Data-driven urban planning.
Pros and cons from city-planning point of view.
An overview of what the smart city movement has been so far.

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***Abstract* - In the past twenty years, we faced a radical change in computer performance: they became more and more smart, powerful and portable, spreading all over our inhabited space. As an inevitable consequence, since the early 2000s, ICT companies started to deal with the increasing amount of data produced by the internet and personal smart devices.**
Nowadays data and information are strongly affecting the way we do and look at things. Even, cities have been involved in the so-called Internet of Things: today, sensors permeate cities, creating an exponential growing amount of raw data spanning different areas of the urban environment, from traffic to human behaviors. Consequently, ICT companies have started playing a crucial role in the decision-making processes related to city management.
But what are the pros and cons in this data-driven decision process? How does it affect the process of managing not just issues like traffic but the whole environment of a city? An overview from city-planning point of view is reported in this paper.

***keywords*: city planning, smart city, serendipity**

I. INTRODUCTION

It was 1994 when Rem Koolhaas in his essay 'what ever happened to urbanism' straightforwardly declared the death of the urbanism, claiming that "modernism's alchemistic promise – to transform quantity into quality through abstraction and repetition – has been a failure, a hoax: magic that didn't work". Yet, Koolhaas related architecture's and city's changes to current social, economic, and cultural issues [1] and, by doing so, he refused definitively modernism and its *modus operandi* with which portions of our cities has been built in the last century.
According to Koolhaas, urbanism dissolved in the time of the major needs; since urban population is growing and the urbanisation process is at its peak, the quest for new urban space is increasing exponentially. For the first time in history, architecture and urbanism have been cut out from the decision-making process that leads the delicate process of envisioning and designing the city's transformation.
So, where have we headed in these years?

II. TODAY'S SMARTNESS

An all new way to look at things that matter in a city arises, as consequence of the exponential diffusion of the internet - from our homes to the public environment.
Since the early 2000s, some of the largest ICT companies - e.g. IBM, Cisco, Samsung - become the main actors in the decision-making process related to city management. This trend begun as soon as the term "smart" started becoming the driving paradigm of the XXI century city's transformation plans (see Fig.1).

Fig. 1. IBM Ecosystem Infographic Building a Smarter City and State (source: ibm.com).

They are not the only new protagonists: the diffusion of internet-connected devices has brought to people-citizen new ways of gathering in as well as acting for the urban space.
As highlighted by Renier De Graaf - head of AMO, OMA's research and design studio - cities are now ruled by someone "who usually build chips and software," driving the urban transformation from the spontaneity of the interaction in the urban life to the utopia of full control and forecast of events [2].
This trend has been clear during the last decade in the Asian countries and some of the South American megacities: the impelling need for new apartments as well as the need for effective heal to traffic and security have been followed by a vast city-wide application of sensors managed by control room.
IBM, CISCO and many other share their own vision on how to make cities sustainable and efficient again. They offer hardware, software and even models of development to make a city smarter. Less than five years ago, the Rio's mayor, Eduardo Paes, invited IBM to design a system able to integrate city-wide data. This system is currently running 24-7 at the Operations Center of the City of Rio's control room, where a giant wall of screens displays in real time what's happening across the city (see Fig. 2).

Fig. 2. Centro de Operações do Rio de Janeiro (COR) Prefeitura do Rio (source: Andre Vieira for The New York Times).

In a 2012 interview for the New York Time, Guru Banavar, IBM's chief technologies officer of the global public sector, called "sense-making software" the ability to process all the collected data and, using computer algorithms, to identify patterns and trends [3].
The control room in Rio is just one example of the many megacities control rooms located in America and Asia. European cities are moving toward this way as well by financing the so called "smart district" project. In Segrate - province of Milan, Italy - the first smart district will be built as a result of a partnership between the Sagnelli Associati, the Politecnico of Milan, IBM and Samsung. They provide respectively the architectural concept, the energy management model and the digital infrastructure. The expectation is to make revenues from the acquired data (see Fig. 3).

Fig. 3. Sagnelli Associati's Masterplan for Milan4You (source: sagnelliassociati.it).

The change of paradigm has been made possible by the transition from analogue to digital technologies, thus allowing the construction of small and low-cost sensors of different kinds powered by growing computing and networking infrastructures. This allows objects to sense, act and communicate with each other, thus making raise what we call the Internet of Things (IoT).
The massive use of internet-connected devices has unveiled a new design tool: information. During the last two decades, information became the new ink through which analyse and design cities: basically, to draw its real shape and appearance. It is not difficult to believe then that the amount of data produced every day is exponentially increasing.

III. PROS & CONS

The consequences of data driven city management have still to be fully understood: while new disciplines are born and others seem to struggle update, this revolution broadens the capacity of understanding the city dynamics. Mobility, water management, energy consumption, safety perception, social interaction, everyday human activities, economic events are just some examples of what it is possible to quantify, squeeze into a spreadsheet and analyse.
The first positive aspect that the smart city movement has brought is certainly that "quite suddenly, it appears that cities have come back onto the research agenda" [4]. In his paper, Batty explains the reason of this trend, setting the possible causes promoting the exponential growing in cities inhabitants in the next few decades so making cities the new economy engines. As a result, the research agenda of municipalities involves a broader group of specialists: not only architects, urbanists and sociologists, but also statisticians, programmers, mathematicians, and ICT professionals. Cities have always been a fascinating topic for architects, urbanists and majors, which envisioned the ideal city: from the Le Corbusier's Ville Radiuses since the today's masterplans, those visions remained unbuilt because of questionable technical solutions, uncertain project feasibility and/or political instability.
As a result of this renewed interest of other disciplines for cities, the urban professional is slowly starting to widen their ability and body of knowledge. Despite Sidewalk's CEO Dan Doctoroff likes to point out that urbanist and technologist do not speak the same language, urbanists like Rohit T. Aggarwala at Sidewalk keep sharing their knowledge to make urban life better. "One thing I've learned along the way is that technologists love to approach problems from first principles, focusing on essentials rather than on existing practice. But I've recently found myself turning to first principles because so many of the questions we need to think about focus on how technology will change the cities of the future" [5] (see Fig. 4).

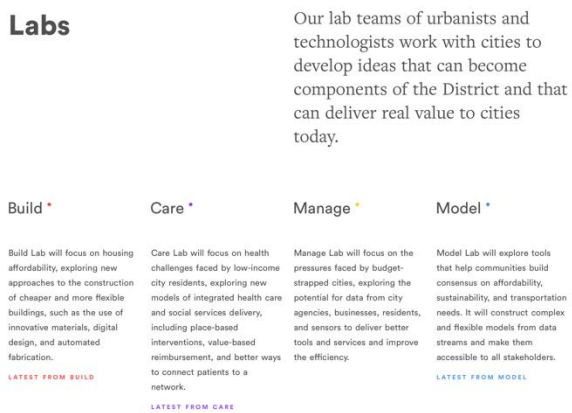

Fig.4. Modus operandi at Sidewalk Labs (source sidewalklabs.com).

To manage the complexity of the contemporary city, multidisciplinary work teams and hybrid professions are a *sine qua non*-condition.
This revolution is not just cognitive, but it affects our way to experience and gets emotionally involved with the urban space as well.
We all have been witnesses of weird behaviours from people with a smartphone in their palms in the last years: what Pokemon Go's Augmented reality suddenly showed us is how easy is today to merge digital and physical space. And this has rather incredible potential for either leisure or urban planning.
Augmented and virtual reality technologies may support not just playing activities, but can significantly enrich the whole urban space. In Singapore, the French software company Dassault Systèmes is creating a data-enriched virtual city [6]. The technology behind this project - called 3DExperienced - is the latest and the most sophisticated attempt to create an all-seeing "urban dashboard". Thanks to the huge and heterogeneous amount of data produced by the city every hour, information about a specific city site is made available in real time. For instance, people can zoom out to explore local transit connections, traffic conditions, weather patterns, or public health data. Furthermore, designers can explore how future buildings will impact shadows, and officials can simulate disaster evacuations.

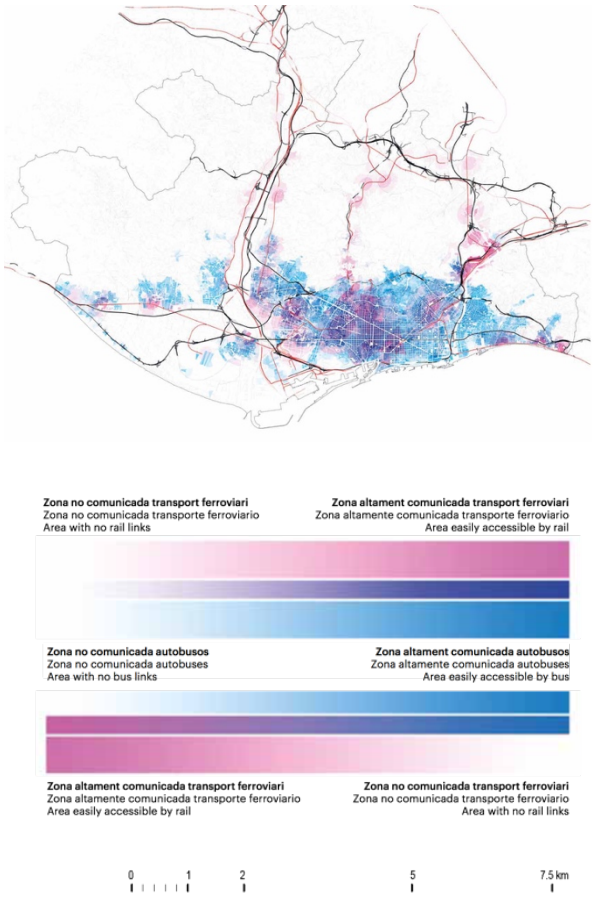

Fig. 5. Visualization of public transport system in Barcelona (source Atles Metropolis BCN - 2015).

Many municipalities worldwide are dealing with this data-driven revolution. In 2015, the Metropolitan Area of Barcelona (AMB) published its report about the real nature of today's metropolis (see Fig. 5). The work was carried on using a large amount of data produced by the huge IoT infrastructure. The output is a series of portrait of Barcelona, each one of it describing a different characteristic of its dynamics. Beside the stunning potential in visualizing the data, the municipality has begun a process to review the tools now in use – like masterplans, that take years to design and decades to carry out, while the city change. Barcelona is one of the most active places where these new tools and data-driven approaches are being tested. In the future years, we will witness - both as citizen and architect - how all these best practices will affect the city, from the design process to the regulation.
All the examples listed above are undeniable pros related to new technologies. Indeed, to achieve more sustainable and efficient environment we need the clearest and deepen knowledge to understand where and how to act to achieve the best result.
But we have not to forget the true nature of our cities. A city is not a car, a smartphone, an Amazon's dash button or any other electronic device with an operative system based on string of codes which manage well specified and unique operations that will never be different from what they have been programmed for.
Machine learning is far more than promising and we are heading toward Artificial-Intelligence enhanced devices and systems that can really identify patterns and trends in acquired data.
Our cities' objects – from traffic light to roads - are now filled with digital sensors, creating IoT networks, but this is just the beginning. As advances in engineering and science keep rushing, we will witness the spread of much more physical-integrated digital systems, such as smart energy grids or autonomous vehicles. These solutions, called cyber-physical systems (CPSs) experience a deep level of interaction between the physical space and the computational elements. This approach will magnify the effectiveness and the resiliency of the theories and the design practices (see Fig.6).

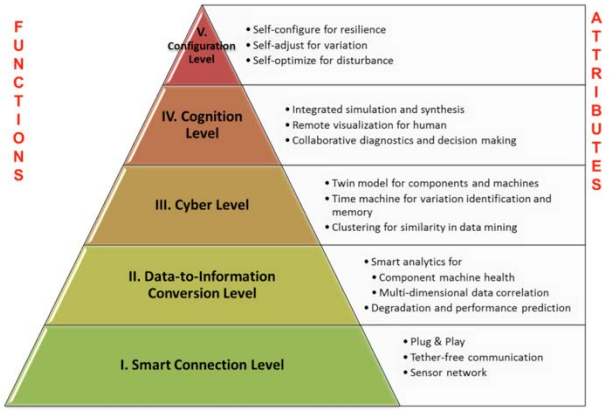

Fig. 6. Cyber-physical systems for manufacturing (source: Wikipedia.com).

As poetically described by the Canadian sociologist Jane Jacobs, the public space is where the essential to urban

life happens: “Lowly, unpurposeful, and random as they may appear, sidewalk’s contacts are the small change from which a city’s wealth of public life may grow”.
Jane Jacobs became famous for her 1961 book ‘The live and the death of great American city’ in which she claimed about the importance of social interaction to design a liveable neighbourhood. At that time, she was in contrast with Robert Moses which was a supporter of that same modern approach Rem Koolhaas tagged almost 30 years later as failed. [1]
The principles of Jacobs have been recently tested by a team of researcher of the University of Trento. No architect nor urbanist were included in the team, composed only by data and computer scientists. They basically tested Jacob’s observations by using geographical data from OpenStreetMap and the Land Use datasets from the Urban ATLAS European project. They also studied Census data to identify population and buildings characteristics. Finally, they analysed mobile phone activity and social network data from FourSquare to check venues’ vitality [7] .

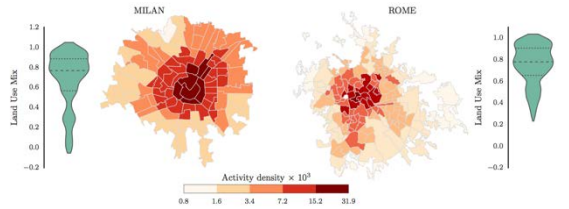

Figure 1: District activity density in Milan (left) and Rome (right), and their corresponding values of mixed land use (LUM). The colors are in logarithmic scale.

*Fig.7. M*obile phone activity and social network data (source *[7]).*

The results demonstrate that the limit between Jacobs’ qualitative observations and the research’s quantitative analysis on the urban spaces is slightly blurred. Also they show how we can support qualitative urban analysis with heterogeneous sets of data.
Due to its scientific purpose in the field of data and computer science, no practical outputs have been gained from the research, as no architect or either urbanist or sociologist was involved in it. Involving these two disciplines will surely broaden the effectiveness of the results. Architecture, urbanism - as well as sociology and other city-related professions - deal with different tools and variables suitable to analyse the urban environment. We are facing the fact that we produce many technical analyses of the problems but we still struggle to merge them together to draw useful conclusions, such as fostering economic activities to move in a specific street of an apathetic neighbourhood or review traffic flows to enhance walkability. The next challenge would be to team up in order to envision solid actions and strategies based on evidences, rather than just show the results of analysis in a map.
The fact is that the smart city movement is “creating technical rather than political/social solutions to urban problem”. [9] The city – and its users as well- has a strong qualitative component which drives its behaviours and appearance, and consequently its space, vitality, use and perception.
The cons about data-driven urbanism regards many disciplines other than architecture and urban planning such as privacy, quality of data, kind of data use, and in general a potential “big brother” effect resulting from the availability of huge amount of data.
Sure that “Data-informed urbanism today is increasingly being replaced by data-driven, networked urbanism” [9], Kitchin continues listing numbers of critiques the notion of smart city has been subject to. He gathers works and opinions to give a picture of the entity of the movement, thus unveiling the major issues that could raise we dealing with smart cities:

- smart city initiatives treat cities as a set of knowable and manageable systems that act in largely rational, mechanical, linear and hierarchical ways and can be steered and controlled [9].
- Smart city initiatives are largely ahistorical, a-spatial and homogenising in their orientation and intent, treating cities as if they are alike in terms of their political economy, culture, and governance [10].
- An emphasis is placed on creating technical rather political/social solutions to urban problems thus overly promoting technocratic forms of governance [8].
- The project of producing smart cities tends to reinforce existing power geometries and social and spatial inequalities rather than eroding or reconfiguring them [11].
- The approach fails to recognise the politics of urban data and the ways in which they are the product of complex socio-technical assemblages [12].
- The smart city agenda is being overly driven by corporate interests who are using it to capture government functions as new market opportunities [13].
- Networking city infrastructure potentially creates buggy, brittle, and hackable urban systems [14].
- Data-driven, networked urbanism produces a number of activities that have profound social, political, ethical consequences, including data-surveillance and extensive geo-surveillance, social and spatial sorting, and anticipatory governance [15].

Another interesting remark about the concept of smart city is proposed by Saskia Sassen, an American sociologist who claims that the “Smart city policies never thought to consider how social logic alter technological capabilities.” And she continues claiming that “the so-called ‘intelligent cities’ run the risk of technological obsolescence because they do not incorporate the customary deviation in their models and can become overwhelmed faster”. She supports her thought remembering that “the city is formed through its complexity and its incompleteness, its unfinished nature, always developing and expanding, with no clear limit” [16].
Yet, recently the hype around the smart city has been slowed down because of the most interested sponsor - ICT companies - realized that most municipalities do not have money to afford a radical change in the shaping and managing process of their cities; for this reason, many companies started to sell just services instead of urban plan schemes [17].

IV. CONCLUSION

Concluding this brief overview on such a broad topic like smart cities, we claim that there is no clear answer to the question if this phenomenon could be nothing but a quest for a fashionable trend, a utopia or an essential element for the future evolution of urban places. Indeed, the answers vary depending on whom one asks to. Big business, regular citizen, or professionals. The views range goes from dream to nightmare [18].

While we all are in the experimental phase, the ones who give a clear lead on how things could work are Carlo Ratti and Dirk Helbing: "Decentralized decision-making can create synergies between human and machine intelligence through processes of natural and artificial co-evolution. Distributed intelligence might sometimes reduce efficiency in the short term, but it will ultimately lead to a more creative, diverse, and resilient society. The price of anarchy is a price well worth paying if we want to preserve innovation through serendipity." [19]

The answer to the quest for a more sustainable and efficient city in all its aspect is maybe to be found in the paradigm of sharing and network the know-hows leaving behind individualist approaches whether they come from a high-tech guru company or some visionary urban planner.

The city has started sensing, the hype is descending: it is time to respond. Collectively.

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