Space as integrator: from horizontal to vertical urban planning

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Abstract

The 'smart city' as an evolving paradigm, situates at the convergence of technology and the city. In fact, a smart city's development is connected to the ICT technology in such a way that its 'smartness' translates into high technological integration. At the same time, the outer space infrastructure opened up critical information to numerous mass market applications, fostering not only urban innovation, but access to fundamental services such as transportation, provision of energy, water and food, and healthcare, among others. Smart cities use information and communication technologies to increase operational efficiency, share information with the public and improve citizens' welfare and the quality of key services. Advances in satellite-based technologies are giving rise to more competitive services, while minimizing environmental and social impacts. Certainly, these intimate integration aspects between space technologies and cities are also valid in the cases of malevolent interventions, disruptive technologies or in any other case in which space technologies are interrupted by intent, this feature trickling down inevitably to the well-functioning of smart cities. In fact, in the moments of failure it is the most visible the profound interconnections between technologies, services and societal well-being.

Historically, urban planning has considerably changed over the last century. When, as a consequence of industrialization and massive rural-urban development in the 19th and 20th century, cities expanded beyond their middle-age walls, engineers planned the urban expansion by designing urban street networks, building electricity grids, water supply and sewage networks. In the beginning of the 21st century, a new era of infrastructure development emerged and information and communication entered the

stage of urban development. Currently, the smart city adds up another dimension of urban development, one in which urbanization expansion is happening in a networked manner, giving rise to a different reality.
The networked city relies on resilience, without which expansion in the 'vertical' plane would not have been possible. Thus, drawing from disciplines of urban studies, aerospace engineering and security studies, this research attempts to answer the question related to what is the nature of the relationship between the outer space and smart cities? In order to answer it, the paper looks into the state of the art that involves the concepts of "smart city", "resilience", as well as "critical infrastructure protection" and "outer space technologies" in relationship to urban settlements. By disentangling the information provided in the literature, the current research attempts to highlight particular patterns, models, frameworks or tools to be further used and developed when discussing how smart cities and outer space are interrelated, as well as to raise critical questions on contemporary understanding of smart cities.

Keywords: *networked city, outer space technologies, critical infrastructure, smart city, resilience*.

1. Introduction

The 'smart city' as an evolving paradigm (Albino, Berardi and Dangelico 2015) situates at the convergence of 'technology' and the 'city' (Yigitcanlara, et al. 2018). While each of these two latter concepts are broad enough to basically incorporate more or less all aspects relating to economy, people, design, infrastructure and many more, a smart city is directly connected to the information and communication technologies (ICT) in such a way that its 'smartness' translates into high technological integration. Using this understanding as a common ground, this paper attempts to make a case on the ways in which we can perceive the boundaries of such a complex system of systems. Consequently, the argument is structured in seven sections as following: after this introduction, the paper asks about the boundaries of a smart city, then in sections three and four addressing a bit of a historical background of how smart cites evolved, before bringing in the real vision of 'verticalisation'. The last sections attempt to set the scholarly context and draw final conclusions. Ultimately, the paper makes a case on how intimately interwined are outer space technologies and the urban services and infrastructures that sustain our daily routine.

2. The boundaries of a smart city

The "classic" vision of the border is that of a demarcation of the nation state. Malcolm Anderson defines the border as being linked to the territory and the formation of the state, to the physical boundaries of political and legal authorities (Anderson 2013). The border can be understood as the limits of the State as a physical demarcation which is a delimitation between different authorities. When discussing the city borders, this geopolitical delineation fades away, with more emphasis on the demarcation of the city proper from the outskirts. Obviously, this limit brings forth not only ownership in terms of taking care of the city, but also raises deeper emotional states of identification.

With urban settlements expanding in the aftermath of the Second World War, and even being now in the so called the "anthropocene" period, i.e. humans overpassing the nature, the logics behind defining the city limits are also changing. From the last built house in the city to the area served by urban utilities, bordering zones were always places of contestation and resisstance. From military borders (e.g. Berlin in 1945) to economic borders (Hong Kong, among others) and to expansions of cities due to raise in informal settlements (most of the mega cities in developing countries), the boundaries of cities are dynamic and in continuous formation.

Nevertheless, all these examples have in common the idea of a finite and well-delineated territory. However, with a smart city, the territory is harder to grasp. Where does a smart city start and where does it end? What actors are responsible for bridging particular infrastructures to others, and where the legitimacy of such actors ends? And assuming all borders are well defined, whom are these borders including and whom are they excluding, because borders are neither eroding nor evolving, but are being re-articulated around the territorial exclusion of undesirables while ensuring easy access for those who have the right to move freely. If we look at the smart city as the new paradigm of urban development, i.e. a new phase of the urban, how do we related to former ideas of territory, borders, authority, and legitimacy?

3. From being smart to getting smart

The concept of 'smart city' represents the new buzz word in all discussions related to the developement and management of contemporary urban settlements. However, its definition is not agreed upon at the global level, nor by legislation, and it pretty much relies on how each of the participants in the decision making process understands and defines it. In fact, the literature argues, it is just on the contrary, the 'smart city' is an evolving paradigm (Albino, Berardi and Dangelico 2015).

Indeed, the novelty of the smart city relates to its high degree of technological integration. A 'smart city' relies on applying the ICT throughout the urban structure (Marin 2020) with the aim of integrating technology with urban services (Albino, Berardi and Dangelico 2015). Other authors refer to the smart cities as "instrumented, interconnected, and intelligent" (Harrison, et al. 2010), where "instrumented" refers to sources of near-real-time real-world data from both physical and virtual sensors, "interconnected" means the integration of those data into an enterprise computing platform and the communication of such information among the various city services, and finally, "intelligent" refers to the inclusion of complex analytics, modeling, optimization, and visualization in the operational business processes to make better operational decisions.

Moreover, the analysis of the literature reveals that technology represents one of the three main drivers of smart cities, alongside community and policy, being linked to five desired outcomes—productivity, sustainability, accessibility, wellbeing, liveability, governance (Yigitcanlara, et al. 2018). Although the literature indicates that these drivers and outcomes altogether assemble a smart city framework, where each of them represents a distinctive dimension of the smart cities notion (Yigitcanlara, et al. 2018), without technology there would not be such

a thing as a 'smart city'. It falls from here the fact that the definitory feature of a smart city relies in its technology integration.

The 'smart city'is also congruent to the meaning of contemporary urban development (Kunzmann 2014). As Kunzmann (2014) argues, the notion of smartness can be added to many dimensions of human life. Smart learning, smart shopping, smart tourism, smart health services, smart governance, smart mobility, smart coworking, smart energy consumption, even smart dating to find the right partner for smart living-together in smart houses and smart city quarters (Kunzmann 2014, 10).

The process of smartification is not a liniar end-to-end path. On the contrary, it actually means aligning all realms or urban space to the technological development and by that, it gets to be inevitable selective, discriminatory and biased. The European Commission defines 'smart city' as "Systems of people interacting with and using flows of energy, materials, services and financing to catalyze sustainable economic development, resilience, and high quality of life; these flows and interactions become smart through making strategic use of information and communication infrastructure and services in a process of trans parent urban planning and management that is responsive to the social and economic needs of society." (Commission, European Innovation Partnership on Smart Cities and Communities, Strategic Implementation Plan 2013, 5)

4. From horizontal to vertical development

Historically, urban planning has considerably changed over the last century. When, as a consequence of industrialization and massive rural-urban development in the 19th and 20th century, cities expanded beyond their middle-age walls, engineers planned the urban expansion by designing urban street networks, building electricity grids, water supply and sewage networks. In the beginning of the 21st century, a new era of infrastructure development emerged and information and communication entered the stage of urban development. Currently, the smart city adds up another dimension of urban development, one in which urbanization expansion is happening in a networked manner, giving rise to a different reality.

The Oxford English Dictionary defines "vertical" as:

A Adjective. 1. Of, pertaining to, situated at, or passing through the vertex or zenith; occupying a position in the sky directly overhead or above a given place of point.

2. Placed, extending, moving, or operating at right angles to a horizontal plane; perpendicular; upright.

The word takes its origin from late Latin verticalis, from vertex 'whirlpool, crown of a head, vertex', from vertere 'to turn'.

In a 2012 interview, the American artist, geographer, and author, Trevor Paglen, posed an unusual question: "What would happen if you took geographic thinking and instead of putting in on a horizontal axis, you added a vertical axis?" (Ellsworth, Kruse and Beatty 2013) Indeed, *going vertical as a way of thinking* means not only shifting the perspective from a linear and finite Euclidean view of space and time, towards a continuum of space-time-speed, uncontained and heterogeneous.

This perspective rather opens up a whole spectrum of critical questions on how verticalising cities is tightly enmeshed in a world of drones, helicopters, satellites, mines and submarines, among others. It is a cross-section of a world that highlights the overlapping layers of humanity's history, development, and patterns of needs and imagination. Furthermore, such a vertical perspective would also raise critical interrogations on the meaning of geopolitics (traditionally understood as the politics of state geography), that essentially represents the study of interactions of nation-states according to their cartographic distribution on the globe. Going vertical therefore, is not a question of space but a whole different ontology of life that this research attempts to disentangle.

The idea of seeing things in a vertical manner is rooted in sacred geometry and religious thinking. "As above, so below" – the famous motto - derives from a passage in the Emerald Tablet, attributed to Hermes Trismegistus, the author of a series of sacred texts that constitute the basis of Hermeticism. Initially, the phrase indicated that earthly matters reflect the operation of the astral plane. However, in a secular context, the phrase can refer to the idea that the microcosm reflects the macrocosm. In the New Testament, the phrase is traditionally rendered "on earth, as it is in heaven", as a reminder of God's work as a reflection of himself.

Figure 1 presents an abstract visualization that shifts our predominantly static and technological view of the world from above, to open a longitudinal lens on the processes and patterns of contemporary urbanization across three horizons: the orbital, the subterranean, and the submarine. The world's deepest mines are over four times deeper that the world's highest skyscrapers are tall. Multiple grounds are revealed as index and interface: a registration of existing temporalities, shifting territories and emerging agencies. This longitudinal landscape provides an augmented understanding of where we live in relationship to thermodynamic exchanges, latitudinal variations and hydrological ranges that are associated with vectors of movement—from logistics to communications, policies to legislations, planetary processes to intertidal cycles, climatic differences to barometric pressures, to better understand the live, dynamic ecologies under the influence of, and exerting pressure on, the altitudes of contemporary urban life. (Harvard University 2013)

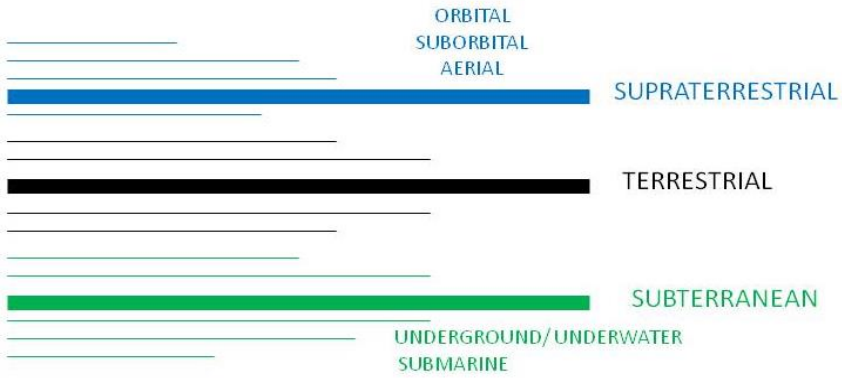

Fig. 1. Vertical planes

However, it is not to say that vertical perspective is only a question of symmetry or reflection. On the contrary, in practical terms, air, land and water are three very different mediums of life that are to be tamed by completely different technological approaches. In this regard, the understanding of 'vertical' in this research is more a question of complexity rather than pure changing the eye view. Figure 1 also attempts to present graphically a cross-section of the complete ecosystem of Earth, in order to highlight that the highest satellite or function that humanity has placed on orbit (say GEO) is or may be connected to the lowest technology we use, such as submarines or subaquatic cables.

In Architecture, the whole idea of verticalization was taken up very literally and translated into vertical build spaces. However, we argue that verticalization is more than just building skyscrapers, or bringing Lunar landscapes into the Earth, but an approach to understanding the whole constellation of system-of-systems that bring these vertical layers into life, including technicalities, politics and perceptions. As the architect Léopold Lambert explains, an expansion of the classical two-dimensional perspective "opens up a new paradigm in which the legal action of a State on a territory will be defined through the complexity of space and its multiple layers". (Lambert n.d.)

These processes bring to the forefront struggles over security, resources, privacy, mobility, basic food and water, across vertical (and horizontal) geographies of power. Going vertical therefore means also going political, opening up how verticality matters in the contemporary world. It is equally about engineering as it is about history, architecture, anthropology or international relations. Therefore, not the geological layers are at stake in this research, but the technological ones that essentially undress centuries of human development, by revealing the logics as well as the tensions in our collective journey as humanity.

5. Politics of verticality

In 2002, inspired by the conflict in West Bank, Eyal Weizman posed the question of a politics of verticality. He argued that "a new understanding of territory had to be developed to govern the West Bank. The Occupied Territories were no longer seen as a two-dimensional surface, but as a large three-dimensional volume, layered with strategic, religious and political strata." (Weizman 2002) He then continues by elaborating on this new approach: "new and intricate frontiers were invented" and control was retained "over the airspace above them and the sub-terrain beneath." (Weizman 2002) As a process, Weizman sees politics of verticality as "a set of ideas, policies, projects and regulations proposed by Israeli state-technocrats, generals, archaeologists, planners and road engineers since the occupation of the West Bank, severing the territory into different, discontinuous layers." (Weizman 2002) In other words, the whole ontological stance of political forces through which the built environment has been shaped to be able to surveil, control and predict resistance, was entirely based on both an expansion of space and time, and an ontological view of security/ insecurity brought by design/in-design.

Too often we think of geographical spaces in terms of areas, not volumes (i.e. as incorporating depth). Territories are bordered, divided and demarcated, but not

understood in terms of height and depth. (Elden 2013) In other words, geopolitics can be understood through processes and technologies of geo-metrics, means of comprehending and compelling, organizing and ordering. Geo-metrics might therefore be a term worth retrieving from the rather bland sense of modern geometry. Geo-metrics remains a useful way to make sense of calculative strategies turned towards land, terrain and territory.

Furthermore, Stephen Graham brings to the forefront the idea of 'vertical geopolitics' by correlating the American military interventions in Baghdad to the concept of 'full spectrum dominance' (Graham, Vertical Geopolitics: Baghdad and After 2004). He argues that "it would need to inscribe the contemporary geopolitical imagination with a paradigm which addresses the ways in which global air and space power are used to marshal geopolitical access to, and control over, key underground resources (Iraqi and central asian oil, Palestinian water, etc.) to fuel the ecological demands of western urban complexes." (Graham, Vertical Geopolitics: Baghdad and After 2004, 17)

In the end, as Weizman argues, "geopolitics is a flat discourse. It largely ignores the vertical dimension and tends to look across rather than to cut through the landscape. This was the cartographic imagination inherited from the military and political spatialities of the modern state". (Weizman 2002, 3)

6. Vertical (in)security: from the unconscious mind to outer space

Verticality seems to be woven into human cognition, as vertical scale is universally used as a metaphor to describe hierarchies of power. "Low-ness" suggests deceit, weakness, vulgarity, or immorality. Words starting with the prefix "-sub" imply powerless status, weakness and invite experiences of violence and domination (e.g. 'subordinate', 'subaltern', 'subhuman'). At the other pole, "High-ness" is related to royalty, superiority ('superior', 'supervisor', 'superman') and brings forth perceptions of status, and power. Although the usages of these words are usually unintentional and unconscious, somehow they manage to shape the world.

The same logic spreads in ubiquitous life instance, the penthouses are perceived more valuable than the basements ('up', 'upper', 'upper-class') or with technologies (satellites are more expensive). Globally, vertical logics operate subtly vertical schemes of attributing worthiness, e.g. the under-developed Global South versus the well-organized and effective Global North. Even the Christian notions of "heaven" (up, harmony) and "hell" (down, inferno) are based on equal meaning-posing vertical distinctions.

Consequently, a whole set of perceptions of (in)securities is related to these unconscious usage of verticality. Aliens coming from the upper grounds, beautiful princesses locked in towers and monsters rising from the underneath have shaped the early-life stories of every child. Mass surveillance, the "eye-in-the-sky" and the entire image of attempted easy control from above, have shaped criminology studies, especially in the Anglo-Saxon world. However, as the multimedia artist Dario Solman reflects, "verticality pushed to its extreme becomes orbital". (Solman 2001)

Figure 2 presents the cover the book "Operating Manual for Spaceship Earth" written by the visionary architect Buckminster Fuller in 1968. The drawing, named "Spaceship Earth", was made in 1928 and emphasized the global, spiritual, practical and vertical challenges facing engineering, architecture and human life.

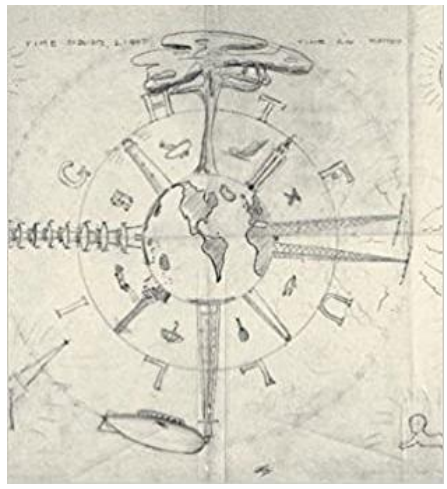

Fig. 2. Spaceship Earth (Fuller 1968)

The Earth's fast-expanding array of more than 1000 active satellites is pivotal to the organization, experience and security of contemporary life on earth's surface. Controlled through ground stations, satellites could be tasked to a wide array of missions, from observing the surface of Earth (important to precision agriculture, monitoring of floods and landslides, or even in conflicts, like the genocide in Rwanda where images have revealed common pits), to conducting military operations on the ground (through the use of PNT/GNSS functions), and to protecting the planet against solar winds and asteroids that enter the atmosphere, TV and radio broadcasting, as well as telecommunication. The messaging between the ground stations and the satellites is being achieved through links of data that could be corrupted. However, once aloft, satellites become distant, enigmatic, and quite unearthly.

7. Discussion: deconstructing and reconstructing the smart city

This paper attempted to open up the ideas of the space of smart cities as open, multiple, permeable, and bound by identities. In other words, the connection with the outer space exemplify the relational forms of territoriality in which urban services that are built in the 'smart city' are spatially regulated based on their different identities. By that, the smart city (as its analogical ancestor) perpetuate 'accessibility' as exclusionary, which subtly underpins the identity differences.

More scholarship is needed in the area of defining boundaries of smart cities, as well as now accessibility is being evasively moderated in discurses of universal access and high technological integration.

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