

Mobility Justice and Big Data in urban planning Towards an ecological approach to space of flows

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Abstract

The necessity to combine sustainable methods in architectural and urban design and democratization calls for a shift from technical to the socio-technical perspectives within the field of architecture and urban planning. At the centre of the paper is the conviction that this endeavour of combining social and environmental equity goes hand in hand with the intention of placing emphasis in critical thinking, self-reflection, and social awareness. It departs from the intention to re-invent what Kevin Lynch called “mental maps” or “cognitive maps” within the contemporary context within which we have the possibilities of elaboration of advanced methods of mapping. Taking into consideration the latest advancements in the field of urban mapping and traffic engineering, the paper intends to enhance a new understanding of historiographical questions concerning the impact of the automobile on our perception and experience of the city. Nowadays, Big Data streams generated by mobile phones allow one to observe urban mobility at an unprecedented scale. Within the current context that is characterised by a rising concern about the impact of climate crisis, the endeavours to shape sustainable methods in architecture and urban planning are based on the use of advanced technologies such as urban scale digital twins and other tools aiming to visualise several parameters that are pivotal for establishing relevant approaches through real-time mapping. Among these parameters are the fluxes that concern both social and spatial mobility. The paper examines how the analysis of issues related to social and spatial mobility can be tackled simultaneously through the use of concepts such as “motility”, and “mobility justice”, which are used by urban sociologists Vincent Kaufmann and Mimmi Sheller respectively. The paper investigates how “motility” and “mobility justice” are of great importance for understanding the relationship between architectural and urban politics, migration and ecology. It also intends to relate Kevin Lynch’s mental maps to the contemporary context. Moreover, the paper relates the endeavours of using urban scale digital twins for urban mobility policy decisions to concepts such as “space of flows”, Ecumenopolis”, and “planetary urbanization”.

Key words: equitable futures, climate justice, mobility justice, urban scale digital twins, mental maps, cognitive maps, planetary urbanization, Ecumenopolis, space of flows, Kevin Lynch, Constantinos A. Doxiadis.

1. Understanding spatial and social mobility conjointly

The necessity to combine sustainable methods in architectural and urban design and democratization calls for a shift from technical to the socio-technical perspectives within the field of architecture and urban planning. At the centre of the paper is the conviction that this endeavour of combining social and environmental equity goes hand in hand with the intention of placing emphasis in critical thinking, self-reflection, and social awareness. Vincent Kaufmann, in *Re-thinking Mobility*, argues that “the speed potentials procured by technological systems of transport and telecommunications [can] be considered vectors of social change”¹. He employs the term “motility” to refer to the operation of transforming speed potentials into mobility potentials, arguing that “[t]he notion of motility allows [...] to distinguish social fluidity, from spatial mobility”². The social sciences approaches which are focused on social fluidity take into account the role of “transport and communication systems as actants or manipulators of time and space.”³ Kaufmann also highlights that the automobile “associates speed and freedom in space and time.”⁴ He distinguishes the following four models: firstly, the areolar model; secondly, the network model; thirdly, the liquid model, and, finally, the rhizomatic model⁵. Useful for addressing the issues of spatial and social mobility conjointly is the concept of “mobility justice”, to which Mimmi Sheller refers in her book entitled *Mobility Justice: The Politics of Movement in an Age of Extremes*⁶. At the core of the concept of “mobility justice” is the intention to suggest a new way of understanding inequality and uneven accessibility to the mobility commons. The concepts of “motility” and “mobility justice” are of great importance for understanding the relationship between urban planning and mobility. Urban planning as discipline, in order to seriously take into account parameters concerning spatial and social mobility, should shape methodological tools permitting to address them in an entangled way that takes into account their dynamic dimension. This implies the creation of theoretical and methodological frameworks that allow us to reflect beyond disciplinary boundaries.

2. Relating Kevin Lynch’s mental maps to the contemporary context

The field of urban mapping entails an embedded geographic technology providing mapping functionality and on-demand data services for online mapping applications. The paper departs from the observation that despite the fact that there have been conducted several theoretical studies focusing on the analysis of the mental mapping methods employed by Kevin Lynch at the Massachusetts Institute of Technology (MIT) in the 1950s and 1960s⁷, there are not many applied projects aiming to provide interfaces enhancing our understanding of how the automobile has influenced our understanding of urban territory. The aim of this paper is to complement the existing scholarship that focuses on a quantitative understanding of issues related to the role of the car for our lives in the city with a qualitative understanding of these issues. It is based on the observation that, despite the fact that there are some quantitative studies focusing on the analysis of our contemporary experience of the relationship between the car and our experience of the city, there are no extensive qualitative studies providing tools that allow us to understand the cultural aspects related to the historical evolution of the impact of the car on our perception of the city.

This paper also suggests a theoretical approach that intends to overcome the existing schism between the methods of historical research in architecture and urban design and the cognitive-sciences oriented research in the domain of cognition, perception and behaviour in urban environments such as those conducted under the leadership of Prof. Dr. Christoph Hoelscher in the framework of the project “Cognition, Perception and Behaviour in Urban Environments”⁸. An interesting case related to the issues that this paper addresses is the project of Future Cities Laboratory entitled “Engaging Mobility” led by Dr. Pieter J. Fourie, which focuses on the analysis of current and future urban mobility challenges through travel behaviour research, big data informed simulation, designing and evaluating alternative solutions⁹.

Kevin Lynch conceived mental maps in the 1950s and 1960s as a tool based on human perception and behaviour aiming to provide an understanding of how a city becomes legible¹⁰. According to Francis James Harvey, “[a] mental map represents particular geographic relationships based on the experience of an individual”¹¹. As Harvey remarks, “Lynch cartographically represented people’s mental maps of the city to show how they perceived and moved about the city”¹². This paper could be interpreted as an effort to rethink the approach that Lynch developed in his seminal book *The Image of the City* “in a new context of technological possibilities”¹³. The main components of Lynch’s urban analysis were the Paths, Edges, Districts, Nodes and Landmarks. His seminal book entitled *The Image of the City* was based on the content of a project entitled “The Perceptual Form of The City” co-directed by himself and György Kepes at MIT. In the framework of this project, which was held from 1954 to 1959, Lynch and Kepes conducted a lot of field work in Boston, Jersey City and Los Angeles. The main objective of their project was to analyse how citizens perceived their landscape. For this purpose, they conducted interviews, produced numerous sketches and took photographs in the framework of their field work. The main concern of Lynch was to understand how people sense their city. He believed that this knowledge could contribute to the shaping of future planning efforts¹⁴. As Andrew Samuel Mondschein underscores, in his PhD dissertation entitled *The Personal City: The*

Experiential, Cognitive Nature of Travel and Activity and Implications for Accessibility, “[c]ognitive maps are those mental processes which allow individuals to store, recall, and utilize information about the built environment to make daily activity and travel choices”¹⁵. A concept that Lynch elaborated in order to address individual and collective perceptions of a city was that of “imageability”. Telling regarding this concept is this following remark:

“A highly imageable city... would seem well formed, distinct, remarkable, it would invite the eye and the ear to greater attention and participation. The sensuous grasp upon such surroundings would not merely be simplified, but also extended and deepened. Such a city would be one that could be apprehended over time as a pattern of high continuity with many distinctive parts clearly interconnected. The perceptive and familiar observer could absorb new sensuous impacts without disruption of his basic image, and each new impact would touch upon many previous elements. He would be well oriented, and he could move easily. He would be highly aware of his environment.”¹⁶

Kevin Lynch considered cognition as “an individual process but its concepts [...] [as] social creations”¹⁷. He defined as paths the “channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals or railroads”¹⁸. Lynch shaped this method of mental mapping in the 1950s and 1960s when he was teaching at MIT. He conceived this method as an opposition against the top-down planning of the post-World War II era. An important study dealing with the influence of the car on the perception of the architecture of the city and the aesthetics of urban highways is Donald Appleyard, Kevin Lynch, and John Myer’s *The View from the Road*¹⁹. Before Appleyard, Lynch, and Myer, and Robert Venturi, Denise Scott Brown and Steve Izenour, several modernist architects such as Le Corbusier conceived the post-war modernist cities as machines, placing particular emphasis on the role of the car. The interest of Le Corbusier in the impact of the automobile vision on urban planning is evident in Le Corbusier’s *The Four Routes*²⁰. Apart from the “The Perceptual Form of The City” that Lynch and Kepes directed at MIT, psychologist Kenneth Craik at Berkeley conducted an important research project focused on similar topics as the project of Lynch and Kepes. Craik’s project was focused on the field of environmental psychology and his approach had an important impact on Donald Appleyard’s work. A note-worthy collaboration is that between Donald Appleyard and Kenneth Craik in the framework of their research in the Environmental simulation Laboratory (ESL)²¹.

3. Cognitively-active and cognitively-passive modes of travel and “deadpanning”

Important for understanding the special character of the experience of crossing the Las Vegas String is the meaning of “deadpanning”, which Robert Venturi and Denise Scott Brown borrowed from Ed Ruscha’s approach. The film *Las Vegas Deadpan*, which Venturi and Scott Brown with their students recorded in 1968 in the framework of the so-called “The Learning from Las Vegas Research Studio” is useful for understanding the implications of the “deadpanning” strategy²². As Martino Stierli remarks, in his article entitled “In Sequence: Cinematic Perception in Learning from Las Vegas”, “[d]eadpanning’ [...] designates a way of looking at things that tries to keep out the personal preferences and allusions of the observer as much as possible”²³. Another notion that is of pivotal significance for analysing the perception of the city from the car is that of sequence. Both Kepes and Lynch were interested in the sequential nature of the perception of the city while crossing it by car. Kepes believed that “[e]ach path of travel offers its characteristic challenge”, claiming that “[t]he basic unit of our urban vision, accordingly, is not the fixed spatial location but the transportation-defined pattern of a sequence of vistas.”²⁴ Lynch remarks, in *The Image of the City*, regarding the sequential nature of the re-invented perception of the city thanks to the automobile: “Considering our present way of experiencing a large urban area...one is drawn toward another kind of organization: that of sequence, or temporal pattern”²⁵. Andrew Mondschein, Evelyn Blumenberg, and Brian D. Taylor draw, in “Going Mental: Everyday Travel and the Cognitive Map”, draw a distinction between the cognitively-active modes of travel and the cognitively-passive modes of travel. This distinction is useful given that it sheds light on the differences between the cognitively-active and the cognitively-passive gaze of different types of travellers²⁶. For instance, Mondschein, Blumenberg, and Taylor consider the moving subjects that view the city walking or driving as subjects corresponding to the so-called cognitively-active modes of travel and the moving subjects that view the city as passengers in a car or on public transit as subjects corresponding to the so-called cognitively-passive modes of travel²⁷. They also claim that the cognitive maps of the travellers corresponding to the former are more accurate than those of active travellers and have realised various tests that prove this hypothesis.

4. Urban scale digital twins and environmental equity

A ‘digital twin’ is a digital representation of a physical process, person, place, system or device. The term ‘digital twin’ refers to the digital representation enabling comprehensive data exchange and can

contain models, simulations and algorithms describing their counterpart and its features and behaviour in the real world. The term ‘digital twin’ firstly emerged in the field of manufacturing sector to refer to digital simulation models that run alongside real-time processes. ‘Digital twins’ are digital replicas of physical entities. Their creation is based on the use of advanced technological applications, such as sensing, processing, and data transmission. Digital twins enhance evidence-based operational decisions and experimentation on urban policies. The current state of research concerning the role of digital twins in shaping urban policies is characterized by a dichotomy between scholars that focus on the technological and sustainable benefits of the use of urban scale digital twins and researchers that criticize ‘digital universalism’. It is of pivotal importance to challenge this dichotomy, shaping methods based on a socio-technical perspective of using urban scale digital twins, and combining the technical, sustainable and social advantages of their use²⁸.

Urban scale digital twins are use nowadays for urban mapping. Digital twins are used in the field of urban analytics, as well as in the field of computational social sciences. ABI Research forecasts that urban digital twin deployments will exceed 500 by 2025²⁹. According to Michael Batty, “[t]he idea of the digital twin [...] has emerged from the representation of the city in terms of its physical assets.”³⁰ The digital twins are able to get updated following the changes of the physical equivalents thanks to the pairing between the virtual and the physical world. To understand what is the main idea behind the creation of digital twins we should bear in mind that “[a]n ideal digital twin would be identical to its physical counter-part and have a complete, real-time dataset of all information on the object/system”³¹. Recently, within the domain of urban planning and, more particularly, within the field of smart cities, the notion of urban scale digital twin has acquired a central place. Li Deren, Yu Wenbo, and Shao Zhenfeng define the ‘digital twin’ as a “simulation process that makes full use of physical models, sensors, historical data of operation, etc. to integrate information of multi-discipline, multi-physical quantities, multi-scale, and multi-probability”³². They also highlight the fact that the current debates concerning the notion of digital twin are characterized by plurality of how this concept is understood. They remark that “a consensus definition has not yet been formed”³³. The common denominator of the different definitions of the term is the shared interest in the “bi-directional mapping relationship that exists between physical space and virtual space”³⁴. The creation of digital twins is based on the intention to establish “real-time connection[s] between the virtual and the real”³⁵. In the case of digital twins, the digital models, apart from “observing, recognizing, and understanding”³⁶ the physical world, they also aim to control and transform it. Martin Mayfield has emphasized the role of urban scale digital twins in providing a holistic approach to urban and infrastructure design³⁷. Danah Boyd and Kate Crawford, in “Critical Questions for Big Data: Provocations for a cultural, technological, and scholarly phenomenon”, analyse critically the role of big data within the current cultural and technological context of data-driven societies³⁸. Li Deren, Yu Wenbo, Shao Zhenfeng argue that at the core of the development of urban-scale digital twins is the creation of “a complex giant system between the physical world and the virtual space that can map each other and interact with each other in both directions”³⁹. They also underscore that the continuous generation of massive urban big data and the use of sensors within the cities for which the digital twins are created are necessary for the construction of urban scale digital twins.

To realize the central role of Europe within the framework of the endeavours to incorporate urban scale digital twins in decision making concerning urban planning, we should take into account the fact that “Europe is emerging as the main centre of development of urban digital twins, with over 60 % of the existing”⁴⁰ urban scale digital twins. The European Union has set the following goals regarding sustainable urban planning strategies: firstly, the empowerment of “urban actors towards common goals; secondly, the development of people-oriented urban planning strategies that aim to contribute to the social equity of communities; thirdly, the development of digital platforms and other digital tools that intend to enhance interactive and proactive approaches in urban planning decision-making, and “the creation of integrated, open, and functional technological infrastructures for the development of programmes and the provision of services (data-driven planning)”⁴¹. Among existing urban scale digital twins that are either in operation or under development are the twins of the following cities or districts: that of Athens in Greece, that of Plzeň in the Czech Republic, that of Dublin Docklands in Ireland, that of Herrenberg in Germany, that of Vienna in Austria, that of Zurich in Switzerland, that of New York in the United States of America, that of London in the United Kingdom, and that of Helsinki in Finland. Other note-worthy urban scale digital twins are those of Cambridge, Gothenburg, Munich, Newcastle, Paris, Rennes and Rotterdam⁴². Two programs that play a major role in shaping sustainable urban planning methods are the European New Green Deal, the Agenda for Sustainable Development and its Sustainable Development Goals, which is also known as SDGs. The former – the European Green Deal – is based on the intention to achieve zero net emissions by 2050. This program places particular emphasis “on achieving a circular economy by 2050, creating a sustainable food system and protecting biodiversity and pollinators”⁴³. As John Hatcher remarks, “60% of organizations across major sectors are leaning on digital twins as a catalyst [...] to fulfil their sustainability agenda”⁴⁴. According to Hatcher, “digital twin implementations are set to increase by

36% on average over the next five years⁴⁵. The following main characteristics of urban scale digital twins should be highlighted: their scalability; their predictability thanks to the use of simulation algorithms; their capacity to integrate new elements thanks to the use of IoT sensors, and real-time data, and their capacity to enhance cooperation due to the fact that they can be broadly accessible⁴⁶. Caprari also underscores that citizens can download and upload data enhancing in this way social equity and participatory design methods⁴⁷. Gordon S. Blair distinguishes three challenges concerning the creation of digital twins: firstly, the challenge of “bringing the environmental assets together in one logical place, including both data assets and modelling assets”; secondly, the challenge of allowing different assets to work together as part of a larger digital twin architecture”, and, thirdly, the challenge of ensuring “that the necessary storage and processing capacity is available when it is needed, especially given the sizes of the challenges and the associated potentially very large datasets.”⁴⁸



Fig. 1



Fig. 2

Urban scale digital twins can also contribute to the establishment of policies aiming to render more efficient several urban intelligence tasks, including, for instance, the management of traffic and power systems. Urban scale digital twins can be used to address climate adaptation and optimisation of mobility models. Their role in optimisation of mobility models within the framework of urban development is apparent in applications such as this concerning the automatic traffic test area in

Hervanta, Tampere⁴⁹ (Fig. 1). Another note-worthy example of urban scale digital twin that places particular emphasis on the simulation of urban mobility scenarios is that of the city of Herrenberg in Germany⁵⁰ (Fig. 2). A concept that is useful for better understanding the connection between decision-making in urban planning and urban mobility studies is that of “Transit-oriented development (TOD)”, which refers to the “planned high-density development containing a mixture of residential, retail, commercial and community uses around a transit hub and surrounded by a high-quality urban realm that prioritises the pedestrian (and more recently the cyclist) over the automobile.”⁵¹ According to Ren Thomas, Dorina Pojani, Sander Lenferink, Luca Bertolini, Dominic Stead and Erwin van der Krabben, “Transit-oriented development (TOD) is often defined in terms of mixed-use development near and/or oriented to mass-transit facilities”, while “[c]ommon characteristics of TOD include urban compactness, pedestrian and bicycle-friendliness, public spaces near stations, and stations designed to be community hubs (Transit Cooperative Research Program (TCRP), 2002).”⁵² Several scholars, such as Miguel Padeiro, Ana Louro and Nuno Marques da Costa have highlighted the significance of “transit-oriented development (TOD) as a critical approach for achieving sustainable mobility”⁵³. Urban scale digital twins could be used in relation to TOD in order to establish urban policies that can provide more sustainable solutions concerning urban planning decision-making.

5. The concepts of planetary urbanization and space of flows

The concept of “planetary urbanization” suggests an epistemological shift in the field of urban studies, promoting an understanding of urban constellations beyond the polarities characterising the field of urban studies in the early 20th century: it is useful for treating the connections between different national contexts and the relationship between the centres and peripheries and the urban and rural landscape. Sue Ruddick, Linda Peake, and Gökborü S Tanyildiz, and Darren Patrick, criticising Neil Brenner and Christian Schmid’s “planetary urbanization”, suggest the elaboration of a social ontology of the urban⁵⁴. They draw upon Marx’s understanding of social ontology in *The German Ideology*. According to Ruddick, Peake, Tanyildiz, Patrick, at the centre of Brenner and Schmid’s elaboration of the concept of “planetary urbanization” was the intention to express the necessity “for a new epistemology of the urban, one capable of deciphering the rapidly changing geographies of urbanization under early 21st-century capitalism”⁵⁵. As Gediminas Lesutis highlights, “the planetary urbanization literature [was] [...] inspired by [Henri] Lefebvre’s work on urbanization”⁵⁶. Lesutis also argues that the concept of “planetary urbanization” aimed to challenge “the city-centric epistemology of urban studies, highlights how cities, accumulating wealth, explode into space by subsuming all planetary resources to the influence of capitalist urban agglomerations and flows of increasingly fictitious and speculative capital”⁵⁷.

At the centre of Manuel Castells’s approach are the following three concepts: ‘space of flows’, ‘space of places’, and ‘timeless time’⁵⁸. According to Castells, the network society is organised around these three concepts. Castells, through these concepts, intends to render explicit how the “incorporation of the impact of advanced forms of networked communication”⁵⁹ calls for a new understanding of societies. He places particular emphasis on the fact that in network society there are no boundaries, and suggested that contemporary urbanisation and networking dynamics should be studied conjointly. Additionally, he argued that transport and digital communication infrastructures should also be examined in relation to each other. To explain how the notions of time and space were transformed due to the transition to the so-called information age, Manuel Castells drew upon the work of several scholars in the field of social sciences such as Anthony Giddens⁶⁰, Scott Lash, John Urry⁶¹, and David Harvey⁶² among others. Through the notions of informational city, metropolitan region and dual city, Castells redefined the field of urban sociology. The main objective of Castells’s approach is to render explicit how urban dynamics work⁶³. In contrast with Saskia Sassen’s global city⁶⁴, Manuel Castells’s informational city emphasizes the significance of the “incessant flows of information, goods, and people”⁶⁵. A turning point for his work is the theory he develops in *The Informational City: Information Technology, Economic Restructuring and the Urban-Regional Process*⁶⁶. As Felix Stalder has highlighted, according to Castells’s theory, cities should be understood as processes and not as places⁶⁷. In the sixth chapter of *The Rise of the Network Society*, which is devoted to the spaces of flows, Castells analyses “[t]he relationships between the space of flows and the space of places, between simultaneous globalization and localization”⁶⁸. He argues that “function and power in our societies are organized in the space of flows”⁶⁹.

6. Ecumenopolis, ekistics and the role of transport planning

Another concept that is useful for understanding the tendency to understand the road networks as a continuous network that connects the different urban and non-urban landscapes within a world-wide entity is the concept of “Ecumenopolis” coined by Greek urban planner Constantinos A. Doxiadis. “Ecumenopolis” started off with the hypothesis that urbanization, population growth, and the development of means of transport and human networks would lead to a fusion of urban areas, leading to megalopolises forming a single continuous planetwide city (Fig. 3). Doxiadis employed

different concepts to refer to different understandings of mobility corresponding to different historical eras. For the city of the 20th century, he used the concept of “megapolis”, arguing that its main characteristic was the perpetual intensification of mobility flows, which would break the limits of the cities, altering not only their structure, and their very meaning. Doxiadis was convinced that the age of automobility demanded the founding of new urban types, which would be organized like beehives around multiple centres⁷⁰. Doxiadis, in “Towards Ecumenopolis” - a confidential report that was prepared in January 1961 in the framework of the Research Project “The City of the Future” - understood infrastructure as a skeleton of a body covering the entire globe and resulting from the balance between settlements, production and nature⁷¹. In his second report on ‘Ecumenopolis’, which was also prepared in 1961 for the Research Project “The City of the Future”, Doxiadis argued that Africa was the largest and most suitable area to welcome inbound capitals and investments⁷². The book entitled *Ecumenopolis: The Inevitable City of the Future* co-authored by Constantinos A. Doxiadis and J. G. Papaioannou is of pivotal importance for understanding Doxiadis’s conception of ‘Ecumenopolis’⁷³. Doxiadis Associates prepared a report entitled “Toward an African Transport Plan” in 1962. This report intended to provide the basic layout of his ‘Ecumenopolis’⁷⁴.

ECUMENOPOLIS 2060

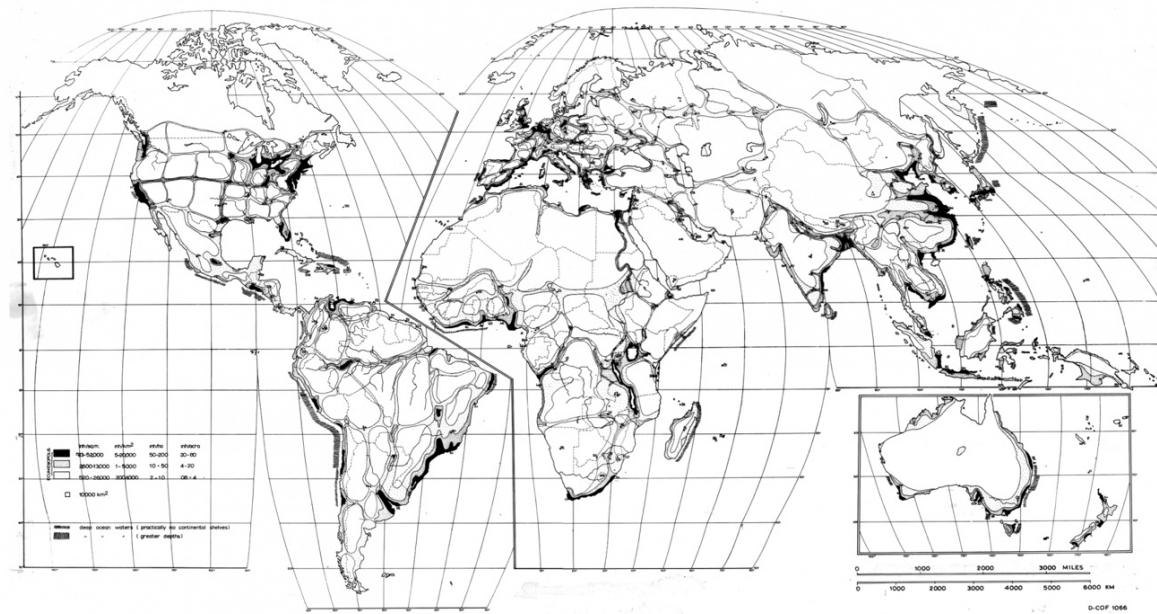


Fig. 3

Helen Couclelis reminds us, in “Conceptualizing the City of the Information Age”, that Doxiadis’s conception of ‘Ecumenopolis’ refers to “the coming network of cities of all different sizes that spans the entire globe, and which becomes, at the limit, a mesh of continuous corridors of urbanization (‘Ecumene’ is Greek for the inhabited world).”⁷⁵ In “Ecumenopolis: Tomorrow’s City”, published in 1968 in *Britannica Book of the Year 1968*, Doxiadis argues that “The big question that arises is not about its dimensions, structure, and form, but about the function of Ecumenopolis, the type of life that will be created within it, and the quality that Ecumenopolis will offer to man”⁷⁶. He also highlights that imagination and courage are pivotal in order “to create a high quality of life within an Ecumenopolis of such dimensions”⁷⁷. In this text, Doxiadis included a diagram of ‘Ecumenopolis’ accompanied by the following remarks: “Ecumenopolis on the earth in the year 2120, by which time it is expected that the population of the earth will have leveled off at a minimum of 20,000,000,000 people, and the population of the definitely urban areas at a minimum of 18,000,000,000 people.”⁷⁸

At the core of Doxiadis’s ideas about how the living conditions in Ecumenopolis would be favourable are the concepts of “human scale”, “human community”, and “human city”. His essay entitled “Ecumenopolis: Tomorrow’s City” was also accompanied by a representation of ‘Ecumenopolis’ at night, as seen from a satellite. Doxiadis mentions commenting on this representation that “[a]gainst the dark seas and continents on a moonless night, the lighted parts show the universal city of man with the white parts being completely and densely developed and the less lighted ones being less so.”⁷⁹ Important for understanding the conception of ‘Ecumenopolis’ is Doxiadis’s concept of ‘ekistics’, which he examines in his essay entitled “Ekistic Analysis” originally in 1946⁸⁰. Ekistics operated at three levels: firstly, general ekistics; secondly, urban planning, and thirdly, building design and construction. Both holism and interdisciplinarity lie at the heart of Doxiadis’ approach to the understanding of human progress. Doxiadis drew a distinction between interdisciplinary and

condisciplinary science. In “Ekistics, the Science of Human Settlements”, published in *Science* in 1970, Doxiadis underscored: “To achieve the needed knowledge and develop the science of human settlements we must move from an interdisciplinary to a condisciplinary science”⁸¹.

According to Doxiadis, ‘Ecumenopolis’ would “form a continuous, differentiated, but also unified texture consisting of many cells, the human communities”⁸². He placed particular emphasis on the hierarchical structure of ‘Ecumenopolis’. He believed that ‘Ecumenopolis’ should be organized around the following units: firstly, the family house; secondly, the small and large neighbourhoods; thirdly, the human community or basic cell or city; fourthly, the metropolis; fifthly, the megalopolis, and, finally, all the “consecutive units that will form the whole system”⁸³ (Fig. 4, Fig. 5). To highlight the significance of conceiving ‘Ecumenopolis’ in a hierarchical way, he discerns the following connections: its universal scale to its general frame, its national or local to the city level, and the individual expression of its inhabitants to their settlements. Doxiadis was convinced that transportation planning and communication strategies would play a major role in the endeavour to shape models of urban planning that would promote a high quality of everyday life. This becomes evident when he mentions that “[t]he systems of transportation and communications will be the circulatory and nervous systems of Ecumenopolis”⁸⁴.

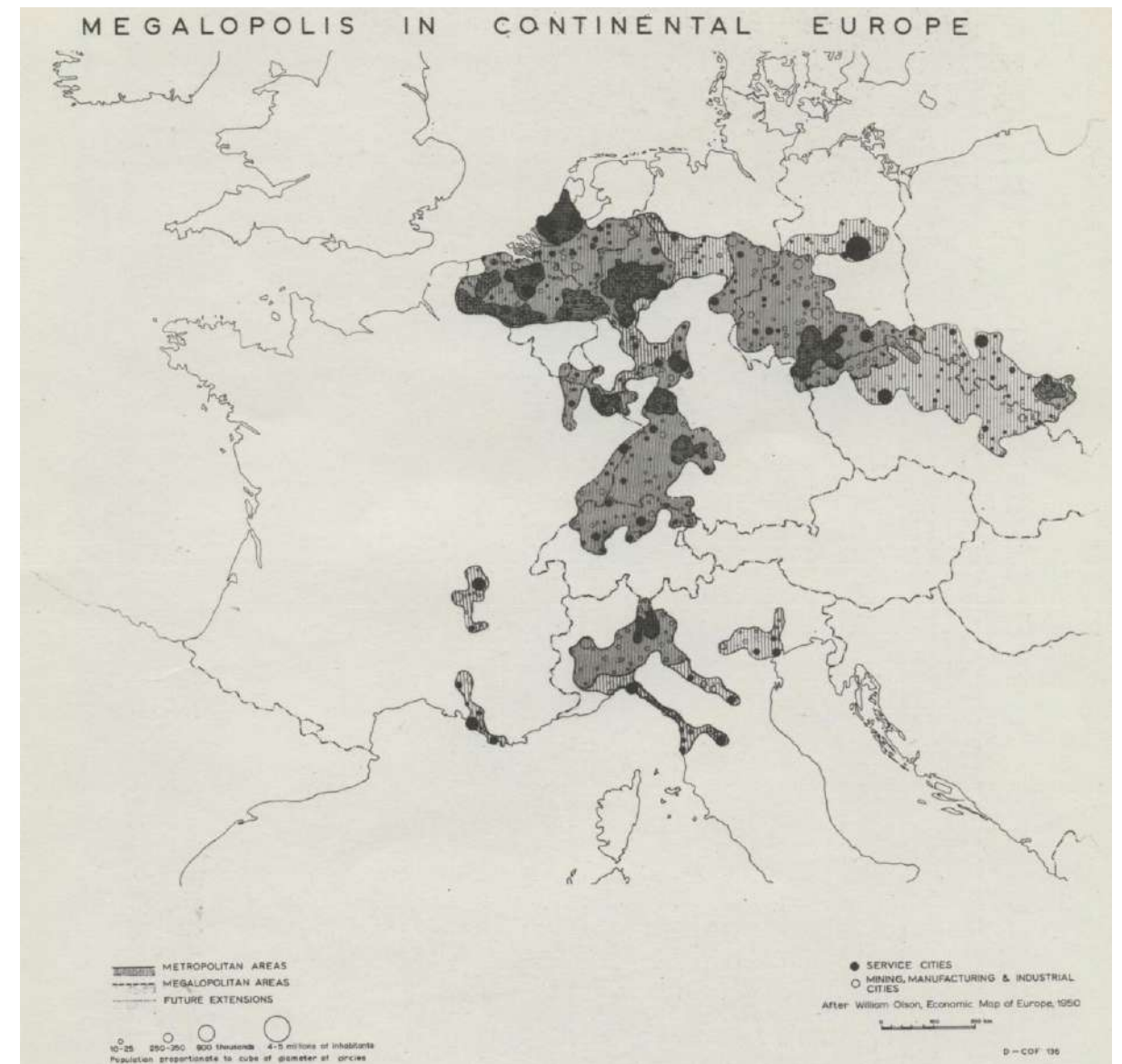


Fig. 4

Doxiadis in his projection in the future, which was the basis of ‘Ecumenopolis’, suggested that “5% of the habitable part of the earth [would] [...] be developed as urban areas, 4,5% [...] [would] be cultivated, and 50% [...] [would] be natural”. According to Doxiadis, each urban unit “should contain no more than 50,000 people, and should permit man to use public as well as private spaces with no interference (or as little interference as possible) from the automobile”. These limits concerning population per urban unit would make possible to provide inhabitants with “clean air”, offering

conditions that would make it possible to “live without noise, and have contact with nature in small planted squares and small parks.”⁸⁵ At the end of his essay entitled “Ecumenopolis: Tomorrow’s City”, Doxiadis included a glossary of terms. There, he defined ‘Ecumenopolis’ as “the coming city that, together with the corresponding open land which is indispensable for man, will cover the entire earth as a continuous system forming a universal settlement.” In “Ecumenopolis: Toward a Universal City”, published in the issue of *Ekistics* of January 1962, argued that “[i]n the network of Ecumenopolis, all parts of the settlement and all lines of communication will be interwoven into a meaningful organism”⁸⁶. At the core of Doxiadis’s research on ‘Ecumenopolis’ was the role of mobility, and the exploration of strategies for combining sustainable design with transportation planning. It would be thought-provoking to relate the ideas of Doxiadis around ‘Ecumenopolis’ to the current debates around planetary urbanization and the endeavours of using urban scale digital twins for establishing policies concerning urban mobility.

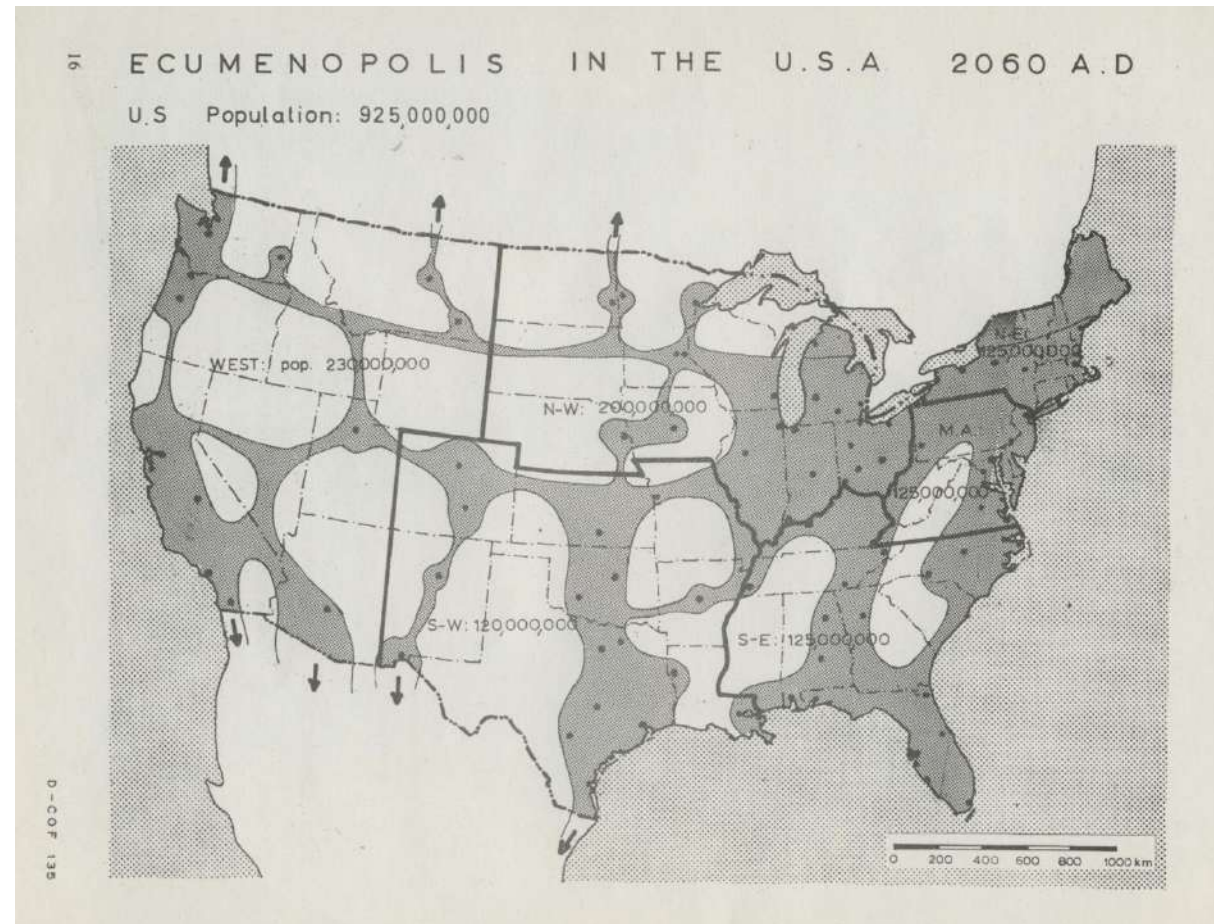


Fig. 5

6. Conclusions

To shape approaches that promote the use of Big Data for urban analytics without neglecting the social aspects involved in the strategies of formation of urban policies, it is important to bear in mind the weaknesses of ‘digital universalism’ and the assumptions on which the creation of urban scale digital twins. To do so, pivotal is the epistemological shift from technical to socio-technical perspectives. Such a shift is related to the endeavour to reveal “multiple dimensions beyond an infrastructure-technology focus”⁸⁷, and goes hand in hand with the effort to construct urban scale digital twins that aim to “reflect the specifics of the urban and socio-political context.”⁸⁸ Particular emphasis should also be placed on the role of mobility in the formation of social positions. A shift that could help us better understand the difference between the concept of ‘mobility’ and that of ‘motility’ is the shift from the model related to contiguity to that related to connexity. As Mimmi Sheller argues, “a strong theorization of mobility justice is the best way to bridge these various dimensions of urban inequalities”⁸⁹. Sheller also underscores the fact that shaping urban planning methods that aim to promote a sustainable future for the cities should go hand in hand with using less destructive modes of urban mobility⁹⁰. Moreover, urban scale digital twins can help us use Big Data to enhance social advocacy. Incorporating urban scale digital twins in the decision-making processes concerning urban planning, urban planners can shape new participatory design methods. This could become possible through the interaction of citizens with the visualization of data concerning the existing situation of

urban environments. The capacity of urban scale digital twins to visualize data and make them accessible to non-specialized audience provide an opportunity to take seriously into account the opinions of citizens concerning a broad spectre of parameters during the decision-making processes. More specifically, the possibility to create applications that would visualize data concerning social and environmental equity in cities could contribute to the endeavours to combine the potentials that advanced technologies offer with the intention to promote methods of decision-making in urban planning that focus on participation.

Notes

1. Vincent Kaufmann, *Re-thinking Mobility*. London; New York: Routledge, 2016.
2. Ibid.
3. Ibid.
4. Ibid.
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Image Captions

Fig. 1. Digital twin of Hervanta, Tampere. Source: <https://www.sitowise.com/customer-story/digital-twins-open-new-world-urban-development>

Fig. 2. HLRS researchers have been using a combination of data and 3D modelling to develop a digital twin of the city of Herrenberg. Credit: Fabian Dembski, HLRS.

Fig. 3. Doxiadis Associates, 'Ecumenopolis' 2060 © Constantinos and Emma Doxiadis Foundation

Fig. 4. Constantinos A. Doxiadis, Megalopolis in Continental Europe. © Constantinos and Emma Doxiadis Foundation

Fig. 5. Constantinos A. Doxiadis, Ecumenopolis in the USA 20160 AD. © Constantinos and Emma Doxiadis Foundation

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Biography

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Comparison of Jiàngòu and Kekkō

Differences in Terminology Translations of Tectonic Between China and Japan in *Studies in Tectonic Culture*

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Abstract

Studies in Tectonic Culture (Frampton, 1995) played an important role in the spread of tectonic as an architectural term. The translators of the Chinese (translated by Junyang Wang, 2007) and Japanese (translated by Tsuyoshi Matsukata and Sotaro Yamamoto, 2002) editions of the book introduce words that have rarely been used as architectural terms as translations for tectonic. Generally, critics, architects, and students at architectural colleges have widely used *jiàngòu*, the Chinese translation. Even other fields, such as social science and literary criticism, borrow the word *jiàngòu* from architecture. However, the Japanese translation, *kekko*, exhibits less influence in Japan compared to that of *jiàngòu* in China. Even in the architectural field, *tekutonikku* and *kōchiku* are seemingly used more frequently than *kekko* as translations of tectonic.

In contrast to *jiàngòu*, which is an entirely new terminology in China, *kekko* originates from architecture. However, nowadays, in the majority of situations, *kekko* is used as a daily term that scarcely recalls its architectural origins. Apart from the cultural differences between the words, the intention of the translators, which can be observed by the words they selected in the translation and their articles, may play an essential role in the unique development of *jiàngòu* and *kekko*. By comparing the words chosen in the Chinese and Japanese editions of *Studies in Tectonic Culture* (Frampton, 1995) and information from related articles, this study reveals the differences in the intention of the respective translators of *jiàngòu* and *kekko*. The results indicate that the Chinese edition indicates the ambition of the translator to generalize *jiàngòu* compared to the Japanese edition, which exhibits the intention of remaining faithful to the original.

Key words: tectonic, *jiàngòu*, *kekko*, terminology translation.