesting to relate later to architecture:

- **“Post-digital: a term that sucks but is useful”**

More pragmatically, the term ‘post-digital’ can be used to describe either a contemporary disenchantment with digital

information systems and media gadgets, or a period in which our fascination with these systems and gadgets has become historical.

- **Post-what?**

'post-digital' can be defined more pragmatically and meaningfully within popular cultural and colloquial frames of reference. This applies to the prefix 'post' as well as the notion of 'digital'.

The prefix 'post' should not be understood here in the same sense as post-modernism and post-histoire, but rather in the sense of post-punk (a continuation of punk culture in ways which are somehow still punk, yet also beyond punk); post-communism (as the ongoing social-political reality in former Eastern Bloc countries) [...] and, to a lesser extent, post-apocalyptic (a world in which the apocalypse is not over, but has progressed from a discrete breaking point to an ongoing condition.) [...]

The 'digital' in 'post-digital' should not be understood in any technical-scientific or media-theoretical sense, but rather in the way the term is broadly used in popular culture. [...] The simplest definition of 'post-digital' describes a media aesthetics which opposes such digital high-tech and high-fidelity cleanness.

- **Post-digital = 'old' media used like 'new media'**

New ethical and cultural conventions which became mainstream with Internet

communities and Open Source culture are being retroactively applied to the making of non-digital and post-digital media products.

- **DIY vs. corporate media, rather than ‘new’ vs. ‘old’ media**

When hacker-style and community-centric working methods are no longer specific to ‘digital’ culture (since they are now just as likely to be found at an ‘analog’ zine fair as in a ‘digital’ computer lab), then the established dichotomy of ‘old’ and ‘new’ media — as synonymous in practice with ‘analog’ and ‘digital’— becomes obsolete, making way for a new differentiation: one between shrink-wrapped culture and do-it-yourself culture.

**A historical timeline of
the use of “post digital”**

In complementarity from the peer-reviewed definition of ‘postdigital’, it is interesting to retrace the birth and evolution of the newly coined term. Here is a short historical timeline of the use of “post-digital” across the different disciplines.

- **1995. Being digital**, book written by Nicholas Negroponte and published in 1995. This book is a very important reference in the definition of the digital word itself. It contains a history of digital medias and forecast possible future of it. Negroponte talks about bits and atoms, and new technological interfaces (smartphones, touchscreens) There is already a vision of ubiquitous computing and dematerialisation of information. No more cd’s...

- **1998.** Negroponte publish the essay **Beyond digital**, 3 years after **Being Digital**. It brings for the first time, this even before the 2000s that the most important changes brought by the digital revolution that appeared in the 1940s is already done. Negroponte claims that we'll be somewhere after the digital revolution, and the most important things will happen.
- **2000.** First mention of “post-digital” as a word, coined by the composer Kim Cascone in a critical essay about Music and technologies: **The Aesthetics of Failure: ‘Post-digital’ Tendencies in Contemporary Computer Music**. Inspired by Negroponte’s, Cascone says that

“the revolutionary period of the digital information age has surely passed. The tendrils of digital technology have in some way touched everyone”

He also mentions already the notion of “**post-digital aesthetics**” in music production, as an “aesthetic of failure” resulting from

“the immersive experience of working in environments suffused with digital technology: computer fans whirring, laser printers churning out documents, the sonification of user-interfaces, and the muffled noise of hard drives. [...] glitches, bugs, application errors, system crashes, clipping, aliasing, distortion, quantisation noise, and even the noise floor of computer sound cards (as) raw materials composers seek to incorporate into their music”

- **2000.** **The Postdigital Membrane: Imagination, Technology and Desire**, is a book published by the multimedia artist Robert Pepperell and the film-maker Michael Punt. The books present an early

notion of Postdigital that may be controversial but that is already bringing the very interesting idea of indetermination and convergence.

“The term ‘Postdigital’ is intended to acknowledge the current state of technology whilst rejecting the implied conceptual shift of the ‘digital revolution’—a shift apparently as abrupt as the ‘on/off’, ‘zero/one’ logic of the machines now pervading our daily lives. New conceptual models are required to describe the continuity between art, computing, philosophy and science that avoid binarism, determinism or reductionism”

“It may be that, in the postdigital era, we are ready to accept a deep continuity between all things that appear to be separate. In particular, the continuity between human and machine will no longer seem fantastic and, indeed, can be regarded as being well established.”

- **2006. The Future of Art in a Postdigital Age** is a book published by the artist and researcher Mel Alexenberg. The book starts with a personal definition of postdigital.

“Postdigital (adjective)—of or pertaining to art forms that address the humanisation of digital technologies through interplay between digital, biological, cultural and spiritual systems. Between cyberspace and real space, between embodied media and mixed reality in social and physical communications, between high tech and high touch experiences, between visual, haptic, auditory and

kinaesthetic media experiences between virtual and augmented reality, between roots and globalisation, between auto-ethnography and community narrative, and between web-enabled peer produced wikiart and artworks created with alternative media through participation, interaction and collaboration in which the role of the artist is defined"

- **2009. Plectic architecture: towards a theory of the post-digital in architecture.** Is an essay published by Neil Spiller, a professor of architecture and digital theory and Graduate director of Design at the Bartlett at this time. Spiller introduce his essay with:

"First, it is important to stress that 'post-digital architecture' is not an architecture without any digital component. Indeed it an architecture that is very much a synthesis between the virtual, the actual, the biological, the cyborgian, the augmented and the mixed. It is impossible, anymore, to talk of digital architecture as a binary opposition to normal real-world architecture. Cyberspace has insidiously insinuated itself into our existence, at every scale and at every turn"

- **2009. Rebecca Roke from RMIT published a thesis called Bits and Pieces: Crafting Design in a Post-Digital Age.** She examines "How designs based on a conjunction between craft and digital techniques may offer new possibilities for an architect or designer in contemporary practice." Roke explains:

"Employing the term 'post-digital' simultaneously implies that a critical assessment of the application of digital tools, which are now familiar and integral to most contemporary design practices, is due. It also suggests that boundaries between previously segregated disciplines can slip and cross known parameters. All of the digitally pioneering practitioners mentioned above [FOA, Lynn, Gehry] call on rules, softwares and techniques that have been appropriated and co-opted from other disciplines to perform in the arena of architecture. Consequently, given our familiarity with the digital realm, we should now be better able to suppose how digital techniques may be re-appropriated and respond to the physical manifestation of a design."

- **2012. Postdigital Print, The Mutation of Publishing since 1894** is a book published by the artist and editor-in-chief of Neural¹, Alessandro Ludovico. The books use the term Postdigital applied to the discipline of edition and publishing for the first time. The Book is a historical exploration of the complex relationships between print and digital publishing.

"For more than a century now, avant-garde artists, activists and technologists have been anticipating the development of networked and electronic publishing. Although in hindsight the reports of the death of paper were greatly exaggerated, electronic publishing has now certainly become a reality. How will

the analog and the digital coexist in the post-digital age of publishing? How will they transition, mix and cross over?"

- **2013. "Postdigital Publishing Archives"** an archive and research platform started by the Italian designer and artist Silvio Lorusso, close from Alessandro Ludovico. The platform explore digital publishing in a broad way, where digital and physical are not in opposition or competition, but develop complex relationships in between themselves. P-DPA.net archives

"experiences in the field of art and design that explore the relationships between publishing and digital technology [...] in order to highlight relevant paths, mutual themes, common perspectives, interrelations, but also oppositions and idiosyncrasies."

- **2013.** First edition of a yearly **"Symposium of Postdigital cultures"** in Lausanne, along with the creation of an online **"Museum of Postdigital cultures"**
- **2014. Post-digital Research** is the name of the 3rd issue of a Peer-Reviewed Newspaper. The publication is the output of two workshops organised by Transmediale Berlin and Aarhus University. A group of 16 recognised artists, art critics and historians discussed together about the notion of Postdigital in the art discipline. The book leads to a commonly accepted definition of post-digital: "Post-digital" once understood as a critical reflection of:

"digital" aesthetic immaterialism, now describes the messy and paradoxical condition of art and media after the digital technologies revolution. "post-digital" neither recognises the distinction be-

tween “old” and “new” media, nor ideological affirmation of the one or of the other. It merges “old” and “new” often applying network cultural experimentation of analog technologies which it re-investigates and re-uses. It trend to focus on the experimental rather than on the conceptual. It looks for the DIY agency outside totalitarian innovation ideology, and for networking off the big-data capitalism. At the same time, it already has become commercialised.”

- **2014.** The British Architect **Sam Jacobs**, use the notion of postdigital in one interview about the current situation of architecture. It is the first observation of the use of this word by a practicing architect. It is interesting to note that Sam Jacobs is making a difference about the technological opportunities of digital tools, and the convergence of a digital culture.

“What is exciting you in design right now?—I’d say that we’re moving into a post-digital phase—or perhaps it should be christened the real digital age? For a while, there’s been a real obsession with digital tools in terms of what they can technically do. Now I think we’re getting over that. Instead what we’re beginning to see is a kind of convergence of intelligence in the design process—that cultural, physical, representational, socio-logical issues are becoming far more entwined in the way we can piece things together. Just as all kinds of information converges on our screens, I think it is beginning to in the things we design.”

- **2015.** Jonathan Openshaw published the book **“Postdigital Artisans”** with the help of Hans-Ulrich Obrist, and placed the notion of postdigital to an interdisciplinary level, as quoted: *“craftsmanship with a new Aesthetic, in fashion, art, design and architecture”*
- **2015.** Sam Jacobs wrote an essay, **Drawing As Project—Post Digital Representation In Architecture**, some ideas about relationship between digital tools, culture and representation of architecture.

“First, digital tools have to date been taken up within architectural culture in a blinkered way. They have explored the formal possibilities of manipulating shape. Parametricism is about technological possibilities of digital tools. Yet in wider culture it is the manipulation of information that is the most striking cultural effect of digital tools. From sampling to Instagram, digital tools allow us to process, alter, and create. They allow us to intervene in information and reshape it for other purposes. In other words, this is collage culture. But collage is now seamless, and not being able to see the join makes collage work in a very different way. In short, it’s Photoshop rather than Grasshopper that is the real site of productive digital speculation.”

The three “Digital revolutions”

“Face it—the Digital Revolution is over. Yes, we are now in a digital age, but the really surprising things will be elsewhere²”

— Nicholas Negroponte, 1998

In 1998, the founder of MIT Media Lab, Nicholas Negroponte published in Wired Magazine the article **Beyond Digital** with the now famous quote: *“Face it — the Digital Revolution is over. Yes, we are now in a digital age, but the really surprising things will be elsewhere”*.

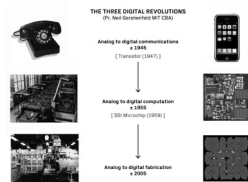
This quote supposes that fifteen years after, we live now in a *“digital age”* where a digital revolution has been completed for already quite a while. The Negroponte’s quote was actually one of the main references for the early users of post-digital in 2000, and has been extensively used since. The *“digital technologies revolution”* is also mentioned a historical event in the peer-reviewed definition led by Florian Cramer. **This short essay aims to clarify what is this “digital revolution”.**

In the history of technology, the digital revolution is a recent historical period where the commonly used analog, mechanical and electronic technologies has been replaced anywhere by digital technologies. This transition originated a serie of **disruptive changes** in our computational systems and in our communication technologies, leading to societal and economic mutations we are currently witnessing. The digital revolution was not sudden or autonomous, but rooted from many decades in already important changes initiated by the “second industrial revolution” at the beginning of the 20th century³, as explain historian Antoine Picon.

² <http://web.media.mit.edu/~nicholas/Wired/WIRED6-12.html>
³ PICON, Antoine, Digital Culture in Architecture, 2010, p.16-21

The productivity leap that resulted from the two major inventions of the first and second industrial revolutions—steam power and electricity—led to a much more complexified world. It created an increased need for information processing and sharing, an “Information Age” that couldn’t exist without advanced computation. The apparition of computers are not directly related to digital revolution. They actually existed before in a mechanic way such as “slide rule” or “differential analyser” at the end of nineteenth century. The invention of the transistor in 1947 and the conversion from analog computers to discrete, digital computers in the 1950s were however the first steps in a long evolution that allowed computational tools to better fulfil our newly increased needs.

One very important thing to understand is that the digital revolution was not an abrupt event, not homogenous one. It took place over more than 50 years and was divided in different phases. Neil Gershenfeld, director of the MIT Media Lab’s Center for Bits and Atoms explained in his book “FAB” that the digital revolution was divided in three main phases, going from the mid 1940s until the late 2000s. There is actually three digital revolutions logically following themselves.

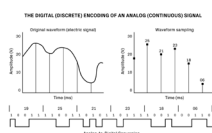


Three digital revolutions

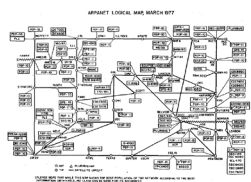
The first phase was the digital conversion of communication protocols in the 1945s. The analog electronic signals used in telegraphy and early telephony were replaced by digital systems encoding the information using 0 and 1. The discrete encoding method allowed an easier treatment of the information, diminishing the quality loss over long distance cables, and enabling better treatment of noise and anomalies in the transmitted signals. This major change led to the digital encoding of communications, and the capacity to

add secondary informations within a transmitted signal; the start/end, the identity and destination of a message for example.

This created later digital telephony, and then the birth of the Arpanet, becoming later the “Internet” (Inter-networking Protocol), and the World wide web in 1989, where any kind of information can circulate around the world by packages, using different paths on a variety of different infrastructures with a large set of different protocols. It allowed a decentralisation of the information transmission, in contrary of direct broadcasting.



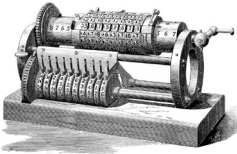
Analog-to-digital



Arpanet Map

The second phase was the digital conversion of computation in the late 1950s. As explained, computers exist for long time, in a form of analog, continuous mechanical equation solving systems. The apparition of transistor allowed the creation of digital computation where information is stored and treated with discrete numbers—0 and 1 materialised by electrons in an electrical circuit. This is at the base principle of a long evolution that computers had with the help of the miniaturisation technologies. Once restricted to specific equation-solving contexts, like ballistic or physical simulation, digital computation develop broader applications in image processing, publishing, entertainment. Digital computation allowed the digital storage of information at the origin of a massive

dematerialisation of content (text, image, video, music) that we experience since the late 90's.



Grant Calculating Machine, 1876



UNIVAC I, 1951



Apple Macintosh 128K, 1984



Apple iPhone 6s, 2015

The third and last phase is the digital conversion of fabrication. It is happening now since the mid 2000s. The fabrication has always been analog until then: the tools were not thinking. Computers computed and machines executed. We start now to embed intelligence directly in the tools, or even the materials themselves. One example of ultimate digital fabrication is biology: A cell is at the same time a computer, a fabrication machine and a material. The

needed information to transform or duplicate a material is encoded in a discrete way in the material itself. That is the case with the genetic information encoded in every cells using the DNA, and allowing a precise cell-duplication with DNA-RNA transcription.

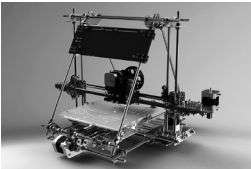
The first step of digital fabrication was to transform material digitally with the help computers, allowing direct transformation from coding “bits” to material “atoms”. A second step is to create more intelligent machine able to maintain or reproduce themselves, in order to free the means of production. With the progress of micro and nano-technologies, we are also at the very beginnings of the creation of “intelligent materials” having the ability to store their own information (like shape, orientation, conductivity) or able to configure themselves after external stimulus (like an thermo-responsive or self-healing alloys)



Handmade “traditional bricklaying



Computer-assisted robotic bricklaying



The RepRap 3d printer



Electrochromic glass able to change opacity

Technological maturation and diffusion of innovation

The maturation of the three digital revolutions

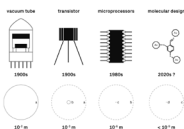
It is important to note that these three phases of the digital revolution are not synchronised. They started at different periods and are actually not at the same level of advancement today. The core-discovery of a revolutionary phase is not absolute, nor definitive. It is evolving from abstract concepts, to experimental projects without direct societal impacts, to mature technologies able to be globally deployed and deeply integrated with pragmatic uses. The “maturation” of a technology is a determining factor for its social impact.

Once discovered, a base-technology takes time to find efficient applications and a large propagation in every layer of the population and disciplines. The diffusion factors of a new technology are usability, standardisation and affordability. It is also related to the human-factor itself with cultural adaptation which have its own inertia. Innovation alone does not mean socio-technological progress. The **technological penetration** or “**diffusion of innovation**” is related to the ability of a technology to fulfil evolving market needs. New technologies create new needs and inversely; and it can make obsolete existing needs and technologies too. For example, electric trams made obsolete horse-powered urban transportation in many cases, because it was cheaper and faster. As Nicholas Carr explains, “*The path of technological progress*

and its human consequences are determined not simply by advances in science and engineering but also, and more decisively, by the influence of technology on the costs of producing and consuming goods and services."⁴

There is not a fundamental difference in the conception principles between a Mainframe Computer from the 1960s, a PC [Personal computer] from the 1990s and the actual devices we are using now like the laptops, tablets and smartphones. Their use and their impact on society are however completely different. The IBM mainframes developed in the 60's used to be room-sized. They were rented up \$30.000/month to large corporations with specific applications and were operated by a dedicated team of highly specialised staff. This condition was a no-go for possible applications to the mass-market. However, the continuous advancement in microtechnologies over the last decades allowed the miniaturisation of the electronic components, the demultiplication of computational power, and the affordability of digital products. These factors propagated the PC's in almost every western homes since the late 90's.

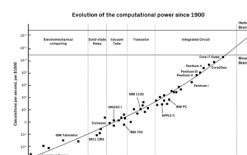
FROM MACRO TO MIND: THE EVOLUTION OF INTEGRATED CIRCUITS



Vacuum tube to molecules

The progress on digital computation evolved incredibly fast and changed the relationship people have with daily use digital technologies. **The Moore's law** predicted that the number of transistors on integrated circuits will double every two years since the late 1960s, and it has been confirmed since then. A vivid example of the extreme penetration of computational power in western society is the smartphone. A high-end smartphone from 2010 like the "iPhone 4" had the same computation power as the Cray-2, the

world's best supercomputer in 1985⁵. The second one was used mainly for specific tasks by governmental agencies, like nuclear or aerospace simulations, whereas the first one brought to middle-class consumers a large set of multimedia and networking services in a pocket-sized phone.



Moore's law evolution

The second “talking dog phase”

The “talking dog phase” is a short anecdote used by Neil Gershenfeld, in order to illustrate a situation that technologies encounter after their discovery, during their maturation period:

“In the life of a technology, there is an early “talking dog” phase: it would be notable if a dog could talk at all; what the dog first says wouldn’t matter as much. Only later do you begin to care what the dog talks about.”⁶

Gershenfeld uses this story to illustrate a re-thinking of internet protocols that started to happen around 10 years after the birth of World Wide Web. The initial optimisation of the internet was about

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6

<http://pages.experts-exchange.com/processing-power-compared/>
GERSHENFELD, Neil, Feb: The Coming Revolution on Your Desktop, 2007

the performance of the network infrastructure. A series of noticeable improvements were developed like “ADSL” and browsing-experience like “web 2.0”, but at the price of an ever increasing complexity. A second phase started when a certain maturity against absolute performance induced engineers to **re-think alternative uses** for internet-based systems. It led to the development of a slower but simplified protocol able to connect a large constellation of small devices together, in an inexpensive way. The goal was not to enhance the existing infrastructure for computers or browsers, but to adapt this infrastructural system to new problematics; to new markets, like the construction industry. The research resulted to the creation of the “internet 0” (I0) which became a groundwork for one of the big visions for digital technologies today, the Internet of Things.

A secondary example is about electricity. [The electrification of western society in the last centuries will be a recurrent example in this research.] In the beginnings of electrification, the first period of electrical engineering was about the use of electricity as energy. A deeper understanding of the physical phenomenon led to the creation of “electronics”: a new science about using electricity not for energetic purpose, but for information transportation and storage.

When a new technology is emerging, a recurrent phase in the **maturation period** consists to first explore the technical possibilities offered by the recently developed innovation, and to optimise it through performance-driven projects. The focus of research is about the technology itself. The second phase of the “*talking dog*” story happens when we “*begin to care what the dog talks about*”—The image is interesting because it is clearly showcasing that people inevitably get used to a new situation, as disruptive it can be. The astonishment then fade, and re-focus about the meaning and consequences of the technology happens.

This presentation of a second “**talking dog phase**” can be obviously related to our current notion of Postdigital: a period after the digital revolutions, where the astonishment for digital technologies is progressively fading. It forecasts a situation where the dig-

ital technologies won't be directly explored for what they are, and what they can technically bring. In contrast, we will care to listen and observe what *"they're talking about"*: Their history, their own culture — The positive phenomena they brought and what we might use in different contexts, or their negative impact we have to understand and protect ourselves from

What is Postdigital architecture ?

The prolog brings us to a core question of the makecollaborate research:

What is “postdigital architecture” ?

It will be wise to start directly by saying that “postdigital architecture” doesn’t exist as such. The aim of the research has absolutely no intention to claim the emergence of a style or an architectural movement. It aims to rather notice a shift of paradigm in our society and provide the reader a set of tools to re-think his own vision for architecture. In the complexity of our current world, architecture is so diverse and fast-changing that is impossible to dare talking about architectural movements (beyond purely marking strategies) anymore.

The “postdigital” of postdigital architecture is used here as an **adjective** to be applied to the architectural context. It is a theoretical or critical tool to suggest a certain postdigital condition that architecture will have to consider in the upcoming decades. The use of the adjective is interesting for the fact it can be applied to more specific situations, like a “postdigital typologies” or a “post-digital construction process”. Some of them will be explored in the next parts of the book.

Therefore, we will use the expression “Postdigital architecture” as a shortcut to describe the diverse concerns and opportunities of “architecture in the post-digital age”.

The postdigital age ?

The Postdigital age can be understood as a socio-technological state of a civilisation, where the three digital revolutions are done. The digital technologies of information, computation and fabrication are deeply assimilated in every layer of society. Ubiquitous and

taken for granted, these technologies are seamlessly integrated into the daily lives of the population without having specific status segregating them from other technologies. A certain technological maturation period induce critical consciousness about them and a re-thinking about their usages and possibilities. In the postdigital age, digital technologies are not an isolated subject of experimentation anymore—They fundamentally influence the physical and cultural landscapes of the world. They change the societal organisations and economic systems the population are living in.

Postdigital architecture is not necessary digital

“Postdigital architecture” inevitably investigates the relationship between architecture and the digital technologies, due to their increasing omnipresence in the built environment. Yet, it is important to understand that “postdigital architecture” can exist without a direct application of digital technologies on it, whereas the “digital architecture movement” of the last decades was centered around the explorative use of digital tools in architecture—A hand designed architecture, built with traditional construction techniques will still fundamentally be considered as “postdigital” if its existence answers to digital concerns or results from a digital-related context: the consideration of digital technologies is indeed integrated in the core of the design process.

Therefore, “Postdigital architecture” is an architecture going beyond a simple, direct application of the digital technologies on it. Not a style, not a movement, “Postdigital Architecture” **represents more an attitude**, seeking to understand and act with the indirect repercussions of “the digital” in the physical, cultural, social and digital environments that humans are creating and living on.

@nicholascarr	#postdigital
@antoinepicon	#historical
@neilgershenfeld	#recontextualisation
@mitmedialab	#industrialrevolution
@jeremyrifkin	#paradigmshift
@alessandroludovico	#conceptualtools
@kimcascone	#appliedresearch
@floriancramer	#contemporaryart
@aprrja	#mediatheory
@nicholasnegroponte	#transdisciplinarity
@melalexenberg	#architecture
@neilspiller	#definition
@thebartlett	#timeline
@rebeccaroke	#beyonddigital
@silviolorusso	#digitalrevolution
@pdpa	#communications
@samjacobs	#computation
@jonathanopenshaw	#fabrication
@hansulrichobrist	#internet
@UNIVAC	#robotics
@IBM	#appropriation
@apple	#technologicalmatura-
@makecollaborate	tion
	#digitalculture
	#bigchange
	#talkingdogphase
	#rethinking
	#architecturalresearch
	#theory
	#postdigitalarchitecture
	#newattitude

0 2

**TECHNOLOGICAL
DISRUPTION
AND
ARCHITECTURAL
ADAPTATIONS**

Direct technological disruption

**Design tools
Buildings tools & materials**

Indirect technological disruption

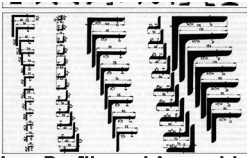
Socio-economic transformations

Architecture being a cultural, and in the same time a technical discipline, the majority of important changes that happened throughout the architectural history were related to technological disruption events. These architectural shifts are resulting to direct technological impacts and also to indirect ones, more diffuse but not necessary less influential.

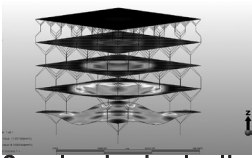
Direct technological disruption

The **direct technological disruption** concerns the innovations which are directly impacting the architectural practice, which have consequent transformative power on the architecture and also possible transform the design and the construction process leading to it as a resulting product. Direct technological disruption concerns new tools, new materials and new construction techniques.

The invention of **new design tools** impacted the work and perception of architects, giving them the opportunity to explore further the potentials of architecture. The democratisation of paper and tracing tools delocalised the design phase from the construction site at the end of the medieval period. The study of geometry and perspective in the European renaissance was at the origin of the complex set of rules and proportions inscribed in the classical language of architecture for centuries. The development of advanced mathematics and physics in the late eighteenth century initiated the idea of an architecture based on performance rather than absolute proportions; this architecture was developed in relation to the new languages of iron construction. The last decade of the twentieth century brought powerful digital tools to architects, allowing them to further explore and visualise in real-time difficult non-euclidian geometries. It empowered them to design optimised shapes and structures with the help of complex algorithms and digital simulations.



Iron Profile and Assemblage element from the 19th century



Complex structural optimisation
advanced digital simulations (finite elements analysis)

Technological innovations in the field of construction, such as the apparition of **new building tools or materials** allowed new kinds of architecture and aesthetics. The mastery of steam power and mechanical machinery in the beginnings of the first industrial revolution at the end of the eighteenth century led to a large-scale iron production that was not possible before. It is considered as a technological disruption because the physical superiority of iron over other material like wood or stone propagated the use of iron elements in the construction industry and directly impacted the architecture of this period. The use of Iron was at the origin of new construction techniques like bolting riveting standardised elements. Larger structural spans combined with industrial flat-glass allowed brighter open-spaces, and new aesthetics were developed by architects, illustrating the big changes of their time. Similar phenomena happened later in the nineteenth and early twentieth century with the mastery of steel production and welding assemblage, and the large improvement of reinforced concrete related to the second industrial revolution.

Indirect technological disruption

From that observation, it is necessary to understand that technology also disrupted architecture in indirect ways through a series of **economic or societal transformations**. As economist Nicholas Carr explains: *“Technologies shapes economics, and economics shape society. It’s a messy process—when you combine technologies, economics and human nature, you get a lot of variables—but it has an inexorable logic”*¹» As presented in the Prolog if technological penetration is shaping the economics and cultural paradigms of a historical period, it predictably impacts architecture as well because architecture is answering the societal concerns and absorbing the culture of its time.

On this viewpoint, the mastery of steam power and the large iron production from the first industrial revolution had also disrupted architecture indirectly with the development of new programs and architectural typologies. The steam engine and steel fabrication led to the Steam Locomotive... and to the creation of national networks of rail transport. It created the need for a new type of urban infrastructure: the train station with its significant impact on occidental cities configurations. Going further, this technological disruption initiated the beginnings of a society of advanced logistics with a new need for infrastructures like railways, bridges, or buildings like warehouses, factories, etc... that constituted a large part of the industrial city of the nineteenth century in Europe.



Crown Street Station

Crown Street railway station, is the first terminal railway station of

1

CARR, Nicholas, The Big Switch, 2009—Reflexion in opposition of Lewis Mumford's Pentagon of Power, p.27

the world, built in 1830 in Liverpool. The fast propagation of railway transportation in the UK pushed the apparition of several train stations across the territory. Crown Street station, as the first large “terminus”, brought a new architectural element unseen until then : the contemporary “train shed” as showed in the engraving. However, these stations also evolved very fast, making the first ones not adapted to an ever expanding technology. The Crown Street station was demolished only 6 years after its construction and replaced by the actual Liverpool Lime Street Station built in the center of the city with more than 10 times the original surface.

@antoinepicon
@nicholascarr
@makecollaborate

#technologicaldisruption
#architecture
#innovation
#directdisruption
#newtools
#designtools
#mathematics
#geometry
#digitalsimulation
#constructiontools
#materials
#iron
#concrete
#newlanguages
#industrialrevolution
#indirectdisruption
#economicshift
#socialshift
#influences
#technologicalpenetration
#newneeds
#architecturalprograms
#typologies
#steampower
#railway
#crownstreetstation
#liverpool

FROM ELECTRIFICATION TO CLOUDIFICATION

Electrification

The Capitalistic segregation

The Canut typology

The second phase of electrification

The computerisation of society
and the post-industrial transition

The digital Economy: From brownfields to greyfields

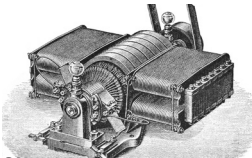
Dematerialisation
Advanced digital logistics

From the room to the pocket:
the architecture of cloudification

The centralised production of computing power
The ubiquity of processing power

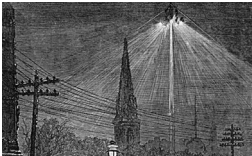
Electrification

The study of the **electrification of the western society** in the two last centuries is a good example to understand the large indirect disruption of electrical technology on architecture. It is also useful comparative tool to forecast the situation currently happening in the early years of the postdigital age.



Siemens Dynamo

Early version of Siemens's dynamo, 1873



Electric lights NYC

Electric public lights in NYC, 1882

The electrical phenomenon is known since antiquity but we can date “electrification”, the **technological penetration of electricity** at different episodes: The invention of the modern dynamo by Werner von Siemens in 1866 allowing industrial applications—Or the invention of electric utility grid by Thomas Edison in 1889. The progressive use of electricity in the western society is at the genesis of a **long chain of disruptive changes** that led to what we call the “second industrial revolution”, up to the 1950s.

The **Electrification** created a significant impact on the existing economic paradigm of the western countries because it changed the way goods were produced and consumed. It had a

strong influence on the built environments at every scale from architectural detailing to territorial configurations. In contrary of the direct mechanical systems of energetic distribution from steam engines, electricity allowed the redistribution of mechanical power in a more flexible way, every machine having its own internal electric motor. The electricity utility grid created the key-infrastructure to sustain a new typology of modern factories. It liberated the production spaces from shafts and belts, permitted the deployment of modern assembly lines—the base of Fordism and mass-production.



Ford Model T, assembly line, 1913

Electrification at the end of the nineteenth century pushed the industrialisation developed since the last seventy years to another level. A mass of labourers came from rural areas to emerging industrial cities to work in large-scale factories owned by an emerging capitalist class. This large rural-urban migration contributed to the fast urbanization of western countries. It created new urban forms and new architectural typologies like collective housing programs or public infrastructures like urban transportation, electric trams and metropolitans.

The Capitalistic segregation

As shown, electrification was determinant actor in the second industrial revolution and in the emergence of the contemporary capitalist paradigm. It led to a major change in the occidental built environment, that we take too often for granted now: **the segregation of working and living environments.**

Capitalism is an economic system where the means of productions are privately owned and operated by a certain class of industrial accumulating capital and exploiting a mass of workers in exchange of wage. The capitalist system is based on a search of profit, possible through a serie of economic or organisational procedures like economies of scale, mass-production, standardisation, specialisation of the labor. It initiated a dissociation between the property and work. The means of productions are gathered into optimised working environments like factories or offices in order to increase the productivity of the businesses. The wage labour produce products or service without owning the means of productions, which are the capital propriety of the business owner.

Before the capitalistic segregation of production means and workforce, the proto-industrial societies had different socio-economic organisation. The emergence of a “market economy” at the end of the Middle-Age created a new category of urban population producing and selling goods. Various craftsmen and merchants with specific skills liberated themselves from the feudal systems, organised in guilds or corporations. These urban workers owned their means of production and used to live in the same place they work. They were using emerging technologies at this time like hydropower to produce and sell small series of goods at a local or regional scale.¹ This economic paradigm related to an early market economy produced during more than 300 years new forms of architecture and shaped the emergence of “villes-franches” (free-cities). A recurrent typology of mixed living-working environment was developed according to the market needs but was discredited few centuries after due to the capitalist shift.



Medieval Triptych : working / living

1

RIFKIN, Jeremy, *The Zero Marginal Cost Society*, 2014 — “the rise of the market economy” p.38-43

The Canut typology

A good example of the separation of the **working/living environment** and typological obsolescence is the silk proto-industry that prospered in Lyon region from the end of the seventeenth century until the first industrial revolution in the 1830s.

The large silk proto-industrial production led to the creation of a manufacturing neighbourhood called “the Croix-Rousse”. It was at the same time a residential and production area, with its own urban and architectural specificities. The “**Canuts**” families of silk-weavers were owning their own loom and buy silk individually through system of cooperatives before re-selling weaved fabrics. The canuts were living and working on the same space resulting to a **specific architectural typology of dwelling**. “L'immeuble Canut” is composed to 4-to-6 floors with 4 flat per floors. Each flat has ceilings of 4 meters high enough to fit the loom used by the families, placed close to high vertical windows. In the depth of the flat a mezzanine divide the high ceiling in two part: the upper floor for the sleeping and living spaces and the lower part for kitchen.

The technological disruption made by electrification and industrialisation of the silk production pushed the creation of silk-factories in the Region of Lyon. It made the “canut-flat” typology found in the Croix-Rousse obsolete because not competitive against industrial standards of production. The former canuts move out of their former workshop-flats to smaller social housing and started to work for the factories. These flats had to be re-appropriated by new categories of populations, transformed into duplex or more luxurious flats well situated in the center of the town. They are now quite rare and praised for their spatial qualities and historical values.



La Crise Lyonnaise (Canut Flat)

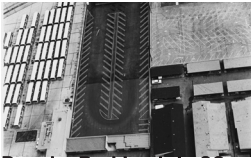
The second phase of electrification

In the early years of electrification, the production and consumption of electric power was first considered as a private responsibility, and it was restricted to a small category of individuals and activities. The deployment and maintenance of personal generator was extremely complex and costly, often reserved to industrial production. It is possible to compare this situation to the optimised use of Mainframes computers in the 1960s at the beginning of digital computation.

The most important factor that propelled the electrification of occidental society was the development of “utility grid” to a national scale. The business of electricity production and distribution became a professional activity for itself, it created large thermoelectric or hydroelectric production plants and distributed electricity to all the territories, first in the cities, then in the rural zones. This allowed consequent economy of scales and cheap electricity. The reliability of the electricity grid, now taken for granted, took some years to be achieved. After an intermediate period, the large industrial companies accepted to not produce their own energy and to rely on externally managed supply, for cost and logistic reasons. The utility grid system also democratised the access of **electricity in domestic environments** for personal use in exchange of an affordable monthly fee. A middle-class emerged later in the early twentieth century, based on ownership and consumerism. The democratisation of automobile and mass-medias such as radio and television contributed to the development of a middle-class suburban lifestyle with its own architectural and territorial consequences. Combined to electrification, the extended use of automobile brought new kinds of retail spaces and their architectural consequences. Big-box stores, Drive-ins, parking lots, gas stations, diners, and in the domestic equivalent: the typical suburban house with private garage and garden. This condition played a considerable role in the development pattern of the urban sprawl observed in Europe and USA nowadays.



Ruscha Parking lots 01



Ruscha Parking lots 02

**The suburban condition:
two images from the artist
book *Thirty Four Parking
Lots*, Ed Ruscha, 1967**

In a smaller scale of investigation, it is important to realise that a large series of domestic configurations or habits we have now are actually quite “recent” and were brought by the availability of electricity in the domestic environments only a century ago. It changed the way we perceive our relationship with social interactions, privacy, cleanliness, etc. As Nicolas Carr explains, cheap oil and cheap electricity

“prompted an exodus from cities to suburbs, and a shift from the public entertainment [...] to private diversions” bringing “the city in the living room”.



Beer advertisement (Garden/kitchen)

**The middle class,
suburban lifestyle at the
core of american pop
culture in the 50s and 60s
(television, garden and
modern kitchen)**

Electricity-based broadcast media like television or radio mutated the traditional “Parlour”, a dedicated room for social formal events and interactions, into the contemporary “living-room”, a new type of room centred on family time and private diversions. Other electric home appliances like refrigerator changed the temporalities of food consumption and conservation. This small “climatic space” arriving in every middle-class households made obsolete the need for naturally cooler spaces like cellar or pantry, which were often replaced by the Garage. The Taylorism brought by industrialisation had effect in the domestic routines with a progressive attempts to rationalise the cooking process. The “Frankfurt kitchen” standardised and optimised kitchen layout designed in the 1920s is a good example. The “air conditioner” had a lot of disruptive effects on both domestic and office architecture that are explored in another essay, “the architecture of the well-connected environment”

All these electricity-based appliances are now considered as totally common. An important majority of them are re-engineered to fit again to our current society and new problems that were not considered before like energy consumption or ecology. Yet, these appliances were still observed as disruptive only three generations ago, in the same way we currently consider smartphones or cloud-based digital services.

“Video killed the radio star”

—The Buggles, 1979

The computerisation of society and the post-industrial transition

As explained in the Prolog, the advanced understanding of electricity in the early decades of twentieth century led to the genesis of a new science, electronics. It was the starting point of digitalisation of electric signals, for communication, then for computation at the base of the paradigm that initiated the three digital revolutions.

The late twentieth century known a period of “**computerisation of society**” where digital technologies of computation were

largely introduced as much in the professional activities such as administrative work, word and image processing, information analysis... to personal hobbies such as digital media consumption (image, music, video), video-games, etc. The fast propagation of “personal computers” placed digital technologies in an exponentially important position in the economy and in the culture. It pushed the society in a “digital age” since the late 70’s. It created a complex imbrication of emerging needs for the development and the maintenance of these digital technologies. It favoured the rise of new markets, new skills and new professions like computer engineering, software development, network technicians.

It is interesting to compare this period to the early years of the western electrification: The “information processing” power were the responsibility of every individual or companies as it used to be for the production of electric power. Consumers were in charge for the upgrade and maintenance of their own personal computers with the necessity to buy new exploitation systems every few years. It created gigantic markets and made computer companies such as IBM, Windows or Apple extremely powerful. In the professional side, every small-to-medium companies or administrations possess their own private computational park of desktop computers and internal servers, and they integrate at consequent cost an IT department in order to maintain a reliable digital infrastructure ready for work. This organisational system was/is however quite costly and time consuming for the users both personal and professionals.



Bill Gates and Microsoft

Young Bill Gates and Microsoft. The emerging market of Computer softwares during the “Personal Computer age”

that changed the
organisation of the world
between the 1980s and
the 2010s.

The computerisation of society was in the same time the cause and the answer of the transition from an industrial “secondary economy” to a more complex and softer “tertiary economy” where information production, distribution and processing took a fundamental position in contrary to former massive goods production from industrial age. The transition to a tertiary economy initiated a mutation of work ethics and environments as it happened once with electrification, modern factories and assembling lines. The computerisation of society propagated new business models asking for **different kind of spatialities** like “modulable privacy”, hierarchical segregation, meeting rooms, etc. It kept contributing to the capitalistic segregation of living and working environments and it pushed for the large dissemination of the contemporary “office spaces” based on a service economy witnessed until now.

This mutation of the nature of work influenced again the creation of new architectural typologies at different scales, from internal floor organisation to business districts planning. Different spatial experimentations were initiated by industrial designers and architects in the second half of the twentieth century in order to adapt to the new working ethics and management methodologies: “open-spaces” “office landscaping”, cubicles, various reception and meetings rooms. These experimentations emerged in parallel with the use of new languages and corporates aesthetics, the flexibility of office planning was reinforced by the already existing Koolhaasian “vertical schism”², a possibly endless replication of open generic floors in corporate office buildings and towers.



Action office axonometric

Prototype for “Action Office” designed by Herman Miller in 1967. One (good) ancestor of the cubicle.



PC Cubicle Farm

1990s “Cubicle farms”: a generic service-based office landscape in the “Personal Computer age”.

The dominion of service-based economy influenced by the computerisation of the western society made a major part of the pre-existing industrial activities less economically attractive and pushed for an important modification of European and American landscapes at a territorial both architectural level. A large wave of industrial delocalisation decimated large employment pools in occidental countries, in favor for emerging countries with cheaper workforce and little social regulation. Many factories shut down and were abandoned, quickly decaying into **brownfield lands**, this in a matter of decades. It brought important economic and ecological challenges for politics, territorial planners and architects. The industrial cities which blossomed just a century ago progressively evolved in “**post-industrial**” ones, where the majority of industrial buildings are transformed into cultural, residential or tertiary spaces in order get a new relevance and usage in the shifted context. The name of this evolution is called “**deindustrialisation**”.

This programmatic transformation and revitalisation of the former industrial built environments is constituting one of the core-subject of research and practice in the architectural discipline since the late 80's with an increasing interest since the 2000s. It pushed a considerable number of architects to develop new building rehabilitation knowledge, material recycling. It originated to new kinds of advanced multidisciplinary projects with landscapers, planners, environmental scientists, with for example the integration of secondary skills like soil depolluting, phytoremediation, cultural campaigns, etc.



Ruhrmuseum OMA

The Ruhr region is one of the largest brownfield in Germany. The former Zollverein coal mining industry around Essen was progressively re-transformed into a cultural district with schools and museums: a typical post-industrial landscape. The transformation and depolluting process took more than 30 years. The Ruhrmuseum developed by OMA was inaugurated in 2008 on the former "coal washing plant". It re-investigates the existing infrastructure, where visitors use the same paths as the coal. The Ruhrmuseum is a typical example of successful post-industrial revitalisation project.

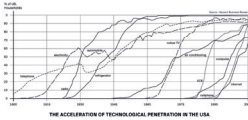
The post-industrial transformation applies also to large cities, impacting the daily lives of millions of inhabitants. Sometimes, entire parts of European and American metropolises were successfully revitalised such as the new HafenCity in Hamburg. But the economic “raison d’être” of many industrial cities from the American rust belt were disrupted by an important post-industrial transition. It led to a recurrent phenomenon of “shrinking cities”. Former flourishing cities like Detroit³, the home of Fordism, are now partially decaying and face considerable political, economic and therefore territorial problems. The scale and the speed of deindustrialisation are sometimes extremely difficult to regulate, especially politics and planners are reacting too late or too slowly.

The architectural profession, beyond the conventional definition of architecture, is taking a fundamental role in the research for many years. Many architects organised large scale urban and territorial analysis, developed awareness rising campaigns about post-industrial phenomena⁴. It is a good example to see the application of architectural thinking efficiently in action.

The digital Economy: From brownfields to greyfields

The “PC age” was just a temporary step in the digital revolutions. The Personal Computers are now more and more considered as primitive hosts in the propagation of the one of the most disruptive technological innovation of the last 30 years: the **World Wide Web**, born in 1989. The Web, as the contemporary form of the Internet knew an incredible technological penetration faster than many of the most important innovations of the last century like cars or telephones.

3 https://en.wikipedia.org/wiki/Shrinking_cities#The_case_of_Detroit
4 <http://www.shrinkingcities.com>



Acceleration of technological penetration in the USA

Within its own short history, the Internet has already known important evolutions. The first decade of the Web was still in a quite experimental situation: networks were slow, interface and navigation still difficult. The maturation of the infrastructure in a “Web 2.0” in the early 2000s brought to the web a major part of the characteristics we know nowadays: the genesis of social media, responsive navigation, user participation, etc. **The Web 2.0** deployed the necessary infrastructure for the rise of a new economic paradigm: the “**web economy**” or **digital economy**.

This economy is using the internet and the digital technologies as a core-infrastructure for producing, distributing and consuming diverse goods and services. In the digital economy, the Internet is disrupting large industrial sectors. It obliges many corporations to rethink their business models in depth, and it made obsolete some of them in a matter of a decade. It created a fertile ground for the blossoming of a new generation of startups, now becoming world giants like amazon.com in 1995 or google.com in 1998. As a medium and as an infrastructure, the Internet impacts communication and marketing strategies as much as production and logistics structures in a very similar way that the radio, the train or the car once did. New kinds of buildings are created for the digital economy, other ones are dismissed.

The transition to a digital economy particularly touched the physical retailing of goods and services. This mutation has increasingly growing consequences on the built environment of developed countries. It impacts both architecture and urbanism through different triggers:

1/dematerialisation

The digital economy is pushing for certain dematerialisation of retailing structures because a consequent quantity of goods and services are now distributed and consumed in a digital, immaterial form. The markets related to digital medias and entertainment are an excellent example. Even already “digitalised” since 20 years, music, films and information were once distributed in a physical form like K7, CD’s, DVD’s—needing physical spaces for storage and retailing. Nowadays, a major part of this market is directly downloadable or accessible through the Internet from everywhere, reducing consequently the need of physical retail spaces in the cities for these markets. This phenomenon is happening as much for goods than for services that used to need physical interaction like consulting or banking. Furthermore, an increasing part of former “physical markets” are also in a similar process of dematerialisation—books or processing power are current examples. Cloudification and personal fabrication are opening this tendency to many other dimensions, yet to come.

2/advanced digital logistics

The retailing of physical objects is also impacted regardless of their nature. The computerisation of society initiated a large optimisation leap in logistics, to the benefit of the digital retailing companies. Digital retailing doesn’t need a lot of costly physical spaces like showrooms or shops in the centers of the cities. Digital retail also reduces transportation traffic and storage costs, making significant economies of scales. Many of these buildings will change too. It results to lower prices in comparison of conventional markets. The consumers can choose the shipping methods to retail points or directly at a selected address. The more advanced the logistics are, the less personal transportation is needed. The architecture of the remaining retailing spaces will consequently change—their typologies, visual presences, etc. The architects will have to re-investigate their properties in relation to the digital environments.

These two factors are considerably impacting the contemporary landscape we are living in: the existing physical businesses that flourished in the society of mass-consumption and the built landscapes that were developed in accordance during the late twentieth century. This landscape of urban and suburban retail, big-boxes, shopping malls and parking lots will progressively be disrupted in an uncanny similar process that the industrial landscapes known during the early phases of the computerisation of society few decades ago.



Amazon Fulfilment Center

The physical footprint of the digital economy: inside one amazon.com fulfilment centers
Amazon developed few giant and automatised warehouses for direct dispatching instead of a network of retail points.

It is interesting to note that a new vocabulary is currently appearing in order to better describe this emerging phenomenon: the “grey-field lands” are describing abandoned or decaying territories that were used for retail or service industry in relation of the brownfields issued from the deindustrialisation of society. Facing the growth of Chicago Metropolitan Area, the phenomenon of **greyfield lands** is for example mentioned on the current “GO TO 2040” territorial planning initiative led by the Chicago Metropolitan Agency for Planning, in parallel with an overall concept of “suburban retrofit”. The “**dead malls**”⁵ represent entire or partial abandon of shopping malls due to a too little consumer traffic level. The “**ghostboxes**”⁶

5
6

<http://www.deadmalls.com>
<http://fyl.uwex.edu/downtowneconomics/files/2012/07/greyfields-and-ghostboxes.pdf>

named in reference of the “big-boxes” are their equivalent in the suburban strip mall context. They are leading to an abandon of numerous retail or storage shopping centers, but also the affiliated car infrastructures such as parking lots or distribution roads. These spaces are becoming more and more economically unviable, and this trend will increase in the following decades, their obsolescence are a good indicator to a paradigmatic shift in an advanced digital economy.



Abandoned Wal-Mart

The greyfield condition and the Ghostboxes: an abandoned Wal-Mart in Beaver Dam, WI, USA in 2005.



Rackspace Transformation

A “cliché” leading the way: the reconversion of dead mall in the corporate Headquarters of internet company Rackspace in San Antonio, TX in 2010.

As observed in the contemporary history, architects played and are still playing an important role in the post-industrial reconversion of territories, cities and building. **This essay is a call for action**—The architects of our generation should start to investigate the consequences of the “**greyfield transition**” along with its reconversion potentialities: how to re-adapt suburban big-boxes into cultural or

social infrastructures? It is possible to transform shopping mall into personal fabrication factories? Into residential complex? What would be the physical spaces needed in order to support the economy of tomorrow? These are fundamental questions that architects will have in mind in their upcoming practices.



Cineroleum Axonometrics

The “Cineroleum” (completed in 2010) from the young architectural collective Assemble is an exemplary greyfield reconversion in the early years of the postdigital age. An abandoned Gas Station in Central London is transformed in a projection room and physical gathering space.

“Unlike the out-of-town multiplex, The Cineroleum celebrated the social experience of filmgoing, from the popcorn machine and bar in the old station shop through to the programme of approachable classics”

From the room to the pocket: the architecture of cloudification

The large use of internet led to a second age in the computerisation of the society that we are currently witnessing: “**The Cloudification**”. This term is used to describe a progressive migration of activities and services on a “*World Wide Computer*”⁷ using “cloud-computing” technology.

“The term Cloud Computing thus refers to the modes of computer data processing where delocalised exploitation is performed via communication networks and interfaces, in the form of services provided by a service provider from remote “Data centers” and whose location and operation are not divulged to customers. The technological setup thus created produces a definite evolution in comparison with the now outmoded model of the personal computer, and forms the already vital infrastructure of contemporary nomadic lifestyles and decentralised communities”

*—Patrick Keller
in “Inhabiting the cloud”, 2014.*

The birth of the cloud computing, can be understood as the starting point a second age of computerisation, to be compared with the second phase of electrification that happened a century before. Like the electric utility grid, Cloud computing consist to an “externalisation” of the computing power. The individuals don’t need to possess anymore computing power on their own tools (historically, the desktop computer or the laptop). They can now rely more and more on powerful external “computing plants” accessible from everywhere through complex wireless networks. The users need only “reception devices” with a minimal configuration and off-line storage. The “reception devices” are becoming very small and mobile, mostly constituted by smartphones and tablets since the last decade. Cloud-computing is extending to a serie of “wearables” such as google glasses. In another direction, a system of “thin client” is progressively replacing the desktop computers. One server somewhere in the world can host thousands of affordable “thin clients” This system has the potential to bring affordable computing power everywhere in the world, developing countries included.

The Cloudification is currently disrupting the perception of space and time because it makes information consumption and processing accessible virtually anywhere and anytime. Computation and information are becoming ubiquitous. It impact the built environments in two majors axis : the centralised production of computing power, and the consequence of ubiquity in the reception of this power.

1/The centralised production of computing power

On one side, the demand of decentralised data processing is increasing simultaneously to the physical infrastructure that is supporting it. Cloudification is pushing for the creation of large computing plants, the “data-centers”. They have to be compared with the electricity production buildings, like thermoelectric or nuclear plants, the hydroelectric centrals and dams which shaped the landscapes of the two last centuries.

“The data center is the most definitive and yet invisible typology of our contemporary world. It is the densest spot in our digital universe, a physically invisible space, virtually visited by many.”

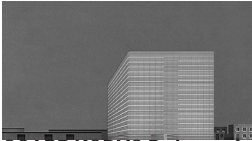
*—Kersten Geers and
Andrea Zanderigo, 2013*

From the generic Big-boxes used today in the early years of cloudification, the architectural knowledge and thinking will be increasingly needed to support the development of these physical infra-

structures. The data centers and affiliated buildings need specific spatial configurations in order to host thousands of servers in an efficient and secure way. They have a critical mass that will have to be integrated in the dense contemporary landscapes. In our current times, they have a high energetic consumption and produce a lot of heat but this condition is not granted for the future decades. As Patrick Keller questions:

“What symbioses can be found by occupying the ground and the space between men and machines? Where and how is this ground, are these “expenses”, to be occupied? Are they to be camped in, to maintain mobility? Settled on a long-term basis? How do we factor in obsolescence factors?”.

The architects will have to integrate fast-evolving technologies while designing architectures for machines and for people. From that, it is important to remember that in our complex world, digital technologies are evolving faster than architectural needs and standards. They and become quickly obsolete in few years, in contrary to a building lifespan. Key directions are already emerging: how to produce a resilient architecture that is however able to support the evolving technologies? How to design such buildings in a sustainable way by developing energetic re-valorisation and by using the by-products of cloudification? An advanced understanding of the cloudification infrastructure by architects will lead to the creation of sustainable design and energetic co-habitations, and possible new forms of architecture.



GSAPP KGDVS Data center

A data-center in Brooklyn, is a “big-box” reinterpretation, using copper piping as external skin for natural cooling. Student Project in the Kersten Geers Studio “The Big-Box”, GSAPP, 2012



Datarock Schema Recycling

“Datarock” is a project designed by Gauthier Le Romancer and Guillaume Derrien for Europan 11 in 2012. It proposes the development of a large datacenter complex and resulting secondary programs in the arctic town of Vardø in Norway.



Datarock (Pool)

Datarock is an interesting example of architecture of cloudification, supporting both the digital and physical landscapes in the postdigital age. The project takes advantages of local properties, electric production from the sea, natural cooling with the arctic climate. It valorises the thermic byproduct by transferring excess heat for the local community program : greenhouses for food production, swimming pool and covered public spaces. However, the architecture is there very dependent of the technology at risk for a quick obsolescence.

2/The ubiquity of processing power

On the “utilisation” side, cloudification is also transforming the perception and the organisation of physical spaces even if the majority of architects are not paying attention to these mutations yet. The notion of ownership and perimeters are changing, the access to services and goods is becoming more important than ownership. Cloud-based systems are progressively dissolving the need for fixed infrastructures and physical devices. This is reinforcing the already advanced dematerialisation of goods and services to another level. Former configurations that used need a full room or a fixed position are now mobile and fit on the pocket-sized device, configurable for each individual. The comparison of computing

power between the iPhone 4 and Cray-2 in the Prolog is a perfect example.

The utilisation and appropriation physical space by humans is therefore consequently changing. New perimeters and hierarchies are emerging; spatial adjectives like 'open/closed', 'noisy/quiet', 'dark/bright' can now be compared to new digital notions like 'connected/disconnected', 'open/private data access' or 'smart/mute'. The characteristics of cloud infrastructures can become interesting tools for architects to design space in the post-digital age, as much it happened once with the emergences of electric appliances during the second period of electrification. This design strategies are explored more in detail in The architecture of the well connected environment.

The ubiquitous access to information by wireless networks and mobile devices is freeing the working environments a step further than electrification:

- spatially by disconnecting devices from a fixed and optimised position in a similar way that electrification did from steam-engine shaft and belts.
- Dynamically by unlocking the "ownership" of devices: anyone can connect to any generic client device and instantly appropriate it after a security login. All the private data is being stored in the cloud. This phenomenon is freeing the utilisation of space, in addition to the space itself.

The cloudification of the economy is changing workflow and professional cultures, but not always in a positive way. Ubiquity and privacy are complex parameters to balance with work ethics and architecture has a possible role to play in this equilibrium. A majority of professionals that used to work in specialised places like a fixed office or lab trend to have an increasing freedom to be able to work from anywhere, home, transportations, cafes, etc. The rigidity of the 'cubicle farm' from the PC age is making place to the design more versatile environments. The programmatic composition of

working environments is also mutating: if a large part of individual work can be done anywhere, the physical space will be reserved for specialised activities such as ‘physical’ collaborative or production spaces. The related flexibility of space can be appropriated by architects to design adapted architectural programs or typologies, but also new aesthetics and symbolisms.

“The ‘New Office’ is an airport lounge on a tablet, a midnight video call on the kitchen counter, a shared table at the office or a collaboration pod for ad hoc meetings. [...] In the last 10 years, we’ve seen a significant reduction in the average office space per employee. In 1995, it was approximately 300 square feet; today it is 225 square feet or less. This workspace shrinkage is due to various work style trends, including companies leveraging hot desking, where an employee temporarily occupies a workspace outfitted to meet their needs, hoteling, reservation-based hot-desking, and incentive programs for employees who work from home”

—Richard Hamilton, 2013.

Studies about the cloudification of domestic spaces are also an important direction to develop. The externalisation of data processing and information, the portability of reception device, and the priority of access over ownership are powerful phenomenon to transforms domestics routines and social conventions. A current trend is manifesting this paradigm shift: a recent “post-crisis” decreasing of the mass-consumption and a progressive shift in a “collaborative economy” where objects or services are shared between consumers through advanced logistics and digital platforms. (Think Carpooling, AirBnb...) The return of minimalism and nomadic lifestyles is also observable since propagation of smart-phones and tablets, becoming one central element in the possessions of individuals.

At the intersection of professional and domestic architecture, the combination of cloudification with “personal fabrication” has the potential to end partially a century-long segregation of working and living environments. This shift could lead to the re-emergence and adaptation of forgotten architectural typologies. A change in the production methods and the economy will give the opportunities for architects to re-investigate hybrid spaces. An updated version of the “canut typology” don’t seems so improbable in the postdigital age.



Double House Harry Wei

Double House #2 (2013)
from Architect Harry Wei,
proposes a personal
making space and robotic
station as a new central
hearth of the home.

“This project is a speculation of the modern day cottage industry. As modern industry becomes cleaner and quieter, the

***spatial distinction
between house and
factory becomes
increasingly blurred.”***

@wernersiemens	#electrification	#web
@thomasedison	#westernworld	#advancedlogistics
@henriford	#nineteenth	#retailing
@jeremyrifkin	#twentieth	#greyfield
@edruscha	#history	#reconversion
@nicholascarr	#industrialisation	#ghostboxes
@thebuggles	#fordism	#urbanstrategies
@billgates	#assemblylines	#wordwidecomputer
@IBM	#capitalism	#cloudification
@windows	#livingworking	#centralisation
@apple	#segregation	#datacenters
@hermanmiller	#architecturalimpact	#smartdevices
@OMA	#cannut	#informationubiquity
@feltron	#workspace	#newoffice
@harvardbusinessreview	#flat	#spatialhomogenisation
@amazon	#utilitygrid	#postdigitalage
@shrinkingcities	#middleclass	
@walmart	#suburban	
@rackspace	#massconsumerism	
@deadmalls	#mall	
@assemblestudio	#bigbox	
@patrickkeller	#stripurbanism	
@fabric_ch	#sprawl	
@officekgdvs	#livingroom	
@gsapp	#television	
@andreaanderigo	#typologicalmutation	
@laplagearchitectes	#personalcomputer	
@richardhamilton	#computerisation	
@airbnb	#society	
@harrywei	#economicshift	
@makecollaborate	#cubicle	
	#secondaryeconomy	
	#postindustrial	
	#bownfields	
	#shrinkingcities	
	#digitaleconomy	
	#dematerialisation	

0 4

BUILDING IN THE POSTDIGITAL AGE

Digital fabrication and architecture

Digital fabrication machines
Creating new “smart materials”

The return of personal fabrication

Fab-labs, maker culture and amateurism in architecture

Fab-labs
Maker culture
Amateurism
Personal fabrication on architecture ?

Shifting geographies: Redistributed manufacturing

Shipping recipes
Observations on open-furniture
Redistributed manufacturing in architecture ?

In the understanding of the differentiation between standard construction and architecture, one major difference is that architecture absorb construction beyond itself. It transcend it through the developement of languages, symbolisms (i.e.Ornament), and with the ability of integrate its complexity . By complexity we mean here the borad interlocking of the building act to other cultural, socio-economic, technical systems. Construction as much in its physical and metaphorical defition is an heavy, meaningful act that made history. In this view point, this present essay explores the construction of architecture in the postdigital age through a trans-disciplinary focus.

How architecture nowadays ‘happens’ in our globalised civilisation, in a world disrupted by digital technologies, with important social, economical and cultural consequences ?

Digital Fabrication and architecture

“At the intersection of physical science and computer science, programs can process atoms as well as bits, digitizing fabrication in the same way that communication and computation were earlier digitized”

—Neil Gershenfeld

As introduced in the Prolog, the digital fabrication is the consequence of the three digital revolutions on the realm of fabrication. At a most fundamental level of comprehension, digital fabrication is about *“bringing the programmability of the digital into the physical world”* in the same way it happened with communication when analog electronic signal were converted in a discrete, programmable units. (0 and 1)

Digital fabrication is currently knowing an important development since the mid 2000s due to the maturation of digital computation and microtechnologies. Digital fabrication is actually becoming a buzzword adapted by the mass, often misunderstood with digital design. The concept of digital fabrication was rooted for a very long time in the history of technology that started before the invention of the computer. The ‘programmability’ of physical materials can for example be observed historically in the textile knitting and weaving methods for centuries. The patterns and properties of a textile existing as the physical result of a specific method and order of processing information.

It is no surprise that one of the first tools to be considered as a mechanical computer and also as a ‘digital fabrication’ machine is the Metier Jacquard designed in Lyon in 1801. A mechanical loom able to reproduce exact patterns by reading instructions stored in punched cards. The digital fabrication in the contemporary form was experimented since the early days of digital computation. In 1952, the MIT created the first computer-controlled milling machine, based on early work on real-time computing¹. A serie of diverse innovations emerged in parallel of the advancement of digital computation , progressively merging the information world of bits to the physical world of atoms.

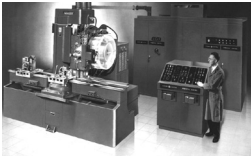


Metier Jacquard

Metier Jacquard and
punched cards in Musée
des Canuts, Lyon

1

<http://www.wired.co.uk/news/archive/2013-03/13/digital-fabrication>



CNC General Electric

CNC and General Electric
Mainframe Computer in
the late 1950s

We are currently talking a lot about digital-design and fabrication, especially with the large interest following the emergence of 3D Printing in the mass-market. It should be wise to remember that 3D printing is just a small, and probably temporary part of digital fabrication. Digital fabrication is not only about designing “additive” or “subtractive” process—or using tools commended by computers. The fundamental goal of digital fabrication is to implement information in the material itself, in order to enhance the manipulation and properties of the materials and reduce fabrication errors. As mentioned, one of the ultimate example of digital fabrication is actually biology. This is the reason that the field of information technologies and biomolecular engineering are currently merging more and more new professional field like “biocomputation”. In that light, the transdisciplinary scientist and activist Joi Ito explains that *“biology is the new digital”*²

In a simple and maybe more straightforward example, Neil Gershenfeld compares 3D printing and Lego bricks. 3D printing is physical extrusion of specific materials by a machine commended by an external program, but the material is standard. The lego system is a good example for digital fabrication because a lot of informations are stored in a lego brick, potential position, anchorage process, etc. It allows small kids to build things at a precision level that couldn’t be possible without the stored information embedded into each brick. The programmability of the material create a system reducing errors. Lego bricks are also a good example for digital

fabrication because the base-material contain enough information for the unbuilding of a completed project (a castle for example), into its fundamental components, the bricks—to be reused later without material loss. The inverse of digital fabrication is digital recycling.

We are still in a quite early phase of digital fabrication. The situation where we will be able program materials at a nano-scale with atoms in a same ease we program bits of information is not mature yet. This level of advancement starts to be observable in the bio-science disciplines, like molecular biology or medicine where scientists learn to program cells able organise and reproduce themselves in particular ways leading to desired results (producing specific molecules, form tissues, etc.) Such advanced applications of the digital fabrication in architecture and the construction field will unlikely happen within the next decades; this due to scale, costs and complexity reasons, even if few prototypic projects may emerge at a certain point.

Having that in mind, we should however understand that the more basic applications of digital fabrication are going to have a considerable influence on the architectural practices in the post-digital age. Many already existing prototypic practices in other professional field are currently democratising fast and will be transferred in architectural construction, as the propagation of digital computation in architectural practices in the 1990–2000's, they will become a standard in a matter of few decades. The future “mainstream” applications of the digital fabrication in architecture are currently oriented in two principal directions. The first one concerns the digitalisation of the fabrication tools and subsequent construction processes. That is leading to the development of advanced programs optimising the links between information inputs and physical outputs, also about improving the quality and the possibilities of the machines processing the physical outputs. The second direction is about developing new “smart materials” with embedded information improving their assemblage, their characteristics or behaviour when in use.

1/digital fabrication machines

In the current stage of digital fabrication applied large scale objects, we are already starting to convert the manual labor done by humans into a machinic work executed by a fabrication tool following instructions from an external “brain”, a computer. The human labor often need the use specific “tools” in order to complement the human action, and “skills” or “Know-how” in order to manipulate the tools in the most appropriate way for the obtainment of a precise output. Human skills are subjective and they cannot be quantified precisely. The human factor of fabrication is producing a lot of imperfections, and tools were historically created to correct them. The ruler, is for example palliating to the fact that human hand cannot trace a perfect horizontal line on free drawing.

In the opposite, mechanic work can be programmed in a discrete process where interpretation and anomalies can be excluded. The computer is sending precise information like cartesian or polar coordinates, speed, pressure, and the output machine can execute the related action with a precision going nowadays, often far beyond the manual possibilities. A laser or a waterjet cutter can for example cut a complex piece in a wood sheet with a precision of a tenth of a millimetre. The point is, that contrary to industrial machines designed to reproduce an identical process over and over (one machine is designed to do one precise action), the digital fabrication machines are designed to follow a large set of different digital instructions, producing a variety of outputs with an industrial precision. So far, the digital fabrication machines can be divided into three main categories of dealing with materials.

- **The additive process** consist to add material only where needed in order to create something, the advantage of additive fabrication reside in the fact that virtually no material is wasted. The results of additive fabrication are often composite objects possessing a non homogeneous nature creating possible structural failure. Example of additive fabrication is 3D printing based on plastic, glass, polymers, concrete or ceramics. Fusions or extrusions executed by ro-

botic arms are also considered as digital additive fabrication processes.

- **The subtractive process** is like sculpture, it consist to remove some selected from an initial block of materials in order obtain the desired shape. The removing process can be done through cutting, with blades, hot-wires, lasers, waterjet and plasma torches, or by milling with end-mills. The advantage of subtractive process resides on the homogeneity and solidity of the remaining pieces.
- **The transformative process** where the shape of the material is modified without addition of subtraction of material. These processes include the weaving of many different fibres, but also thermoforming, moulding, casting, bending on a large variety of materials such as plastics, metals, glass, ceramics, etc.

In the reality of building construction, digital fabrication is, [and will continue to be] rarely a single autonomous process from design to final result, but rather takes part in a combination of different processes implemented successively in an overall project as it was already in traditional fabrication. However, digital fabrication is likely going to take an increasing part of the overall process, and the traditional work, reduced to a bare minimum in between steps.

For example, during the construction of a timber pavilion, it is possible to use a CNC (Computer Numerically controlled) milling machine to cut and shape various wood pieces ready to be assembled—it is using a subtractive fabrication process when material is precisely removed by machines. The second step is to assemble the resulting elements together. This can be done traditionally made by human workers, but robotisation is starting to master these kinds of more complex actions. The advanced integration of digital fabrication methods by architects during the early phases of the design will optimise the final product (object, building, etc), and its construction. This attitude can reduce the number of necessary steps during the material transformation processes, and/or reduce the human implication. It can also reduce the quantities of used

material and limit fabrication waste. Digital fabrication is enhancing the overall quality of the final products, and give the opportunity to take specific factors into consideration like environmental concerns, logistics, etc.

2/Creating new “smart materials”

The embedding of information within a material leads to the creation of a **“smart material”**

Allowing an information transfer in whatever form between material units, or material and construction machine in order to facilitate their assemblage or their properties. We shouldn't be confused by the “intelligence” of a material and starting to imagine fanciful materials like “computer bricks”, or whatever in that direction. “Programmed” information can take indeed a lot of diverse, more simple forms like the reaction to a particular stimulus. We can design for example, materials which are changing properties—surface, conductivity, opacity or color when reaching a certain physical or chemical condition like temperature, pH, humidity, etc. A lot of new materials can be “programmed” to give a specific answer to a particular external stimulus: the feedback can be electrical, magnetic, physical or chemical too.

The fast evolution in material engineering is currently allowing the birth of a large collection of smart materials, widely used in diverse technological fields, mechanical engineering and bio-technologies. The quantities and the price of these materials are often too high to be used in the ordinary construction and architectural realm. Specific applications are although starting to be observed, like self-healing cements, opacity-changing glasses. The utilisation of smart materials and digital fabrication machines in building construction is leading to promising innovations in architecture. The programmability of the construction materials themselves rather of distinct equipments can lead to a more efficient management of architectonic elements and new aesthetics. For example, a thermochromic glass can be “programmed” at a molecular level to change colour and reflect UV when receiving a certain amount of

solar radiation. It allows to maintain better a defined atmospheric condition all along the year by regulating the thermal transmission coefficient of the class. This embedded programmability is freeing the need of traditional solar protection like sun-breakers.

We can also imagine simple informations, like “position” or “anchorage” that could enhance and facilitate the communication of the material with the digital machines during the fabrication processes, like reducing errors, or continuously checking properties like insulation factors.

The modern construction brick has been designed and standardised during the industrial revolution as an optimised material for hand construction; one brick fits in one worker hand. Bricks also have particular proportion leading to standardised structural or non-structural bounds. Architects may be more and more involved in smart materials design in transdisciplinary projects. This direction can originate for example new kinds of “bricks” optimised for digital construction like autonomous robotic assemblage: Simple magnetic or thermal programming of these bricks could lead to an instant, non-visual feedback during the assemblage processes done by non-human builders. In another direction, Architects can co-develop material adapted to new economic shifts: (cf. Amateurism) blocks like the lego bricks that facilitate the construction and reduce errors when manipulated by unskilled builders. A company called Kite Bricks³ developed a construction system based on large bricks designed to be manipulated by a specific robot. Despite a lack of architectural design, the Kite Bricks are self-insulated, and pre-dimensioned for classic piping and electrical installation, reducing time and costs.

“The intersection of 3D scanning, modeling, and printing blurs the boundaries between artist and engineer, architect and builder, designer and developer, bringing together not just what they do

but how do they think. When these functions are accessible to individuals, they can reflect the interests of individuals”

—Neil Gershenfeld.

Another fundamental property of current digital fabrication lies on the capacity of direct exchange between information inputs and the physical outputs. A designer can use a “Computer Aided Design” (CAD) program to implement a serie of information like a cube of 100x100x100 mm on a flat surface and directly export to a “Computer Aided Manufacturing” program that will translate this geometric information into a manufacturing information readable by a 3D printer (like the position of the object, speed and position of the material extruder and its execution paths). 3D printer will execute precisely the CAM instruction without needing any other intermediates such as execution plans, explanations etc. Digital fabrication is allowing integrated design and fabrication process “from bits to atoms.” By reducing the intermediate steps. No execution plans are needed and interpretation errors are dismissed. Fast prototyping is democratised with digital fabrication.

The return of personal fabrication

“My hope is that FAB will inspire to start creating their own technological futures. We had a digital revolution, but we don’t need to keep having it. Personal fabrication will bring the programmability of the digital worlds we’ve invented to the physical world we inhabit.”

—Neil Gershenfeld

Personal fabrication is a postdigital phenomenon that is currently (re)appearing in its contemporary form at the intersection of digital fabrication and technological penetration.

Personal fabrication is empowering individuals to design and make their own things, adapted to their very personal desires and need, with the help of simple and affordable digital fabrication tools. This condition, in which individuals are creating their own products already existed in a quite similar form during the pre-industrial society. A majority of the population were manufacturing themselves a larger part of their personal belongings: tools, furniture, clothes toys, etc. Each object had an important value, and its life cycle was commonly extended by the practice of mending and repairing them. In the industrial society, mass-production changed this socio-economic paradigm, with the emergence of standardised, cheap and disposable objects. This shift had several consequences—social because people lost the habit of repairing things, and changed their relationship to materiality and fabrication. Bricolage became a quite marginal hobby especially in the urban environments.—Economic and environmental because it favoured the obsolescence of physical objects, and propelled the waste produc-

tion. Professor Neil Gershenfeld claims, ***“In the past, art became separated from artisans and mass-manufacturing turned individuals from creators into consumers.”*** As observed in the Prolog, the transition of the society into an industrial, capitalist one initiated the segregation between the living and the working environment, by differentiating the work and the ownership of the means of production. In some aspects, the personal fabrication born in the early years of the postdigital age can be considered as a return of the means of production by individuals.

The digital revolutions brought a considerable democratisation of the means of expression during the last half of the twentieth century. In contrary to their Mainframes ancestors, the large propagation of personal computers led to the computerisation of the society. It happened because a computation unit represented by the PC was cheap, portable, and simple enough to be bought by the average citizen for a generic, utilitarian and recreational use without the need for constant profitability. Since the 1980s the PC's placed an incredible computation power in the hand of individuals. In a matter of few decades, every occidental households possessed the same computational capacity that was once reserved to world leading institutions or universities.

The same happened in the field of personal communications. In contrary to the unidirectional and hierarchized of broadcast medias such as Television or Radio that were controlled by governments and large private companies, the decentralised nature of the internet gave the opportunity to the users to take an active role in the media consumption and diffusion. Historically for the first time, the production and diffusion of information at a global scale was possible for individuals at virtually no cost and time. For example, producing and sharing a youtube video to thousand viewers doesn't need either an expensive broadcasting material or advanced technical skills. A smartphone with camera and internet access are good enough. The democratisation of the manipulation of physical world by individuals is currently knowing a similar development. As it happened computers, many digital fabrication machines are becoming more and more affordable. Their sizes are

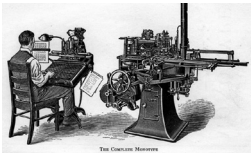
decreasing increasingly and new models are appearing, specifically designed for personal markets. Advanced automatization and user-friendly interfaces are simplifying their utilisation.

“Typesetting was once a career for a trained typesetter, laying up lead type, rather than an expected menu choice in any word-processing program. It may well be that in the world of personal fabrication it is the fate of engineering to similarly become a shared skill rather than a specialised career”

— Neil Gershenfeld.

A good example illustrating the digital democratisation of the means production for individuals concerns one of the most important invention in the history of communication: printing—or the capacity to create, reproduce and distribute physical text. For a long time, printing was divided in two major parts: typesetting and printing. The material needed for printing was extremely expensive, and necessitating complex maintenance, specialised staff. The ancestor of the contemporary desktop printer as the “Monotype machine”⁴ invented at the end of the nineteenth century. It was composed of two machines: a first one with a keyboard for type-composition and a second one building the frame to be placed in a press. The Monotype was costing \$2500 in the 1910s the equivalent of \$50.000 in today’s purchasing power, and a dedicated room was needed to host the machines ables to print a simple booklet. The Machine workflow, revolutionary at the time, was not flexible in our current standards. It needed hours to typeset

only few pages, it was not possible to change size or format once composed. Nowadays the needed material and skill in order to produce a similar simple booklet is ridiculous compared to the situation of 100 years ago: a smartphone, a small digital printer, and the Internet are only needed. Word-processing softwares are now free, like google docs or openoffice, and provide a large set of powerful tools, including the now totally banal “ctrl-z”. A small portable ink-jet printer cost around \$150, connect wireless and can fit in a backpack. The convergence of the technological penetration of printing and digital devices completely changed the perception of individuals on the notion of personal publishing. Something that was restricted to special project or events once became a banal act performed everyday by millions of individuals without particular skills.



Monotype Machine

Engraving of the Monotype Machine, 1887



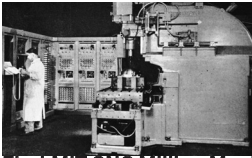
iPhone + Printer

The iPhone 6, google docs and Brother Portable A4 printer as a common printing set

This similar scenario is highly conceivable in the architectural context. Like personal publishing, personal fabrication will progressively empower individuals to produce industrial grade, personally

customised objects for similar price ranges that mass-produced ones. Probably reserved in a first time for relatively simple and small objects, personal fabrication will eventually be advanced enough to be tested and deployed to domestic architecture in the following decades. Partial transformation or even entire housing projects will be produced by individuals without specific skills, accompanied or not by professionals. This vision might sound fanciful, but the technologies are starting to becoming matures, and the market is aggressively evolving since the two last years ?

The history of digital cutting should be compared to the printing one. 50 years ago, the first CNC milling machine used to cost half million of dollars. It was, as mentioned before an experimental project developed from MIT, restricted for applied research by leading scientists. The CNC milling and routing technologies propagated quite widely in the professional world since and some few model became world standards, but the arrival of CNC routing in the realm of personal fabrication is relatively recent. The first personal CNC routers were restricted to small scale and had similar inconvenient as the industrial ones, they are space-consuming, quite dangerous and complex to manipulate precisely. However the Personal CNC market evolving extremely fast, and regularly disrupted. For example, "Crawlbot"⁵ was a new kind of CNC router released this year: it is able to cut at a professional precision (0.5 mm tolerance) full-sized 122x244 cm plywood sheets traditionally used in the building industry. The Crawlbot CNC can be used from any personal computer with a simple interface, and is also the first machine to be packable. It fit in a golf-bag size box when not in use, and cost around \$4000, the price of high-end personal HP laser printer in 1991.



First MIT CNC Milling Machine, 1952



Crawlbot CNC Router (2015)

The current evolution of CNC machines allows us to understand that complex tools designed for heavy duty works, once reserved for professional activities, are now emerging on the consumer-market. A full-format CNC cutting machine can now be bought by a typical “family dad”, and can be used in a garage during the weekends without needing a dedicated room. With this kind of tools, it is now possible to download free furniture models and make them in a simple, precise and affordable way. In that viewpoint, the transition from furniture making to architectonic elements becomes quite logical. This example has to be related to a recent emergence of diverse powerful fabrication tools in the domain of personal fabrication during the two last years. The market is often called “desktop” so we can observe the appearance of “Desktop Precision CNC”⁶, “Desktop laser-cutter”⁷ “Desktop Stereolithography 3D Printing”⁸

The next important step in the evolution of personal fabrication machine resides in the development of versatile “personal robotics”. Contrary to specialised machines, industrial robotic arms⁹ can move in all the directions (6 or 7 axis), and can be equipped with a variety of tools adapted to evolving needs. A robotic arm can

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<http://www.carbide3d.com>

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<https://glowforge.com/tech-specs/>

8

<http://formlabs.com/products/3d-printers/form-2/>

9

<http://www.kuka-robotics.com/en/>

re-write a Luther bible with a pen, as much to sculpt a wood log with a chainsaw. These robots are often fixed but also start to move on caterpillars, gaining the ability to work directly “on-site” on objects larger than themselves.

The incoming propagation of “Personal Robotics” will increase the size and the range of possibilities to personal fabrication by individuals up to the building construction level, and architecture will inevitably be concerned.

Fab-Labs, Maker Culture and Amateurism in Architecture

We are still in the 2010s, in a quite early age in the maturation of the digital fabrication technologies. The mentioned machines are still expensive and cumbersome. The more functional ones are costing more than \$1500 each while the cheaper ones are quite anecdotal. In contrary to the computers or advanced robotics, these machines are also not versatile yet: they have a specific function can be used only on a specific set of material. It is quite relevant to compare the current Digital fabrication to the equivalent age of “Minicomputers” in the 1970s during the introduction of digital computation in the personal-use market. It won’t be realistic for a single owner to possess a full set of digital fabrication tools just for personal use, but the consumer demand is increasing a lot.

Fab-Labs

Answering to this emerging demand, a new form of institution emerged in 2001. The “**Fabrication Laboratories**” or “**Fab-Labs**” are the equivalent for digital fabrication that a public library is for Books and Media products. A typical Fab-Lab is regrouping a series of digital fabrication tools in an optimised space. Expensive and powerful tools are accessible for personal use by everyone for free or at reduced price after a membership inscription. The Fab-Labs are also a community of individuals helping each other for the reali-

zation of their own projects. Like a global social club for making and personal fabrication.

“Fab-Lab is the educational outreach component of MIT’s Center for Bits and Atoms (CBA), an extension of its research into digital fabrication and computation. A Fab Lab is a technical prototyping platform for innovation and invention, providing stimulus for local entrepreneurship. A Fab Lab is also a platform for learning and innovation: a place to play, to create, to learn, to mentor, to invent. To be a Fab Lab means connecting to a global community of learners, educators, technologists, researchers, makers and innovators—a knowledge sharing network that spans 30 countries and 24 time zones. Because all Fab Labs share common tools and processes, the program is building a global network, a distributed laboratory for research and invention.”

—Fab Foundation

Fab-labs are a fast developing both physical and social network. Each certified Fab-Lab follow the “Fab Charter”, a set of guidelines developed from the worldwide, non-profit organisation Fab Foundation¹⁰. In exchange, the Fab Foundation is supporting the development of local projects and provide advanced technical or organisational knowledge.

“Our mission is to provide access to the tools, the knowledge and the financial

means to educate, innovate and invent using technology and digital fabrication to allow anyone to make (almost) anything, and thereby creating opportunities to improve lives and livelihoods around the world. Community organisations, educational institutions and non-profit concerns are our primary beneficiaries”

—Fab Foundation

The Fab-Lab network is having a noticeable impact on the society since the early 2000s. The network is deployed as much in developed as developing countries, in dense urban and in remote rural areas. The Fab-Labs are new kind of public program appearing in the existing infrastructures. Abandoned factories or workshops are converted in large fab-labs with a minimum of physical intervention, “Maker corners” are created by municipalities in Public libraries or secondary schools. The Fab-Lab phenomenon is intriguingly both answering and promoting the (re)emergence of a “Maker culture”, impacting especially the younger generations of digital natives growing up with digital fabrication tools.

Maker Culture

The Maker Culture¹¹ can be typically understood as core-phenomenon in the postdigital age. It is situated in the crossing of the recent Internet culture and traditional bricolage. The Maker culture is bringing massive regain of interest for “Do-it-Yourself” fabrication extended by digital fabrication technologies. The collaborative hacking and repairing of mass-market consumer becomes more and more popular, this going from Ikea furniture hacking¹² to “electronic guerilla” against corporate programmed obsoles-

11 “The Maker culture is a contemporary culture or subculture representing a technology-based extension of DIY culture”—Wikipedia
12 <http://www.ikeahackers.net>

cence¹³. It brings the broader notion of “digital bricolage”¹⁴ This cultural shift is somehow changing again the relation that individuals have with materiality and objects ownership.

The desire of individuals to produce their own things is progressively taking over the mass-consumerism desire that ruled the market over the last 50 years. The maker culture is deeply connected to the notion of prosumer appearing in the same period. It describes the transformation of individuals from “simple” consumers into extended consumers preferring to produce or customise their product themselves, often with the external help of hardware or software they buy or rent. “Prosumerism” is particularly popular in our current society because it develops stronger emotional connections between the products and their creators/users. The personal fabrication often allow customisation of it, a considerable attribute in a world suffering from mass-consumerism and cultural standardisation.

Prosumerism is the reason why the markets of personal fabrication tools are currently blooming. Desktop 3D printing, led by Makerbot Industries¹⁵ is for example overlapping other markets segments like What happened few years ago with the “immaterial” market of digital photography is now happening with “physical” hobbies and personal fabrication. If this trend continues to evolve, it will re-organise certain economic organisations. Prosumerism may probably not replace the traditional markets and mass-production schemes for a majority of physical objects. It will however have considerable influence on a large range of personal objects or projects, to be uniquely made for a specific use/customer. “Big machines continue to mass-produce things used in large quantities; but little machines will custom-make the products that depend on difference [...] *If the market is only one person, the prototype is the product.*”¹⁶

Since the industrial revolution, architecture is using a large set of industrialised components going from material like bricks or

13 <https://www.iftxt.com>

14 see. MK-CO / Integrated aesthetics vs. Techbrutalism

15 <http://www.makerbot.com/>

16 GERSHENFELD, Neil, FAB: The Coming Revolution on Your Desktop, 2007

metallic profiles to standardised components such as windows, installations, etc. Stepping back, it is important to have in mind that architecture, is a professional field where the built product is almost every time a single customised project: the market is only one building, so the prototype is the product.

Personal Fabrication will probably take an important place in the design and construction process of architecture in the post-digital age because the maturation of digital technologies is bringing back a strong connection between the architectural users (i.e. The builders and the inhabitants) and the physical environment.

“Amateurism”

“As technology advances, it reverses the characteristics of every situation again and again. The age of automation is going to be the age of ‘do it yourself.’”

—Marshall McLuhan

These previous statements about personal fabrication, maker culture and prosumerism are leading to a central point in the postdigital debate—It consequently ask the question of **“Amateurism”**.

It is not a coincidence that Musician Kim Cascone declared in the first essay about “post-digital”(firstly used in the Music industry): ***“Over the past decade, the Internet has helped spawn a new movement in digital music. It is not academically based, and for the most part the composers involved are self-taught”***

Amateurism lays on the fact that the emerging category of prosumers is composed of amateurs, not professionals. Their fabrication activities are independent of their professional knowledge and the needed skills to achieve their personal projects are learned on-the-go, often through self-taught or empirical way. Neil Ger-

shenfeld depicts in FAB¹⁷ a learning shift in the contemporary society from a traditional ***“just-in-case”*** curriculum to a ***“just-in-time”*** education on demand model where only the needed skills are partially learned during a project development.

The postdigital age is a period witnessing the incredible propagation of a myriad proprietary or opensourced self-learning platforms on any kind of subject. khanacademy.org is one of the major ones. Websites such as instructables.com are specialised cookbooks for DIY/Hacking projects; w3schools.com or codecademy.com to learn programming; duolingo.com to learn foreign languages, etc. The majority of them are free.

Combined to this learning shift, the fact is that technological progress is inevitably overcoming the need of advanced skills to master a difficult fabrication process. Advanced automation is able to solve complex technical problems without the full understanding of the user. Advanced interfaces are transforming complex operations into simple graphics or friendly wizards.



Maternachine “desk” screenshot

Photography is again a very good example to compare with the incoming architectural disruptions. The maturation of digital photography over the last decade led to an explosion of “photographic amateurism” that disrupted the whole industry in every level. Compact digital cameras and smartphones are now highly automatised, with extended ISO sensibility, HDR and auto-corrections. Real time indication allow the used to fine-tune settings even with any technical knowledge. It is now almost impossible to fail a decent picture. Digital photography unleashed a gigantic production of images, all around the world. Images that can instantly be shared online

or directly printed from the camera without any technical skills nor specific materials as it used to be with chemical photographic processing. Photographic studios are now becoming a professional niche, along with film-based products. Professional photographers and reporters have also hard times: the quantity often wins over quality and it is possible to obtain a specific picture already taken by an amateur freelancer for a specific project without commissioning a professional. The whole photographic industry had to restructure itself in a matter of decade.

Personal fabrication on architecture ?

What will happen within the architectural discipline ? Unlike activities like photography that can be done by a single professional, architecture has a level of complexity and a scale of production that will restrain it to be fully “amateurized”¹⁸. However, the traditional professional relation between the architects, engineers and clients will be drastically be recomposed, especially in the developed countries. The implication of a prosumers/clients will probably ***“play a much brighter role that they used to have”***¹⁹.

On small projects like individual housing, the prosumers may design and produce themselves buildings with the help of automated interfaces and advanced personal fabrication tools. The role of the architects, in this case, will partially shift from building design, to system design. Architectural designers will for example design “responsive models” that can be easily adapted to each particular condition. The prosumers will then in a second time customise themselves the spatial, and material configuration of their project through simple interfaces, without having the need of particular skills. “Parametric algorithms”²⁰ will maintain the quality level and the fundamental properties of the original design by re-adapting in real-time the architectonic elements. Non-possible options will be automatically blocked. (For example, auto-dimension-

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This is clearly a neologism, depicting the mutation of a market or discipline to prosumer-based scheme.
PICON A. & BUJNOWSKYJ M., MK-CO #conversations, 2015—“Postdigital and the architectural practices”
To not be confused with the popular sense of “parametric architecture”

ing beam elements related to structural spans. After a specific ratio, the span width is blocked) The advanced automation of fabrication process will transfer the design directly from the prosumer interface to digital fabrication machines. The pieces will all be customised for affordable prices. The prosumers will assemble the resulting parts by themselves with a limited professional team.



Mattermachine “Wikihouse Section” screenshot

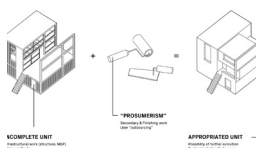
This scenario differs from traditional vernacular architecture or self-building because the build product will still be designed “indirectly” by architects. Instead of designing a house as a single project, architects may become kind of “spatial developers” creating a set of parameters, in which a “kernel building” can be derived in several compatible forks. The prosumer clients will have the opportunity to customise the house to their own preferences and adapt it to the available land. Amateurism and personal fabrication may affect some existing architectural offices, but should be understood as an opportunity for the architectural profession to take back a large part of the construction industry dominated by profit-driven “catalogue houses” companies. This depicted scenario already exist since 2012 at a prototypic stage with the opensourced wiki-house.cc project.

On larger or more complex projects, the architectural profession will probably stay organised in a more traditional way. However, the “outsourcing” of design or construction parts of an architectural project by the prosumers is also to be expected, directly related to the empowering of individual by digital technologies.

In the case of co-housing development projects in developed countries, a collective of individuals/prosumers may take care to larger parts of the project than it used to be. They will probably prepare consequent material for the architects with the help of

digital tools. Several programmatic options can be achieved through automated interfaces, adapting in real-time areas allocations and costs and preparing detailed options for the architects and planners²¹. The co-housing collective may also participate personally in the construction phase of the building(s) and the integration of non-professionals should be included by architects in the design phase.

In the case of private developments destined to be sold or rented, the internal layout and design will probably be outsourced more and more to the future inhabitants/prosumers. This already started to happen on specific contexts for economic reasons. This phenomenon will probably happen to a large scale in the developed countries, influenced by a growing Maker culture and for flexibility reasons. The architectural typologies and construction techniques may consequently evolve in order to implement personal fabrication direct and indirect disruptions in the lifecycle of the buildings. Personal fabrication may participate in architecture in a similar way it is happening with smaller objects today, it will lead to new architectural aesthetics of heterogeneous composition. Distinctions between “main structure” and secondary works may be popularised in that direction. (see. Techbrutalism)



Elemental chile Concept



Elemental chile before customisation



Elemental chile after customisation

The projects of Elemental Chile from Alejandro Aravena are a possible example of controlled personal fabrication in architecture, for social advantages.



Gramazio Kohler NEST 1/2



Gramazio Kohler NEST 2/2

The recent NEST project



WikiHouse 
 Wikihouse Project (see images book)

Shifting Geographies: Redistributed Manufacturing

*“It is easier to ship recipes than
cakes and biscuits”*

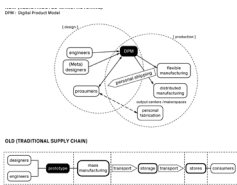
—John Maynard Keynes.

Redistributed Manufacturing is another postdigital phenomenon at the intersection of the personal fabrication and digital networking cultures. It is an organisational and economic model consisting to re-think the production and supply chains of physical goods in the world.

As explained in “electrification” The second industrial revolution led to a capitalist paradigm in which industrial companies are producing large series of objects in order to achieve economies of scale: the more produced objects, the lower price per unit is. It influenced a society of mass-consumerism where quantity of goods need to be sold in order to justify the large production. This economic paradigm contributed to a world of complex logistics with gigantic warehouses to temporary store the production and specialised companies for the transportation of the goods between the production, storage and retailing spaces. Consequently, successful industrial companies has the tendency to grow in order to develop a “vertical integration”—the ownership and the control of all the intermediate steps in order to produce profit on each phase from design to distribution. Large construction companies dominating the markets in Europe are a good example for the architectural context. In opposition of small architectural practices, large corporation like Bouygues in France are both real estate developers, architects, engineers and promoters.

Disintermediation is in contrary, a core-principle of redistributed manufacturing. The traditional Fordist economy of scale is replaced by an economy of scope. In redistributed manufacturing, the digital technologies of communication and fabrication are creating a system where the intermediate steps and actors are con-

siderably reduced between the producer and the consumer. The designers design the goods and all the necessary information to produce them. The consumer is purchasing this information and is able to produce it in a local manufacturing center, in whatever form it can take regarding to the concerned good. The manufacturing centers are polyvalent and not necessary related to the designers: they behave as a third-party autonomous business centred on manufacturing. In redistributed manufacturing, the products storage and physical transportation are reduced to the bare minimum. There is virtually no stock because every produced good is already bought.



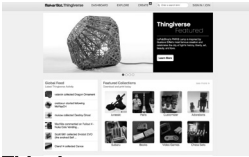
Distributed Manufacturing Diagrams

In the postdigital age, the personal fabrication is transforming every household into a potential manufacturing point for majority of small objects. For larger or more complex objects, every Fab-Lab and Makerspace is becoming a potential “output center”. It is possible that many retailing companies that used to sell manufactured goods evolve in “local manufacturing” companies in order to survive in the digital economy, as mentioned in “from brownfield to greyfields”.

The more manufacturing points are created throughout territory, the more “redistributed” the manufacturing is and the shorter the production channels are. A downloaded mug fabricated at home with a ceramic 3D printer has the transportation radius is close to 0 km per unit, compared to a mug made in Shenzhen, stored in Rotterdam and sold in Zurich. Redistributed manufacturing is having considerable ecological consequences, it reduces carbon footprint and overproduction. In a long term vision, it even may encourage prosumers to make only needed goods, and fight

against the society of mass-consumption because mass-production will become less economically attractive on many objects. The flexibility of redistributed manufacturing may also encourage repairing against programmed obsolescence, with the possibility to re-craft broken or missing parts locally.

In redistributed manufacturing, the information for fabricating an object is becoming as important as the object itself. It is leading to a new kind of service: platforms and stores for sharing or selling not products but the needed information to produce them. These “objects recipes” are often called “digital designs files” and are ready to be executed (outputting) Thingiverse.com is one of the major one, owned by the 3D printing company Makerbot. The propagation of these kind of platform in the architectural context may quickly appear. This phenomenon has very important social, ethical and design consequences that is already shaping our politics. Immaterial information is way more difficult to control than physical objects and “objects recipes” can easily be shared at a global through internet bypassing all kind of physical or social borders. It may have social and economic advantage, but is also contribute to the propagation of forbidden or dangerous products like firearms or synthetic drugs out of the control of governments and institutions. The Liberator is for example the first fully functional handgun to be 3D-printed in 2013. It is possible to anonymously download and print this pistol bypassing any kind of surveillance or restrictions. The US government obtained the revocation of the source code but it is impossible to stop the replication and sharing of this source code on the Internet.



Thingiverse.com

Many kinds of plastic based objects are downloadable on the Thingiverse platform, going from furniture, to gadgets and diverse tools. Objects are shared by individuals to other individuals and upgradable.



Liberator Gun

The Liberator Gun was the first fully 3D-printed handgun in 2013. Cody Wilson, the founder of Defence Distributed is a young lawyer and crypto-anarchist currently on trial with the US government.

Observations on Open Furniture

Furniture design played an important role in the modern and contemporary history of architecture. Many architects such as Mies or Le Corbusier used furniture as a tool to develop ideas and concepts in parallel of architecture. Other ones like Jean Prouvé were pioneers in the *transdisciplinary practices* between industrial and architectural design. The analysis of the furniture design innovations is often a good tool to observe possible transpositions

at a larger scale in the architectural discipline—this going from material development to innovative fabrication processes.

We are now progressively entering in a “Post-Ikea” situation where the mass-production of cheap furniture is becoming increasingly irrelevant. Ikea was/is a successful company because it achieved to offer cheap furniture adapted for urban living. It uses flat-packing to save transportation and storage costs, and created decades ago an early form of prosumerism by outsourcing the final assembling to the customer. Ikea is however, still based on a non-flexible industrial production. The overall quality of ikea furniture is just OK, often built with cheap materials like fibreboard, and customisation is not possible.

It is interesting to notice a recent considerable shift in the furniture industry, Ikea and high-end design companies like Artek or Vitra are investing a lot on new forms of “Open Design”²² based on redistributed manufacturing and personal fabrication, as paradoxical it can be perceived. This phenomenon has been considered as a strong evidence of the postdigital transition of design. New initiatives are also emerging since few years—Opendesk.cc is currently one of the most promising projects in the furniture industry, pioneering on the postdigital age. The start-up founded in 2014 is taking advantage to the current economics, open-making and redistributed manufacturing to rethink furniture production and distribution.

In a DIY context, manufacturing an Opendesk table in birch plywood cost almost the same price that a medium-range Ikea table for a much higher quality and personalised output.



Vitra Zip Chair

In this important paradigm shift, the role of the furniture designer is also evolving. Opendesk is for example is a design company producing furniture, but also an internet platform developing a network between consumers, designers (including themselves) and a constellation of digital workshop “makers” dispatched everywhere on the world. Opendesk provides the full documentation for the making of the furniture. The majority of the models can be made for free in a self-made, noncommercial use. But each time an individual is ordering a model in a local maker-space (commercial use) the furniture designer and Opendesk are taking a small percent.

Focusing on the product itself, the design needs to adapt to the new resulting conditions of open design²³ and redistributed manufacturing. The selected materials have to be available in a standardised form everywhere in the world. Wood CNC furniture is for example often designed to be produced from standard 18 mm plywood sheets. (244x122mm) It takes advantage that plywood sheets are locally made with available wood. (Finnish Birch, American Maple...) allowing shorter distribution channels. The furniture designers need also to take in consideration the available production means and its characteristics, in this case standard full-size CNC router able to cut the plywood sheets at an industrial precision level. The cut shapes have to be designed to fit in a minimum of plywood sheets. The designer also design their position in order to save surface and time by reducing the milling paths.

Redistributed Manufacturing design is also limiting external factors and elements. Some designs are allowing the use of common and cheap elements like zip ties, but the most efficient ones like Opendesk tables are designed to be assembled and disassembled without tools, nor screws. The precision of CNC milling is allowing screwless assemblages and beautifully designed digital wood joints. The formal design and visual appearance of a piece of furniture fundamentally interconnected with its digital, redistributed fabrication process, creating new particular aesthet-

ics like screwless assemblage, slightly rounded shapes due to the mill radius, etc.



World Map Opendesk



Opendesk Flat Table

Redistributed Manufacturing in architecture ?

It is interesting to realise first that architecture is somehow already a form of redistributed manufacturing. The architect designs a building and share the execution plans. Construction companies follow and execute them locally on a building site. Taking again the idea of “recipe and cakes” it is possible to integrate the notion of redistributed manufacturing in a second level within an architectural project considering the final building not as a product but as a context with its own market. Thinking in term of “redistributed construction” can be useful to innovate on questions related to production channels, sustainability and social consequences: a lot of construction materials, skills and tools have to be imported on site for each projects.

As redistributed manufacturing is acting within the furniture industry, “Redistributed construction” in the architectural practice should integrate locally available construction methods, skills, context and prosumers in the early phases of the design, this going

far beyond the “simple” use of local materials. For example, the design and use of bespoke tools necessary for a building construction can be designed by the architects, and then manufactured on site or in a neighbouring zone thanks to the development of personal fabrication. These “redistributed tools” have the possibility to upgrade local building standards and empower the local workforce (or the clients/prosumers). These tools can ease the use of local materials that would be impossible otherwise for diverse reasons like lack for specific skills, etc. It is strategically more efficient to redistribute tools or fabrication process than import materials or workforce.

Tadao Ando is famous for his beautiful raw concrete buildings with surfaces of rare quality. For a luxurious private house project in Sri Lanka, the lack of concrete construction knowledge in the local industry obliged him to “import” Japanese construction workers on site in order to guarantee the quality level of the output at considerable costs. This attitude seems outdated and inefficient socially and economically in the context we are living now. At the opposite of this attitude, the new “Redline project” from Foster & Partners is taking the best of digital technologies and social practices by designing a high-performance project to be made with local material by the local community in Rwanda. The project is using redistributed construction methods by developing a specific brick machine and customised CNC cut, ready to use plywood vaults in order to maintain the quality level of the final construction.



Foster “redline project” construction

Observations on these few scenarios are validating the interdisciplinary transposition from the media to architecture of the peer-reviewed postdigital definition done by Cramer:

“post-digital neither recognises the distinction between “old” and “new” media, nor ideological affirmation of the one or of the other. It merges “old” and “new” often applying network cultural experimentation of analog technologies which it re-investigates and re-uses”

At the opposite from the formal explorations of “digital architecture” during the last decades, the digital fabrication in the postdigital age will increasingly be used to provide tools and frameworks for simple actions and local solutions. It will have the opportunity to absorb and transcend traditional construction methods with the merging of high and low technologies. The observable separation between digital fabrication and traditional construction will therefore make less and less sense because digital technologies won’t necessary position themselves as a segregated experimental practice. Digital fabrication is increasingly integrated when needed, as a solution for larger architectural concerns such as sustainability or social empowerment and this phenomena will become a standard in the architectural practices.

“[For me] the “true” postdigital aspect in architecture will be the merging of the digital preoccupations, the digital researches and the increasing sustainability preoccupations. And this hasn’t happened yet. So far, we have in one corner architects looking for advanced sustainability, recyclable materials, neo-carbon energies, etc. In the other one the “digital kids” where everything is about

*algorithmic, sensors, responsive spaces and digital fabrication, as you named it. These two tendencies haven't merged yet."*²⁴

—Antoine Picon

The “**postdigital merging**” mentioned by Picon is actually already happening. The previous examples from Redline project or Wiki-house.cc are clearly illustrating an application of digital technologies in architecture going beyond a “direct” application of digital fabrication. These examples are showcasing the beginning of a potential “second talking dog phase” towards digital technologies in the first years of the postdigital age.

@neilgershenfeld	#digitalfabrication	#hitechlowtech
@wiredmagazine	#bitsandatoms	#postdigitalmerging
@MIT	#programability	
@jolito	#metierjacquard	
@kitebricks	#CNC	
@monotype	#millingmachine	
@apple	#history	
@brother	#3Dprinting	
@crawlbot	#additive	
@kukarobotics	#subtractive	
@fabfoundation	#transformative	
@mitmedialab	#process	
@makerbot	#smartmaterial	
@marshallmcluhan	#physicaloutput	
@mattermachine	#CAD	
@antoinepicon	#CAM	
@billyguidoni	#personalfabrication	
@elementalchile	#desktopfabrication	
@gramaziokohler	#personalrobotics	
@ETHZ	#fablabs	
@wikihouse	#makerculture	
@johnmaynardkeynes	#DIY	
@thingiverse	#hacking	
@defensedistributed	#digitalbricolage	
@vitra	#prosumerism	
@artek	#amateurism	
@opendesk	#automation	
@tadaoando	#wikihouse	
@fosterandpartners	#personalconstruction	
@redlineproject	#redistributedmanufac-	
@EPFL	turing	
@floriancramer	#digitaldesignfile	
@makecollaborate	#liberatorgun	
	#openfurniture	
	#redistributedconstruc-	
	tion	
	#skillintegration	

0 5

**THE RISE
OF
FULL-SPECTRUM
ARCHITECTURE**

The electromagnetic landscape

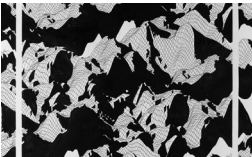
**The Infosphere
An invisible layer**

Full-spectrum architecture

**Physiological approach and “meteorological architecture”
Informational approach and “crypto-architecture”**

"I move through space, my body gets coated by electronic waves. I do not recognise them physically but the connecting instrument that I am constantly bonded informs me about their appearance. Through apparatus my body, organs and environment are in close contact. The city that I'm in, is subdivided, carved, segregated and coated by electromagnetic oscillation. Dimension unit for public space is not meter, kilometre or decibel anymore, it's milliwatt, hertz and gigabyte."

—Peter Jellitsch (2009)



Peter Jellitsch Drawing 38

Data Drawing 38: pencil, crayon, acrylic and lacquer on paper / 60 x 49 cm, unique, 2015

The electromagnetic landscape

The postdigital age is bringing a new condition where information is becoming ubiquitous. **Physical and digital environments are becoming deeply interconnected** in the everyday activities of the population, to the point that it is becoming extremely difficult to

differentiate something that would be specifically digital. The Internet, once understood as a parallel or segregated digital space, is now progressively “colonising” the physical environments, mutating into a new kind of “**Internet of Things**” that is implementing a networking capacity into every physical objects, and connecting these objects together into a gigantic new intelligent rhizomatic network. In the upcoming decades, nearly all actions or situations happening in the physical world will be constantly collected, digitised and archived in the digital space in order to be further analysed and aggregated with other information. This phenomenon called “**big-data**” has already started in the early 2010s and is quickly progressing. Inversely, as mentioned in “the architecture of cloudification”, the phenomenon of cloudification is making digital information virtually accessible anywhere and anytime in the world with simple and configurable and unrooted “terminal devices”.

The development of these important changes was made possible only in parallel of the technological improvement of the continuous exchanges happening in-between the physical and digital spaces. These exchanges can be described as the “**Infosphere**”, populated by informational entities; transiting or stored information.

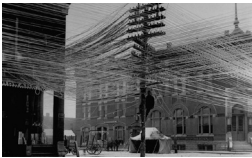
“The infosphere relies on an intricate network of signals, wired and wireless, that support it. We are completely surrounded by an invisible system of data cables and radio signals from access points, cell towers and overhead satellites. Our digital lives depend on these very physical systems for communication, observation and navigation.”

—Richard Vijgen 2014

These exchanges started in the early digital applications of the last century, with electronic communication and the development of a maze of underground and surface electric cables. A physical complex network of cables was created to connect houses, buildings,

cities between themselves. The further creation of broadcasting technologies expanded the communication technologies from a linear organisation to a volumetric dimension developed in space that began with the mastery of electromagnetic theory. The human perception of the “void” and the physical space knew an important extension, as it previously happened with the discovery of air composition in the first chemical revolution at the end of the eighteenth century.

“Photos from the Days When Thousands of Cables Crowded the Skies”

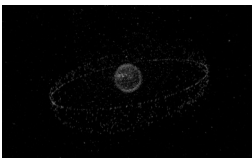


A Telegraph pole in Pratt, Kansas, 1911



Stockholm Telephone Tower

A telephone tower in Stockholm, Sweden, with 5000 connected lines. It was used between 1887 and 1913.



NASA Satellite arounds earth

The physical trace of the electromagnetic layer : A

from NASA of all the orbital geo-stationary satellites around the earth

The precise manipulation of electromagnetic frequencies transformed the apparent emptiness of the Earth atmosphere into a complex field of dynamic information. Each signal belonging to a precise frequency. Broadcasting and wireless technologies exponentially grown ever since, colonising large portions of the invisible electromagnetic spectrum. Advanced satellite communication, combined with terrestrial relays and mesh wireless networks are providing information accessible on almost the totality of the planet surface, even in remote territories like forests and oceans. This invisible yet fundamental “**electromagnetic layer**” is now overlapping the existing “physical substrate”¹ that is constituting by our built environment.



The architecture of Radio

The Architecture of Radio² is an iPad app and data visualisation tool developed by artist Richard Vlijgen. It is observing and representing through the “eyes” of the digital device the complex “network of networks” that humans are living in. (cell towers, wifi routers, communication, navigation and observation satellites and their signals) The Architecture of Radio application can be

1
2

See: PICON A. & BUJNOWSKYJ M., MK-CO #conversations, 2015—“digital, electrical and physical layers”
See the demonstration video at <http://www.architectureofradio.com>

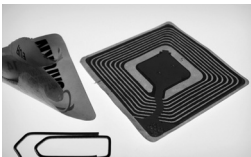
understood as an interface for transposing the human visual perception of space to an electronic machine perception. "reversing the ambient nature of the infosphere; hiding the visible while revealing the invisible technological landscape"

Imperceptible by the humans, this invisible electromagnetic layer is however not homogenous nor static. The infosphere possesses its own topography and meteorology, constituted by a constellation of different electromagnetic signals travelling physical space from transmitters to receptors in continuous and dynamic patterns. Each signal possesses its own set of properties such as wavelength, propagation range, transmission speed and reaction to physical elements. The differences between each kind of electromagnetic signals are used by humans in an optimised way, various wavelengths cohabiting together, chosen for specific uses and range. For example, the action radius of a low frequency RFID³ band is about only 10 centimetre and the signal very weak. The RFID receptors are extremely small and inexpensive(\$0.15 in 2010) and are placed in a multitude of small objects such as cards, packages, for contactless identification or close range activation. In the other extreme, one of the representing tools of cloudification and smart cities, powerful wireless protocols such "802.16 m WiMax" have an extended range of action up to 3 miles (4.5 kilometres) and are used to provide hi-speed internet access to whole neighbourhoods.



Wimax Panel

Wimax Panel (directional) antenna. It is used to broadcast network in a restricted angle over long distances, to create mesh relays in order to cover large territories, they are combined to local wide-range, omnidirectional or 120° range antennas in order to diffuse signal in dense areas.



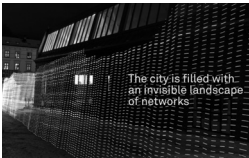
RFID Tag

A standard RFID disposable tag. RFID embeds digital information in physical objects. Tiny RFID tags can be found on many packagings and are commonly used for product identification (ID, price, traceability...), or security when combined with Electronic Article Surveillance (EAS)

This invisible and imbricated network of electromagnetic signals is particularly dense in the populated and technology-driven environments constituting the postdigital cities. Not directly tangible, the infosphere has a strong influence on the human interaction behav-

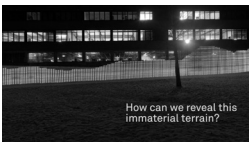
four: toward space, between human and machines and between human themselves.

Furthermore, it is also very important to realise that this invisible layer has a direct impact on the physiological reality of our bodies. The humans of the postdigital age are literally, as much metaphorically navigating in an information ocean of electromagnetic waves.



Immaterial Wifi 1/2

Two images issued from the art movie *Immaterials: light painting WIFI* by Timo Arnall, Jørn Knutsen and Einar Sneve Martinussen in 2011. The long-exposure photography project poetically showcases glimpses of the invisible and fluctuating electromagnetic waves we are living in.



Immaterial Wifi 2/2

"We built the WIFI measuring rod, a 4-metre

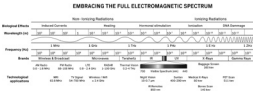
tall probe containing 80 lights that respond to the Received Signal Strength (RSSI) of a particular WiFi network. When we walk through architectural, urban spaces with this probe, while taking long-exposure photographs, we visualise the cross-sections, or strata, of WiFi signal strength, situated within photographic urban scenes. The cross-sections are an abstraction of WiFi signal strength, a line graph of RSSI across physical space. Although it can be used to determine actual signal strength at a given point, it is much more interesting as a way of seeing the overall pattern, the relative peaks and the troughs situated in the surrounding physical space.”⁴

Full-spectrum architecture

As explained in the *Prolog*, the “postdigital architecture” should not only use the digital technologies as tools to produce new conditions, but to integrate furthermore their direct and indirect consequences in its design process and built results. The impact of the infosphere and of the electromagnetic layer on the physical environment is one of these postdigital consequences.

The electromagnetic layer is becoming extremely important, to the point it is currently re-conditioning the spatial conditions we currently use and took for granted for decades. This transformation is happening in an organisational level as much in the physicality of space itself. The densely charged electromagnetic

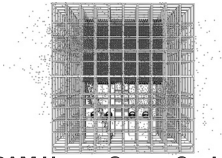
atmosphere we live in is transmitting continuous flows of digital information that buildings and humans are producing and consuming through digital devices. These fluxes are influencing our spatial and territorial perception—the way we behave and organise life in the space. The build environment is a complex milieu where quantities of ionised particles and invisible rays are passing through our buildings, objects and bodies.



The Full Electromagnetic Spectrum

In that viewpoint, a fundamental re-thinking of architecture in the postdigital age need to be developed. It is becoming urgent for architecture to extend itself to new dimensions and integrate the consequences of this invisible yet important electromagnetic layer. As it already happened before with environmental/climatic concerns, the integration and control of the electromagnetic factors should not be simply reduced to few technical installations or a norm to be fulfilled during the completion of a building project. It should rather be explored in the early design stage, leading to new design strategies, spatial concepts, architectural configurations and materialities to be developed. This “upgraded” architecture going beyond the (small) visible part of the electromagnetic spectrum has been recently evoked by the architect and editor Joseph Grima from Space Caviar as “Full-spectrum architecture”⁵ during the research from RAM (Radar-Absorbing Materials) House⁶.

5 <https://youtu.be/Jl9-AxtFxeo>
6 <http://www.spacecaviar.net/projects/ram-house/>

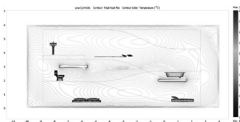


RAM House Space Caviar

The RAM House, designed by Space Caviar, is a domestic prototype that explores the home's response to a new definition of privacy in the age of sentient appliances and signal based communication. As the space of the home becomes saturated by "smart" devices capable of monitoring their surroundings, the role of the domestic envelope as a shield from an external gaze becomes irrelevant: it is the home itself that is observing us. The RAM House responds to this near-future scenario by proposing a space of selective electromagnetic autonomy. Wi-Fi, cellphone and other radio signals are filtered within the spaces core by various movable shields of radar-absorbent material (RAM) and faraday meshing, preventing signals from entering and — more importantly — exiting. Just as a curtain can be drawn to visually expose the domestic interior of a traditional home, panels can be slid open to allow radio waves to enter and exit, when so desired. RAM house is a proposal of cohabitations with technology other than by a constant default presence.

Physiological approach and “meteorological architecture”

“Full-spectrum architecture”, or “electromagnetic architecture” can possibly be understood as a logical continuity from the **meteorological architecture** projects developed over the last decade by architects like Philippe Rahm or Nicolas Dorval-Bory. “Meteorological architecture” can be related to “full-spectrum architecture” in the sense it is integrating invisible, non-geometric properties of space like thermodynamics in the most primitive phases of the architectural design. The focus of meteorological architecture is on the relationship between the physicality of space and the physiological reality of the human body. In that context, physical phenomena such as “pressure”, “convection”, “conduction” or “radiation” are becoming architectural design tools used to observe and shape space. Meteorological architecture is fundamentally re-questioning the geometric and proportion-based architectural composition that was developed and assimilated for centuries since the birth of classical architecture. Consequently, it claims that space should not only be determined or qualified by its geometrical or physical boundaries, but also by its own fluctuating properties, such as temperature, light, humidity, etc. With a direct intervention on the meteorological qualities of space, it is indeed possible to re-think basic architectonic elements such as floor, wall, heating, light, ventilation and to create new possible architectural typologies more adapted to the current condition and spatial consciousness we are living in.



Interior Gulf Stream Section
Interior Gulf Stream⁷ is a

private house project for the artist Dominique Gonzalez-Foerster in which the invisible properties of space — the air temperature and circulation are used as the base-principle to design and organise the domestic environment. There is no rooms but a configuration of open slopes where the different domestic functionalities such as sleep, rest, wash, etc., are placed regarding to their thermal requirements. (22°C for the bathroom, 18°C for the toilets, etc.) The indoor space is continuous but differentiated by its own thermal asymmetry. This project is encouraging a new form of indoor nomadism and perception of the domestic landscape, in contrary of the traditional programmatic organisation of modern architecture where the space is thermally standardised at 21°C.

“At the end of the 1990s, following the arrival of new technologies such as mobile phones and the internet, there emerged the notion of an electromagnetic field and hence, the idea that matter is not only visible but invisible, electromagnetic. From then on, electromagnetic geography superposed itself on physical geography. In 1998, also, the first real provi-

sions on electromagnetic pollution were published, to regulate thresholds of non-ionising radiation. [...] The field of architecture and urbanism had thus slid towards the invisible dimension. Sure, one didn't know so far (and still doesn't) whether or not such dangers are real yet the very notion of an electromagnetic field opened up a new way of thinking about space. Space was from this point on no longer imagined simply as a void, as an absence defined by walls, floor and ceiling but as a less dense mass, disconnected, transparent and yet nevertheless filled with material; a void invisible to the eye, certainly, but in which the body was immersed.”⁸

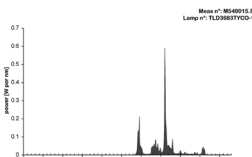
Philippe Rahm is one of the first architects to mention the possibility of a new kind of architectural thinking and design to be based on invisible yet “physical” factors such as radiations or air particles. It is no coincidence that the electromagnetic spectrum is playing a recurring role in his experimental projects. However, Rahm’s architectural explorations are mainly centred on the physical impact of this electromagnetic layer in the human physiology. Rahm is recurrently using precise analysis of solar spectrum in collaboration with

other specialists like biologists to better understand the impact of light on living organism: humans, but also plants. This allowed him to re-question commonly accepted architectural typologies of houses, social places like cafés, or botanical environments like greenhouses.



Diurnism Picture

Diurnism was an experimental installation developed for the Musée National d'Art Moderne in Paris, 2007. A series of specific +570 nm (red-orange) lights illuminate a room in which the space is visually perceptible by the visitors, but physiologically perceived by their bodies as a complete darkness.



Diurnism Diagram

The melatonin⁹ production is indeed not inhibited by light wavelengths above 570 nm.

In Diurnism, meteorological architecture is an interesting example showcasing the exploration of new dimensions for spatial

⁹

Melatonin is the sleep-hormone regulating the biological day-night cycles. (circadian cycles) The presence of light is inhibiting the production of melatonin during the day, which rise again in the night.

conditions like “bright and dark” that were historically reserved to visual perception. It is creating a new “paradoxical” segregation between visible and invisible spatial descriptions. In a similar attitude, Full-spectrum architecture is calling architects to embrace non-visual factors to develop architectural solutions and to re-question spatial notions, going beyond the traditional visible part of the electromagnetic spectrum.

“Called to live in a wireless indoor universe, the future generations will need for their mental and physiological well-being, an environment able to purge the electromagnetic effects of their digital lives”¹⁰ — Future Outdoors

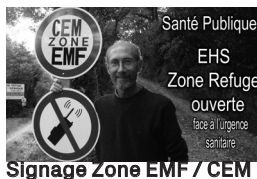
It has already been proven that some invisible portions of the electromagnetic spectrum such as X or Gamma rays have particularly negative biological impacts : hormonal deregulation, DNA alterations or cell damages, in extreme cases, irreversible cell damage or death. Researches about Radiofrequency (RF) radiation exposure are in progress and are showing potential links between RF radiations and diverse biological stresses, such as fatigue, cerebral disorders, and influences and infertility and cancer risks.¹¹ With the large propagation of electromagnetic pollution (sometimes also called “electrosmog”) new diseases are also appearing such as EHS or “Electromagnetic Hypersensitivity” that has been recognised and diagnosed since the mid 2000s.

The postdigital condition we are starting to face will bring the need to create new kinds of regenerative spaces protected from the negative impacts of the electromagnetic fields. This new condition will contribute to the awareness raising for a “full-spectrum architecture” going beyond a small cluster of architectural thinkers. The design and control of “invisible” environments will increasingly be developed in parallel of the progress of the medical

¹⁰
¹¹

ARISTIZABAL J.C, CUELLAR G., GIOBERTI S., *Future Outdoors*, Berlage Institute, 2011 p.44-46
Biological Effects from RF Radiation at Low-Intensity Exposure, Ph.D Ronald M. Powell, 2013.

knowledge about the electromagnetic effects on the human body. This, especially in an advanced society where the consciousness of “health” is shifting from a passive form (the absence of illness) to an active from (a status of well-being and performance to maintain)¹². It is possible to imagine in this direction “electromagnetic-free” spaces as much in the domestic landscapes than in the public spaces of the smart cities. Few “EMS free zones” are already existing in the world in 2015, for diverse medical or scientific reasons. The “NRQZ”¹³ is a special zone in the US which is electromagnetic free because of the presence of a large scale radio-telescope in the small city of Green Bank, Western Virginia. The Quiet zone is attracting hundreds of EHS individuals who moved there in order to escape electromagnetic pollution.



We are at the very beginning of this architectural thinking. The RAM House project started to investigate an “airplane mode” for architecture in reference to the commonly used smartphone function. This is an important conceptual step, but these architectural explorations can go beyond a simple binary condition by using similar methods that can be found in “meteorological architecture” design strategies. “Full-spectrum” asymmetries, gradients or paradoxical differentiations need to be explored. The notion of environmental comfort will be transcended from a perceptible, “sensorial comfort” to an imperceptible “physiological / electromagnetic comfort”. Spatial legislation may follow and new building norms appear, like it once happened with energetic concerns in the construction industry, or smoking policy in the urban public spaces¹⁴.

12 BORASI, G. and ZARDINI, M. *Imperfect Health: The Medicalization of Architecture*, CCA Montreal, 2012
 13 https://en.wikipedia.org/wiki/United_States_National_Radio_Quiet_Zone
 14 See MK-CO — The well-connected environment, The full-spectrum extension of public space

Informational approach and “crypto-architecture”

In complementarity to the meteorological architecture exploring the physical properties of the electromagnetic layer, the “full-spectrum architecture” is also integrating the informational aspect of the Infosphere. Information is a major organisational factor at the very base of our social and spatial interactions. Architecture was, and still is, an instrument for the mediation of information. Information has been a fundamental element historically encountered in the most primitive forms of architecture under its physical forms such as “opacity / transparency” or “public / private”. These spatial problematics were only related to the visual or material or aspects of space until now : Opacity basically means “the visual information can pass through or not” “public” means the physical access is restricted to specific individuals or not: a public place, a private garden. Architecture developed specific answers in a form of architectonic elements or spatial configurations. The notion of room; the wall and the door; the window and the curtains as primitive examples. The infosphere and the electromagnetic layer are now extending these spatial problematics to the informational comprehension of space, going beyond physical limitations. The digital information, freed from the physicality of space, is becoming ubiquitous. The ubiquity of information access is currently raising considerable, socio-spatial, political and technico-ethical questions that will constantly asked in the postdigital condition.

Full-spectrum architecture is for example re-questioning the physical notions of “opacity” or “privacy” in an informational comprehension of space. It is operating through the lens of the access, consummation and protection of digital information in the built environment and is exploring its possible consequences in architectural design. In a continuity of the idea of a “full-spectrum architecture” Joseph Grima is describing this thinking approach with the term of “crypto-architecture” in reference to Cryptography¹⁵.

15

Cryptography : “The practice and study of techniques for secure communication in the presence of third parties”
— Wikipedia

The notion of crypto-architecture is relatively recent, to be considered as one postdigital shift of architecture. It has been explored in the Architectural Association Unit “Intermediate 14” in the academic year 2014-2015.

Crypto-Architecture

“The utopian vision of cyberspace as a place of refuge for the anonymous, instant and endless sharing of knowledge has so far proven radically unfulfilled. It is, rather, the Net that has seeped into the spaces of everyday life, becoming more full-bodied, saturating the most intimate spaces of the home with smartness. As the distinction between the spaces of labour and domesticity blurs, the idea of ‘machines for living’ morphs into a factory of data: technology is the charismatic roommate from which there is no escape.

As open-source decentralised technologies such as Bitcoin, Tor and Silk Road Marketplace become household words, the significance of cryptography and the block chain spill over into the evening news stream, and increasingly frequent and violent disruptions on the existing economic and political order rekindle the flame of social revolution. This year Intermediate 14 breaks through the wall between privacy vs security to explore the possibilities of a new crypto-architecture that reaffirms architecture’s relevance as a participant in this struggle. The unit will begin by reconsidering the

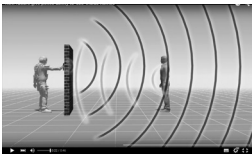
architectural potential of the wall itself as a device deeply entangled in the concept of privacy. In both the physical and digital environment, the wall is a constructed element tasked with filtering, concealing and manifesting identities; mediating the relationship between the personal and the public; and, increasingly, hoarding and guarding information. Responding to this idea, Intermediate 14 will take the electromagnetic spectrum as a notional site whose geography imperfectly overlaps with the physical space of the city, reconsidering the typology of the smart home as a primitive hut and exploring the architectural expression of anonymity and trust as the organising principles of the contemporary city.”¹⁶

—Joseph Grima, Pernilla Ohrstedt

As mentioned by Grima, the private space of an individual house can informationally be understood as “public” when its internal informations [that should remain in the private sphere] is made accessible to external tiers, with or without the consent of its owner. The internally produced information is concerning as much the physical space than its human users—it is going from domestic data such as daily energetic consumption to the behavioural patterns of the inhabitants such as internet browsing history, occupancy, etc. In that context, it is important to realise that the relationship between physical buildings and infosphere is not restricted to punctual interfaces or specific digital appliances considered as autonomous from architecture. It is going deep in the architectural materiality itself and the architects have therefore the

opportunity (or even the duty) to play an important role in the increasing cryptographic challenges of the postdigital age.

In after all, what is the opacity of a solid 25 cm concrete wall which is nevertheless allowing the penetration of all kind of wifi or radio signals between so-called “protected inside spaces” and “hostile outside environment” ?



Youtube Screenshot Radar Police

The propagation of radar-technologies or thermal imaging, once restricted to specific uses and military application are extending the vision range beyond the visible spectrum to large part of the population. “enhanced perception” devices are currently becoming miniaturise and affordable.

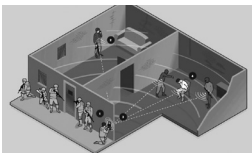


Illustration Range-R Radar

The Range-R developed in 2011 is the first portable, handheld radar. It is now

commonly used by police and firefighters squads to localise through floors, walls and ceilings individuals with a 160° field of view and to a distance up to 16 meters. It functions with standard AA batteries and weighs 0.5 kg.

@peterjellitsch	#signals
@richardvrijgen	#electromagneticlandscape
@NASA	#digitalubiquity
@architectureofradio	#infosphere
@antoinepicon	#voidperception
@jykswonjub	#electromagneticlayer
@timoarnall	#wifi
@jørnknutsen	#wimax
@einarsnevemartinus-	#rfid
sen	#invisiblenetworks
@spacecaviar	#immaterials
@josephgrima	#fullspectrum
@phillipperahm	#postdigitalarchitecture
@nicolasdorvaldory	#spatialrethinking
@laurentstalder	#physiological
@futureoutdoors	#meteorologicalarchitecture
@theberlage	#nongeometric
@pernillaohrstedt	#intangible
@aaschool	#diurnism
@rangeradars	#electrosmog
@makecollaborate	#EHS
	#quietzone
	#informational
	#privacy
	#paradigmshift
	#cryptoarchitecture
	#opacity
	#cryptography
	#buildenvironement
	#postdigital

**THE ARCHITECTURE
OF THE
WELL-CONNECTED
ENVIRONMENT**

The material redefinition of architectonic elements

**Counter-surveillance materialities
Faraday cages**

**The re-thinking of technical installations
in architecture**

**Two technical attitudes
Technological resilience**

The adaptation of architectural typologies

**The postdigital re-calibration of domestic environments
The full-spectrum extension of public space
Active equipment / Positive spaces
Passive equipment / Negative spaces
“From smoking to instant messaging”**

Just quitting the digital revolutions, in an epoch of technological hysteria, let's remember ourselves than "well" is not "more" neither it is "less".

The understanding of the "well-connected environment" should not be restricted to a "simple" architectural protection from the negative effects of electromagnetic layer, nor it should be reduced to the integration of smart equipments in an architectural shell. At the intersection of physiological and informational concerns of the Full-spectrum architecture, the "well-connected environment" will be an important part of the architectural practices in the postdigital age.

The main challenge of the "well-connected environment" is about finding new cohabitation patterns and fertile overlappings between the physical and digital spaces. It is about integrating the expanding electromagnetic layer as a recognised tool in the design of new forms, new spatial delimitations and compositions in architecture. It is about the creation and communication of new symbolisms and languages to transcend invisible phenomena.

The "well-connected environment" is both the duty and the opportunity for architects to adapt the built environment to the evolving needs, habits and standards of a fast-changing postdigital society based on information and digital ubiquity.

The well-connected environment has the possibility to be thought, designed and built with the help of three principal design strategies:

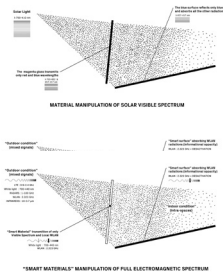
- The material redefinition of architectonic elements
- The re-thinking of technical installations in architecture
- The adaptation of architectural typologies

The material redefinition of architectonic elements

As explored previously, a fundamental re-thinking and re-engineering of the basic architectonic elements composing architecture need to be explored in full-spectrum architecture.

With the technological innovations in “smart materials” [as described in “Digital fabrication and architecture”] the notion of opacity/transparency will be extended and dissociated in between visual, sonic and electromagnetic factors. As in “Diurnism”, the physical or chemical exploration of architectural construction materials will consequently lead to paradoxical conditions in which visual and non-visual perception of space will not be coherent, to the benefit of architecture and design possibilities. Transparent windows illuminating the space, or meshes allowing natural ventilations will be considered as electromagnetically opaque if designed to disconnect spaces from any electromagnetic exchanges. Metallic-based alloys disposed in bricks or concrete may have the possibility to absorb radar technologies, or specific reflective coatings will block thermal vision efficiently. In the opposite approach, opaques installations such as curtains, wall or mobiles panels will be specifically designed to block direct views and provide visual intimacy, while enhancing electromagnetic propagation over large distances in order to reduce energy consumption and relays.

Going beyond a simple “binary relationship” such as “on/off” it is very probable that smart materials will gain the capacity to filter specific kinds of electromagnetic signals in a very precise way. Smart walls will be programmed to be permeable to only pre-selected signals, like specific local wifi but to block external exchanges such as GPS signals, radio broadcasts, etc. Coloured glasses are a good example to understand a possible passive electromagnetic filtration: a red stain glass is filtering only few precise red wavelengths from the full solar spectrum, and is absorbing all the other wavelengths.



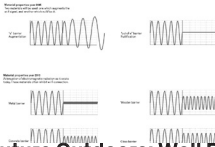
Material Manipulation Spectrum

The electromagnetic properties these new materials will be used in architectural design and compositions. Architects will have to make the choice to hide, or showcase these properties. New aesthetics and symbolism will appear consequently.

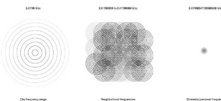


Aluminium Interior for EHS patient

One EHS patient has fully coated his attic and its furniture with conductive materials. It has for effect to prevent from any EMS radiation and static electricity, and possesses its own deviated aesthetics.



Future Outdoors: Wall Radiation



Future Outdoors: Wifi Interconnection

The Future Outdoors project developed in the Berlage Institute in 2011. The project is exploring the electromagnetic properties of current and future materials to be used in architectural construction.

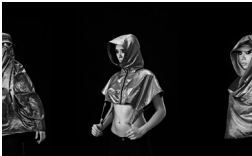
Counter-surveillance materialities

“Privacy is necessary for an open society in the electronic age. Privacy is not secrecy. A private matter is something one doesn’t want the whole world to know, but a secret matter is something one doesn’t want anybody to know. Privacy is the power to selectively reveal oneself to the world”¹A Cypherpunk Manifesto,
—Eric Hughes, 1993

In a period of governmental mass-surveillance, big-data, digital guerrilla as much for military than commercial purpose, the notion

1 <http://www.activism.net/cypherpunk/manifesto.html>

of personal-cryptography and **countersurveillance** is a raising problematic significant of the postdigital age. A logical continuity can be forecasted between the emerging clothing or object projects from the last years to possible furniture or building application to come. As actors of the built environments, architects will face countersurveillance related programs and commissions.



Stealth Ware Visual View



Stealth Ware Thermal and IR view

Stealth Wear² is an art and fashion project developed by artist Adam Harvey in 2013. The presented models are the Anti-Drone Burqa, hoodie and Hijab, shown in optical, infrared and thermal vision. “a vision for fashion that addresses the rise of surveillance, the power of those who surveil, and the growing need to exert control over what we are slowly losing, our privacy”

Faraday cages

The faraday cage is a primitive example of this phenomenon has already been developed since nineteenth century. Once observed

as a marginal experiment, the faraday cage was increasingly be used in the late twentieth century in various situations such as medical or warfare application. It is interesting that the faraday cage is becoming a recurrent protagonist in the technological science-fiction movies produced in the last years. Illustrated on fictional, extreme situations such as world war or alien invasion, the cinematographic exploration of “full-spectrum architecture” is offering us a glimpse of the potential problematics we are starting to witness in the early years of the postdigital age : surveillance society, electromagnetic resilience, survivalism, etc.



Transcendence Film Still

In an age of electronic warfare, EMP bombs and infrastructural hacking, the faraday cages are becoming new the new equivalent of electromagnetic bunkers. In “Transcendence”(2014), computer scientist Will Caster is warping his pergola with a copper mesh in order to prevent any electronic eavesdropping or connections.



The Darkest Hour Film Still

In “The Darkest hour”(2011) Sergei is “upgrading” his apartment into a giant Faraday cage

that “hides” the protagonists from the aliens’ electromagnetic vision. The aesthetic is particularly interesting, acting like a secondary improvised skin enveloping the internal domestic landscape, from ground to ceiling.



Anti-Drone Tent

**Anti-Drone Tent, Sarah van sonsbeeck, 2013
(thermal space blanket, frame)**



Faraday Tent

**Faraday Tent, Sarah van Sonsbeeck, 2013
(electromagnetic radiation shielding fabric, steel [tent poles], tent herrings, rope)**

The artist Sarah van Sonsbeeck (educated as architect) is investigating the conceptual relationships between space and silence. Her researches led her to the idea of informational or electromagnetic silence with the development of thermal or electromagnetic-proof camping tents³.

The re-thinking of technical installations in architecture

Architecture was historically related to the technical installations it is incorporating in its envelope. The most primitive example of these installations were related to environmental management of space, that can be done passively through an envelope such as a tent, and actively through the “technical installation” such as the campfire⁴. The crossing of these two passive and active approaches to environmental design is questioning the very notion of architecture itself.

“When your house contains such a complex of piping, flues, ducts, wires, lights, inlets, outlets, ovens, sinks, refuse disposers, hi-fi reverberators, antennae, conduits, freezers, heaters—when it contains so many services that the hardware could stand up by itself without any assistance from the house, why have a house to hold it up?”⁵

—Reyner Banham

The vision of Reyner Banham in “A House is not a Home” may seem a bit extreme, but the continuous emergence of new technical installations created consequent changes in the organisation and utilisation of space and architecture. The two last centuries witnessed the democratisation of these technical installations to a level never seen before. As previously explored in “the second

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BANHAM, Reyner, *The Architecture of the Well-Tempered Environment*, 1969
BANHAM, R. DALLEGRET, F. *A Home is not a House*, 1965

phase of electrification”, many modern technical installations based on electricity contributed to the disruption of spatial or territorial behaviours and architecture had to adapt consequently. Other ones such as electric lighting or the elevator even made possible new architectural typologies. such as the modern Chicago-skyscraper.⁶

The progressive development of heating technologies from a simple central hearth to modern systems re-organised the internal domestic landscapes from thermally defined rooms⁷, with thermal asymmetry, to program-based rooms with precisely controlled atmosphere and thermal standardization. The propagation of electricity in the occidental middle-class houses brought a new layer in the architecture and influenced domestic routines. “electrical boxes”, “light switches” “plugs” and a constellation of disparate appliances such as televisions, fridges, radios, air-conditioners... colonised the indoor domestic spaces to the detriment of architecture, many of them were not integrated at all in the architectural design



Schwarzwaldstube Painting

Georg Saal, “Schwarzwaldstube mit kleinem Mädchen auf der Ofenbank”, 1861

The “Stube” is the single heated room of traditional vernacular German Houses. It was understood as place for cooking, eating and living, in a context where space was not defined programmatically but thermally. The Stube space is always organised around a

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PICON A. & BUJNOWSKYJ M., MK-CO #conversations, 2015 — “Postdigital and the architectural practices”
See the stube example, as one in many other vernacular housing configurations.

central stove. The architectural integration of this technical element is done with the common ornamentation by coloured ceramic tiles for visual and thermal result (Inertia) but also with design of secondary functions such as a benches, or hot water storage.



Centre Georges Pompidou - Facade Est

The Centre Georges Pompidou, as a precursor of High-Tech movement is a significative example of the celebration of technical installations in architecture. The pipes, electrical, fluids and mechanical networks are clearly exposed, being part of the facade composition of the building. In that attitude, each network has a specific colour code to facilitate the technical reading of the architecture and developing a proper language.

The architects were consequently confronted to a recurrent choice that can be observed throughout the history of architecture, and that led to different architectural movements or attitudes:

- **A “subversive” attitude**, to hide the technical layer in the thickness of the architectural elements. This in order to “free” the plasticity of space from “impurities”

- In opposition, an **“honest” attitude**, to valorize and celebrate this technical layer with the creation of new aesthetical languages, ornaments or programmatic insertions. These two attitudes were often combined in intermediate solutions.

Going beyond the simple aesthetical valorisation, the proactive integration of this technical layer was used also sometimes as a conceptual base to develop spatial or organisational theories. This situation can be found, for example, in the organic architecture theory developed by the american architect Frank Lloyd Wright. Organic architecture is placing the traditional hearth as the central core of the home where space and program are organically growing from it. The placement and the design of the central fireplace is particularly thoughtful in the large majority of Wright's projects.

In a contemporary context, the scientifically driven architecture of Philippe Rahm is trying to celebrate the modern environmental technologies [such as double-flux ventilation, glass insulation, or low-heat radiant panels] as core-elements considered in the spatial organisation of the contemporary living environments. This integration is made possible by different triggers : the re-design and valorisation of the technical installations themselves, but also by an alternative use or symbolism of these elements—In Rahm's architecture, insulations layers are dilating to become big enough to be inhabitable, convectors are becoming furniture, usually hidden elements such as heat-exchangers are transformed into a new symbolic elements in the room. The role of digital technologies such as advanced thermodynamic simulations are fundamental in these processes.

Therefore a fundamental question needs to be addressed to this integration strategy : the question of the technological obsolescence and the dependency on installations facing the resilience of architecture—***How to design a building with a predicted lifespan of at least 50 years, based on a particular technology that might be obsolete in the next five years ?***

It would be particularly dangerous (irresponsible ?) to not take in consideration the incoming obsolescence of a visible tech-

nology that is planned to be used as a central element of an architectural project. Secondary to the obsolescence problem, lies the less important yet considerable question of style. What should be the place of the particularly unstable digital technologies in architecture, in a society where 5 years old smartphones are looking more outdated than a 50 years old building ? In the postdigital age, a condition of advanced interlacement between physical building and digital interfaces. The notion of technological resilience in architecture need to be explored by architects.



Falling Water : Hearth



Falling Water: First floor plan

A view of the central fireplace and living room in Fallingwater from Frank Lloyd Wright and the corresponding first floor of the house project.



Rahm double flux installation



Rahm Stone heating



Rahm “Deteritorialized Milieus”

In “deteritorialized milieus” (Paris, 2009) Philippe Rahm integrates the technical installations such as ventilation, lighting or heating as core elements in the definition and utilisation of the domestic space. The double-flux ventilation is transparent and placed as a central element of the room. It uses a composition local wood essences to regulate the humidity and symbolically re-connect the conditioned air with the composition of the Parisian historical terroir. The radiant heating system, originally placed under the floor is becoming a distinctive surface to use and appropriate in the room. The thermal inertia is maintained with a composition of local sedimentary stones from the Parisian basin, also for symbolical purposes.

The digital revolutions have been the fertile ground for the large propagation of the electromagnetic layer in the built environment. The two last decades brought quantities of new technical installations and equipments in the offices buildings and domestic places. Screens, computers, internet cables, servers, wifi routers, etc. Dedicated buildings and rooms were even designed for that in some cases. The cloudification of architecture is currently re-balancing this situation by freeing again the spaces from cables and fixed equipments in the majority of the “cloudified spaces”, but paradoxically it is also bringing the new possibility of an “internet of things” and the multitude of small connected devices resulting from it such as sensors, activators, interfaces that already started to colonised the build environment. As cynically observed by Koolhaas in his “smart landscape”⁸ recent essay, it is a massive “stealthy infiltration of architecture” of the digital technologies without the awareness of the architects.

In that direction, It is important to observe that the emerging phenomenon of “smart homes” or “smart buildings” that are currently buzzing in the mass-media is happening not through architecture but by external initiatives: entrepreneurs, tech companies, that unfortunately are not focussing on the architectural consequences of their projects. A quick scan of the internet and technological reviews is clearly showing the lack of architectural implication in the “smart revolution” of the built environment.

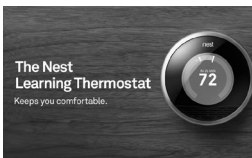


A typical “Smart Home” ?

Is the “smart home revolution” doomed to be reduced to a bunch of sensors, big screens and data-gathering installa-

tions placed in generic
“pitched-roof-over-
sized-suburban-villas” ?!

The potential of “smart
elements” need to be
developed beyond simple
environmental or ludic
concern, with the
emergence for example of
configurable, responsive
and efficient spaces.



NEST Thermostat

“Nest” is a “smart
thermostat” that learns
your behaviour and
preferences in order to
reduce your energetic
consumption. Nest
operates between a series
of sensors dispatched in
the domestic environ-
ments, your smartphone,
your wifi and this central
small interface presented
above. It is one of the
precursor on the “smart
home movement” but
similar application are
expected to be developed
in almost the totality of
domestic installations like
lighting, kitchen, toilets,
etc., and even architec-
tonic elements such as
doors or windows.

“MBU—In a world where our everyday lives will be more influenced than ever by the digital environments in whatever form they will take (virtual reality, augmented realities, ambient intelligence, etc.) [...] What should or could be the form of the physical architecture ?

JHL—At the moment, it's true that there is a clear separation between digital and physical space. You can say you prefer one to the other, but I think there's a trend that suggests they will blur into one—things like google glass and augmented reality are moving the digital from the screen into physical space and maybe we will laugh in 20 years about carrying around a glass rectangle all of the time”⁹

In our present situation, it is now more and more difficult for architects to forecast the technological and built landscape of the next 10 years. It is even more difficult to understand how architecture should adapt. Questions that were unimaginable two decades ago are now becoming crucial factors during the conception phase. The increasing speed of the technological evolution seems to be barely compatible with the current commonly accepted building lifespans—In a technological perception of time, centuries are becoming decades—and decades, years. Paradoxically, construction and digital technologies are on a merging direction. In that context, postdigital architecture will need to develop technological resilience strategies in order to keep its value in this fast-accelerating world.

Technological resilience may be achieved by these different approaches:

The Cyber-Luddite approach:

This first strategy might be useful but it is an extreme one. It is the choice for architects to “simply” segregate digital technologies¹⁰ from the architectural design. To not integrate any complex technological infrastructures in the built environment in order to clearly differentiate the digital layer from the physical layer. This can be considered as an act of resistance in a digitally driven civilisation. “Cyber-luddism” may result in a very resilient form of architecture, freed from technological obsolescence. The fact is in a postdigital condition of cloud and ubiquity, the large majority of users will indubitably appropriate the space with their own digital appliances and installations, for a final result in contradiction with the original intention.

The “Architectural upgradability” approach:

One probable direction can be foreseen the incoming notion of fast or flexible “technologico-architectural” upgrades. It is about creating an architecture where the digital layer is easily adaptable by the users/prosumers. This will probably be a consequent challenge in postdigital construction. This capacity of “upgrading architecture” can be understood in the continuity of the current notion of architectural renovation, in an upcoming context where small appropriation processes like internal layout, technical installation will likely be achieved by prosumers¹¹ within a day or two without specific skills. “Architectural upgradability” may be developed with the capacity of a “primary” physical structure of a building to successfully integrate successive generations of a similar technologies without important sacrifices, and with the conservation of the initial

¹⁰
¹¹

<https://en.wikipedia.org/wiki/Neo-Luddism>
See “amateurism”, “digital fabrication” and “redistributed construction” in “postdigital building”

properties and symbolism of the initially planned configuration. This solution might be achieved by using as much as possible universal technological standards like Internet 0¹², and to design an architecture being easily assembled and disassembled, where possible technological installations may be upgraded without specific skills. The choice between hardware and software based solutions is also an important factor, immaterial upgrades obviously being less destructive and faster than physical ones.

The technological nostalgia approach:

In the opposite, another solution may reside in the responsibility of architects to assume the temporality of a technology and to transcend it through design to a point that obsolescence is not threatening the architectural language or utilisation. The problem of this approach is the fact it is creating an inevitable nostalgia forcing the user to accept all the resulting inconveniences. The failure of his nostalgia might result of a very similar consequences to a cyber-luddite approach, the user always having the possibility to abandon the original installation and to implement themselves a new layer to the detriment of the original design.

As a consequence, it is necessary to remind that these three possible approaches shouldn't be isolated as single possibilities and should probably be combined regarding the situation, the program and the planned lifespan of the regarded architecture. In an overall building project, such as a house, some rooms may need to be designed as "cyber-luddites" while other ones to be easily upgradable, such as enhanced "media rooms". The currently established "programmatic definition" of space based on rooms with specific purpose may shift to a definition of space by "programmability level" of each rooms. In large buildings such as public programs, it is possible to design durable parts, to be resilient to technological change, and in complementarity, to aggregate around these parts voluntary obsoleting parts designed to be easily up-

dated. In that perspective, architects will need to develop building techniques in an even closer collaboration with other professional fields such as programmers or IT scientists, in order to better integrate the digital factor in the architectural elements. An early example can be observed in the Media House project as a collaboration between MIT Center for Atoms and Bits and the Institute of Advanced Architecture of Catalunya.

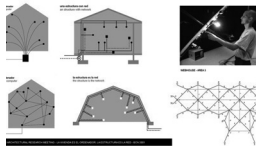


HDM Prada Tokyo CRT

The Prada Aoyama store was designed and built by Herzog & de Meuron in 2003. It was integrating state of the art touch-screens with multimedia content and interactive catalog. In this project the technological layer is incorporated both in the architectural and retail experience through a meticulous and poetic design. However, a decade after [in an age of customisable applications, cloud and paper-thin tablets] a strong technological nostalgia is already appearing. The chunky CRT screens and beamers are already the witnesses of a gone era although the poetics of the material space remains intact.

Should the technological layer represented here by the CRT screens be updated ? Removed ? Are they indispensable for the architectural reading of

the space ? These questions are related to the notion of technological resilience in architecture.



MIT Media-house diagrams

The MIT Media House Project (2001): The structure is the network, the house is the computer



MIT Media-house Structure detail

The structural triangulation is also hosting a general infrastructure for the “Internet 0” as a universal transmission protocol in the domestic environment. The structure become also the possible network for digital information.

The adaptation of architectural typologies

The electromagnetic layer and the infosphere are influencing architecture beyond its materiality and its technical dimension. As mentioned before in Full-spectrum architecture, it is redefining the properties and the perception of space itself, it extends existing spatial notions such as open/close, or opaque/transparent to another level going beyond visual or geometric perception. New needs are generally meaning new answers, it is consequently influencing architectural design methodologies and spatial appropriation phenomena. New architectural typologies must be explored in a “full-spectrum” context more relevant than ever for postdigital architecture.

The current exploration will focus on two fundamental points concerning the adaptation of architectural typologies in the well-connected environment

- The postdigital re-calibration of domestic environments
- The full-spectrum extension of the public space

The postdigital re-calibration of domestic environments

In cloudified environments, the ubiquity of information is freeing a majority of the physical objects from their spatial conditions. Cloud-based systems are flattening the spatial perception and utilisation of their users. This has for consequence, a current de-programming of the built elements from their original uses. Joseph Grima is mentioning this phenomenon with the catchy sentence “***the end of space***”¹³, sometimes also described as a “digital homogenisation of space”.

In the first years of the postdigital age, this phenomenon is already observable with surprising results. People are using and

considering many furniture pieces in different way that they were designed for decades ago. Toilets are becoming desks¹⁴, desks are becoming dining tables and inversely. The design and the perception of furniture is mutating as a result of the evolving needs of their users. The bedroom used to be perceived as a place only dedicated for hosting the bed, and associated with the action of sleeping. In the last decade, especially for the majority of urban dwellers living in dense, shared environments¹⁵, the bedroom has extended its status to a multifunctional room used and furnished for personal activities such as work, leisure, rest—in opposition to the living room hosting the social/collective version of these same activities. The traditional bed, a piece of furniture originally designed for sleeping has indifferently mutated into a working place, a sofa, a library, a movie theater. This programmatic mutation of the furniture and the dedicated space is mainly due to the portability and versatility of small portable devices like laptops or tablets allowing a large range of actions in any kind of environment.

In a situation where rooms are not only defined by the function anymore, it is necessary for architect to re-question the very notion of room in a post-digital context:

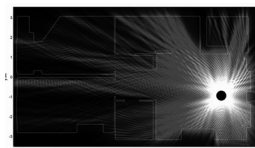
- **What is a room, and why should we still need them ?**
- **How a “postdigital room” should be qualified, delimited and designed ?**

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<http://lifeathome.ikea.com>
The mutualising of space is another important postdigital phenomenon linked to the emergence of a “sharing economy” that will be investigated in the next versions of makecollaborate.ink > See GUIDONI B. & BUJNOWSKYJ M., MK-CO #conversations, 2015 — “a collective form of individualism”

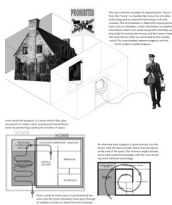
In a postdigital domestic environment accepting the idea that rooms have no dedicated purpose anymore, the notion of room should then be “programmatically atomised” and re-composed by its fundamental functions such as sleeping, eating, resting, sitting, talking, washing, etc. The traditional notion of room is based around the idea of spatial segregation through the use of material elements such as walls. This idea must be extended to the notion of non-physical borders like electromagnetic or atmospheric borders, the hot-air curtains in building entrances as a good example.

The postdigital re-calibration of the domestic environments may follow alternative design strategies with the use of non-programmatic spatial differentiation and composition as it used to happen in the history of architecture. In pre-classical and vernacular architecture, many rooms used to be defined and organised by thermal properties. In a contextual transposition, the new “post-digital rooms” might be defined, and internally re-organised by their capacity to filter or not, invisible electromagnetic signals. This leading to “full-spectrum typologies” or elements such as thermal-vision curtains, electromagnetic shutters, faraday furnitures or blankets that may appear in a logical extension to the existing, traditional ones. Furthermore, the phenomena of local heating sources and “Thermal asymmetry” that influenced centuries of architectural composition may be re-interpreted as possible “electromagnetic asymmetries” within the domestic environment. Asymmetric typologies will result to a “de-homogenisation” of the domestic space that is questioning our current notion of environmental and informational comfort.



Wifi Home visualisation James Cole

The physical visualisation of a wifi router in the flat of physicist James Cole to be compared as the thermal radiation and heat repartition of a fireplace. Can the rooms be organised around an informational, "Digital infrastructure" like a wifi router, as it used to be with a fireplace ?



The Heterogenous Home Diagrams

The Heterogenous Home (2007) from the Berkeley Institute of Design and Intel Research is the first example illustrating the potential of electromagnetic segregation between "a house" and a "home" with a resulting alternative typology based on electromagnetic permeability.

Full-spectrum, “Asymmetric typologies” have the possibility to bring new spatial poetics¹⁶ that may create interesting architectures in a postdigital context of informational ubiquity and indiffer-entiation. They can invite the dwellers to appropriate their domestic environments in alternative ways by creating new domestic routines and indoor nomadism.

Here few proposals for full-spectrum typologies in the domestic environment

- The re-transformation of the multi purpose living room, into a digital-parlour, a room specifically permeable to electromagnetic signals, connected to the world and hosting all kind of “public” activities such as collaborative work or entertainment, communications, game, etc.
- The creation of intra-spaces, to be considered as the spatial equivalent of an intranet in architecture. Spaces that are electromagnetically insulated from the outside environments, but in which is deployed private network for internal use, and filtering external internet through firewall and VPN for privacy concerns. The usual digital tracking done by external individuals is not possible in the intra-spaces. (GPS localisation, National 4G networks, etc.) This kind of intra-space may host dining, cooking, washing activities, regarding the program or the preferences of the client.
- The creation passive, OFF spaces that are electromagnetically insulated and designed for personal or collective off-line activities. These spaces are disconnected from the rest of the world, and can be considered as regenerative spaces for introspection, relaxation.
- In opposition of the a-synchronisation and a-spatialisation of the digital-parlours continually connected with the whole planet, these OFF spaces should be rooted on the local natural cycles, for a phys-

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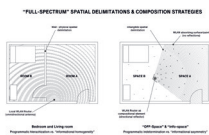
BACHELARD, Gaston, *The Poetics of Space*, 1958 “I should say: the house shelters day-dreaming, the house protects the dreamer, the house allows one to dream in peace”.

iological re-calibration of their users. (local time, local light conditions, etc.)

The spatial delimitations between those spaces, may not necessarily be achieved by the use of physical elements such as walls or mobile panels — Spatial delimitation or hierarchisation may also be archived in an immaterial level by a direct design of the spatial properties of the space, by the use and calibration of electromagnetic devices. It is possible to divide a room in two parts by orienting wifi propagation antennas in a specific direction.



Wifi Antenna Hacking



Full Spectrum composition strategies

As example of digital bricolage¹⁷, the antenna hacking of a standard WLAN omnidirectional router into a parabolic directional antenna with a specific broadcasting angle. Such a modification may lead to new forms of spatial configurations: the intangible delimitation of a room into a connected and disconnected space at the base of new full spectrum typologies.

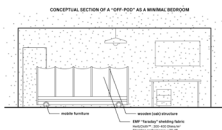
17

see MK-CO / Integrated aesthetics vs. Techbrutalism, "digital bricolage"



Slow West Film Still

A domestic scene happening in a Scottish vernacular house in the 1800s, in the movie *Slow West* (2015). A lot of pre-industrial, vernacular houses were composed of a single, non-insulated room, internally organised around a single source of heating, a fireplace. The notion of bedroom is reduced to a minimal “installation” understandable between a space and a furniture, locally enhancing the environmental comfort of the main space. The volume of the “bed-box” is minimised to the scale of the body for spatial and thermal efficiency. It is visually and thermally insulated with wood and heavy wool curtains in order to limit the thermal depletion of the body during the sleep.



Conceptual section for “OFF-Bed”

This configuration may lead to a “full-spectrum equivalent” where the bedroom is shrinking

again to its primitive function and become a mobile installation, insulated from any electromagnetic signals for an enhanced psychological and physiological recovery during sleep and resting periods.

The full-spectrum extension of public space

“I think there is a shift in the spatial experience in cities, from metropolis shaped by physical buildings and objects to digital networks, which are fundamentally in shaping the futures we are all racing toward. What the network has done to the planet is utterly radical. It defines new forms of communities, and even new forms of cities. We can imagine new cities organised around satellite sight lines, or inversion of property values as getting a good mobile phone signal becomes more important than having access to natural light”¹⁸

— Liam Young, 2015

The design of “physical infrastructures for digital environments” is completely interconnected and complementary of the design of “digital infrastructures for physical environments”.

Therefore, the integration of the electromagnetic layer in the public space becomes a key element of postdigital urbanism for the future of our (smart) cities. This consciousness is going beyond the simplistic idea of overconnected “smart cities” as we currently envision them since the early 2000s. It will be necessary to consider the active and passive design strategies of the non-visible infosphere as a possible element for the planning and development of “well-connected” both civic and healthy public spaces.

The design of digital infrastructures for the physical environment is currently, and will probably still be mainly managed by information technologies sector. The digital infrastructure is about the development of a digital layer improving the use and perception of the physical space. This digital layer, in progress to become ubiquitous, is composed of different cloud-based programs, and smartphones/mobile apps enhancing the territorial and spatial perception. It is for example developing services based on geo-localisation, augmented reality, spatially based social medias, or the development of real-time responsiveness related to dispatched sensors such as RFID. (as mentioned before in the electromagnetic layer) The development of these complex, transdisciplinary projects will probably need the integration of architectural thinking and spatial expertise from architects. Few of us may choose to specialise as consultant or spatial/interaction/media-designer working for larger tech companies.

In a complementary approach, The creation of physical infrastructures for the digital environment is oriented on the design of physical spaces and material objects that are supporting or counterbalancing the previously mentioned digital layer. The fact is that new technologies create new needs and new dynamics— This paradigm shift introduces the evolution of spatial habits and logically influences the design and the organisation of the cities in a similar way it is changing the domestic environment. [as previously investigated]. The emergence of new kinds of public spaces,

public-utility programs, urban furniture, or different public installations or initiatives is therefore to be expected within the next years, as it is already observable in a prototypical form. It is clearly understandable that these physical infrastructures, may not systematically be architectural projects in the “conventional” acceptance of it. They are sometimes more related to object design, sometimes transdisciplinary projects between design, applied sciences and architecture—The role of architect has there the opportunity to evolve and grasp new potential collaborations. An occasion to bring his spatial expertise beyond the traditional building construction.

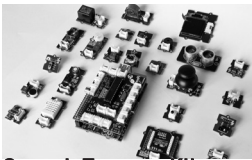
These “physical infrastructures for the digital environment” from various sizes can be divided in two kinds, the active equipment, and the passive installations.

Active equipment / positive spaces

The “**active equipment**” is regrouping all the physical installations or objects playing an active role towards the digital environment. They have the possibility to “**input/output**” spatial information between the physical and the digital space. The active equipment is creating “**positive space**”, charged with information and computational power that consequently reorganises the physical dynamics of the concerned public spaces.

Input elements can be envisioned as physical sensors that transform physical or spatial information such as presence, localisation, spatial perception, into digital information to be further archived and analysed. Architects will need to more and more integrate these elements within architecture and urban design projects. Some of these elements might even become the basis of new architectonics elements or composition. A light switch or a door knob can be considered for example as input elements. In that similar mindset, what could be the consequences of the implementation of a material Facebook “like button” on a building entrance ? A physical “check-in” integrated on door steps ? Should these kind of analog-digital inputs be considered as a chosen, pro-active ac-

tion to be performed by a user—or a passive feature, almost hidden and integrated in the design of the space itself (to be compared for example as the legal conditions dissimulated in the complex agreement contracts of digital platforms such as iTunes or Facebook.) A lot of ethics problems about digital privacy, data-management are already creating major debates on the digital world. These debates and controversies will certainly be extended to the physical realm in a very consequent way. The blurring of sensitive physical information on Google streetview is for example only one tiny tip of a massive iceberg.



Grove IoT sensor Kit

A multitude of very small and affordable sensors are now available on the consumer market. Here, the IoT Grove Sensor kit for the microcontroller Raspberry Pi (2015) with pressure, heat, light, humidity, presence, etc... The sensor are fully configurable and can be used for rapid prototyping.

The output elements are installations that export/execute digital information from the digital space to the physical space. This can be achieved through a variety of sensorial experiences and should not be restricted to visual feedback. The output elements are supporting and complementing more fluid mobile devices such as smartphones, wearables , etc. One of the most basic “output interface” is the screen. The screen condition may be considered as a universal basic in our current timeframe [tablets, smartphones, televisions...] but this condition is already starting to mutate into more physical, tangible interfaces as currently explored in the MIT

Media Lab¹⁹ since the last decade. The increasing development of “beyond-the-screen” experiences is one characteristic of postdigital architecture, with the mix and indifferentiation of old and new media—digital and physical visualisation techniques.



Fliike

“Fliike” (2013) from the french startup Smilri²⁰ is a “physical Facebook like counter” in order to visually connect a physical place (a shop, a restaurant, etc.) to its digital equivalent: its Facebook page. Fliike can be then considered as can be considered as a “beyond-the-screen” output element, placed in the physicality of space and delivering information in a non-invasive way. Seen here in a restaurant in Lyon, France.



Berg: Pixel Track

“Pixel Track”(2015) from Berg Cloud is also a system to be considered as non-invasive “physical”

¹⁹
²⁰

<http://tangible.media.mit.edu>
<http://www.smilri.com>

output element designed as an alternative to screen informational displays in the built environment. A typical “postdigital project” including digital technologies in a traditional physical medium. More information on the prototype video here²¹

This development is made possible by a certain maturity towards screen culture and smart materials. It is now possible to “physically program” objects to change colour when receiving digital information that is transformed into electric signal (electrochromism) or a thermic stimulus²² (thermochromism). We can imagine for example a “smart wallpaper” in a room that change its colour or pattern when you receive a message, or to remind you something specific in a non-invasive way. At the landscape level, in the public space, similar development may be applied in facades, street signs, furniture etc... changing their visual or haptic properties in regard to public-related information. this could be done for civic purpose, in order to give politic feedback, When a city is winning a match, or when an ecological-challenge threshold is achieved by a community... These phenomenon must be investigated in order to implement new forms of visual communication, non-invasive ambient intelligence in the public spaces.

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<https://vimeo.com/95723855>
In Heat, HUA Gallery, New York, USA, 2005



In Heat Jürgen Mayer

"In Heat Hut" (2011) by Jürgen Mayer H in NYC was an installation with thermochromic paint on the walls and the furniture in order to keep temporary traces, "body-prints" from the visitors.



Bit-shift Thibault Brevet

"Bit-shift" (2013) by Thibault Brevet, Lausanne is an installation using thermochromic paint combined with electronic resistances, in order to activate a local, temporary colour evolution.

In the comparison between digital information and water as public goods—If the smartphone is the informational equivalent of an individually owned water bottle, the wifi hotspot needs to be understood as the equivalent of a public fountain, providing free information access in the public space, this independently or in complementarity from personal mobile devices.

In the case of public water access, the design and the integration of public fountains in the historical cities were going beyond the simple role of providing water. They were used by local governments to propagate symbols and moral in the public space by the use of complex ornamentation and composition. The water distribution points have also historically organised the public

space surrounding them: The fountain as a civic place for meeting and socialising around a shared common good. Going beyond the “simple” physiological need of water distribution, the fountains started then to be used as recurrent urban design element for every major public places, as a symbol of “publicness” even with the use of non-drinkable fountains.

In some particular cases, the relationship between the fountain and the urban configuration were tightly imbricated. Some urban forms such as the *Venetian Campi* are for example directly dimensioned and dispatched in regard to the water distribution. A “Campo” has to be understood almost as an “urban planning unit” in Venice, designed around a central water well, providing a certain water capacity for a delimited district having a determined number of possible inhabitants. The campo historically provided a specific common good as well as a related civic space for a certain community. They are at the heart of Venetian social life and urban composition.



Campo San Toma

The Campo San Toma in Venice, as a central place with its own church, public space and the related “Vera da Pozzo” the central ornamented well provisioning the surrounding buildings.

In a similar attitude, the design and repartition of public “output elements” in the public space of the cities should be investigated by architects. The distribution of free digital information is becoming as important as other tangible factors like water and vegetation in the emergence of a “full-spectrum urbanism”. It will progressively leads to new urban forms adapted to the postdigital condition. In

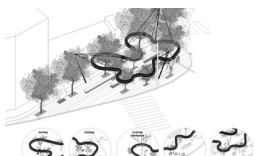
the public space, as much as in the domestic environments, technical equipments may aggregate secondary functions such as resting places, weather protection or service production in order to integrate them in the physical territories. Digital or physical ornamentation may appear too: the ornamentation of these output elements may propagate themselves public information in “ambient”/non-aggressive forms.

It is easy to imagine the possibility of “Wifi-fountains” as small pavilions or integrated public furniture locally extending the notion of public space to the digital realm in specifically designed environments. The architects in collaboration with other professionals will have the possibility to design local “public digital spaces” overlapping the physical ones, providing complementary experience based on location—The equivalent for example, of a “local intranet” accessible only on a certain range that is physically delimited by the physical space. The architects will need to integrate privacy, security and identity factors in the design of such hybrid places. This may be achieved by restricting the access range to a certain distance, or to symbolise these places through architectural design.

What could be the postdigital form of an “informational campi” where the size and the design of the public space could be related to the propagation range and propriety of a local information hotspot? Combined with other tools such as localisation and spatial/social medias, how it could extend the civic dimension of the public space around the common goods? In which direction the merge of physical and digital services can appear?



Communication Hut



Communication Hut Axonometric

“Communication Hut” (2011) by Estudio Herreros in Gwangju, South Korea. The project is designed as a “Public space for individual use” providing physical meeting space, radiant heating and a set of diverse urban furniture. The place acts also as a local digital infrastructure for the neighbourhood with medium range WLAN access.



Escale Numérique

“Escale Numérique” (2012) by the french designer Matthieu Lehanneur, propose a new kind of public shelters for the city of Paris, a place to rest, with hi-speed internet access, WLAN and a public touchscreen for people without

devices. The concrete chairs have a usb and electricity supply for smartphones and laptop, providing also charging service.

“We are Human, in after all”

—Daft Punk, 2005

Passive equipment / Negative spaces

As presented before, The domestic environments may be re-calibrated in “full-spectrum” configurations providing “regenerative spaces” in the private sphere. Full-spectrum architecture leads to the idea of home as a shelter protecting from external weather but also from electromagnetic intrusions.

This approach should be applied at the urban scale in the design of public spaces too. The implementation of **non-digital “enclaves”** in the “smart landscape” of the postdigital cities must be investigated in a counterbalancing posture from the extreme propagation of active equipments and “extended public space”. The creation of **“negative spaces”** may be needed for the hosting of “offline” social interactions in the public sphere. This exploration proposal must be understood in a logical continuity from the atmospheric planning that emerged in metropolitan areas since the two last centuries. The planning of urban parks and various public facilities supporting the wellbeing of the city dwellers as good examples.

This present essay motivates the exploration of new infrastructures supporting the physical and psychological sanity of the postdigital inhabitants in over-connected spaces. New public programs based on electromagnetic and informational control must be investigated in the condition we are currently facing: the informational saturation of the build environment, and the progressive inversion of indoor and outdoor spaces. These “well-connected” programs are extending the spatial notions of noisy/quiet or “busy/

calm” to a non-tangible level, in complementary of the already treated visual or sonic aspects. It is possible to imagine the design of new buildings [or the upcycling of existing ones] dispatched in the cities, having for main property the “simple fact” of creating electromagnetic shelters for the general interest. New forms of “negative spaces” allowing people to relax, gather and disconnect from an overconnected, homogenised life. Specific places whose properties help their users to re-calibrate their body to a natural perception of space and time—To enjoy a small talk with friends or strangers or to read without constant notifications. These potential places might even develop their own internal rules or etiquette, locally inviting their users to the (re)discovery of pre-digital civicness and social interactions. The formal design of these programs should integrate appropriated symbolics and specific kind of furniture, internal layout organisation, etc.

These proposals for “negative spaces” may take different forms regarding the location, the nature and the size of the project. They will also need to be integrated in larger configurations of connected and unconnected places. In that direction, it is possible to imagine the deployment of “off-chapels” in a european city center, with a tearoom or a café to spend lazy Sundays.— The upcycling of historical “Bandstands” into “blackout-gazebos” or “offline-kiosks” as a small enclaves to play cards, escape or relax in the middle of a fully connected metropolitan park.—A small “off-playground” nested between buildings in the density of Manhattan, with a large faraday umbrella and a place for kids to play away from electromagnetic pollution.



Music Kiosk in Cambrai

One of the oldest “kiosque à musique” in France situated in Cambrai and built in 1867 with a steel and wood structure. Similar kiosks are dispatched in many metropolitan parks, squares, and may be upcycled in the postdigital age.

The legislation of such projects in the cities will probably need to evolve in order to integrate this non-tangible extension of spatial consciousness. Urban legislation and building conventions may appear consequently in order to protect the citizens. Indeed, the design of non-traceable spaces in the city such as “negative spaces” may be envisioned as “cryptographic spaces” rising political / ethical questions related to individual surveillance, freedom and privacy, especially in the complex and unstable world we are living in.



One Nation Under CCTV

One Nation under CCTV (2008) painted in London by the street artist Banksy can be understood as a critical, crypto-anarchist

work calling the awaking of citizen against over-surveillance. It is no coincidence that London is the city with the most surveillance camera per inhabitant in the world. The wall painting was removed one year after its realisation, in a controversial situation.

The use of “negative spaces” might empower the privacy of individual for the good sake and civiness as much it has the potential to support illegal or dangerous behaviours such as drug retailing or murder. Another common question may reside in the capacity of calling emergency services in such disconnected spaces. This **ethical debate** is very similar that the recent one about the traceability and legality of 3D-printed firearms mentioned in the other essay Redistributed Manufacturing. It will take an important role in the evolution of the postdigital cities organisations.



Harajuku Smoking Pavillion

Harajuku Smoking Pavilion
Project, Tokyo, Suppose
Design Office, 2013

“From smoking to instant messaging”

Public smoking policies may unveil potential solution for urban planning in overconnected smart-cities. Once “ubiquitous” smoking was allowed everywhere in the private and public space, in indoor and outdoor situation. The progressive discovery of smoking health consequences had very important **repercussion in public habits**, urban legislation and **spatial design**. The increasing consciousness of electromagnetic consequence might lead to new urban planning policies. The use of mobile phones is for example already banned from specific areas such as planes or certain hospitals.

Tokyo is progressively shifting from a ubiquitous (homogeneous, non-spatial) to a spatially determined (heterogeneous) perception of cigarette consumption. Smoking in the outdoor public space has been banned in some districts of Tokyo since 2007 and specific “smoking area” has been consequently disseminated in the city. The architecture and urban furniture is following this recent politico-spatial shift with the design of various restricted smoking pavilions and cabins dispatched in the cityscape. It is possible to imagine similar pavillion or delimited areas with restricted electromagnetic access for health and sanity purpose in fully connected “smart-cities” In a totally opposite direction it is possible to imagine a multitude restricted “connected” points with small range access in an overall non-connected city for similar health purpose.

@futureoutdoors	#fullspectrum	#urbanlegislation
@gabrielcuellar	#electromagnetic	#debate
@theberlage	#countersurveillance	
@adamharvey	#thermalvision	
@erichughes	#faradaycages	
@transcendence	#antidrone	
@thedarkesthour	#homenotahouse	
@sarahvansonsbeeck	#technicalinstallations	
@reynerbanham	#stube	
@georgsaal	#deteritorializedmilleus	
@centrepompidou	#fallingwater	
@frankloydwright	#technologicalresillience	
@philliperahm	#cyberluditte	
@nest	#upgradearchitecture	
@jykwonjub	#technostalgia	
@johnnylui	#postdigitalrecalibration	
@mediahousebcn	#architecturaltypologies	
@herzogdemeuron	#fullspectrumcomposition	
@prada	#assymetry	
@mitmedialab	#domesticenvironment	
@jamescole	#offroom	
@berckleydesigninstitute	#offbed	
@slowwest	#hacking	
@liamyoung	#publicspace	
@grovesensors	#positivespaces	
@raspberrypi	#inputoutput	
@smlrl	#internetofthings	
@bergcloud	#IoT	
@jurgenmayerh	#sensing	
@thibaultbrevet	#venicecampo	
@estudioherrerros	#wifiscape	
@matthieulehanneur	#negativespaces	
@daftpunk	#blackoutgazebo	
@banksy	#cyptographicspaces	
@supposedesignoffice	#security	
@makecollaborate	#surveillance	
#wellconnected	#civism	

0 7

POSTDIGITAL AESTHETICS IN ARCHITECTURE

The deep integration of digital culture

A global phenomenon
Cultural indifferentiation

The mediatic transition

Digital artefacts and Language
The birth of “emoji-architecture”?!

The architecture for/by digital natives

Millenials, generation Z and beyond
Immediacy and architectural flattening

“The New Aesthetic”

James Bridle
Postdigital Aesthetics of Failure
“Youth Mode”

“Digital culture goes beyond the technology—Digital culture is how we live our lives in and around digital technology—and it’s how that infuses who we are, what we do, and what we make, including artists. Love letters written in FB Messenger; emoji celebrating the birth of a baby. [...] It’s the rate at which information travels, and how comment culture affects our public discourse. It’s how these things are reshaping in the context of digital technology. It’s the vanishing of interfaces between technology and human input, and whether or not that needs to be addressed, It’s the growing of the ‘global village’ and the problems with how we fit that in our head. It’s a bunch of practices that are inextricable from living in the world in which we live, and which have new storytelling practices emerging or re-emerging from them. It is not the technology, but how we are humans in the context of it.”

—Hannah Nicklin¹

The deep integration of digital culture

As explored in Postdigital building or Full-spectrum architecture, the postdigital age is an upcoming period where architects will inevitably need to consider digital concerns in their projects—concerns related to “pragmatic” problematics such as technology, space, economics or ethics for example. The integration of the resulting digital culture will also be a consequent element for the ar-

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www.hannahnicklin.com/about/

chitecture of the next decades. Digital culture is progressively becoming a universal standard in the postdigital age. To the point it cannot be envisioned as an autonomous subject anymore. It is actually either extending or consolidating other cultural productions in so complex imbrications that is almost impossible to observe them separately—We are witnessing a deep integration of digital cultures in every part of the human culture at a global scale.

A global phenomenon

It is true that digital culture is for now more present in technological environments such as large cities in developed countries. However, it would be a big mistake to understand the propagation of digital culture to these milieus. The phenomenon is actually impacting wider environments, also present in rural or remote territories and in a majority of developing countries. The Digital culture evolves extremely fast and takes peculiar forms, related to context and locally encountered cultures. It is important to remember that digital technologies are quickly spreading all around the world, often before the access of clean water, food or physical infrastructures. Mobile telephony is for example one of the most important element in contemporary african economic dynamics. A lot of services are provided in african countries through SMS-based systems, like mobile banking or payment services, developing faster than in the some western countries. The emergence of african smartphones is expanding fast. It will lead to a new wave of innovation and the shaping of digital culture emerging from it.



African pay-phone systems

SMS-Payment systems
and smartphone develop-
ment in Kampala Uganda,
Margaux Pelen²

Cultural indifferentiation

The deep integration of digital culture in the contemporary society is a major postdigital phenomenon in itself. It is a good tool to better understand the conceptual differences between the “digital architecture” explored in the last decades; and the recent emergence of a new form of “postdigital architecture”. As Florian Cramer claims:

“postdigital neither recognizes the distinction between “old” and “new” media, nor ideological affirmation of the one or of the other”.

Having this in mind, postdigital architecture is expected to face a deep integration of digital culture within its own culture, a large cultural heritage from thousand of years. The proactive distinction between old and new from architectural culture will not be at the center of the architectural discourse, rather the integration of current concerns, digital or not. The results of this deep integration will be observable in every parts of the architectural practice: in the design of the buildings as much as in its representation to the world—new narratives and the aesthetics it consequently develops.



Predator Drone War Rug

A Predator (drone) war rug, Pakistan, 2014. This rug crafted by Afghan refugees integrate stylised version of american drones in a traditional rug composition and colour scheme. It is an interesting example of the deep (cultural) integration of new technologies in a local culture and a traditional craft.

The mediatic transition

“The medium is not only the message, the medium is the mind. It shapes what we see and how we see it”

—Nicholas Carr³

One recurrent characteristic of the postdigital condition lies in the massive democratisation of the means of production and distribution through digital tools. As explored in the Prolog and other essays, the digitalisation of communication, computation and fabrication technologies fundamentally transformed the organisation of these phenomena. The Internet and cloudification decentralised the communication forms and made information ubiquitous. Digital

fabrication empowered individuals to produce their own goods and re-questions in depth the current logistic and economic systems we took for granted for half a century.

This “digital democratisation” witnessed in the digital revolutions was accompanied since the beginning of the 2000s by a significant “mediatic transition” from relatively linear, traditional analog medias, to new diverse, distributed and interactive digital supports. This phenomenon happened without the disappearance of the former media that have been re-investigated, adapted and combined with the new ones. This mediatic transition evolved to the benefit of “new digital platforms” that extended the pre-existing media systems and which appeared with their own new specificities. A multitude of Social Media⁴ emerged and were developed to a global scale never observed before. It is safe to declare that Social Media immediately took an important position in the everyday life and cultural habits of digital natives adopting them. It already provided, and will keep providing a major contribution to the shaping of the ongoing digital culture. New “digital tools” were specifically designed to support the development and the use of each social media, understood here as a “digital infrastructures”

These tools could not emerge without the technologies and the infrastructure they are supporting. The hyperlink, as a historical example is supporting the possibility of non-linear reading that has been initiated by the digitalisation of text. Hypertext navigation became a standard reference for all digital text for both online and offline products. Its usage is still evolving, replacing sometimes former organisational forms such as footnotes, indexes or chapters. In the more recent history of these digital tools, other tools appeared and took an extremely important place in the shaping of the digital culture. The search bar, the #hashtag, the “Facebook like” the concepts of “follow”, “forward” or “re-tweet” and their associated buttons. Some specific app “features” such as sounds, or visuals, images “filters” “tag clouds” have been already deeply integrated in

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“Social media is defined as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0. Furthermore, social media depend on mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content” —Wikipedia

the common culture of the last years. Many other tools will emerge and disappear along with the new digital platforms to come in the next years, some of these feature will be temporary, other ones will become historical references as it is already the case for the hyper-link. Each of these “digital tools” can be understood as much as “visual element” with their own aesthetics, than organisational artefacts with their own protocols and etiquette. They have various usage particularities : aggregation, indexation, navigation, validation, hierarchisation, etc. However, they have all the in common the primordial function to manipulate large quantities of information, in a nonlinear and dynamic, evolutive way. These new “digital artefacts” are certainly contributing to the shaping of our current culture and furthermore, influence even the development of new thinking forms, cognitive habits. They also participate to the development of new visual and written languages. It is now common to observe the introduction of #hashtags as cultural reference⁵ or connotation tools in non-dynamic text, putting an emphasis on a particular #keyword or trend for example. “Hashtag fingers” are also becoming a popular hand gesture used to support oral communications a similar vein as “air quotes”.

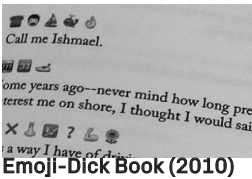


Hashtag Fingers (Nimrod Kamer)

“Hashtag fingers” was invented by the journalist Nimrod Kamer and became a recurrent feature in popular shows such as The Tonight Show Starring Jimmy Fallon.

The birth of “emoji-architecture”?!

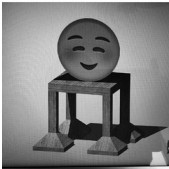
The emojis are also an interesting investigation subject. Created in 1998 in Japan and then globally democratised with the launch of the iPhone in 2007, the emojis are now considered as proper characters. They have been integrated in the universal “unicode” in order to be used in different platforms, languages, everywhere in the world. It is important to realise that they are the sub-product of technological innovation, the smartphones and have a cultural influence going beyond their original purpose. The Oxford Dictionary named in 2015 “😂” (Face With Tears of Joy) the Word of the year⁶ which can be understood as a strong element supporting the idea of a postdigital, “mediatic transition” of our global culture. The Oxford dictionary noted that 2015 has seen a sizeable increase in the use of the word “emoji” and recognised its impact on popular culture. It is no surprise that the first “bilingual” book, Emoji Dick, or 📱⁷ was crowdfunded, then published in 2010 through print-on-demand services.



It is also interesting to already observe some “appropriation tentatives” of the recent emoji language in contemporary art, fashion and even some forms of “experimental architecture”. The greek artist Andreas Angelidakis, trained as architect and close from postdigital concerns, is exploring the relationship between the density of emojis and the “venturian duck” as tool for architecture. The British architect Sam Jacob created a conceptual work called “Emojipolis” as a tool to question the relationships between this evolution of the language and the potential repercussions in

<http://blog.oxforddictionaries.com/2015/11/word-of-the-year-2015-emoji/>
<http://www.emojldick.com>

architecture. These “explorative works” are for now still conceptual, without direct applications in built projects, but have however the interest to investigate new problematics directly related to the large propagation of the digital culture within the built environment.



107 likes

angelidakis #postdigital #postduck

Angelidakis Emoji Duck



70 likes

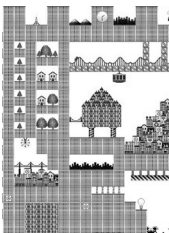
angelidakis Domino Duck #workingarchitecture

#postdigital

design #

Angelidakis Venturi Duck

Two Instagram screenshots from @angelidakis about postdigital culture, emoji and venturian duck, 2015



Emojipolis

“Language, according to the Sapir—Whorf hypothesis, shapes our

thoughts. If this is true then what might emoji's be doing to our thoughts? Now that we've begun scattering pictures amongst the traditional structures of letters, words, grammar, punctuation and so on, what kind of new thoughts might be forming in our minds? Do we already find there are some things we can only express through emoji's? How, for example, could traditional language express the exact sentiment represented by the dancing lady emoji? Emojiopolis explores one possible consequence of this communicative shift. What if by using pictures to augment the ways we describe places and landscapes we are also making places and landscapes? Could the agglomeration of symbols we tap into our screens take on a life of their own? If so then is this image of Emojiopolis might be the kind of world that emoji-speak creates. Just as Wordsworth, through written language, shaped a romantic understanding of the Lake District's landscape so powerfully that it still frames our own vision, perhaps the emoji characters will become building blocks of new kinds of landscape that could never have been conceived without them." —Sam Jacobs⁸

The architecture for/by digital natives

The long-term integration of digital culture in the architectural practice is also to be considered as an important factor in the up-coming of a postdigital architecture A phenomenon to embrace in order to create new poetic forms, to connect the built environment and the people evolving in it.

We have to remember that we [as architects graduating between the 2010-2020's] will work with clients having a very different perception and behaviour than our parents and professors. Different culture, different needs and desires. The so-called “**generation Z**” born after 2000 will enter in the active life around 2030, in the midst of our professional career. If our generation born between 1990 and 1995 are the first generation of architects to be considered as **digital natives**⁹, A large part of our client from generation Z will be the first generation of “true, or “full” digital natives having also integrated advanced digital culture since their birth, cloudified spaces, information ubiquity and emoji as few examples.

Dear Santa,
How are you? I'm good.
Here is what I want for
Christmas.
<http://www.amazon.com/gp/product/B0032HF60>
Mrekes9_hps_bw_g2l.
if03?pf_rd_m=ATVP
DKIKX0DER&pf_rd
s=cmr38&pf_rd_r=1X1W4
42HAK03Y78MVAQNM
6pf_rd_r=101pf_rd_r=12159
0154L&pf_rd_r=176529

Amazon Santa Letter

What does it means to
design buildings for digital
natives ?

For people who are
currently growing up with
a very different perception
of the world ?

To question the rise of digital natives architects, is also to question the shaping of their architectural culture that will progressively be developed in the next years, the next decades. By studying the social or cultural particularities of the digital natives, it may be possible to already foresee recurring patterns, opportunities to think an architecture better adapted to postdigital condition.

Dealing with a context transformed by digital culture, we will face new business and spatial ethics, new communication strategies: The visual representation and storytelling of architecture is already evolving since few years at a fast pace. The large propagation for example of “rendering culture” and video medium in architectural representation. The booming of social media dynamics and the increasing influential power of architectural blogs.

Immediacy and architectural flattening

“The printed page, the dominant information medium of the past 500 years, moulded our thinking through, to quote Neil Postman, “Its emphasis on logic, sequence, history, exposition, objectivity, detachment, and discipline.” The emphasis of the Internet, our new universal medium, is altogether different. It stresses immediacy, simultaneity, contingency, subjectivity, disposability, and, above all, speed. The Net provides no incentive to stop and think deeply about anything, to construct in our memory that “dense repository” of knowledge that Foreman

cherishes. It's easier, as Kelly says, "to Google something a second or third time rather than remember it ourselves." On the Internet, we seem impelled to glide across the slick surface of data as we make our rushed passage from link to link."¹⁰

—Nicholas Carr

The phenomenon described by Carr, is one central element of the postdigital condition — the flattening and acceleration of information, and its cognitive, cultural consequences that are changing the relationship of digital natives with the notion of knowledge and skills. This phenomenon provokes consequently a “densification” and probably a certain impoverishment of the contemporary culture : a certain flattening of information in a world ruled by the speed and density of fluxes. The propagation and the popularity of emojis is a perfect example, as the reduction a feeling in a single visual icon easily transmitted, compact and subject of interpretation.

Since the late nineties, it is possible to observe, unfortunately or not a visible “simplification” of the architectural discourse in many influential practices. The reduction of complex design strategies into simplistic design gestures, easily graspable for the “uneducated” clients and the mass audience. The advent and popularisation of “diagrammatic architecture”. The recurrent presentation strategies consisting to a apparently logical sequence of successive design steps. The popularisation of “bold concepts” easily graspable and shareable. Andreas Angelidakis develops a large part of his artistic work around these mentioned phenomena under the concept of “Abbreviation”¹¹. His explorations about

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“CARR, Nicholas, The Big Switch, 2009. “the medium is not only the message”, p.208
https://s3-eu-west-1.amazonaws.com/postdigitalcultures/2015/PDC2015_handout_EN.pdf

“1-click architectures” are particularly interesting because it is pushing the boundaries, with a certain irony of what corporate / mainstream architectural practices are currently doing in more “subtle” ways. Angelidakis is comparing the current Abbreviation of architecture (in the age of internet as information highway)—to the venturian duck, originally designed in order to grasp the attention of drivers in high speed roads in strip urbanism. In that viewpoint, the notion of Abbreviation in architecture may be considered as relevant in a context of informational saturation where the attention of individuals is becoming an expensive resource. Marketing and communication strategies are constantly developed by the professionals to gain and keep the extremely evanescent attention of digital natives, as determinant part of running business strategies.



1-Click Architecture Geneva

The proposal for “a 1-click solution” for a renovation project in Geneva. To paint the building integrally in white. to put the building out of context in a grey-beige city and attract the flaneur’s attention (2001)

From these [quite pessimistic] observations, a critical posture need to be developed. Should architects develop “resistance” strategies against this **cultural flattening** and informational acceleration ? To keep designing and communicating “subtle” architectural projects, to keep developing complex architectural theories ? Or in the opposite direction, to accept this paradigm shift and em-

brace these phenomenon in order to develop new storytelling and new aesthetics ? If yes, is architecture doomed to drastic simplification ? It is possible to “subversively” separate the quality and subtlety of a building from its apparently simplistic representation/discourse ? From the acceptance or the resistance to immediacy, new kinds of beauty standards, new languages that will be integrated in architectural programs and construction methods. New symbolics that may appear in architectural ornamentation.

“The New Aesthetic”

“[I’m going to talk today about a project] that I’ve been sort of accidentally engaged in for the last six months or so, to which I gave the name “The New Aesthetic,” which is a rubbish name but it seems to have taken hold. And people are responding to it, which is good. And I’m going to try and talk through some of the symptoms of that, this project, this way of seeing, that is itself about ways of seeing. And this talk is about the aesthetics of that. So this idea extends in all directions and through all forms in media and technologies. [...] I started noticing things like this in the world. This is a cushion on sale in a furniture store that’s pixelated. This is a strange thing. This is a look, a style, a pattern that didn’t previously exist in the real world. It’s something that’s come out of digital. It’s come out of a digital way of seeing, that represents things in this form. The real world doesn’t, or at least didn’t, have a grain that looks like this. But you start to see it

everywhere when you start looking for it. It's very pervasive. It seems like a style, a thing, and we have to look at where that style came from, and what it means, possibly. Previously things that would have been gingham or lacy patterns and this kind of thing is suddenly pixelated. Where does that come from? What's that all about?"

—James Bridle, 2011

The “**New Aesthetic**” is a term and an artistic posture that had been developed by the British artist James Bridle on the dedicated platform new-aesthetic.tumblr.com since 2011. The New Aesthetic is an ongoing project that collect and criticise “phenomena” or art pieces that are related to the “materialisation” of the digital culture in the physical world. New Aesthetics that could emerge only due to an evolution of the human perception influenced by digital technologies”. The New Aesthetic share interesting common characteristics with the postdigital observations that were done by the musician Kim Cascone in 2000 in the essay “***The aesthetics of Failure: “Post-Digital” tendencies In Contemporary Computer music***”. From that viewpoint, The New Aesthetic can be understood as a postdigital phenomena, as a proof of a deep integration of digital culture in our current society, a form of “cultural derivation” of technologies that could be also understood as the transition to “second talking dog phase” for digital technologies.

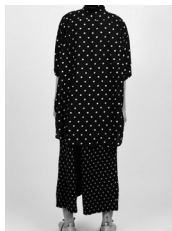
Cascone was actually the first to mention the term “post-digital” in 2000, and the world was closely linked to the world of contemporary electronic music. This definition is useful to grasp and shape our current understanding of the world. They underline important concepts that bring new possibilities for architecture. With the first mention of “post-digital” Cascone is praising a new kind of movement of digital music that is shaped by the tool producing them but also by a new attitude from musician towards their tools, and their own characteristics. A condition where the un-

avoidable imperfections and technological failures are embraced to create new sounds and new emotions directly connected to them. The appropriation of digital by-products such as “glitch” “noise” “snap” directly as tools in the musical composition¹².

It is very interesting to observe the recent consequences of the “New Aesthetic” in a variety of cultural production of nowadays. In contemporary art, fashion, communication, even at a prototypic level, architecture. The New Aesthetic may be used to create emotional connection between space, the build environment and its user, especially Digital Natives having integrated the digital culture since their birth. The first observation of the New Aesthetic is obviously related to pixelation, machine vision and visual representation transposed to the physical properties of the tangible objects and human perception. But successive generation of “New Aesthetics” will constantly evolve in relation with the used technology and related digital culture. The integration of social-media symbolism and aesthetics are also currently investigated.



CDG Polka Dot Dress



ANREALAGE Pixel Dot Dress

The New Aesthetic and perceptual deformation in contemporary fashion: the left image is one classical outfit from the Japanese brand Comme des Garçons. The polka dot is used as a signature feature in many designs from Rei Kawakubo since the 1980s. The right image is a “pixel dot dress” from the young Japanese brand ANREALAGE from the 2011/2012 collection. The dress is clearly referencing the Comme des Garçons heritage and aesthetics re-appropriated through the filter of digital culture. The full 2011/12 collection from ANREALAGE was described as a “an 8-bit interpretation of the range of women's fashion”¹³

“YOUTH MODE”



Been trill NYC snapback

The integration of digital culture in contemporary streetwear can also be considered as part of the new aesthetic. Destined and appropriated by a generation of younger

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<http://www.designboom.com/design/pixelated-fashion-by-kunihiko-morinaga-of-anrealage/>

digital native street fashion is integrating social medias or internet aesthetic in their visual language. The snapback cap was made in collaboration between the street art collective #beentrill and the New-York brand 40-oz-NYC with an obvious reference to the instagram culture.



HD is Off Sweater

The black sweater “HD is off” is made by the NYC skateboard company Mood NYC in collaboration with the internationally recognised K-Hole “trend forecasting group”. The “HD is off” sweater is a reference to the current video culture in skateboard, Mood NYC is indeed producing physical good but also producing a lot of skate video distributed on the Vimeo platform.



Sculpture Amanda Ross-Ho
The Character and Shape
of Illuminated Things

**(Facial Recognition),
2015—Amanda Ross-Ho**

As a good example of the transposition of machine vision in the physical world. The sculpture in the public space is referencing to the face detection systems present on current point-and-shoot digital cameras and smartphones. Digital culture is used here as a “common ground” to emotionally connect the city dwellers with contemporary art.



Google Earth Dead Pixel Large



Google Earth Dead Pixel Close

Dead Pixel in Google Earth, 2008-2010 by the dutch artist Helmut Smits. This also can be understood as an early example of postdigital landscaping / art project with a reference to machine vision and digital representation.



HEEEEEK : Large View

H3333333K I(2015) is a permanent art installation designed by the Medien-gruppe Bitnik as the physical translation of a digital image error, a glitch, onto the façade of the museum «House of Electronic Arts Basel» (HeK). It can be observed as an early example of the deep integration of digital culture in architectural

narratives. It is also a good example of the possibilities for the New Aesthetic in architecture.



HEEEEEK : Close-up Photo

“Bitnik’s public art piece for the House of Electronic Arts in Basel echoes the dedication of the HeK to a radically contemporary use of media within the arts. The Glitch refers to current art production, which involves reflecting its underlying technological and social conditions. It also alludes to the intrusion of chance, temporality and playfulness caused by erroneous data transmissions. But where the digital glitch usually is a very short-lived phenomenon, Bitnik here translate it into a long term public art piece. H333333K I engages with the building by applying a visual software error, a glitch, directly into built stone. The glitch is staged as an architectural dimension, subtly shifting parts of the buildings façade and giving it a surreal property.”

The apparition of the new aesthetic in architecture is currently observable in ornamental or facade design, but it may even lead to architectonic mutations in the next decades.

- What's the architectural equivalent of a ctrl-z ?
- Why digital native are so in love with “glitch architecture” ?
- Can we physically “swipe to unlock” a door ?
- What's about instagram filters integrated in windows ?



BEUYS Vitrinen HD-ON



BEUYS Vitrinen HD-OFF

Pay an extra for “HD windows” in a contemporary art museum ?! No way!

@hannahnicklin
@margauxpelen
@floriancramer
@nicholascarr
@wikipedia
@nimrodkamer
@jimmyfallon
@emojidick
@angelidakis
@robertventuri
@samjacob
@amazonsanta
@generationz
@jamesbridle
@kimcascone
@commedesgarcons
@anrealage
@beentrill
@nyc40oz
@moodnyc
@k_hole
@amandarossho
@helmutsmits
@hek_basel
@bitnikgruppe
@josephbeuys
@makecollaborate

#digitalculture
#deepintegration
#globalphenomenon
#postdigital
#culturalindeferentiation
#warrugs
#mediumisthemind
#mediatictransition
#hyperlink
#like
#hashtag
#follow
#socialmedia
#popculture
#digitalartefacts
#hashtagfingers
#emoji
#emojiopolis
#digitalnatives
#newculture
#immediacy
#abbreviation
#1clickarchitecture
#criticalposition
#newaesthetic
#aestheticsoffailure
#glitch
#noise
#machinevision
#pixelisation
#polkadot
#pixeldot
#HDisoff
#youthmode
#deadpixel
#googleearth
#H3333333K

#beuysvitruvius
#instagramwindows

0 8

INTEGRATED AESTHETICS VS. TECHBRUTALISM

New forms of digital divide

Digital literacy
The architectural context

Digital perfection and the “quality-rat-race”

The “quality rat-race” and
integrated aesthetics
The quality threshold

Techbrutalism

Digital bricolage
A visual sampling for Techbrutalism
A short exploration of “Elysium aesthetics”

New forms of digital divide

Since at least the introduction of the VCR —perhaps the first truly domesticated computational object—it seems there has been a concerted, societal rejection of technical understanding, wherein the attitude that “I don’t understand this and therefore don’t like this and therefore I will not investigate this” is ascendant and lauded. This attitude manifests in the low-level Luddite response to almost every technical innovation; in the stigmatisation of geek culture and interests, academic and recreational; in the managerial culture of economic government —and in the elevation of sleek, black-box corporate-controlled objects, platforms and services, from the iPhone to the SUV, over open-source, hackable, comprehensible and shareable alternatives. This wilful anti-technicalism, which is a form of anti-intellectualism, mirrors the present cultural obsession with nostalgia, retro and vintage which was one of the spurs for the entire New Aesthetic project; it is boring, and we reject it.”¹

—James Bridle, 2011

The last years of the digital revolutions were a period in which the digital technologies were designed, developed and used only by a restricted group of professionals and early enthusiasts. The large majority the population was technologically segregated from an

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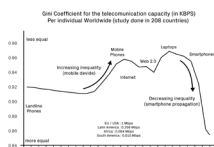
<http://www.webdirections.org/resources/james-bridle-waving-at-the-machines/>

elite having the control on the shaping and ethics of the evolving technologies. The population were, and are still nowadays in a large majority still **“digital illiterates”** having only a very superficial understanding of the complexity of the digital systems they are using everyday. Someone using a smartphone is not necessary conscious of his own usage, ignoring the mechanics behind the interface provided to him. However, a certain technological maturity inherent to the postdigital condition is progressively, slowly changing this socio-technological condition. The average citizens are slowly gaining consciousness of the complexity and the power of the dense digital layer they are evolving on. Their “digital literacy” is progressing in parallel of the emergence of a more mature digital culture. As example of this progression, digital fabrication and programming are becoming more popular. A series of ludo-educative applications of digital technologies and programmation are emerging in a same way it used to before electricity and chemistry few decades ago—the behaviour and the technological skills the last generation of digital natives are proving these tendencies.

If the **digital divide** is progressively fading in the original definition we had from it², but is evolving in new forms. We are facing in the early years of the postdigital age, a kind of historical situation in the “ideological war” between technological control and transparency. Political and economic battles between a traditional system based on “technological patents” and open-sourced initiatives, between capitalism and “digital communalism”³—in a more material way, between “opaque” integrated designs, and more flexible, composite designs. As explored further, this **technological schism** is mainly based in the intellection of digital as a perfection ideal. The issue of these battles concerning our definition of “digital” will be determinant in the shaping of our postdigital world in a long-term vision. As consequence, architectural ethics and aesthetics will be impacted too.

2 Digital divide is a term that refers to the gap between demographics and regions that have access to modern information and communications technology, and those that don't or have restricted access. This technology can include the telephone, television, personal computers and the Internet.

3 Read : GUIDONI B. & BUJNOWSKYJ M., MK-CO #conversations, 2015 — “a collective form of individualism”



GINI Digital Divide Diagram

The evolution of the “digital divide” following the evolution of the technological penetration of digital tools (generations of innovation : phone, laptop, smartphones etc.)

The architectural context

The quote from James Bridle: ***“societal rejection of technical understanding, wherein the attitude that “I don’t understand this and therefore don’t like this and therefore I will not investigate this” is ascendant and lauded***” is presented in the original context, as a general situation in our contemporary society. This statement is also symptomatic of the architectural profession. Until now, the large majority of architects were not concerned with digital technologies, even less with the digital culture because their education was not including advanced courses related to digital technologies.

The digital divide was, and still is very present within the architectural profession. Architectural historian Mario Carpo, fairly observes that: ***“architecture was an early adopter of digital tools. Starting from the early 1990s, digital design theories pioneered and often anticipated the digital turn. Now gone mainstream digital technologies seems to be nurturing a new and pervasive style of digital making”***⁴ but these explorations were achieved by a very restricted group of “digital architects” with a specific background and often hybrid education between architecture and digital

tal technologies that we can compare to a “technological, corporate elite” with their own language and culture. If considering the architectural profession as a population, the rest of the profession was [and still is] digitally illiterate. In this precise case, the mastery of CAD softwares that is now a standard, should definitely be not considered as a technological formation because the architects are using digital tools “ready to use” developed by external companies. As consequence of this digital divide within the architectural profession, a clear segregation was developed between an experimental, so-called “digital architecture” celebrating digital technologies and pioneering early forms of digital culture in architecture—and the rest of architectural production focussed in different problematics and concerns, with its own culture. In our present situation [a transitional one, likely to evolve fast] it is even more surprising to observe that the majority of young architects or architecture students are still segregating their own personal interests deeply influenced by the digital (videogames, social media, internet culture , etc.) and the relatively “traditional” architecture they are learning and producing.

The postdigital shift of architecture, as investigated in the other essays, will probably trend to erase these ideological, cultural and formal schism between “digital architecture” and “traditional architecture”. Digital technologies are already taking an important part of almost the totality of the architectural projects of nowadays, with the reign of CAD and its extension to BIM systems. Diverse forms of digital cultures will recurrently be integrated in a large majority of projects. The traditional “digital divide” and its inherent debates will fade and mutate in a **new crucial debate**⁵ for the future of the profession : the segregation between a technologically opaque **“integrated architecture”** evolving from the previous “digital architecture” explored in the two last decades—and the birth of new forms of more **“open-architecture”** based in the integration of the current social experimentations achieved in the technological and IT realms. As a more visual example, the incom-

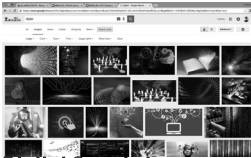
ing confrontation between the evolving forms of “parametricism” and “wiki-architectures”

Digital perfection and the “quality-rat-race”

As mentioned in the Prolog, the early “talking dog” phase in digital technologies was focused on the aggressive disruption of existing technologies, and performance-based applications. The digital transitions brought a substantial improvement of many technologies and re-organised many industries. The digital communication systems improved the quality of mobile telephony, radio and television. Digital photography, once considered as a gadget, quickly disrupted the photographic industry by constantly reducing the size of digital cameras while increasing the size, quality and ISO sensitivity of produced images. It was for example extremely rare to use sensitivities above 800 ISO in film camera, while it is common to find ISO 6400 and more, even on consumer digital cameras. In the architectural practice, Computer Aided Design (CAD) allowed the manipulation of complex geometries it was not possible before and improved the quality of drawings.

The notion of “digital” was until now intrinsically linked to **the idea of perfection**, or at least technological superiority. This observation is still common nowadays, even if the postdigital maturity through digital technologies is pushing for the exploration of new attitudes towards digital. The digital stays somehow “perfect” in the collective unconscious.

Florian Cramer mindfully observed in 2013 that the color associated to the term “digital” is blue, in relation with an a recurrent association of digital with the idea of perfection and cleanliness. ***“The first thing we notice is how the term ‘digital’ is, still in 2013, visually associated with the colour blue. Blue is literally the coolest colour in the colour spectrum (with a temperature of 15,000 to 27,000 Kelvin), with further suggestions of cultural coolness and cleanness.”***

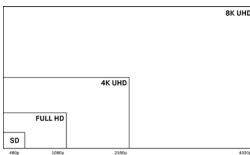


Digital Google Images screenshot

Florian Cramer's observation is still true in 2015. Digital is associated with complexity, intangibility and a recurrent form of cold perfection, cleanliness. It is also possible to add from this, the notion of continuity, curves and networks.

The “quality rat-race” and integrated aesthetics

The large majority of digital technologies were driven since their creation by a **relentless quest for quality**: the improvement of quantitative factors such as speed, size, definition, power etc. A context of constant innovation where the competition between tech companies is very hard, where the products are evolving extremely fast, where **obsolescence is programmed**. It is possible to observe a strong acceleration of technological innovation since the last 30 years, as it was already investigated in the Prolog or Post-digital building. Many laws predicting the exponential growth of computing power, storage capacity, or energetic production have been proved in the last decades. Our current society is facing a very visible **“quality rat race”** for technological innovation.



SD to HD Diagram

A perfect example to illustrate the quality rat race we are currently facing : the exponential progress in the digital video resolution standards in internet (in youtube for example) The original “360p / SD” in 2005 and “8K UHD” video in 2015. Obviously, this incredible improvement of resolution standards is not improving the quality of content, and a better technological quality doesn’t necessary mean a better product or better experience.

In the last decade, the digital tools brought us a level of perfection that was impossible to imagine with the former “analog” design and construction process. In the mediatic realm, with image and sound, but also in architecture with spatial and material manipulations. This “quality rat race” obviously brought us valuable outputs, and useful technologies, but it has also heavy consequences: to feed an insatiable desire for even more streamlined, sleek shapes constantly trying to satisfy a digital ideal of perfection. This is observable as much in product design, consumer goods than architecture. The quality rat race pushed for the reign of “**Integrated aesthetics**” since the ninties for design and architecture.



Motorola Micro Tac



iPhone 6s

The quality rat-race and integrated aesthetics in devices design. 1/ The Motorola “MicroTAC 650” (1996) with clearly visible elements and assemblage : antenna, screen, buttons, hinges, etc. 2/ The technological advancements such as touch-screen allowed the creation of integrated designs in smartphones where assemblage is hidden as much as possible and all elements merged in an monolithic objects. Here the last iPhone 6s. (2015)

These “integrated aesthetics” are the result of the strong digital empowerment of designers in the conception and construction phases of a physical product (a phone, a building, etc.) The extreme precision of design softwares and digital fabrication tools deregulated the spatial, material and scale perception of both designers and users. The autocad “Regen” tool made possible to perceive a door-hinge in the same way and precision as an coastline. The digital zoom and the scaleless vectorial precision certainly changed the understanding of space and objects. The immateriality of a vector line is very difficult to apprehend in comparison of the defined thickness of a pencil and the human “technical” limitation of the hand. The mastery of bezier curves, then NURBS made possible geometric perfection that **transformed the perception of architects**. It reinforced even more the association of architecture with a need of constant, continuous optimisation of space and materiality. The “integrated aesthetics” furthermore pushes for a visible “demate-

rialisation” of the physical reality, where materiality is becoming difficult to interpret due to the high complexity of its manipulation. Wood, metal, plastic, concrete etc. can be now transformed and imbricated to a precision erasing visible joints, or obvious material differentiations. Antoine Picon explains that digital tools created “an architecture of inflexion” or ***“fluids without clear separations [...] in contrary of a classical vision of architecture of composed elements⁶”*** As an aesthetic consequence of the “quality rat race”, the level of “integration” in digital design evolved in parallel of the advancements in digital technologies during the last decades.



UNStudio : Moebius House

The quality rat-race and evolution of “Integrated design” in the built work of “digital pioneers” UNStudio. The Moebius House (1998) experimenting the fluidity of space, with still a visible separation of materiality and architectonic elements (ceiling, wall, stairs).



UNStudio : Arnhem Station

The recent completion of Arnhem Central station (2015) exploring the same thematics, but achieving the mergence of architectonic elements. The digital transitions were important factor to the achievement of the last project (Advanced digital design, complex structural simulation, digitally made bespoke formwork, etc.)

After the gigantic quality leap induced by the digital revolutions in the 20 last years, we are now approaching **an historical threshold** that will motivate a fundamental re-investigation of the previously developed digital technologies : the unavoidable threshold of the **human natural perception**. The digital technologies may still increase their “quantitative” capacity, like size or definition, but the perception of these improvement will progressively decrease to a fixed limit. Consequently, it will incite to the development of a more mature approach towards technologies: the second phase in the talking dog story, new behaviours, or new cultures.

An example of this three sold are the evolution of screens: the progress in the definition of mobile phones screen was incredible since 2000. From monochrome, to color screen. From extremely pixelated displays, to resolutions so high it is becoming impossible for the human eye to visually perceive the pixels. The screen size are also reaching a certain size, from one-line displays, they colonised the entire surface of devices, where the physical limit of the object is reached. In parallel, different technologies appeared, due to the maturity of the technologies and the evolution of the market, **the return of a low-definition, monochrome e-ink** providing a more

natural perception of information, and an exceptionally low energy consumption. The return to lower quality levels in production of goods or services, to the benefit of other factors such as visibility, compatibility or even emotional reasons is an observable phenomenon since few years. It can be understood as an early postdigital phenomenon related to technological maturity, as researcher Silvio Lorusso investigates in his essay: In defense of poor media⁷

Techbrutalism

As a typical example of an early talking dog phase, the quality race of current digital technologies is already showing major limitations, and producing numerous “aberrations” with non-negligible consequences. It has important social, and ecological concerns. It favours an accelerating programmed obsolescence, the products and their aesthetics being quickly outdated and non-upgradable. This phenomenon is further supporting new forms of the digital divide: between “optimised” corporations keeping their technological literacy and superiority at great costs—and the rest of the population struggling to learn and appropriate less advanced technologies: there is a certain “**technological delay**” between “corporate” and “individuals” that is at the very center of our current ethico-technological debate. The professional are protecting their privately owned and developed technologies through hermetic, “perfect” products, reinforcing the “integrated aesthetics”.

As an answer to this integrated and heavily protected designs, the next generation of digital native designers and architects needs urgently to mature their relationship to this **ethico-technological impasse**. The ethics and perception of “digital” must be re-investigated in order to dissociate digital from an ideal of perfection. This dissociation will bring new opportunities for digital technologies, as it is already observable in few initiatives such as fab-labs and hackerspaces. In the postdigital age, an al-

ternative attitude towards digital technologies and integrated aesthetic must be investigated.

One possible solution may be developed in a more transparent, straightforward celebration of the digital : the appropriation of its qualities but also its limitations, its imperfections. The reconciliation of digital with its primitive form, with empiricism and experimentation. A new kind of uncomplexed, honest **“digital bricolage”** accessible for everyone, and not reserved to a technological elite or optimised corporations. This celebration of the digital must be associated to the promotion of a new kind of digital culture investigating the beauty of **“the digital layer”** in its physical materialisation, but also its intangible organisation. It is possible to compare this attitude towards digital technologies and the integrated aesthetics of digital architecture, to the situation that happen with construction and modernist architecture in the essay developed by Banham, **“the New Brutalism”**. As reference we may call this new attitude **“Techbrutalism”**.

In a context of the deregulation of the material perception, and a **“sterilisation”** of space and products, Techbrutalism may invite to reconnect the humans with their own production by celebrating the aesthetics of the making. It may showcase the traces of material transformation, the trace of digital tools and processes, leading to new poetic forms and new emotional connections between body, mind and objects. As a **“byproduct”** at the intersection of open-source ideologies, maker culture, digital fabrication, **techbrutalism** celebrates a certain prototypic aesthetics, visible assemblages and imperfection as many invitation for further extension, transformation, reparation that will inevitably lead to new forms of alternative beauty. Embracing humanity and imperfection, Techbrutalism promotes a return of the human affect⁸ in the physicality of the objects without discarding their digital nature.

A visual sampling for “techbrutalism”



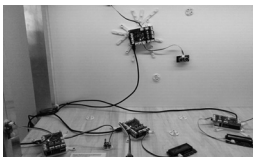
Fresh Breeze Old Smell (2015)

Fresh Breeze, Old Smell (2015) A sculpture from the young german artist Mathis Altmann as the celebration of the aggregation of disparate technological elements around a concrete mass.



Lacaton & Vassal Palais de Tokyo (2012)

The art piece might be envisioned as a synthesised condition for architecture : lighting, ventilation, structure, media installations etc. It may be compared with the renovation project from Lacaton Vassal for the Palais de Tokyo (2012) as a possible example for techbrutalism in architecture.



Raspberry Pi HEK

Another example of techbrutalism in the installation by swiss architects fabric.ch (Christophe Guignard and Patrick Keller) The "raspberry Pi" microcontrollers used in the scenographic project are mounted on bespoke, 3D printed structures, and displayed without cases. Their own properties and mechanisms are observable by the visitor, along with their cables and plugs.



Tom Sachs: godfather viewing station (2013)

The work of American artist Tom Sachs may also bring interesting hints in the definition of techbrutalism. His sculptures are celebrating the poetics of making, the transcendence of humble, common materials through a paradoxical attitude between minutiae, and human imperfection. What Sachs calls "Haute Bricolage" Tom Sachs' sculpture are extremely emphatic, emotional —

they achieve to create a strong relationship between the viewer, the object and its own material history. And can be an interesting direction for architects to follow in the complexity of the postdigital age.



Tom Sachs: Apollo LEM 1:1 (2007)

“His sculptures, which often mimic mass-produced objects, make use of humble materials and tools — Scotch tape and plywood, screwdrivers and vice grips — and the finished products have a deliberately scruffy quality, with glue drips, duct-tape traces and the ragged edges of jig-saw-cut wood left visible, foregrounding what Sachs calls the “scars of labor.”⁹”



Opendesk CNC Table Mounting

In a more subtle way, CNC furniture is also an early example of techbrutalism. It celebrates materiality

and its transformation through digital fabrication. The material history of a CNC table is easily understandable by its users : the round angles related to the end mill size, the apparent edges, the assemblage detailing, etc. They are easily mountable / demountable without instructions.

A short exploration of “Elysium Aesthetics”

The recent science-fiction and anticipation movies are interesting critical tools for architects to explore the possible evolutions of the digital technologies in built environment, and their **aesthetic consequences**. The science-fiction thriller **Elysium (2014)** is a particularly interesting example to observe the aesthetic consequences of a socio-technological (fictional) context presented as an extreme vision of our current socio-economic paradigm. The story takes place on Earth, in a relatively near future in 2154. The majority of the population live in extremely difficult conditions in an overpopulated and polluted Earth controlled by a small group of “privileged” exploiting it, and controlling it through superior technologies. Our planet becoming barely liveable, the “privileged” are living in an ultimate form of gated community: a luxurious orbital space station, Elysium. In the plot, **the class segregation is also a technological one**. The privileged have the most advanced technologies, in term of lifestyle, entertainment and healthcare while the poor populations on earth are living on self-improved, technological residues and second-class technologies.

It is interesting to observe that the film visually support this clear socio-technological divide with two kinds of aesthetics that are easily transposable to the previously explored notions of **integrated aesthetics** and **techbrutalism**



Elysium: Integrated Limousine



Elysium: Hacker Race-Car

The opposition in transportation systems: a streamlined limousine with monolithic design, integrated cold lights, no mechanical elements. A "hacker style" race-car with a visible aggregation of technical elements, shown here as progressive, incremental improvements. Composite wheels, cameras, and safety labels.

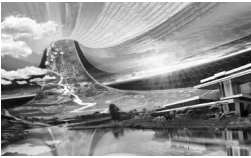


Elysium: Prada Escort-bot



Elysium : Nurse-Bot

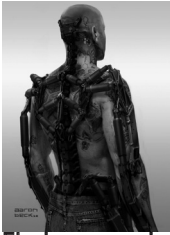
The design of “privileged” cyborgs have also strong integrated aesthetics. They are associated with pleasure, luxury brand, and healthcare. In this case, a Prada Escort-bot and a Nurse-bot. Both are anthropomorphic, with smooth and shiny surfaces. They have fluid articulations: no visible assemblage, no screws, opaque and “proprietary” design with brand and logo.



Elysium: Internal Perspective (tore)

The architectural design of Elysium is also following specific codifications : the Hexagonal skin evokes an idea of complexity and technological perfection. Few pieces of architectures are dispatched in a land of green, where everything seems fully integrated.





Elysium: screwing exoskeleton

The “exoskeleton” of the main protagonist is an extreme example for “techbrutalism” at the intersection of counter-culture (tattoos), “digital bricolage” and advanced technology. A powerful, cyberpunk representation where technology is celebrated by help of visual, recurrent effects: screws, visible assemblages, triangulated elements, voronoi geometries, chips, cables — Row (in this case violent) interfaces between the biological and mechanical elements.

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