Territorial Intelligence Project: Governance for Megalopolis Urban-Rural Linkage Pattern: Comparative Study Between Po River Valley Megalopolis Region, Italy & Chennai and Kolkata, India

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Abstract Megalopolis or Mega-city is a new scale that should not be defined by population numbers. We are in a new dimension, a new DNA. In the context of Megalopolis and regions where the scale of the urbanization goes beyond the traditional definition of a Metropolis, defining an effective governance structure and strategies is a challenging yet fundamental goal. Information technology plays a vital role in

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building the global Megalopolis, as the virtual infrastructure and data allow a city to be strategic at the international scale while advancing inhabitants' daily life at the local scale. In this chapter we attempt to define the governance strategies in the mega global cities in two steps: first, to trace the dynamics between the various stakeholders in the mega-project that is often complex and less hierarchical and provide a framework where the genome of a Metropolis is evident. The second step emphasizes the importance of the direct relationship between the governance structure and the territorial contexts and intelligences.

Keywords Megalopolis · Cartography · Smart city · Metropolitan Milanese area · Governance

I. Megalopolis

Megalopolis is a crucial word and the concepts related to it were defined by Gottmann in 1961 in the book: Megalopolis: the urbanised North-eastern Seaboard of the United States.

In the coming years, several scholars such as J. Jacobs 1961, The Death and Life of Great American Cities, K. Lynch, 1964 The view from the road, R. Venturi 1972, Learning from Las Vegas: The Forgotten Symbolism of Architectural Form, and finally K. Frampton 1999, Megaform as Urban Landscape, formulated a theoretical criticism to the immeasurable growth model which was unable to produce urbanity. At that time, a new set of methodological rules, interpretative hypothesis, explanatory models, and defined practices took place that initiated a revolutionary breakdown facing the rise of a generic city.

In today's context, we would like to frame the Megalopolitan issues as something that is much more linked to the need for a shared vision regarding today's infrastructural, mega trans-national and regional projects. Nevertheless, these projects due to the lack of a metropolitan and megalopolitan political culture are usually defined by following the management rules which deal with the geopolitical needs and the needs of global companies only, thereby ignoring the participation from local communities.

II. EU Mega-region and Data

The national quantitative figures alone, are incapable of depicting the whole and complex picture of what is happening at a more detailed level, especially in the European Union. This incapability of quantitative data constitutes to be one of the major reasons behind why Metropolises can never be defined by population numbers alone.

In this regard, statistical information at a subnational level is an essential tool for highlighting specific regional and territorial aspects (NUT Region). It helps in analysing the changing patterns and the impacts that policy decisions can have on

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the daily life of citizens. In order to provide a detailed picture of the diverse EU territories and to monitor EU regional policy targets, Eurostat has developed a range of statistics based on different classifications and typologies. These include data for regions, cities and greater cities, metropolitan regions, rural areas and regions. Specific geographies such as coastal regions, mountain regions, border regions or island regions are also covered [1].

For the EU, 'NUTS' stands for Nomenclature of Territorial Units for Statistics. EU is categorised in:

NUTS 1: 3–7 million

NUTS 2: 800,000–3 million

NUTS 3: 150,000–800,000

North-West Italy falls under NUT 1, Lombardy Region in NUT2 and the Milan Province NUT3.

The European Union (Eurostat and EC-DG Region), in collaboration with the OECD, has developed a harmonised definition of urban areas as functional economic units, in order to overcome the previous administrative limitations and build functional urban areas. This vision, linked to economic areas and functional areas, although closely linked to a geography as the main element for the definition of a mega European region, remains the fundamental one.

We think that it is sensible to state that neither the Metropolis nor the Megalopolis can be conceived as the fulfilment of a new hierarchy between cities following a pure quantitative datum.

Metropolis and Megalopolis are not the results of a dual paradigm that extracts, from the induced void of intermediate territories, the metropolitan entity and the idea of functional macro-regions. The paradigm thus risks having totalising connotations [2].

It erases the differences between habitats; homogenises and unifies the cities, by making them interchangeable, thereby moving in the direction which is difficult for the survival of the human being on the planet. In one sense, we are dealing only with the asphyxiated horizon of the Metropolises and mega-regions that, unlike the Greek poleis and Renaissance cities, have expelled from their urban space both the animal life of the oikos and the political life of the agora. Today, Metropolis and Megalopolis are nothing more than the space of alienated production and consumption in which oikos and agora disappear and become confused [2].

This opens the discussion on whether the democracy can be exercised and whether a political culture on the mega scale is possible. Where the relationship between those who are ruling and those who are getting ruled is physically closer, it becomes possible to erode the verticality of Governance by conditioning political power with control from bottom or even self-government from bottom. Bookchin distinguished statehood, within which individuals have little influence on political issues given the limits of representative government, from politics where citizens have direct and participatory control over their governments and municipalities.

The Po Valley is made up of a network of towns (a considerable thickening of small and large towns, where the density of inhabitants is higher than the average of the megalopolitan region). The demographic dimension alone (we do not reach

Gottmann's 25 million inhabitants) in a territory like the Po Valley is not entirely relevant. On the contrary, it can even become secondary, considering the level of economic interconnection (in addition to labour issues, linked to commuting, made evident by the number of industrial districts concentrated in the area–70 out of 141 in Italy as of 2011, with unparalleled density also in Europe), infrastructural (it is one of the most highly infrastructural areas in southern Europe, with 9 airports in a few km, including the technological networks of the future, such as fibre) and social (supported by the wide variety in land use, population, occupations and interests), but also environmental, landscape, ecological and biological [3]. Moreover, according to urban geography, a Megalopolis concentrates, on a small area, at least one fifth of the population of its own country. The area of the Po plain concentrates 22,000,000 inhabitants, 36% in Italy, for 47,820 km, 15.83% of the national surface area, for about 460 ab/skm, much more than the 250 planned for the Megalopolis.

III. A thought on the global governance dimension of Megalopolis

Generally, the issue of governance of Megalopolis cannot be solved by nation alone within which it is located. The solutions depend on several factors beyond the nation and Megalopolis as the megaregions change organically with their context (physical, social, economic, cultural). Governance must not be limited to following the spirit of the times. Rather, it must anticipate it, like a visionary who promotes forms of life beyond the future.

In Europe, Transnational metro-regions are dealing with transnational megaprojects. To be able to manage them in a shared way, first thing that might be necessary is to create a transnational confederation (like the Hanseatic league from the Renaissance). Even before the requirement of being a single administrative union, the EU would have become the United States of Europe [4]. Nevertheless, we can start dealing with an agreement regarding the management of shared megaprojects but beyond a severe cultural, political debate regarding the European shared values.

Before theorising on the legal instruments which can regulate the relations between the megaregions and their national States, it is, therefore, necessary to approach the problem from a semantic point of view.

There are different ideas of subjects involved: the megaregions, the different states, but also the cities interested in the construction of the mega infrastructure and the local territories on which the work has an impact. Thus, there are different roles played by different actors. Hence, there are also different visions of subjectivity, different processes and different result indicators. Here, we deal with a structuralist vision of an essentialist type and a pragmatic vision of a performative type. In the first case, especially at the metropolitan scale, the administrations must interpret the essential characteristics of its territory even when it is not aware of it as it is completely immersed in a social, territorial context that changes it with expectations. They prefer to look at what always remains the same rather than at what changes. In the second case, on the other hand, no structure always remains the same concerning changing secondary characters.

IV. Governance and Management

Every metropolitan city needs a tool to help politicians define objectives based on SDGs and their impact indicators in order to be able to make decisions at the scale of the megaregion. We will have global and local goals that must find a sustainable balance to transform the vertical colonial Governance to parallel and globally good Governance. That is the challenge of Megalopolis governance; we propose to start finding an agreement regarding the management of the transnational territorial projects.

The agreement between such different actors with different competences does not require a ready recipe, but a time for dialogue and observation, in the first phase of agreement between Metropolises that are part of mega transnational regions. The agreement is built on the opportunity to have common result indicators: what kind of common result indicators (IR) do we want to achieve?

We start from the analysis of the constraints on which result indicators depend for those who manage a process on a global scale according to a geopolitical strategy and must be able to measure if they have done their job well in social (quality of life), economic (budget), governance, physical space. (Qualitative Indicators, instead, are measured according to the concept of on-off).

There are also result indicators for the beneficiaries (Citizens) of the local territories. They must be consistent with the IR of the global goals because the global and local projects must coincide. That is a process, and obviously, it is necessary to establish who is responsible for making the decisions and at which political level, because not everything is shared.

There are also process indicators (IP) more related to the management of the organisation of large transnational projects.

These are the indicators that go in parallel with the result indicators and are the first ones to tell whether the path followed is correct or not. However, first, what must be shared politically, is the same values that must be recognised and shared at different scales. The question to ask then will be related to what kind of critical processes to produce to build this value (a sustainable project) and in how long and short time.

Therefore, regarding the transnational project, when the focus of economic and political power is evidently on one side, the importance of participation and consensus is as much as the project itself. Many topics require different groups of stakeholders due to the very nature of the subject. Moreover, Governance cannot be separated from management. For example, water governance is a sensitive and challenging issue around the world where there is freshwater scarcity, and the infrastructure inadequacy for serving the growing population. Many Metropolises have water authorities that control the quality and quantity of water. However, in practice, it became an issue because the water authority does not define the land use around the watershed–the same at the Global scale. Due to the green, blue and grey infrastructure continuity, an international agreement on water management and protection is required. Flexibility and cooperation in dealing with such an issue are mandatory, advancing from the current situation of working in silos.

In our methodology, therefore, we try to address the issue of Governance by creating a stakeholder map that reflects the core value and the issue of the subject matter and balances the participation amongst the local and global metropolitan actors, and the metropolitan experts. The stakeholders bring the relevant topics on the table to discuss following the Metropolitan Metro-dology [5] and provide a strong case for the matter. However, the decision-making of a metropolitan project is always done at the political level.

V. Physical territory towards territoriality with international common laws

Many Metropolises and Megalopolis lie outside the nations where the Megalopolis is located. However, to deal with this phenomenon, so that the physical territory becomes territoriality with common laws internationally, requires a cultural leap in scale, even before the legal framework.

The phenomenon of the contemporary Metropolis, however, differs from the modern industrial *big city*. The unrestricted urban growth we are experiencing presently, has exceeded the timeframe of planning. Moreover, the main drivers of urban development in the past two centuries were not the physical shape of the city but external logics such as economic models, political agenda, and technological optimisation. These growth models focusing on the efficiency of growth demonstrated their limits in addressing the quality of the well-being of the citizens. The existing urbanised spaces have not been able to accommodate the incoming population and unplanned occupancy in areas. For example, the main water basins that serve the entire city and flood-prone area become a risk for all inhabitants, only exacerbated by the effect of global climate change. The colonial past has cast long shadows over many of the developing countries to struggle with not only the physical, social, and economic difficulties but also with the cultural identity of the population. Moreover, the prevailing inequality has only escalated the conflict amongst groups of people.

These backgrounds of extreme urbanisation leave us with a big question of how to deal with the metropolitan complexity to realise the goal of sustainable growth to reach the well-being of the population in the post-colonial, Anthropocene era. These issues cannot be addressed with a single, static, and traditional disciplinary approach, but need a comprehensive and multidisciplinary vision to understand them [5].

The Metropolis and Megalopolis thus must be conceived as trans-scalar arenas. It is necessary claiming for a link among local processes and necessity of inter-metropolitan cooperation, hollowing out of the state and interstate coordination. Global issues, global competitiveness must be balanced within local goals looking for territorial cohesion.

However, we must investigate whether Megalopolises are also an arena of collective actors, like the Metropolises. Since the Metropolis is conceived as multiple actions arena, newly emerging spatial actors at metropolitan scale arise. Investigating if Megalopolis can advocate the metropolitan collective actors such as enterprises that need a frame defining a possible direct relationship within the different National State authorities, could be the theoretical effort.

VI. Megalopolis territory as an intelligent global territory

The Megalopolis as a space of innovation in public policies and citizenship is meant to deal with citizenships and rights. Hence, in the context of Megalopolis, addressing the questions on climate change, natural hazard and emerging policy, demands for social innovation as answers to new policy and public goods demands.

These are the principles that critically introduce a discussion on the main institutional settings responsible for Megalopolis government, in a public policy perspective with the aim at describing some relevant policy tools. In the fast changing urban and metropolitan environments which characterise the contemporary age, the roles that government institutions play in planning and policymaking varies significantly according to several variables (political, legal, administrative context, urban dimension, sectorial vs cross-sectorial approach). Through literature overview and primarily through case study introduction and discussion, it is mandatory to define the competences and skills needed for analysing the institutional environment, in which the Mega trans-regional project experts operate to identify the main actors and policy networks. This approach is needed for being able to use a variety of policy tools, choosing the most appropriate ones according to the context and the role of different actors, in particular government and non-government institutes.

Every institutional and Governance arrangement rises into different legal and administrative systems at global level. Hence, we would like to analyse the basic principles and to enable Mega Project Experts to reflect about the most common institutional settings and policy mechanisms that deal with the metropolitan dimension.

We think that it is mandatory to analyse the legal, administrative and planning systems from an international perspective, introducing the most relevant principles and differences, identifying actors and policy networks at the global and metropolitan level, the local institutions and policy tools (activation, orchestration, modulation). The law can establish the responsibilities of a possible Megaregion administrative level. The principle applied in the law (EU and USA) is that of subsidiarity. It is the principle that social and political issues should be dealt with at the most immediate (or local) level that is consistent with their resolution. Anyone who has to perform the service of defining the sustainability requirements for the trans-regional mega project can be assigned by law to a supra-metropolitan authority.

VII. The Megalopolis D.N.A

We do not have yet an acceptable standard definition of Megalopolis.[1] As we have discussed above, size or the population of megalopolis is not the right approach to define it. Consequently, it is difficult to make the list of those multi-metropolitan groups that will pass the definition and can be incorporated to the list of Megapolises.

Actual standard definition of Megapolis is based on the concept of ‘very large cities’ and thus defined by population size. The size adopted is the 10-million threshold. 47 cities across the globe comply with this figure. The last one is Lima,

[1]Megalopolis and Megapolis are equivalent terms. Many authors use Megalopolis. As in mathematics and Linguistics, the shorter, the more elegant.

which is actually a Metropolis, and not a Megapolis. If the categorization is not supposed to be based on size but on structure, it is possible to reduce the number of these cities to a range of 25–30. This is the number that could form a practical group for horizontal exchange and experience sharing.

VIII. The Governance Challenges

In the management of Metropolises and megalopolises the need for coordination, for complex responses to complex problems is necessary. The problems of the Metropolis are not the addition of the problems of the municipalities. The problems of the megapolises are not the aggregation of the problems of the Metropolises. They might have a municipal effect, like the symptoms in a disease. But it is not from healing the symptoms that we are going to address the disease. Metropolitan problems must be addressed in a comprehensive approach at the metropolitan level, and not by the summation of municipal policies.

Megapolises as Metropolises, in the territorial-physical realm, apart from the economic, social or institutional one, have 5 sectors: Environment, Transport, Housing, Productive-activities and Social-facilities. Each of these sectors are a system within and should be addressed at a metropolitan level. The location of economic activities or large metropolitan facilities has an influence on all the municipalities in the Metropolis although they might be in one specific municipality. It is not a municipal issue. It is a metropolitan issue.

Among these five sectors, two of them are continuous systems. They are, namely, the Environmental one (Green Infrastructure) and the Transport one (Grey Infrastructure). The other three sectors are discontinuous systems. By continuous systems, we mean the systems which have the physical assets linked continuously. We cannot have a discontinuous train track, or we cannot, on arrival to the intermodal station have the connection with the other modes of transport of a more urban scale as metro, BRT, buses, bicycles, etc. The parks and protected areas must be linked as well to allow the biodiversity transfer. Due to the scarcity of the resources and the climate change issues the continuity of the green/blue infrastructure must be secured. The green/blue systems are obviously metropolitan and not municipal or urban. We cannot have a river clean just in a municipality if it is polluted upstream. Even if we can, we should not have the burden of pollution externalities produced by others. The same is for the water management and the land uses: we need a share vision at all scales. Hence, a higher-level institution, that will enforce a comprehensive policy for the Metropolis is necessary.

So, we need a metropolitan institution that will address at least environmental and transport issues. The same reasoning has to be made for the three other dis-continuous systems, systems altogether, but we are not going to go into it. The argument is set up. Thus, we could argue for the economy; on economic terms, the single market the Metropolis is built on, and takes its strength from, as it is the result and one that benefits from the agglomeration phenomena. Nevertheless, we can argue on the Social component even if social exclusion works hard to seclude the lower-income groups in the worst located municipalities-no need to mention the institutional setup (Fig. 1).

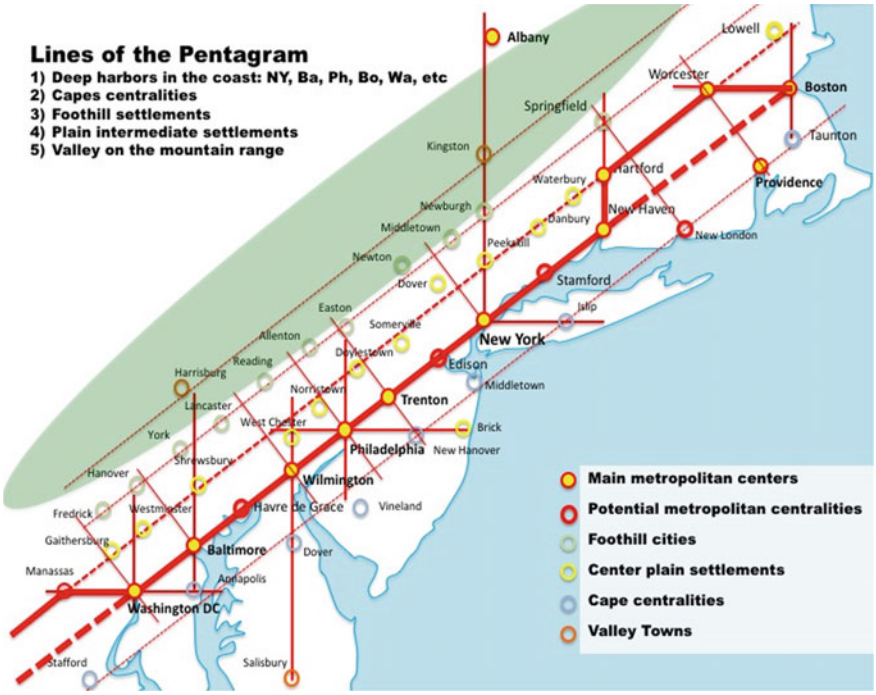

Fig. 1 Mega-York metro-matrix structure *Credit* P. Ortiz

IX. Megalopolis Governance: New scale, new challenge, cautious solutions

The phenomenon of Megalopolises is however a new scale detected already in the 60's, but that goes beyond Metropolises. A scale and that we have not yet addressed, nor comprehensively understood.

Megalopolises are defined not by numbers, but by their inner structure, their DNA. Megalopolises are sets of interactive Metropolises. Just the way Metropolises are sets of interactive cities. Megalopolises are not Metropolises over 10 million inhabitants, as Metropolises can neither be defined by population numbers. Metropolises are not conurbations as the conurbation phenomenon is a metastasis of unmanaged urban expansions.

X. The recent Beijing Megalopolis

We are looking at a new DNA and not just in a new dimension. Mega-York runs from Washington DC to Boston incorporating several Metropolises within its system. Delhi Megalopolis (Mega-Delhi) runs from Meerut to Rewari and from Rohtak to Aligarh, if not Agra. Probably in the future we will have to address the Delhi-Mumbai Megalopolis (now just call it a Corridor), including Jaipur, Udaipur, Ahmedabad and Surat among others. Beijing is another good example, where Chinese authorities have already defined a Megalopolitan area of 250 million inhabitants.

XI. Confederations, national or transnational

Metropolitan and Megalopolitan governance structures need to be distinguished from the municipal or regional structure due to the decentralization of power. Each institution involved in the decision-making process has its own legitimation, its own assignation of competences. This condition requires the governance structure to be horizontal and interrelated, rather than vertical and hierarchical. A matrix system of the stakeholders of the metropolitan genome allows a more democratic dialogue where each actor can express one's concern and negotiate to achieve a common goal.

Can megalopolises, a set of Metropolises, address their governance systems in the same framework of Metropolises or nations? Can they look for a solution on the frame of the three alternatives of Unitary, Federal or Confederal structures applicable to nations and Metropolises?

A Unitary system would be impossible, and inadvisable, as the metropolitan system is already a federal one, and it would be incompatible. A Federal system of a higher magnitude integrating the federal systems of the Metropolises could be conceptually envisaged. It would be the subtle extrapolation of the subsidiarity principle already applied in the European Union and the USA for their institutional inter-government management of tiers and competence's assignment.

A safe first step to Megalopolitan governance, instead, would be a Confederal system, where the diverse Metropolises that on joining will keep their own sovereignty within their own federal system. A confederation is a very loose system approach that we already know it does not work for Metropolises, but it is the first step that can give time and room to think about what the best would be, in the long term, for megalopolitan governance.

A Transnational Confederation of cities already has existed in history and it worked relatively well in for a 300-year span. The Confederation of Metropolises in a Megalopolis does not confront, nor jeopardizes, the national existence. That will just provide a framework to address megalopolitan issues now unaddressed, and the time to build the metropolitan federal system in view of what would be the best for megalopolises to address their institutional governance in the long term, in 40 years' time.

XII. Introduction: A Comprehensive Approach towards the Megalopolis governance, management, and new ICT tools

Starting from the Metropolitan and Megalopolitan concern as background, the chapter aims to investigate not only on governance as an architecture of relations between different institutions but also preferers to aim at a description of a method of regional governance that can structure context-based practices.

Governance cannot be separated from the vast and diverse territory that a Megalopolis stretches over. One of the challenges of overcoming contemporary urban issues is to overcome the dichotomy of urban and rural. The arbitrary division, based on little evidence, does not consider the reality of endless fluxes of people and goods, yet impact the lives of inhabitants in various levels [6]. Based on the general acceptance, in both theoretical and practical circles, the urbanization takes diverse form in

different contexts, in a rather dispersed manner [7] and that it could be considered as a net-city of various scales of urban centres [8] the governance strategies on the territory recognize and reflect the urban-rural continuum. Therefore, it is essential to recognize both the material and immaterial values of territory and develop tools that allow the territorial actors to elaborate, to manage and to evaluate partnership and participative projects of territories' sustainable development at all scales. What kind of governance strategies do we need for a smart territory?

In particular, the chapter analyses the relationship between Lombardy and Po River Valley water system Governance and territory.

For this reason, the final comparison with the Indian desakota region is relevant for us. Moreover, what we wanted to highlight is the position. By now, all European cities are moving towards the concept of Smart City. Our region has always built its wealth from the effective management of its waters. Management entrusted to a very refined technique used by industry since the 18th century. We can say that through this technique, an agreement was signed between the territory and its manufacturing and agricultural production realities. It was an intelligent territory.

Today, to manage the complexity of the Metropolis, we no longer rely only on technique, but on technology too. Nevertheless, firm in our tradition, even now, technology must be located and adapted to the territory. That is why we have presented an example of metropolitan cartography that works with open-source data. This intelligent and cognitive approach to complexity is fundamental for the interpretation and enhancement of the intelligence of a tricky territory. Then, we present a system of mapping through big-data, necessary for the definition of the size of metropolitan cities and Megalopolises (linked more to virtual than physical relations), as well as needed to make the territory more porous through the identification of its values. That is our Smart City Approach to develop key factors stimulating the growth of Italian desakota regions during the urbanization process.

Regarding the architectural and urban disciplines, the question about the relationship between science and technology arose through the distinction between the conscience of the engineer and the conscience of the architect. The problem of technology is, therefore, to identify an existing thought with an evolving thought, that is, the relative to the absolute. In this context, the recovery of Banham's thought on the value of the technological image is fundamental in order to overcome the problem–increasingly felt in architectural culture of the division between technological innovation and the development of the architectural and city organisms.

Substantial cultural changes are never easy [9]. If in the last century the theme of fundamental research concerning the city was condensed in the statement the need of finding the correct measure, today, defining the correct distance from technology seems to represent the most remarkable perspective of investigation. The value of the city project that meets technology, especially the information and communication technology (ICT), lies in the purpose that technology itself allows the subject to set. Technology can be conditioning, in the sense that Technology appropriates the subject or instead it can be acted by the subject, when it strengthens the awareness as a citizen, in the case of its utilization in the city context. Only in this case does

technology become fundamental to the implementation of the development trajectory of the subject, and in this lies its value.

The chapter investigates the relationship between the bigness of the Metropolis and Megalopolis dimension and the concept of smartness. Several elements are always present when showing it: increase in quality of life increase for citizens, investments in human capital, social development and physical assets, usually in a blend of public and private initiatives, key role of Information and Communications Technology, and more effective and efficient use of available resources. But how can we be sure to develop a Metropolis or a Megalopolis based on actual citizens' lifestyles and not only a city underpinned by advanced technology-based infrastructure?

We are interested in the setting of those operations which let us define the public and common realm as a more porous space, through the making of a layer, that we used to call Meta-city [8], at the scale of Metropolis and Megalopolis.

Our attempt is to explore the integration of ICT into urban and architectural discipline. The dimension of the Meta-city is necessary to recognize urban space in the bigness dimension as a desirable object from far away and as appropriation field from nearby. Then, the urban space will be no more used according to the relationship housing/factory, as radical theme of the city, but concerning its substitution with a relationship with the public/communication space theme in real time. The consequences will influence:

– economic and social aspects; institutional aspects;
– research of the consensus;
– local and global values and their influence on the citizenship concept itself.

XIII. Megalopolis Governance 4.0. Systemic Approaches and Solutions

XIII.I. The Mega-project Transnational Role as condition for the Megalopolis Governance need

The project of a new open-data and big-data cartography is a basic instrument to achieve a systematic approach for the development of related mega-projects of a Megalopolis. It is a cognitive structure, which gives real reading and appropriation capability to the people interacting with spaces, even those dealing at the scale of the metropolitan region creating new codes of visibility.

The issue is to create a new imaginary model for the matrix of the territory's elements at the Metropolitan and Megalopolitan scale. Different maps are created where every final draft is brief and integrated, as it tries to show at the same time the different information pointed out from the analysis, focusing on possible links and connections; and it is dynamic, as these maps are the representation of a metropolitan mega process showing landscape mutations over time due to the Mega-project's impact.

Metropolitan Cartography Protocol Maps are the tools to conceive the conditions for the Metropolitan and Megalopolitan Governance. At the extra-Large scale, a Protocol map bounding box must be established considering the trans-national metropolitan boundaries relations necessary to enlighten the Metropolis' role within

the international arena. Nevertheless, Transnational relations are crucial, framing the geo-political scenario for Megaproject planning.

Nevertheless, the aim is also to support the top-down, but also bottom-up governance forms. Influencing a decision-making process is more suitable for environmental protection and transparency allows a participatory planning approach to engaging the local communities in the comprehension of the benefit of a Megaproject even at the local scale. To avoid the alienation that a so-called incommensurable project could determine on the local inhabitant population [10].

Changing our way of looking at cities becomes the medium by which we reconsider our relationship with the territory and our habits. It becomes a tool to evaluate the city, speculating its extension beyond the administrative boundaries and shaping the invisible dynamics that steer it, in order to draw draft considerations regarding its commitment to protect biodiversity and human rights. Moreover, in opposition to the usual indicator-based analysis, the research answers to the need of spatialization that is systematic in contemporary city's issues, raising a deeper level of awareness through an efficient medium: the map, which becomes the catalyst of analytical and communicative purposes.

XIII.II. Approaches and Solutions to Megalopolis Smart City Model

Starting from the typo-morphological and the landscape reading of the context, the issue of representation can be introduced as a community visualization instrument, and bottom-up governance participatory activity which involves media and aims at the symbolic construction of another space inside the city.

Our aim is to create learning, interpretative, interactive, and experimental instruments through the identification of an apparatus, which collects spatial data from the urban context and simultaneously returns information in crossing scales. Our attempt is to demonstrate that the most important mapping 4.0 value and its smartness is to allow citizens to localize a place to be able to relate it with their own life. Therefore, ubiquity is no longer the most important value associated with new technologies. The proposed maps are evocative instruments mediating between physical forms and dimensions and immaterial qualities, through which users will be able to explore, interpret, conceive and transmit the components of the Metropolis and Megalopolis context throughout the passage of time and corresponding to the urban context [11].

We are framing the Smart City concept and process within the Anthropocene era looking at urbanism, energy sources, policies and ICT approaches that are able to perform detailed geographic analysis, mapping much more broad impacts but also looking at the global energy scenario and urban distribution. This approach also brings out the landscape and public space issue as a participatory governance process, establishes performative spaces approach with agents/actors, that open also the critique of neo-liberalism and choice discussion, overlapping perhaps planetary urbanism arguments.

In this context, a direct relation between local community and private sector could be innovative in terms of the Governance approach, but it is clear that the large companies have an interest not only in political interventions in the rural and/or

peri-urban areas through their typical corporate social resposibility programs, but also in shaping the cities in accordance with their needs and greeds. They succeed in intervening in the material interconnection of transnational infrastructure networks with their intangible and symbolic dimensions, and in the political areas through their planning, installations and governance. The political role of transnational companies on the territory is growing; while the capital accumulated in the extraction of raw materials (copper mining, forest industry, for example) is rooted in the territory through peri-urban mega-projects. The territorial resources could be under attack.

The institutional issue of governance of megapolises requires some attention. Tokyo's smart cities are not government-funded, unlike India's, but cooperation between industry and the local community to solve certain technological and local problems takes place without a governance structure as such. The invisibility of government in the governance of the Megalopolis is what is needed. The question we ask ourselves is whether a sort of shadow dictatorial and paternalistic power of the big ICT companies is taking shape.

Often, the smart city projects refer to a small urban scale development where the information system and technological advancement provides full support to the inhabitants' lives.

The concept of Fujisawa SST [12], a smart city project conceived in collaboration between Vodafone and Panasonic provides a robust strategy that meets the principles upon which sustainable cities are designed. Its vision, targets, and provision of services are functioning with the primary focus of creating a city based on actual lifestyles.

However, the city size is strategic to the creation of the vision and achievement of the desired targets. This project allows the postulation of the creation of a smart city vision and strategy is applicable to cities of only one thousand households, that have the particular characteristics of a small size functioning community. A big city can be defined as a Smart Vertical; since its complex dimension, it is only possible to sum different smart solutions. Instead, it is possible to apply a Systemic Smart approach in a small town with a greenfield initiative. According to the project, the implementation priorities expecting high potential impact are education, living and health, followed by the secondary priorities of utilities, public services and working environment. Mobility has the lowest priority with the low expected impact. According to the project report, "*To make a town truly sustainable, we need to involve its residents in building a community. With the participation of partner companies that implement advanced initiatives, innovation through co-creation among industry, government and education along with residents will be generated*" [13]. Besides some considerations related to the architectonic and urban design results and the possibility to reply that model of participation in another context not so close to Far East culture, the project conveyed us to reinforce in the Megalopolis governance approach the local variations and intelligence. These we must transform into the invariant elements of a Megalopolis city not to generate another generic city only.

However, when the scope is expanded to the Megalopolitan scale, the application of smart city model becomes complex, not only due to scale but also due to the diverse territorial context and due to the provision and availability of data. The

Territorial Intelligence, a concept developed under the Sixth Framework Program of the European Community between 2002 and 2006, addresses the development of technology and information innovation for sustainable development of territories and community.

Flexibility in governance is also closely related to the metropolitan management of resources. An example commonly observed is water governance that is often a challenging and sensitive issue, especially where the fresh water is scarce, and the infrastructure system is not adequate to serve the increasing population. Many Metropolises have water authorities that control the quality and quantity of water, but in practice, it became an issue because the water authority does not define the land use around the watershed. Flexibility and cooperation in dealing with such issues are mandatory, advancing from the current situation of working in silos.

The governance strategies of Lombardy region in Italy is an example where the new policies, often through the application of information technology, advanced the integration between the urban and rural areas and successfully promoted the territory in the global network. According to the Milan Charter prior to the 2015 Expo, the great challenge for contemporary societies is to reconcile growth and sustainability by doing more with less, thus breaking the link between economic development and environmental degradation, in order to enhance or preserve the present level of wealth with fewer resources [14]. The agricultural park model is a noteworthy strategy where the interface of the urban-rural area has a balance between the values that need to be preserved and the functions that should be developed [15].

The chapter investigates whether the processes triggered by Smart City constitute to be the basis for a paradigm shift in city models, through the creation of new metropolitan values capable of supporting convivial engagement and territorial development. The research examines if the Smart City and Territorial Intelligence are models of a city oriented towards the values expressed by contemporary society, if it is a feasible plan, and how the concepts place the project according to the definition of policies that meet the criteria of verification of impact on the territory and society.

Staring from an analysis of the Lombardy within the Po River Valley Region water system governance, chapter puts a proposal for the Megalopolis Eco-Centrality of the East Metropolitan Milanese Area. The second aim of the chapter investigates whether the processes triggered by Smart City constitute to be the basis for a paradigm shift in city policies and governance at the *bigness* scale, especially through the creation of new metropolitan values capable of supporting convivial engagement and urban-rural development. Through the new Eco-Centrality case study based on theoretical hypothesis, the research assesses a model oriented towards the values expressed by the contemporary society; if it is a feasible plan; and how our Smart City concept allows the definition of policies that meet the criteria of verification of impact on the territory and society.

Focusing on the social aspect of technology allows us to explore the following questions: What is democracy model, that the public and common spaces of Smart City communicate? Can we talk about the ethics of Technology that do not impose constraints but push towards collective responsibility? What is the real power of the

technology deployed by Smart City? How can a global interconnected data infrastructure change the life of the city? And finally, what does globalization impact the Smart city approach bring out?

ICT is not only intended as a tool for the exchange of knowledge or competition between cities. Instead, it is a tool that implies the acceptance of open collaboration and project sharing. Technology enables us to recognize the contribution already made by others in the social field and by doing so multiplies its effects.

XIV. The Metropolitan Glossary and the Semantic Question

Language is a fundamental tool for the metropolitan practice. The word accompanies the evolution of society (the Subject), the city and its architecture (the Object), the transformation of the environment and its landscapes, and introduces into culture the words of technology. The glossary helps us to define a theory of inclusion because it maintains words as symbolic values that arise from the stratification of culture. It educates to the integration between the single individual dimension and the *macro* dimension of the city (the social discourse) and introduces the *meso* dimension of the relations between disciplines and cultures. The metropolitan identity is therefore no longer linked to a general sense of belonging, but the ability to understand information: the new relations established between the different spaces and the inhabitants within the metropolitan dimension [16] defines it. The word, therefore, defines common spaces between different cultures and helps us to decode the different meanings.

Smart and intelligent are two adjectives often attributed to the city and the territory, cancelling essential differences in the meanings that they convey. Smart city is a model where technology is implemented as part of the urban development. Even though there is not one clear definition that everyone agrees upon, we can define the Smart-City model through some projects:

1. City or foundation settlements: new construction of Masdar city; it is a Vertical Smart City;
2. Cities with existing structures within sectorial development in smart areas, mainly supported by ICT technologies: Cat Med UE Project http://www.catmed.eu/index.php?idioma=en;
3. Smart Cities at a human scale: http://www.openlivinglabs.eu; https://eu-smartcities.eu/place/lisbon; New Amsterdam Climate pdf.

In the post-industrial societies, Territorial Intelligence is the science with an objective of sustainable development of territories and having for subject territorial community. More specifically, the concept puts the multidisciplinary knowledge of territories in relation with their dynamics; strengthens abilities of territorial communities to take part in their development in a transparent and sustainable way; improves territorial information sharing and spreads its analysis methods and tools using ICT; promotes governance, decision making processes and practices which value participation, partnership and research-actions that contribute to transparent and sustainable development of the territorial community.

The concept underlines the contribution of the immaterial resources to general development, allowing the differences not becoming an obstacle to the affirmation of these needs but underlining a territorial heritage. Territorial intelligence conciliates the post-material values with those of the industrial society culture, by supporting the territories resources development and recognizes the latter implicit qualities, uniqueness and makes their use attractive for the heterogeneous *glocal* societies.

In the context of Mega-City and regions where the scale of the urbanization goes beyond the traditional definition of Metropolis, the two approaches do not exclude each other. It is important to recognize both the material and immaterial values of a territory and develop tools that allow the territorial actors to elaborate, to manage and to evaluate partnership and participative projects of the sustainable development of territories in all scales. How do we juxtapose Smart City project with Smart Territory project? For this, two cartography tools are necessary: open-source and big data maps, for the definition of the size of megapolis as well as to make the territory more porous through the identification of its values.

XV. Comparative Key Studies: The space-economy transformation in the desakota region. General principles, issues, and related questions

The territory we are currently dealing with is a hybrid territory. Together with the hyper-dense urban cores that structures the basis of the Mega-city region, the body space of the in-between" landscape once was defined as periphery has an important role in the contemporary Metropolis. The desakota model [17] determines the new regions of extended urban activity surrounding the core cities of many countries, in Asia and particularly in India by studying the space-economy transformation in the desakota region.

Distinctive areas of agricultural and non-agricultural activities are emerging adjacent to and between urban cores defining large mega-urban regions. It deals with set of conditions in one place, which interact with broader succession of metropolitan change: the local dimension implementing the global vision.

The informative layer that is becoming more and more significant in today's urban scenes, has a significant importance in the Desakota region. The virtual connection that it provides, allows us to be somewhat free from the physical distance and disconnection that the urban-rural continuum may preserve the local cultural landscape and yet be connected through the Green-Grey infrastructure.

The chapter will explore, through comparison of Indian mega cities projects, the possibilities of the meta city level network on the desakota region and how the new morpho-type composed of Green-Grey infrastructure act as a backbone and how the local pattern may provide a vision for the future of the metropolitan territory that is constantly exposed to complexity in multiple scales. We also demonstrate a methodology and tool of digital mapping that concerns issue of data availability at the local scale and the validity of open-source data.

Thus, not only public spaces must be considered, where metropolitan inhabitant can meet physically, but also those common spheres provided by communication technologies, that have strongly changed our conception of space, time and relations.

Starting from the physical dimension we could define the rules of governance issues for the desakota space, giving an answer to the question: *How to regulate the public, collective and private space of the rural-urban linkage that constitutes the desakota space and that is by its nature a hybrid space? How to create networks of small and medium municipalities? Moreover, how to relate them to the mother city? How to determine the possibility of e-democracy in the meta-city*? [8].

The Governance, so within the Metropolitan framework, even assuming all that concerned with the traditional polycentric city knowledge, must deal with metropolitan city and its desakota region as in-between spaces: looking beyond the traditional definition of borders, aiming at investigating metropolitan region as spaces of interaction of local and global forces and powers, challenging fixed administrative borders at different scales (state, region, city). The goal must be the balance between the various interests of actors who are, although different, must aim to reach an agreement on what are the public goods and services at the metropolitan scale.

Metropolis and Megalopolis as multiple space is a complex and fragmented action arena. Looking beyond traditional urban regime theories, the chapter aims at investigating new emerging spatial actors in desakota contexts.

Metropolis and Megalopolis, as fields of innovation in institutional design and planning, need innovative forms of institutional organization and planning to be able to cope with problems of public action in the in-between contexts of Megalopolitan and metropolitan cities, regional institution, inter-municipal cooperation, functional agencies. Moreover, we have to study the Indian Cities and their desakota spaces as spaces of mobile citizenship and acceleration in change, looking beyond traditional models of citizenship, and democratic issues investigating how the traditional right to the city takes different forms and meanings (right to the landscape and right to the lifestyle) under the pressure of accelerated process of social change and producing pressures-resources for change within public policy design and implementation (multiple citizenships; new social demands; third sector and social innovation). We must then investigate the real significance of services at the *mega* scale: can we think that it is possible to scale municipal services to the upper scale?

1 The Italian Po Valley Case Study and the Indian Desakota Region Comparison

In the desakota region, the urbanized area consists of agricultural and non-agricultural activities beyond the major cities and its peri-urban areas, much flexible governance is recommended, ranging from most urban to least urban areas [17]. Even though the desakota model has emerged from studies in the Asian context, the recognition of this in-between space as a potential driver of the economy allowed scholars to explore the rural-urban partnerships embracing different geographies beyond administrative boundaries in other contexts, especially in Europe [18]. While recognizing

this in-between settlement pattern, the study of this chapter goes beyond and investigates how the Meta-city of information [8] layer can shape the governance of the Megalopolis that encompasses the urban-rural continuum.

2 The Metropolitan City of Milan: Constitution Process, Objectives and Instruments of Government

The Metropolitan City of Milan (Città Metropolitana di Milano) is located in the north-western region of Lombardy in Italy. The metropolitan city has 133 municipalities (comuni) covering an area of 1,575 km2. The metropolitan city has a population of 3.279.944 inhabitants (2019). Since 2015, as an effect of Law 56/2014, the Metropolitan City of Milan replaced the province of Milan, inheriting some of its functions and assets. The Metropolitan City of Milan has a metropolitan council, a metropolitan mayor which coincides with the mayor of the provincial capital city -Milan-, while the metropolitan conference is the assembly of the city. The Metropolitan City Council has divided the metropolitan area into 7 homogeneous Zones, characterized by geographical, demographic, historical and economic specificities and institutional. Each area is functional to better articulate the activities in the area and to promote an ever-greater integration of the services provided with those of the municipalities.

The Statute of the Metropolitan City of Milan was approved by the metropolitan council on 22 December 2014. The Statute contains stipulations regarding the territory, the objectives, participation, among other in the metropolitan areas defining provisions and functions for the organs of government in the metropolitan city. Furthermore, the Statute defines the general dispositions of the city, including its competences and also stipulates the Metropolitan Strategic Plan as the fundamental instrument to carry out the necessary actions in the metropolitan city in the long-term span. This plan formulates the development vision of the city for every three years and determines the general objectives of development of the city. The 2030 Agenda for Sustainable Development is the reference for the Strategic Plan that aims build a territorial Pact within all the agents of the territory. The Metropolitan City in that vision is an interlocutor for the other municipalities. According to the plan that aims to define a vertical structure within integration of horizontal territorial agents for the creation of multi-stakeholder platforms for the promotion of initiatives and projects and sharing a common horizontal strategy.

The plan proposes 10 strategic projects, 8 territorial agendas (homogeneous zones) and 24 operational projects for the three-year period 2019-2021 within 6 policy areas. Namely:

Simplification and Digitalization; Intercommunity relations, support to the municipalities and European policy; Economic development, training and employment; Territorial planning, urban regeneration and metropolitan welfare; Environmental Sustainability and Parks; Infrastructure and Mobility.

The Strategic Plan is the reference framework for financing the actions of the municipalities by the Metropolitan City. The Territorial Metropolitan Plan is the instrument that the Metropolitan City shall use for detailing the spatial planning of its territory. The plan is composed by four principles: Principles on the protection of non renewable resources (soil, water, air, energy from fossil sources); Territorial equity principles; Principles inherent to the landscape and environmental heritage and; Principles for the implementation of the simplification of procedures, the digitization of documents, support to municipalities and inter-municipal initiatives. In addition, the plan has 10 objectives and refers to the SDG.

The technical proposal of the PTM is accompanied by the Environmental Report. Both are filed for the purposes of the Strategic Environmental Assessment and the request for the Impact Assessment. The proposal of the PTM is also forwarded to the Lombardy Region and to the entities managing Natura 2000 network.

Through the Economic and Social development and Private transport and Tourism sector of the public administration as well as through the Labour Policies Sector, the Metropolitan City of Milano seeks to support the sustainable growth, improve the productivity of businesses and the attractiveness of the metropolitan city for investments.

2.1 Overall Protocol of the Methodological Approach of the Analysis

We are defining a set of analyses structured within three actions: Explore, Extract and Enrich. The case study is the complex territory of the Area Metropolitana Milanese. The ambit of analysis in this chapter is the physical context and the focus is on the stratification of the consisting layers of the physical morphology. The main objective of this part is to study the physical context in a different yet innovative way. In other words, the analysis aims to re-read the physical context based on the multi-dimensional complexity of its constitutive components. The relations among the elements of physical contexts and the new technologies infrastructure then, will reveal the complex mechanism of relations between the physical context and the communication dynamics.

Explore:

This action is related to the analytical exploration of both the physical and communication contexts. Regarding the first one, this action aims to explore multi-characteristics of the physical context through a set of morphological analysis. We demonstrate that the Area Metropolitana di Milano was framed by infrastructure technologies able to interpret, evaluate and implements the local resources and territory intelligences.

Same analysis is evolved on today's communication ambit (the meta-city) as the new infrastructure technologies, order to explore the communication infrastructure

the way the hardware part put its roots down to the physical context creating a material layer of its immateriality. In other words, the context-based morphology of the communication ambit is the issue of exploration aiming to produce a new model which is meant to give alternative solutions for the problem of discontinuity between the spatial and communicational experiences of the metropolitan physical context.

The exploration of the physical context regarding to the contextual and technological evolution of the city of Milan, starts from the fourteenth century and proceeds until the present day. The hypothesis is that the communication technology and new devices are potentially able to act as those evolutional elements of the past.

Regarding the architectural and urban disciplines, such processes, besides innovative and experimental aspects, also study the territory according to suitable and sophisticated perspective for the urban mobility, infrastructure and spatial operations. The references and examples have been taken up from There have been taken references and examples of the Territorial Plan published by Milan municipality, the studies of PIM Research Centre, Green Corridors of eco-sustainability, the project of the nodal function of the Segrate Municipality (such as a metropolitan eco-centrality) for the new railway station for high speed trains, the re-qualification of the transportation system in local, regional and inter-regional scale as well as national and international scale according to the integration of the city with the Linate airport. In order to distinguish the potential relations between the elements and generate the relational network, we refer to a study [19] that defined three types of contrivances as harvesting data operators in a shifting scale process and according to three different levels of knowledge and experience. Starting from the territorial scale and gradually descending to the local and architectural and finally to the single elements, the Study show how it is possible to activate further stimulate interaction between the user and territory by leaving visitor a chance to experience physically the place, or virtually through technological supports from distance or both simultaneously. That is the meaning of Smart-City related to the Area Metropolitana Milanese.

Extract:

In these actions, the interface elements of the physical context are extracted as potential symbolic mediators [20]; convergence points between subjective and objective interactions and space-use. In other words, what differentiates this analysis from the traditional similar ones, is based on the inter and intra-relations between the components of the physical layers-infrastructure, urban spaces, water and green ambit, etc. not in a compact simplified map but through analytically deconstructive ones to reveal the multi-dimensional hidden complexities. Such inter and intra relations are looked through an apparatus as the contextualization of a network of relations [21], which despite being rooted in the physical-material-context, associate it to an immaterial layer of subjective spatial-temporal relations (Protocol Maps).

After the extraction of the interface elements-developed in the previous phase of the protocol adaptation, in order to activate them into a system which embodies their both physical and mental relations, they were categorized, itemized and differentiated based on their geographical, historical and social characteristic and finally arranged in a matrix. Such matrix has basically two major functions: incubation of data related to

the so-called elements and the generation of narrations between them. Such narrations make the relation between the elements by generating physical paths on the territory, tangible.

Enrich:

Through the superimposition of the two previous phases, a set of experiments regarding quantitative and qualitative indicators are evolved. The experimentation is related first to the re-examination of analytical indicator of urban analysis from a more complex point of view and secondly, as quantitative and qualitative indicators regarding the effective dimensions of the physical context. Consecutively, on one hand, the emerging areas where, the dynamic flux of communication converge with the physical context are identified and on the other hand they are neglected, yet effective ones are recognized, each based on their effective scale and dimensions both qualitatively and quantitatively.

The main objective of these analyses which evolves regarding the physical context and then relating to the communication dynamics is to analyse the physical context with superior level complex porosity, not only regarding to the new technological achievements but also according to the emergent and resilient areas. The so called 'complex porosity' is driven from combinational permeability in both physical-spatial context and communication ambits. This means that besides the studies related to the communication technologies, we need to deepen also the question of urban transformation in its spatial senses. In words, if the area is going to be highly permeable, first it needs to have flux of people coming into the area and this is possible only through a careful study related to mobility, transportation system and accessibility to the area through a well thought framework.

3 Megalopolis' Governance of Green-Grey Infrastructure: A Glocal Ecosystem Project Through Metropolitan Cartography

Nowadays, Megalopolis is protagonist and responsible for the changes that are also taking place globally because they are the main focus of consumption of large quantities of natural resources such as water and soil. The contemporary Megalopolis, according to the principles of consumption and Metabolic process, produced large amount of waste causing high gradients of alteration and ecological vulnerability with effects not only in the urban limit but especially in rural areas where small and medium-sized cities survive.

For this reason, while the dramatic effects on the structure and function of ecosystems is of particular interest for the development of Megalopolis, on the other hand are the medium-sized cities (with a population between 1 and 5 million inhabitants) that will see the highest levels of urban growth in near future. In fact, it is estimated

that the majority of the global population will live in cities of about 1 million inhabitants by 2050. However, the inhabitants of urban and rural areas of Megalopolis are exposed to risks to human health arising from the degradation of environmental quality. For this reason, air pollution is one of the most significant effects on the quality of life in urban areas [22].

Recently the EU Court of Justice has upheld the application for failure by the EC to fulfil its obligations against Italy for systematic and continuous overcoming in various areas of the national territory, the limit values laid down in the European Air Quality Directive for concentrations of particulate matter PM10 [23].

Following the Health Crisis caused by the effects of the Covid-19 pandemic, it is very clear that air pollution also has a considerable economic impact. Impact which can be quantified, and which represents the cost to society of environmental and health damage. In addition, due to the presence of industrial sites and the high intensity of vehicular traffic, the urban areas of Megalopolis contribute to global warming to a higher degree through greenhouse gas emissions such as CO2, CH4 and O3. For this reason, encourage projects to arm spaces according to the principles of the Green-Grey Infrastructure (based on tree coverage areas, urban and peri-urban forests, road trees that coexist with armed structures) constitutes a priority action for environmental improvement in order to facilitate the activation of the Ecosystem Services. Green-Grey Infrastructure development is strongly promoted by the EU, starting from the EU strategy for biodiversity 2020, up to the program Enhancing Resilience of Urban Ecosystems through Green Infrastructure [22].

In addition, according to the Italian State, the main regulatory instrument is the law 10/2013 *Norme per lo sviluppo degli spazi verdi urbani*, which constitutes the ministerial implementing tool for the development of public natural green capital. However, from a technical point of view, the most important executive document is the Guidelines for the management of urban greenery and the first indications for sustainable planning" of the Ministry of the Environment supported by statistical and monitoring data provided by ISRPA: national research body essential for the provision of open-source data and open-access documentation, as well as driver of investigation for local municipal authorities of the Megalopolis. However, scientific experimentation and cartographic practice in the academic field detect a clear gap between what is disseminated in universities and in technical literature and what is happening in the territorial management of ecosystem resources, especially water and vegetative heritage, thus favoring a considerable pressure on the natural capital of Megalopolis.

The management and design of new spaces for sustainable development of the Green-Grey Infrastructure is strongly linked to the Water Management Policy as it is necessary for the management and mitigation of the risks of exposure to climate change of contemporary Megalopolis. Focusing on the growth of the Green-Grey Infrastructure means to be efficient in the use of resources, especially the local water resource, in order to achieve a sustainable recovery that will allow us to exit from the current economic and environmental crisis, adapting to climate change and increasing resistance to natural disasters [24].

According to Communication from the Commission to the European Parliament, the Economic and Social Committee and the Committee of the Regions, the EU could focus more on the growth of the Green-Grey Infrastructure strengthening the sustainable use of water resources in order to achieve a sustainable recovery that will allow us to emerge from the current economic and environmental crisis and thus to adapt to climate change and increase the inventive resilience of cities to disasters natural. Addressing the current and future hyper-vulnerability of the internal territories of the Megalopolis means boosting the competitiveness and growth of the European water sector, which includes 9,000 Small and Medium-sized Enterprises, offering more than 600,000 direct jobs in water supply companies. There is also potential for green growth in other water-related sectors (water-using industries, development of hydraulic technology), where smart innovation can increase operational efficiency. Moreover, increasing efficiency means, at the same time, ensuring the accessibility of the water also to urban settlements disconnected from the water infrastructure of Megalopolis, thus being able to ensure the right to the Water for all [25].

In conclusion, it can be inferred that, according to the EU's Legislation Directive of Water (Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy), water management is an extremely relevant issue to the geography and tectonic structure of the Megalopolitan Green-Grey Infrastructure. It is a Glocal dimension issue, since it is believed that water management goes far beyond the activity of treatment and distribution of the resource on the hyper-local dimension. Water management, in inventive Green-Grey Infrastructure project, is a problem that determines the quantity, the quality and accessibility of Water as a public good. Therefore, water management requires coordination with water management planning by Megalopolis member regions/districts, not only government measures are needed, but above all urban and architectural planning choices with immediate socio-environmental spatial effects integrated into Ecosystem Service Accountability.

3.1 Metropolitan Cartography as a Support-Analytic Theoretical Practice Tool for Data Mining of the Trans-Scalar Spatial Relationships

Interpreting the complexity of the modification processes of the contemporary city requires the transversal reading of multiple inter-disciplinary analyses so as to understand how the territory is constituted. This has to be done by reading the morphological and anthropic structure existing in the territory, analysing the spatial components and their relations through the representation of maps that highlight the discontinuity of the Green-Grey Infrastructure. The study has to be done to understand how the territory is exploited through the geo-localized reading of the factors of land use and its temporal change according to the dynamics of Urban Metabolism, how to live and transform the territory considering the potential social and environmental

accountability evaluating the relationship between individual and environment with respect to the benefits of the ecosystem that the inhabitant could still enjoy through the assessment of Ecosystem Services active in the Metropolitan Land-scape Unit where the project field of action operates.

The need to read the territory through a context-based analysis approach was developed through the investigation of the research unit MSLab with European International Universities (Italy, Spain and Slovenia) and Latin American (Argentina and Mexico) within the framework of the project co-financed by the European Union (EU) TELLme 2017–2020 (Training for Education, Learning and Leadership to a new Metropolitan Discipline); in the three-year research period the objective was to develop a theoretical framework to study the problems of metropolitan territorial complexity starting from the observation of the city and its transformation processes through the application of space operators of Metropolitan Discipline: structured rules to support the economic, social and environmental dimension of urban and rural areas.

The purpose of Metropolitan Cartography (MC) is to generate a set of open-source maps for different cities, which can be comparable with one another, in order to connect the generative principles of Metro-dology [5] with a more operational and technical section related to territorial reading and spatialization of quantitative and qualitative data; therefore, MC map project is as new analytic-theoretical practice device.

Using alphanumeric data, the Metropolitan Cartography selects, orders and relates the values of unexpressed quality of the territory. It is therefore a matter of evaluating and representing qualitative-relational data through a new logical sequence of choices.

Through the practical approach of the Metropolitan Cartography, the metropolitan expert, the planner, and the designer might be able to grasp the symptoms, the exposures, sensitivity and adaptability of the environmental and social variables that make up the territory.

The potential of maps produced through the methodology of Metropolitan Cartography is expressed in the investigation and analysis of open access data that can not only explain the meaning of use of alphanumeric data but also of those that contain relational value, distributive and device of the implicit properties of the territory. This study allows to generate synthetic maps that try to mark the communication of information through analytical maps that represent the implicit connections between the levels of information. For this reason, Data Mining is the preliminary research phase that is the criterion capable of extracting the implicit knowledge from data and informative patterns that have not been explicitly associated with specific spatial conditions; this step is determined by the preliminary knowledge of the territory.

It is therefore necessary to define spatial rules through which it is possible to understand the usefulness of a global or local data for the cartographic representation of the metropolitan dimensions. Spatial data analysis is a fundamental condition for investigating the property of information, researching the spatial attributes of informative level, but also quantitative attributes linked to the eco-nomic and governance dimension to clarify their usefulness in urban planning.

Currently, the production of local data is carried out by institutions or public administrations that produce open data in digital format for specific purposes of managing their territory. Many national and regional European public bodies, with the support of EU funding, can provide a high potential and reliable service for the research of data related to the protection of national environmental ecosystems, with high spatial detail. They are entities that, through the participatory collaboration of various institutions, allow the totally open and accessible exchange of geo-referenced data in space.

The national, local (regional) and communal apparatus allows to guide the searching the data through transmission, in a not always explicit way, of the internal structure of the dynamics of administration of the territory.

However, the local and global Data Mining and Data Collecting phases determine a great potential of the methodology. They allow to understand the inter-dimensional and scalar dynamics of the metropolitan area, facilitate the choice of information related to the field of action project and guarantee the understanding of peculiar aspects to the metropolitan city through the classification by category of the level of information. It is an introductory research phase of spatialization and relationship between data in synthetic maps, but at the same time it is a necessary step for the association of the individual informative layer to the spatial dimension of evidence. For this reason, the Metropolitan Cartography map project is fundamental to define the relationship between spatial data dimensions (XL–extra Large, L–Large, M–Medium) in the process of choosing global and local information in the field of study. Methodological experimentation, through digital technologies such as the software GIS (Geo-graphic Information System) and the processing of data generated in Remote Sensing, allows to exploit information on a global scale that follows a temporal catalogue through the identification of a chronological evidence threshold of the geographic, historical or environmental phenomenon linked to the Urban Biography of the project area. So, there is a need to direct research towards the achievement of local and open data that can ensure an adequate quality of expression of the level of information by position (relative to its altitude, latitude, longitude coordinates), shape (shape defining a polygon, line and point), size (relative to the state, supra-regional or regional size) and orientation of the data related to the field of action reference system.

TELLme maps have allowed the generation of an experimental process that makes it possible to structure the representation of the territory, redefining the information system through the determination of criteria such as:

- The categorisation of the concept and data, from the Semantic Package to the map, using ISO 37120: 2014 standards, indicators for citizens services and quality of life for sustainable development, defined by the Member States of the United Nations (Sustainable Development Goals) as set out in the 2030 Sustainable Development Agenda;
- The quality of the data (Data Quality) identified in relation to the potential use of the data through a selection that takes into account their integrity, accuracy,

timeliness (time of acquisition and production of information), consistency with the purpose of the map;
- A sequence of historical data (Data Time Series) that allows to identify a series of interrelations between the changing physical variables, ordering them in relation to the dynamics expressed in each phenomenon.
- From this research it is deduced that the setup of a project of Metropolitan Cartography allows the expert to know the territory understanding its structure, identifying events and causes, in progress or in evolution, triggering factors of development and critical regression of the urban context.

3.2 From Narrative of Urban Statement to the Extraction of Spatializable Keywords

The Metropolitan Cartography experiment was also presented as an innovative support tool for local territorial intelligences in participatory planning processes [5]. That is way, according to the development phases of the Metro-dology, the comparison between the narratives of the local agents, their interpretation and diagnosis constitute to be a fundamental step for the extraction of keywords that can be associated with the concepts contained in the Semantic Packages of the MGIP TELLme Software Glossary.

Semantic Packages are containers of a finite number of keywords (categories) to which correspond the specific concepts of the descriptive variables of the metropolitan complexity, through which it is possible to select and pull out spatializable concepts in the map.

The individual Semantic Packages may contain concepts related to each metropolitan dimension: physical, social, economic and governance, according to the classification structured by categories or Keywords.

Semantic Packages are the theoretical tool for researching and arranging data in the GIS space and are essential for building two types of maps: Protocol Maps and Maps of Dynamics. Protocol Maps are maps that show the fundamental relationship between the elements that make up the metropolitan system and reveal its structure through the stratification of the physical aspects of geographic, historical, and geometric data. The Maps of Dynamics are maps that represent the factors of change of the metropolitan landscape in the time through the differentiated perspective of the local agents that interact with the instruments of the Metropolitan Discipline through specific software: MGIP Software Glossary and TELLme Hub (Fig. 2).

Therefore, Metropolitan Cartography (MC) presents itself as a methodological tool consisting of a strong innovative and technological apparatus through the support of theoretical and executive software tools. Thanks to the technical knowledge of the MC, the construction of the map allows to evaluate the city as an experimental laboratory of innovation and research. For this reason, the designer of the urban and architectural discipline and the metropolitan expert need to work with new types of maps that can give a persuasive image of the territory.

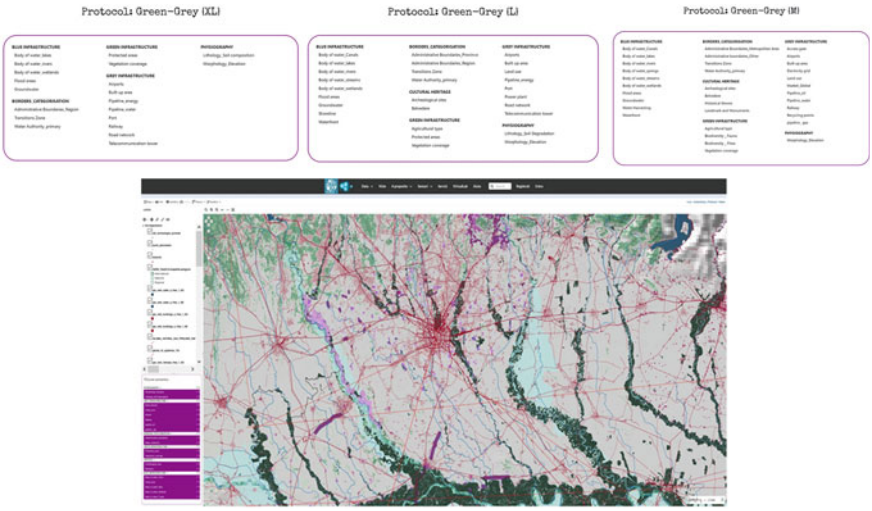

Fig. 2 Correspondence between the Semantic Package in TELLme MGIP Software Glossary and the Protocol Maps in TELLme Hub as a dynamic in-formation system. Image from TELLme Hub.getit

The link between the keywords and the associated levels of information allow the metropolitan expert and the designer to acquire a practical-theoretical inventive ability working through interaction between geography and history [26], geography and function [27] in order to build a new logical geography of the city [28].

3.3 Metropolitan Cartography Protocol Maps to Structure the Knowledge of the Territory

3.3.1 Green-Grey Infrastructure Protocol Map

The attractive value of the territorial image linked to digital information and technological interaction, in the last decade, reveals its importance in Smart Mega-City research according to professional and academic field. The Smart City is commonly intended as a model of urban development built following a structuring of systems and processes highly performing and efficient for monitoring the operations of land change in accordance with recent urban dynamics: it is space paradigm based on new technologies, sensors and Big Data.

Therefore, the research purpose is to demonstrate how the spatial trans-formation process of the city, and its urban and rural context, should not be understood as a result of a sequence of automated processes in the technological field, but as an investigation linked to the possibility of developing new skills deeply rooted in the territorial knowledge. It is therefore a matter of updating the techniques and knowledge of the

past, which have characterized the development of territorial intelligences and the strengthening of theoretical-practical awareness for the construction of new urban quality spaces. To achieve this goal, it is essential to start from the morphological analysis of contemporary geographical and urban contexts in order to orient new sustainable planning strategies through a new techno-morphological objective [29].

For this purpose, the maps of Metropolitan Cartography are preparatory to the understanding of the basic principles of spatial evolution over time.

It is therefore necessary to begin by understanding the morphological structure of the city and its territory, considering its structural and formal aspects, by reading the existing topographical, morphological and anthropic property, analysing the spatial components that highlight the discontinuity of the Green-Grey Infrastructure.

In current urban planning and policies scenarios, the Green-Grey Infra-structure is the strategically planned network of natural and semi-natural areas with environmental characteristics designed to provide the activation of ecosystem services such as: water purification, air quality, space for recreation and mitigation and adaptation to climate. This network of infrastructure armatures, green and blue areas can improve the environmental conditions and, therefore, the health and quality of life of the inhabitants [30]. According to the Conservation International Practical Guide to Implementing Green-Grey Infrastructure [31] there are different synonyms for understanding the complexity of Green-Grey Infrastructure as Ecosystem-Based adaptation. It is a concept based on the use of biodiversity and ecosystem services in the context of a local design strategy with global repercussions. It is therefore a complex system adaptive to the obvious effects of Natural Hazards, due to climate change on human-engineered armature.

According to this theoretical awareness Metropolitan Discipline considers Green-Grey Infrastructure as an operative project strategy with territorial-scale effects, aiming to overcome the fragmentary nature of urban extensions in the metropolitan area through a structural reading of the landscape system, characterized by forms of continuity with which architecture collaborates to define unitary interventions aimed at generating a new form of urban places.

In design field of action, the continuity project of the Green-Grey Infrastructure considers architecture and landscape as co-participants in the definition of a unified intervention characterized by a structured and organized form of soil. The interaction between architecture and the environmental dimension is born in a gradual process of transformation of the existing natural heritage from which landscape emerges defined by the relational forms that architecture establishes with the landscape system. For this reason, the purpose of the protocol map Grey-Grey Infrastructure induces map-reader and local agent to detect spatial interruptions of interface elements of the physical context, in order to ensure the continuity of the ecological infrastructure not integrated with the territorial urban system yet.

The object of the Green-Grey Protocol Map XL is to represent the intermittent spaces between the most densely built-up areas and high natural capital ones of Lombardy. The map outlines a strategic framework in which the city of Milan is a large dynamic urban exchange centrality between the region of Lombardy, Piemonte and Liguria. The maps show an historical linkage of urban and regional centralities

of flows trades based on the primary and secondary sector of the Italian national economy.

The purpose of the map is to tell the narrative of the metropolitan city of Milan, strongly linked to the complex water system of canals, underground waterways, linked to the hierarchical scheme of primary and secondary roads that sets up territory as Net-City [8] (Fig. 3). Nevertheless, the map highlights the lack of connection between the infrastructure and the ecological system of the plains. It is a condition that allows to consider Milan and its territory as an ecotone [32] reality. This spatial condition could be identified in the ecological corridors currently existing at the main rivers of the city. The River Lambro and the River Ticino are ecological wedges to encourage biodiversity links between the Po and the pre-alpine valley and the Alpine relief.

The map Grey-Green Infrastructure L (Fig. 4) shows how the link between densely urbanized areas is inseparable from their geographical roots and how informal urban settlements grow constantly by contaminating areas recognized as protected. The representation of the corridors of high and low anthropization in the maps of the dimension Large (L) and Medium (M) dimension, points out the emphasis on the following note: the urban footprint of Milan is constantly growing and expanding at the expense of the existing ecological heritage. In the last decade the Lombardy Region, through the regulations and the territorial plan of the region has focused on the ecosystem and landscape value of the territory, recognizes the potential ecotonal value of urban settlement and the territorial value of regional canalization

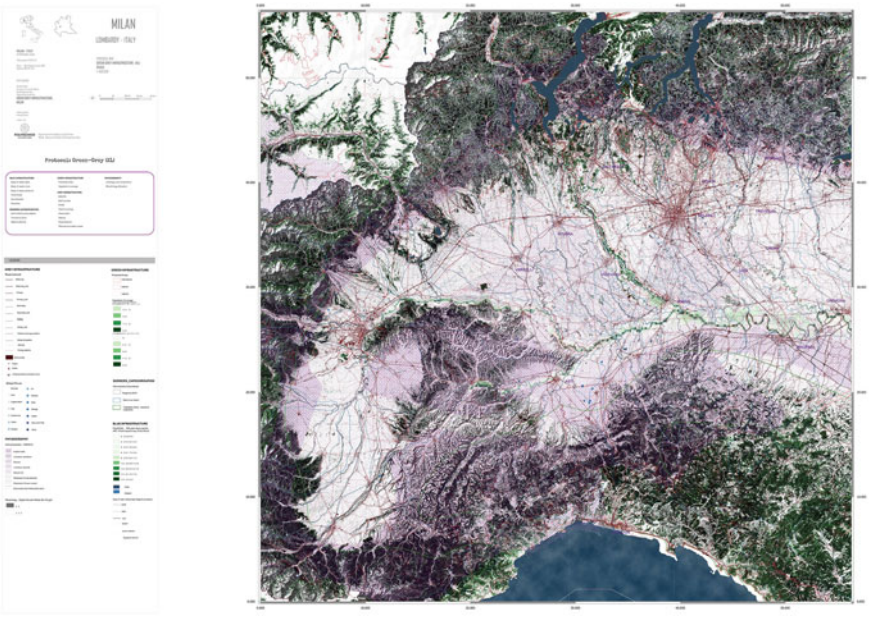

Fig. 3 Green-Grey protocol map XL–1:500000. *Credit* 2019, by V. Galiulo, MSLab–TELLme

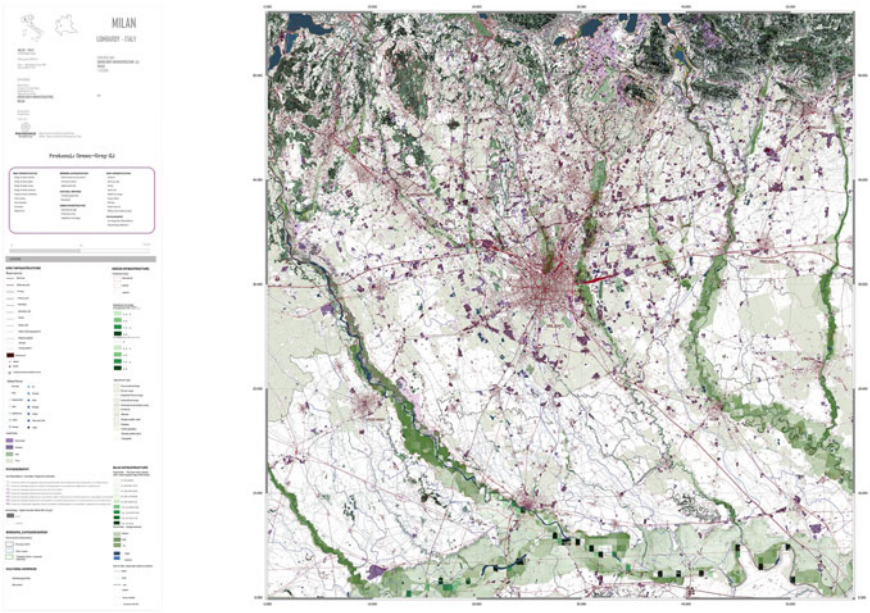

Fig. 4 Green-Grey protocol map L–1:150000. *Credit* 2019, by V. Galiulo, MSLab–TELLme

systems (Fig. 4). The relational constant of each map is the river Po and its tributaries, understood as an invariable geographical reference through which it is possible to explain the spatial relationship between informative elements that generate lines of force on the territory [33]. The lines of force allow to root the use and the meaning of the quantitative information of the data to the cultural identity of the space context in which it acts. In the Maps of the Protocol, the change of bounding box and scale is determined by the will to represent the constant and permanent relationship with the geographical and structuring lines of force of the three dimensions XL–L–M, which correspond to three different scales: 1: 500,000, 1: 150,000, 1: 50,000 (Fig. 5).

In summary, the maps produced with the TELLme methodology are not simulations of reality, but are instruments through which, in the projective geo-referenced space of the GIS (Geographical Information System) Spatial relationships, not yet expressed through a new vivid and memorable image, become visible [34]. It is therefore interesting to understand how to read and interpret the fragility of a territory through spatial images related to the time variable of the data processing. Metropolitan Cartography map become a technological tool for the transmission of a new methodology and new knowledge that allow to move from urban analysis to the theory of metropolitan design, which requires the presence of geographical references strongly bound to the topography, considering it the main support for the analysis of the city.

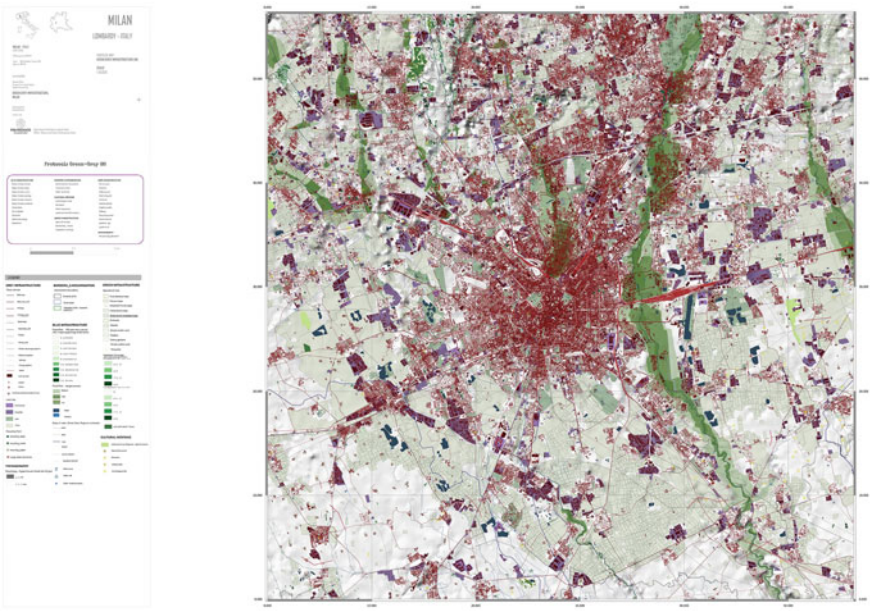

Fig. 5 Green-Grey protocol map M–1:50000. *Credit* 2019, by V. Galiulo, MSLab–TELLme

3.3.2 Urban Metabolism Protocol Map

According to Urban Political Ecology vision (UPE), it is possible to deal with Urban Metabolism when the city is considered as a living organism that functions in a similar way to the natural system, in terms of production or consumption of energy. Reading metropolitan territory must be carried out considering the natural and artificial processes of consumption of the resources of the ecosystem, and this implies the tracing of the flows, not always explicit, linked to the production and processing of building materials, traffic in goods, food, transport, energy and marking the possibility of depletion of energy resources and the over-production of municipal waste.

The intersection of social and economic variables and the consequent spatial changes of shapes and uses are the constituent attributes for the composition of contemporary urban social landscapes that are subjected to the acceleration of the metabolic transformation today are more visible, in both physical and social dimensions.

According to Metropolitan Discipline, Urban Metabolism has a dual meaning of the term: it is not only a concept empirically measurable through the ecological footprint of the urban inhabitants, but it is a complex system of actions that tend to enhance a sustainable urban planning approach. It is a criterion for the design of a coordinated, interdisciplinary, and changing territorial strategy to optimize spatial,

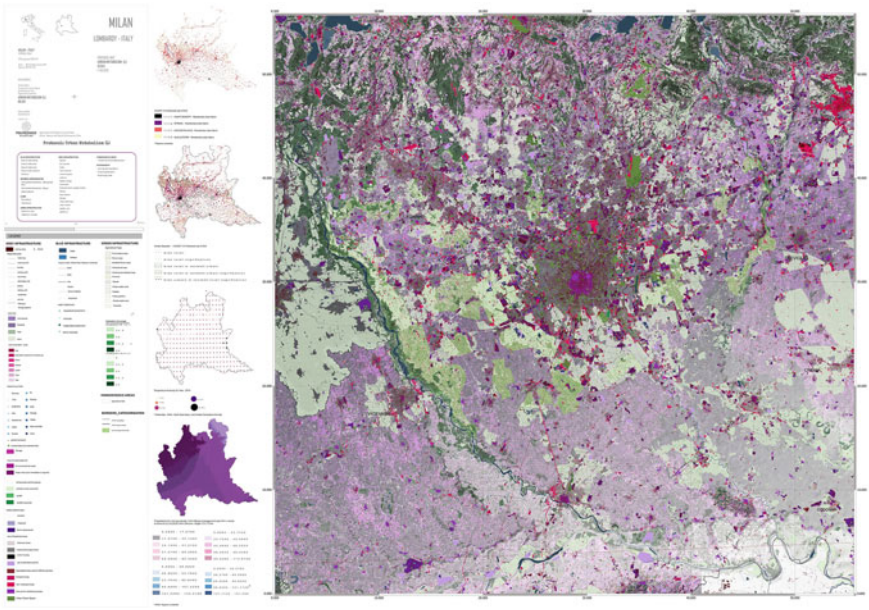

Fig. 6 Urban metabolism protocol map L–1:150000, How the territory is exploited. *Credit* 2019, by V. Galiulo, A. Contin, MSLab–TELLme

social and economic dynamics that can guarantee a quality of life accessible to all citizens.

The incremental objective that the maps of the Metropolitan Cartography propose is to think to a plan that, although consuming, compensates, shapes and increases also the quality of the life of the citizens and the natural ecosystem in which they live (Fig. 6). If on the one hand this approach integrates the temporal space of the Urban Biography and the time of the urban agenda, on the other, it is possible to make the individual interest coincide with the social interest through targeted strategic metabolic actions of maintenance, replacement and transformation [11], which are inspired by the ethical axis of governance and the principles of equitable and sustainable well-being [35]. A further important aspect of the metabolic approach in the design of the metropolitan city spaces is the possibility for institutional bodies to manage environmental, social and economic changes by implementing the ethical axis of territorial transformation in shared urban planning policies starting from the municipal dimension.

3.3.3 Unit of Metropolitan Landscape Protocol Map

The definition of Metropolitan Landscape Unit, in the Metropolitan Discipline, arises from the synthesis between different concepts such as Landscape Unit in the context

of regional planning; Figurative Landscape Unit [36], Cultural Landscape Unit [37] and Implementation Unit [38]. These definitions are the key concepts to outline specific criteria for the description and measurement of Metropolitan Landscape unit. They are definitions deeply related to the geography and morphological structure of the Green-Grey Infrastructure at the scale of Metropolitan Region. This means extracting the components that make up the minimum Metro-unit by placing it in reaction with the formal anthropogenic-geographical types [39] de-signed as indicators of formal transformation following urban and architectural planning project aims. For this reason, each unit of Landscape must contain at-tributes related to the cultural biography of the territory and the citizens who inhabit it.

The goal of the Landscape Unit Map is to be able to understand how to live and transform the territory. The Metropolitan Landscape Unit map allows an in-depth analysis of the human, natural and technological systems that insist on the territory (Fig. 7). The map spatializes the overlap of activities, land uses and local habitus, and then organizes reciprocal relations in territorial sections that show the overlap of activity processes in the context of the reconstruction of the ecological balance of the site [8]. In addition, the map of the Landscape Unit aims to represent not a new model on which to rethink the city, but rather identifies a structured dispositive organization according to a flexible physical configuration, repeatable and practicable not only on the scale of the single urban unit but above all on Metropolitan Region scale.

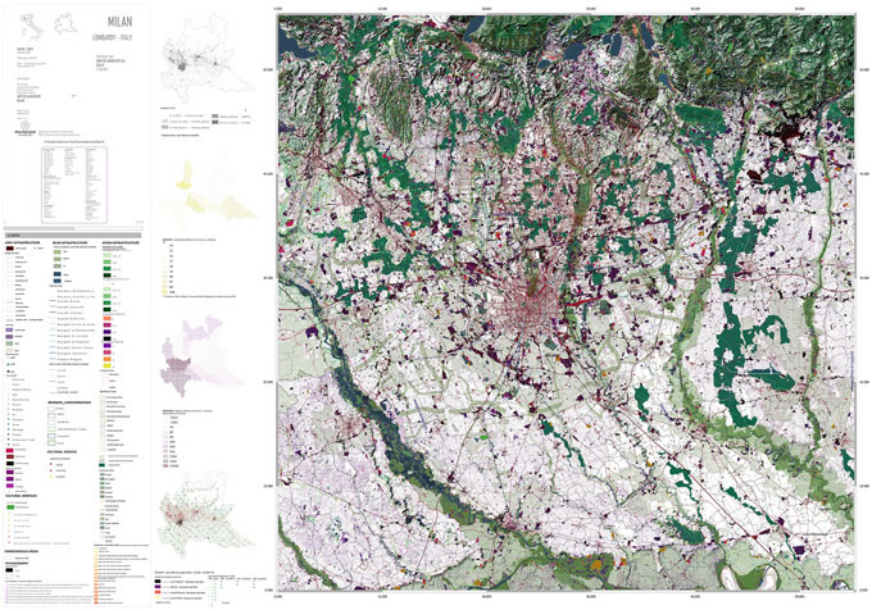

Fig. 7 Unit of landscape protocol map L–1:150000, How the territory of the Smart Mega-City is lived and transformed. *Credit* 2020, by V. Galiulo, A. Contin, MSLab–TELLme

The Protocol maps presented are some of the possible reproducible ones to investigate the MESA (Metropolitan Existing Situation Analysis) and the phenomena and transformation impacts of the contemporary city. The Metropolitan Cartography maps are methodological projects supported by technology that make it possible to read spatial dynamic correspondences between quantitative and qualitative data. Knowing how to decipher and interpret certain correlations means being able to understand the principles of selection, order, hierarchy, and composition of the cartographic project. Moreover, the Metropolitan Cartography (MC) allows to draw up maps through a synthetic process that helps metropolitan experts to interpolate the different perspectives of interdisciplinary specialists with the narration of local actors.

Furthermore, MC maps allow to define the structural schemes of the intrinsic reasons of the territory, enabling the activation of pilot projects through communication between local actors. For this reason, maps are projects that produce spaces that are not limited to the two-dimensional delimitation or to their symbolic communication.

For Metropolitan agents, the inter-scalar coefficient of Metropolitan Cartography is necessary to define which physical and immaterial spatial variables can ease the mapping of the territory. It is a tool of dialogue and the representation of reality, interpretation of what is possible considering the needs of the residents, temporary inhabitants with the aim of activating practices for the implementation of a pilot strategic project.

The main research goal is to identify, through cartography, investment projects with a high social impact in order to advance integrated and sustainable urban development for all and to promote environmental and social cohesion between local citizens, migrants, commuters, temporary users and local authorities. The high purpose of the methodological tool is to activate and stimulate continuous experimentation to strengthen dialogue between different agencies, governmental authorities of different levels and sectors, UN Agencies and development partners, representatives of small communities and private sector actors. Therefore, the investigation leaves the questions in suspense temporarily and critical observations raised by the context-based analytical approach. However, the methodological research and Metropolitan Cartography have made it possible to highlight the variables that leave open discussion in the academic theoretical and practical through dialogue with local administrations and agencies.

4 Morphological Layers and Constitutive Elements in the Milan Metropolitan Area Scene

It is important to consider the particular situation of the Milan Metropolitan area in depth, which is not only rich of history, agricultural and landscape fabrics and images, but also is characterized by overlapping infrastructural systems–railways,

urban motorways and airport that make of it a paradigmatic example of a multi scalar territory.

The starting point of this research line [19], is to analyse the deep infrastructural change that the city is dealing with due to the construction of the new bypass road–Tangenziale Est Esterna-, a freeway, parallel to the existing Tangenziale, linking the two main existing motor ways in Italy and converging to Milan; the Milan–Naples and the Turin–Venice. Such emerging infrastructural change and the realization of a new high-speed train connection between Milan and Venice stimulate the idea of a possible new station/infrastructural Hub to be directly connected to the Linate Airport.

These new elements increase the possibility to look at this landscape through a new dimension in the metropolitan area–that would go beyond the traditional binomial city countryside. This part tries to imagine a new synergic system made of landscape, urban fabrics, and infrastructural nets through the recognition of the physical constitutive layers.

The infrastructural presence indeed, has been felt as an alien element that is totally detached from the local dynamics. This point of view aims to go deep in the relationship between local and global levels, between green and grey infrastructure that must work together and look for the necessary continuity which can generate new possible figures of public space at the scale of a net city giving it a new system of references.

Lombardy is a metropolitan region between the three main airports that could be considered within a scale of the net city defined by the infrastructural net, different urban fabrics, and the landscape system within a square of 100 × 100 km. In this scenario, the focus on Milan and its Eastern metropolitan area is mostly regarding to the new infrastructural scenario Tangenziale Est Esterna, the new high-speed railroad, a possible new Station and connection to Linate airport.

5 Milan Metropolitan Area, Infrastructural System

For several years, the existing motorway ring had worked first as the border between city and countryside and then as the edge of the compact-dense city towards what we might call sprawl. Among the fundamental natural and artificial elements that have been forming the agricultural and urban context of the area, it is important to consider the old bypass road and the Lambro River on the eastern side, the new bypass road and the borders of the Parco Sud and its preserved areas on the west, the street towards the cities of Monza and Lecco on the north and finally the railway tracks, Idroscalo and the Linate Airport on the southern part that on the one hand perform as physical barriers surrounding the area and on the other hand, form infra-spatial conditions for the embedded-ness of the agricultural system. Such expansion model of parallel streaks will in fact, replace the obsolete concentric model of the urban growth fitting in a more equilibrated way-into the territorial system and pursuing more effective roles within the global sustainability perspective (Fig. 8).

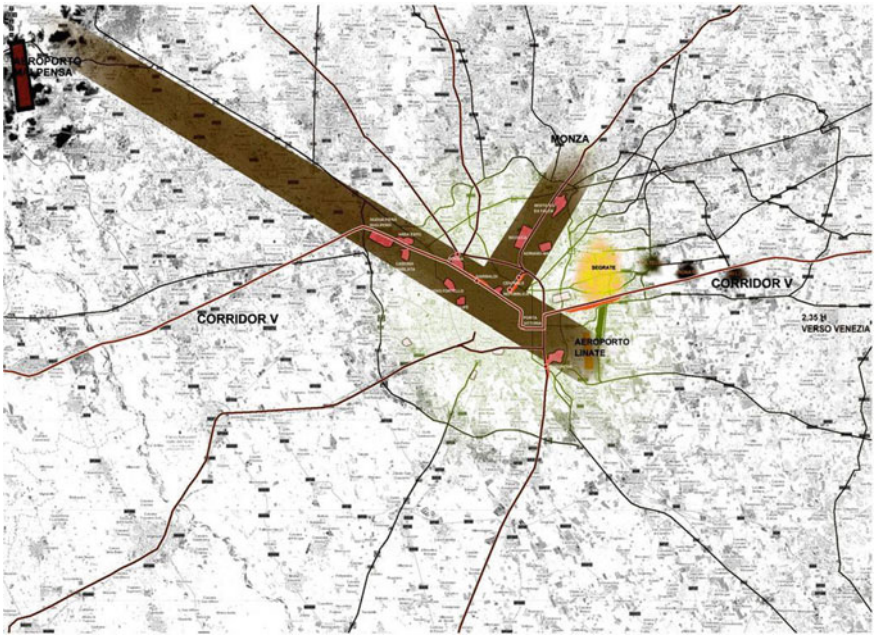

Fig. 8 Milan metropolitan area, infrastructural system

The existing rail yard had been for decades, a wall that disconnected the southern and the northern part of Segrate. The re-connection of the two parts asks for a comprehensive way of dealing with continuity of green and grey infrastructure converging in a dense point of interchange.

The new tangenziale might define, 15 km far from the existing one, a new threshold: and by this, a new centrality. This perspective gives an important chance to experiment new possibilities of interaction able to deal with the contemporary idea of identity and sense of belonging to a place.

Natural vacant areas mostly structured by the water system of the territory–as a fundamental feature of the local economy based on the agricultural character of the place must be revalorized as multifunctional green areas within the urban scale that are able to meet both, the necessities of inhabitants and sustainability requirements of the place.

Accordingly, we can consider this territory as a Strategic switching location structured by strong infrastructural systems that bring the area into the light of accessibility in different scales. In the national and international scale, its proximity to the international airport of Linate is the link between the city of Segrate and other European countries especially during the Expo 2015 events, while within the regional and inter-regional scale, there is the rail yard, that on the one hand acts as a strong physical barrier cutting the area into two parts and on the other hand, makes it accessible from other cities. The train station located in Segrate and the realization of the metro

line number 4 makes the city become an eastern entrance gate to the city of Milan and through that to the western Italy and the departure city within the leaner system towards the eastern parts. Coming down the scale into the local one, the transversal parallel longitudinal streets that exiting from Milan and entering to it, perpendicularly to the city, provide the access to four major points: the Cascina Gobba stop of the metro line number 2 on the northern extreme, the Rogoredo stop on the extension of the metro line number 3 on the southern extreme, the railway station itself and the Linate stop on the future metro line number 4 in the middle.

In this scenario of large infrastructural transformations, attention has been brought to some specific issues, which clarify how the local context-mainly characterized by infrastructural networks and natural and artificial fabrics can be re-activated as a multi scalar continuity. To achieve that, it is necessary to consider the macro-configuration of the territory especially according to the intertwined green and grey infrastructures. In this regard, four parallel 'streaks' are taken into consideration, all in the north-south direction. From east, respectively:

– The one consisting of the Lambro River occupied mostly by the old bypass road. In this first strip, there are already naturalistic paths aimed to the re-qualification of some ex-industrial areas such as the park of ex-Innocenti Maserati;
– The second streak is that of the lakes of Segrate that in the southern part includes the Idroscalo;
– The third and the fourth pass through the Cascine Park and Invernizzi Park that are actually considered as the access points to the agricultural southern park.

All of these four parallel streaks are traversable, on the East-west direction, by the railway tracks where there was reanalysed the high-speed train that connects the western parts of the city of Milan, and also western Italy, with the eastern parts. According to the west-east continuity, the railway has the role of linking several cities, starting from Segrate as the terminal, Pioltello, Settala, Vignate and Melzo, and so will form a sort of complex linear city that perpendicularly connects and overlaps with the parallel strips (Fig. 9).

According to the model, it is important to consider, that the transformation of the built and non-built areas in these parallel streaks, does not take place in a solid and boundary making manner, but it is expected to interconnect the bands with each other and converge gradually from one condition to another. Moreover, the re-qualification of the marginal areas, buffering between natural and artificial context, has to emphasise the unique values of the territory such as its green footprint of agriculture and re-activate the historical and genesis identity of the place.

In order to go deep into the context of spatial configuration, it is classified into four layers, which are: the water system, the green areas, the local companies, and the cultural spaces. Such stratification is based on two main scopes: first to study and analyse the context through its physical constitutive layers, and then, to prepare the ground for evolving a new reading of the context through the revelation of the multi-scalar relations between its layers. In other words, these layers will be broken down into urban space-scale components and re-structured within an analytical apparatus in the next part.

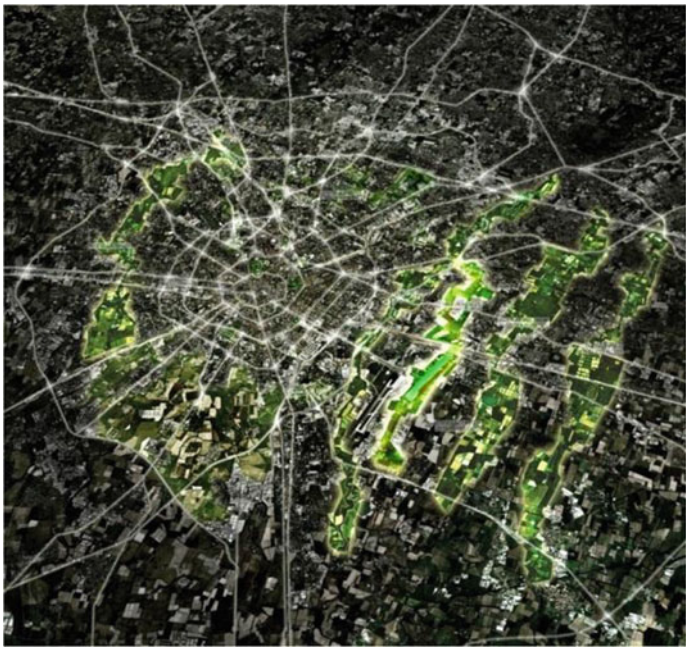

Fig. 9 Parallel green streps [40]

The first layer is the water system. Based on the previous explanations, the area of Segrate and Linate, like the whole Lombardy system are structured based on the penetration direction of the water resources from north to south. Such configuration is based on the agricultural characteristics of the territory which is rooted in the ancient roman land constructions. The productivity of the land and its rich subterranean aquatic means have always had the main role of giving economic support. Such system is composed of the natural lakes, rivers, artificial canals, irrigation ditches, resurgences, etc. The examined area is defined on the north by the Martesana Canal and on the west by the Lambro River as the two main water tracks and barriers. Proceeding southward, there are three main islands-like water concentrations penetrating the land through small-scale lakes. The three main ones are the Centro Parco lake which is mainly used for the sand extraction; the Idroscalo artificial lake on the eastern side of the Linate airport, which was built as a seaplane during the 30's and converted into a leisure area during the 60's and the Pioltello lake on the south-eastern part. However, there are other scattered water concentrations in the territory such as Forlanini, Redecesio and Lavanderie lakes. Another group of components of this layer is the irrigation ditches and the resurgences, which configure the distributary permeation of the water system.

The next layer is the green ambits as another natural infrastructure of the territory that relates to the water system. Although the main characteristic components of the area are the agricultural lands, the green layer relates to those areas with are

not considered mainly productive. In other words, the public green areas and the protected green resources are the components of this layer. Such components, as previously explained, closely follow the water infrastructure. For example, the two main green traces are found on the two sides of the Martesana canal and the Lambro River on both and west as sell as Pioltello and Forlanini parks. Other important elements of this layer-form the historical point of view as well as their dimension and scale-are Cascina Park, protected lands on the eastern side and the Parco Sud on the southern side.

Accordingly, the interconnection and co-performance of these two layers result in the agricultural and productive character of the territory, which is consisting of local products, and artisan manufactures. On the other hand, such productivity accompanied by the strategic location has caused the area to host several industrial companies as well as institutional and logistic sites. Such a functional transformation from one side makes this area, the eastern hub for the Milanese metropolitan industry especially Media-related products and on the other side emphasizes on the spatial fragmentation of the context especially regarding the space-use and connectivity. The third layer thus consists of the both agricultural sites–also the cultural and historical heritages–and the institutional and industrial ones. Mainly, the components of the first layer are old Cascinas–complex residential bourgeois villas with productive lands rooted in the feudalism history-such as Baraggiante on the north-east and agrotourism lands on the east-south. Regarding the industrial one, companies and institutional components are the most important ones as effective in the scale of performance are Mediaset, Mondadori, IBM, 3 M, etc., which are mostly related to the Media and communication industry.

The last layer in this studied consists of the cultural places which are related to both public cultural activities and hybrid ones of social exchanges. The latter one is mainly related to the connection hubs such as railway station and Linate airport while the first one includes the libraries, public expositional spaces, and educational complexes (Fig. 10).

So far, the analysis proceeds with the stratification of the physical context based on their individual characteristics. These layers then are merged together based on a hypothesized apparatus which is meant to magnify the context through different yet more complex relations. In other words, the purely material context can be observed over immaterial shaping orders. It is important to note here that the analyses are gradually tending towards the non-physical layers especially the communication dynamics and space-use-movement aspects. But first it is necessary to extract the immateriality hidden in the material context.

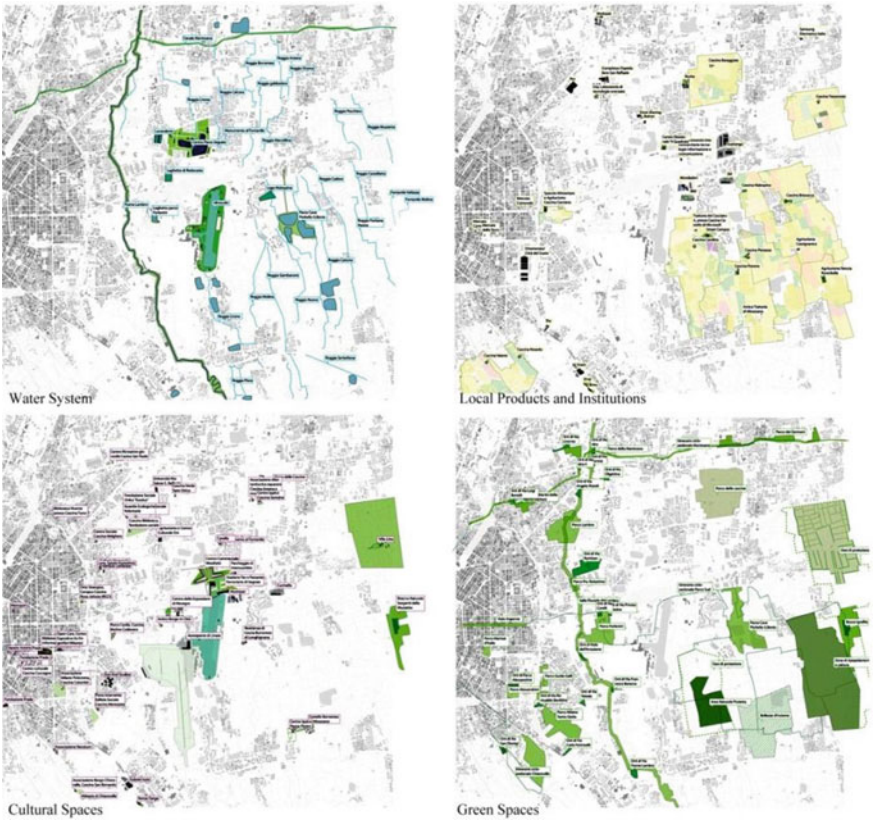

Fig. 10 Physical layers: water system, local products, cultural spaces, green areas

6 Water Management and Milan as Core of the Po Valley Smart Megalopolis

The tradition in the exploitation of water in the Po valley comes from a much older culture, related to the use for energy purposes of the rich natural and artificial water systems, starting from Roman times (but probably, even before) and leading to Middle Ages [41]. Milan was already a Smart City in Roman times and the Po valley had a Smart technological component that developed in the following periods, using water at several different levels, being a primary resource for drinking and watering fields, thermal purpose (for the famous Roman Spas), transportation of people and materials/goods through waterways, and energy production source (for mills). Actually, the abundance of water has certainly been a very important resource for the development of the Po Valley and has necessitated, more than once, interventions of regulation and drainage that have contributed strongly to imprint a particular conformation on the land. In the Roman times already, there were numerous projects of

canalization and intense yet diligent commitment to the maintenance of the canals, used for navigation, irrigation and for the working of the mills [42]. This also comes from the peculiar situation of the Po valley and its special geological, pedological, and hydrological condition, being delimited by "two mountain ridges, the Alps and the Apennines" [43], that create a natural amphitheatre leading to the Adriatic Sea, the enclosed marine basin that represents the last extension to North of the Mediterranean sink [44].

The natural and artificial water system of the Po valley [45] is divided between surface (lakes, reservoirs, rivers, channels, streams, swamplands, transitional waters, humid areas, and so on) and underground water bodies, identified through specific hydrographic basins and sub-basins. This is the first Italian area by river extension (including rivers, like Po, Sesia, Ticino, Adda, Oglio, Mincio, Brenta, Adige and Piave, for a total of more than 46.000 skm): water bodies and streams are divided into types and classified by water quality, ecological status and hydrographic levels [46]. The main collector of water flows is the Po river, the longest Italian waterway: it receives all the waters coming from Prealpine lakes (the main ones are Garda, Maggiore, Como, Iseo, and Endine), both through surface and underground bodies. Another unique feature of the local water system, which has been smartly used from the Roman times, is represented by Thermo-mineral Waters [47], generated by the prolonged contact with rocks, which makes them acquire a particular chemical composition, exploitable for therapeutic purpose, independently from their spring temperature. The quality of and quantity of water is constantly monitored by a network of Public Agencies and Administrations with different duties and tasks.

As a matter of fact, the Po valley has a long course of historical events connected to water management and the development of artificial water bodies [44], starting, in the modern era, from the renowned 'Navigli', the navigation and irrigation canals [48], linking the Maggiore and Como lakes and converging in Milan, connecting Switzerland and the Ticino area both to the Northern navigation systems and the Adriatic Sea through the Po river [49]. The drainage works started in the 10th century, with the facilities planned by local monks (who also invented a primigenial Cash-Flow Analysis method to check the economic efficiency of their investments) and lasted up to the 19th century [42]. The city of Milan, the core of the Po valley, was considered to be a 'water town', having a circular canal enclosing the centre (termed as Cerchia dei Navigli' or 'Fossa/Cerchia interna'), that was covered only in the 30 s of the 20th Century [44]. After the II World War there has been many different proposals of reopening it, but the lack of space for the internal roads and mobility spaces always restricted the municipality from accomplishing it [45].

This network of artificial and semi-artificial water bodies was a primigenial Smart Infrastructure of the Po valley, as it has been conceived as a multifunctional system [42] from its origin, being a hydrographic, agricultural, economic and resource management, transportation, communication, risk management and energetic facility grid [46], centuries before the idea of Smart Cities was introduced. Artificial and semi-artificial channels in the Po valley have always been used for fulfilling many

different regional and local management objectives [50]. The technological development of water facilities also encouraged the development of economic and environmental assessment methods [51], from the beginning of the 14th century, that will lead to the development of the modern Project Appraisal sciences in the Italian tradition (called 'Estimo') since the first half of the 16th century [50] and through the development of ancient and modern cadastral systems [52].

Another peculiar set of semi-artificial water bodies, meant to have a multifunctional use with a high technological content, is represented by the so-called 'fontane' or 'fontanili' (namely, spring, trough, [48], or better "*lowland man-made springs […], which originate from natural resurgences occurring along the alluvial fans of the main watercourses, namely in the transition zone from the higher to lower plain which is characterized by changes in slope profile and sediment granulometry. These habitats usually show low variation in hydrological, hydro chemical and thermal conditions throughout the year*" [43, 53]. The quality and quantity of water in the Po valley have always been a good starting point for the development of human settlements and economic activities [41, 54], not only in the agricultural field, but also in the industrial sector [44], considering that the 'lack' of water in the higher part of the valley (known as 'piana asciutta', where springs and troughs are not found commonly) has led to an early industrial development of the Como-Varese-North Milan area, after the 14th and 15th agricultural revolution (*ibidem*) (Fig. 11).

6.1 The Governance Structure of Water Management in Italy and in the Po Valley

The governance structure that is in charge of water management, supply, protection and treatment in Italy is highly complex and it is divided in many different functions and duties, related to the multidimensional nature of water and its administration, which includes the consideration of the resource itself and the related services, in terms of supply for different uses e.g. domestic, agricultural, industrial, of wastewater treatment, of infrastructure provision and management, of risk detection and controlling, pollution assessment and monitoring/reduction/mitigation, energy production and management [55]. The complexity of the structure, basically referring to the development of Smart Cities in Italy, is represented by a fragmented scenario, in which duties, related to policy making, coordination, advisory, policy implementation, management and surveillance, lead to a situation, where many issues can be identified: "*the fragmentation of responsibilities between State and Regions, the difficulty of coordination among the several bodies at national and subnational levels, the inadequate basin planning in the river basin districts, the preference for emergency actions instead of prevention measures to face floods and drought risks, the slowdown of the municipal water services reforms can be identified as the main weaknesses*" [55, 56].

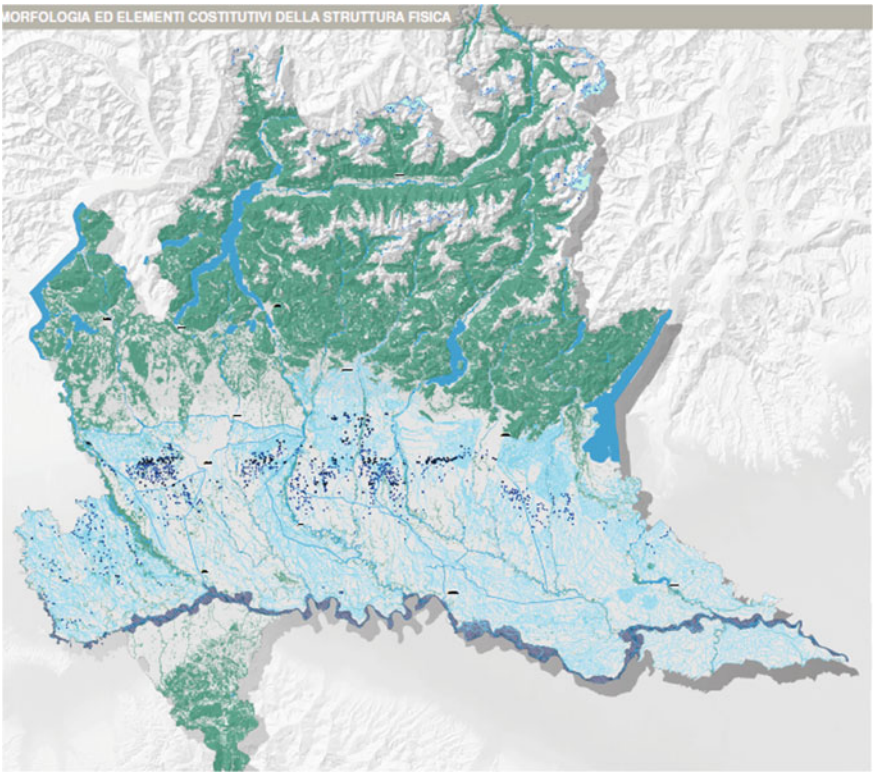

Fig. 11 Morphology and physical structure of Lombardy, Regional Plan (Piano territoriale regionale), 2019

The recent change of approach in the legislative definition of the role of water in the Italian Regulation [57] is fundamental, also for the role of Smart Cities in Italy, as the previous attitude, related to ensuring a sufficient provision of fresh waters (as per the Royal Decree n. 523 of 1904 for hydraulic infrastructures), the Sanitation Laws ('Leggi sanitarie'), promulgated in 1934 and connected to the RD n. 1775 of 1933 on hydroelectric power plants, turned to a new consciousness towards the quality of waters (see Law 319/1976 for the protection of waters from pollution) and hydraulic risks (see Law 183/1989 for the hydraulic protection and Law 36/1994 for the water sector reorganization through Territorial Divisions called 'Ambito territoriale ottimale', or ATOs), significantly influenced by the modern European legislation (see Legislative Decree 152/1999 for the water protection, then abrogated by the Leg.Dec. 152/2006, the new reference framework for the Environment protection rules). Though the water protection is basically overseen by the State and its bodies (mainly, the Environment and the Transportation Ministries, *ibidem*), being a matter included in Environmental protection, which is a duty assigned to the State by the Italian Constitution (1948), also Regional and Provincial Authorities have an

active role in it, with a number of other Public Administrations [55], focused on other tasks, such as the Integrated Water Supply Service and its economic management, that will be described, for the Po valley (as other Regional Authorities have different structures and tasks distributions), in the following paragraphs.

6.1.1 The Main Public Administrations Managing Water in the Lombardy Area

The local Regional Authorities in the Po valley (Piedmont, Lombardy, Emilia-Romagna, and Veneto) include the management and protection of water resources in the list of their main political and environmental objectives, regulated through legislative, planning (including infrastructure), and decisional tools [46]. The regional authorities are responsible for the identification of areas, characterized by high hydrogeological risks, and the hydraulic police, meaning it is the subject that controls activities and works that can be performed inside water state properties and/or in the related buffer areas of waterways (10 m or more, as established by Minor Hydric Network documents compiled by Municipalities), and that determines the related fees. Regional authorities are also responsible for overseeing the irrigation and drainage authorities (Consorzi di bonifica), defining fees and the standards for their respective planning norms, tools, and the integrated water supply service, which includes all the public services related to water supply, sewage and treatment facilities, directly managed by the provincial territorial divisions for the integrated water supply service authorities, as described in a specific annual report edited by the regional authority [57] (Fig. 12).

Priority infrastructures are identified by the regional authorities through the Priority Objectives (POs) of their development plans (*Piano territoriale regionale*, PTR), and updated annually: i.e., lamination basins are included in the list of POs with the municipalities involved, being the highest strategic level that influences 'River Agreements' and sectoral planning tools. The Regional Authorities are also the reference bodies for several planning interventions (Water protection Plan or *Piano di Tutela delle Acque*–PTA; Water Use and Protection Program or Programma di Tutela e *Uso delle Acque*–PTUA), for the identification of the Main Hydric Network (*Reticolo idrico principale*, RIP) and for the data production and update [46], through its Geoportal Services (e.g. for the Regional Water Assessment or Bilancio idrico regionale and the cartography for the first layer underground hydrostructure), plus the implementation of a long list of programs and projects related to water. Another interesting planning intervention at the regional level is called the 'Contratto di Fiume' (namely, River Agreement) promoted by Lombardy, that is, in the regional authority definition, a voluntary tool of strategic and negotiated planning, contributing to local development, that pursues the protection and accurate management of water resources, the enhancement of river basins, together with the safeguard from hydraulic risks, which are enforced using local development agreements, or *Accordi Quadro di Sviluppo Territoriale*–AQST (e.g. the Agreement for the remediation of the Varese lake–AQST per la salvaguardia e il risanamento del

Public Authority	Duties	Tasks	Planning tools that can include policies/ actions influencing water	Geoportal
Regione Lombardia Lombardy Region	Resource management, strategy, policy making and implementation, priority setting, quality standards, economic and environmental regulation, control at sub-national level of national regulations enforcement	Planning (including infrastructure) and large derivations decisions, water supply management for all uses, wastewater treatment, compliance of service delivery for agriculture and industry	Piano territoriale regionale (PTR), Piano gestione acque, Piano di tutela delle acque (PTA), Programma di tutela e uso delle acque (PTUA), Piano di gestione per la tutela del rischio idrogeologico, Piano di gestione del rischio di alluvioni (PGRA), Piano regionale per l'adeguamento delle infrastrutture, Contratti di Fiume, Accordi Quadro di Sviluppo Territoriale (AQST), Programma d'Azione regionale per la protezione delle acque dall'inquinamento provocato dai nitrati provenienti da fonti agricole nelle zone vulnerabili ai sensi della Direttiva nitrati 91/676/CEE – 2020-2023, Programmi d'azione, Piano territoriale regionale d'area dei Navigli Lombardi	yes
Direzione Generale Ambiente e Clima di Regione Lombardia Department for Environment and Climate of Lombardy Region	Technical-administrative and planning activities	Plans enforcement, technical advice		yes
Province e Città metropolitana di Milano Provincial Authorities and the Metropolitan City Agency	Resource management, allocation of uses at local level	Small derivations, water supply management (domestic, agriculture, industry) and wastewater treatment	Piano territoriale di coordinamento provinciale (PTCP), Piano cave, Piano provinciale di gestione rifiuti (PPGR), Programma provinciale di previsione e prevenzione, Piano energetico provinciale, Piano di settore del demanio lacuale	most
Comuni Municipalities	Allocation of uses at sublocal level, compliance of service delivery commitment	Domestic water supply management, wastewater treatment, control at sub-national level of national regulations enforcement for domestic waters	Piano di governo del territorio (PGT), Piano urbano di gestione dei servizi del sottosuolo (PUGSS), Piano energetico comunale, Piano di emergenza comunale, Elaborato semplificato invarianza idraulica, Reticolo idrico minore, Piano regolatore generale degli acquedotti	only few
Città di Milano City of Milan	Allocation of uses at sublocal level, compliance of service delivery commitment	Domestic water supply management, wastewater treatment, control at sub-national level of national regulations enforcement for domestic waters	Piano di governo del territorio (PGT), Accordo Quadro di Sviluppo Territoriale (AQST) Milano Metropoli Rurale, Piano urbano di gestione dei servizi del sottosuolo (PUGSS), Piano energetico comunale, Piano di emergenza comunale, Elaborato semplificato invarianza idraulica, Reticolo idrico minore	yes

Fig. 12 Main public administrations involved in the water management activities at regional level

lago di Varese, and the AQSTs for specific river basins, such as Olona-Bozzente-Lura, Seveso, Northern Lambro), that are executed by specific action programs (Programma d'azione) and strategic sub-basin programs (*Programmi strategici di sottobacino*), that define the framework of measures and actions (general and local), coordinating planning intervention at different levels. AQSTs also implement the environmental objectives of the European Union, particularly related to water, as per the 6th Environmental Action Program and Directive 2000/60/EC.

Regarding the thermal and mineral waters, regional authorities are responsible for determining incentives, marketing activities on the hydromineral heritage, planning and supervising the touristic and economic development of the sector, plus monitoring and controlling the entire industry [55]. Another important duty of Regional Authorities is linked to their participation into Environmental Impact Assessment (*Valutazione d'impatto ambientale*, VIA) and Strategic Environmental Assessment (*Valutazione ambientale strategica*, VAS) procedures concerning projects, on one side, and programs/plans, on the other, that can involve water at different levels and

for several purposes, plus the Landscape Autorization (Autorizzazione paesaggistica) and various other environmental authorizations procedures (e.g. *Autorizzazione unica ambientale–AUA, Autorizzazione integrata ambientale–AIA, or Autorizzazione unica*–AU) for major public works and infrastructures, main agriculture, industrial developments and waste management projects [57].

Regional authorities and their departments administer the resource management, including planning interventions and large derivations, while small derivations have been transferred to provincial authorities and the Metropolitan City Agency [57], as a reference body for Milan and the Po valley as Smart Megalopolis. This means that water derivation and drawing can be authorized by the Regional Authority (e.g., over 1,000 l/sec for irrigation purposes, over 100 l/sec for springs and wells, over 3000 kW for energy production), or the provincial ones, that deal with minor instances related to water use and energy production requests related to stable or temporary uses of superficial and underground (through springs, wells and pits) water bodies [46]. Every province has a specific service with different procedures [55], which is also responsible, usually, for authorizing new urban wastewater connections to new and existing facility networks, and industrial or domestic wastewater drainage activities into surface waterbodies or into the ground (as per Legislative Decree n. 152/2006).

Provincial authorities, besides being the administrations entitled of ensuring water quality protection, safeguarding soil, defining water regulation and use [57], and approving the Minor Hydric Network (Reticolo idrico minore, RIM) layout identified by Municipalities, can also be involved into different environmental authorization procedures (VIA, AUA, AIA, or AU) in the waste management field and in the research and cultivation permit for mineral waters. Another important duty of Provincial Authorities is related to collecting, digitizing, and controlling volume notifications about water derivation and drawing activities (sent before the 31st March of every year), as per art. 22 of the Leg.Dec. n. 152/2006 [46]. Provincial authorities are also involved (through a specific written recommendation) in the assessment of the delimitation of protection areas for surface and ground water collection for human consumption, through services offered by third parties using pipe installations of public interest.

The city of Milan, as core of the Po valley Megalopolis, has an active role in this topic as well, being a part of the Regional Agreement made in the support of integrated rural systems and multifunctional agriculture as drivers for the soil consumption control and the ecosystem services strategies implementation [46]. In general, Municipal authorities have an active role both in the planning sector and in service providing and management [57]. Concerning the planning tools, townships are involved in water management through the geological studies for the general planning tools, which include a simplified document for hydraulic invariance, the identification of the minor hydric network (*Reticolo idrico minore*, RIM) and the related regulations [46]. Another important role that municipalities can have is regarding the definition of the General water management plan (*Piano regolatore generale acquedotti*), that is not mandatory though, differently from the Underground Facilities Networks Management Plan (*Piano urbano generale dei servizi nel sottosuolo*, PUGSS). Townships also have an active role in the development of minor hydraulic

works for the mitigation of risks, plus in the management of the compliance of service delivery commitment at local and sublocal levels [57].

6.1.2 Sectoral Public Bodies Representing the Governance Structure in the Lombardy Area

Park Management Authorities of national and regional level (in Italian, Enti parco nazionali e regionali) have a primary role in the environmental protection and the landscape management, but they are also involved in many sectoral activities concerning water quality and its biodiversity [57], as the Minimum Vital Flow (MVF, deflusso minimo vitale, DMV) calculation and management. The MVF is the runoff that, in a natural waterway, must be guaranteed, considering all possible intakes, in order to keep the functionality conditions and the ecosystem, quality of water-bodies, compatible with a sustainable use of water resources [58]. Park authorities also oversee the definition of compatible activities with the environmental protection, such as the opening of new dockyards and the environmental and landscape authorization of new developments (being also involved in assessment activities regarding implications on Natura 2000 sites, in Italian, Valutazione d'incidenza, VINCA). Plus, Regional Park Authorities also have specific duties in hygienic and drinking water infrastructures, water, air and soil pollution reduction, aquaculture regulation and sectoral planning interventions, aimed at protecting water as a source of biodiversity [46] (Fig. 13).

The Territorial Divisions (*Ambito territoriale ottimale*, ATO) for the Integrated Water Supply Management, one for every Provincial Authority and for the Metropolitan City of Milan, manage water services in the Po valley [59]. ATOs oversee the entire water cycle management, which includes collecting (reception), inducting (production), and distributing water for civil uses, sewerage, and wastewater purification. From the planning point of view, Territorial Divisions can approbate their own Catchment Area Plans (*Piano d'ambito* ATO).

From the infrastructure and resource management point of view, several sectorial authorities and agencies are in charge of different functions and duties [55]. The most important Authority in the Northern Italy area (covering 8 on 9 Regional Authorities and including also some French and Swiss regions) is the River Basin Agency for the Po river (in Italian, *Autorità di bacino del fiume Po*), which is responsible for the hydrogeological risk management (based on the 2000/60 EU Directive and the basin definition given by the Italian laws, through the D.P.R. 06/01/1998), that is realized through several legislative, planning and regulatory tools, starting from the Hydrogeological Structure Plan and its excerpts (*Piano di assetto idrogeologico*, PAI, established by the Law n. 183/1989), the Flooding Risk Management Plan (*Piano di gestione del rischio di alluvioni*, PGRA, introduced by the EU Directive 2007/60/CE), the Hydrographic District Management Plan (*Piano di Gestione del distretto idrografico del fiume Po*, PdG Po, approved by the Institutional Committee Resolution n. 1/2010) with its Water Balance Plan (*Piano di bilancio idrico*), and the Strategic Sub-basin Plans (*Piani strategici di sottobacino*).

Public Authority	Duties	Tasks	Geoportal
Enti parco nazionali e regionali Park Management Authorities of national and regional level	Resource management and protection, allocation of uses at local level, environment and landscape management and protection	Water supply assessment (domestic, agriculture, industry) and wastewater treatment evaluation	most
Ambito territoriale ottimale (ATO) Territorial division for the Integrated Water Supply Service	Compliance of service delivery commitment, economic regulation	Domestic water supply management, wastewater treatment, compliance of service delivery for domestic waters and wastewaters, economic regulation for domestic waters and wastewaters, control at sub-national level of national regulations enforcement for domestic waters	no
Autorità di bacino del fiume Po (AdBPo) River Basin Agency for the Po river	Resource management, allocation of uses at local level	Agriculture and industry water supply management and wastewater treatment	yes
Agenzia Interregionale per il fiume Po (AIPo) Interregional Agency for the Po river	Allocation of uses at local level	Water supply management	yes
Agenzia Regionale per la protezione ambientale (ARPA) Regional Authority for the Environment Protection	Information, monitoring and evaluation, quality standards	Water quality standards definition for all uses and for wastewater treatment	yes
Consorzi di bonifica Irrigation and Drainage Authorities	Resource management, allocation of uses at local level, compliance of service delivery commitment, economic regulation	Agriculture and industry water supply management and compliance of service delivery, wastewater treatment	several
Agenzie per la promozione turistica Agencies for the promotion of artificial waterways	Resource management, coastal areas protection, navigation management	Touristic development and promotion of artificial waterways	no
Agenzie di Tutela della Salute (ATS) Health Agencies	Resource management, health risks prevention	Wells and springs management and protection, local regulations assessment, burial ground areas protection buffer definition	no
Gestori servizi idrici Integrated Supply Companies	Resource management, allocation of uses at local level, compliance of service delivery commitment	Water Mains/Sewage/Water Treatment services	some
Gestori dighe e centrali idroelettriche Hydroelectric Energy Production Plants and Dams Management Companies	Resource management, energy production, water levels definition	Dams, Energy Production Plants, Water level management	no
Autorità di regolazione per energia, reti e ambiente (ARERA) Authority for Regulation Energy Networks and Environment	Resource management, energy production regulations	Competitive markets development	no
Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) Institute for Environment Protection and Research	Environmental Research and analysis	Datasets collection, research activities and programs	some
Protezione civile Civil protection	Risk management, Emergency management	Alert Systems management, Emergency activities	no

Fig. 13 Sectoral public administrations involved in the water management activities at regional level

The second most important body is the Interregional Agency for the Po river (*Agenzia Interregionale per il fiume Po*, AIPo), which was introduced by 4 Regional Authorities (Piemonte, Lombardy, Emilia Romagna, Veneto, corresponding to its 3 different offices and the headquarters in Parma) in 2003 for the management of the main water system (that formerly was a duty attributed to the Magistrato per il Po, instituted in 1956), dealing with safety, public resources and property management, navigation issues and water levels monitoring, thanks to actual and historical datasets, that are made available through its geoportal [59]. The River Basin Agency has some Territorial Divisions, entitled of managing specific rivers and lake basins.

From the point of view of the resource management, the Regional Authority for the Environment Protection (*Agenzia Regionale per la Protezione dell'ambiente*, ARPA)

is in charge of managing the water quality and the reduction of pollutants, focusing on ground and underground waters, but also considering sustainable uses and wastewaters, through data and indicators, synthesized in annual environmental status reports [46]. Most of the available data collected, processed, and synthesized in indicators is also made available through a geoportal, that is focused on the hydrological information.

In the regional context, the management of water consumption and distribution for different purposes, including agricultural uses, is a task of Irrigation and Drainage Authorities [59]. They promote the development of projects, initiatives, and interventions for the multiple and sustainable use of water, hydraulic soil protection, safeguard and enhancement of the environment and the landscape. From the planning point of view, Irrigation and Drainage Authorities, being entitled of the management of artificial water bodies and their infrastructure, have an active role in developing their own District Plans (*Piani comprensoriali di bonifica, irrigazione e tutela del territorio rurale*), coordinated with specific Three Years District Programs for hydraulic works (*Programmi comprensoriali triennali delle opere*), Hydraulic Police Regulations (*Regolamenti di Polizia Idraulica*), Properties Classification Plans (*Piani di classificazione degli immobili*), and Hydrogeologic Risks Mitigation Works Maps (Mappe degli interventi di mitigazione del rischio idrogeologico), plus, being the manager of physical infrastructures, their own Facilities Details Abacus (*Abaco delle opere idrauliche*).

The local Health Agencies (*Agenzie di Tutela della Salute*, ATS) have several important duties in the field of water protection and management as well, according to the Regional Law n. 23/2015, mainly focused on prevention and reduction of pollution, including the definition of buffer zones for wells, springs, and burial ground areas, potable water and water mains analyses, vulnerability classification assessments for water-bodies, swimming pools opening permits, monitoring and controlling (chemical and microbiological assessment) of waters for the human use, and so on [57]. Health Agencies can also monitor and control the 45 Integrated Supply Companies and the 238 Townships managing their own Water Mains/Sewage/Water Treatment facilities.

Dams and Hydroelectric Energy Production Plants are managed by different local companies, though they are mostly owned by the Company for Electric Infrastructures (formerly, a National Agency managing the Electric Networks and Facilities, in Italian, Ente nazionale per l'energia elettrica, E.N.E.L.). There are different companies managing both the infrastructures (some dams are only regulating infrastructures, some include energy production facilities as well) and the energy production plants, involving Electric Supply Commercial Companies directly, or Public/Semi-Public Agencies, but also specific Consortia and Groups.

The Authority for Regulation Energy Networks and Environment (*Autorità di regolazione per energia, reti e ambiente*, ARERA) promotes the development of competitive markets in electricity, natural gas and drinking water supply chains, mainly through different policies involving fees regulation, access to networks, service quality standards, and the protection of customers and end-users.

The Institute for Environment Protection and Research (*Istituto Superiore per la Protezione e la Ricerca Ambientale*, ISPRA) is involved in several research programs concerning water in all of its dimensions (quality, quantity, pollutants, ecological role, risks, and so on), and produces many important databases (actual and historical, spanning from inner waterways to Hydrosphere indicators), plus it provides many important services, as the Operational Hydrology, Hydro-morphology, Floods, Water Resources and Drought Service [55]. Plus, the Pesticides Portal of ISPRA presents datasets synthesizing national monitoring programs on inner ground and underground waters, including a specific geoportal.

The last two important roles at regional level in water management policies and actions are played by Touristic promotion agencies and the National and Local Civil protection (Protezione Civile, PC), which are responsible for the prediction and prevention of natural and anthropogenic risks and the management of the National and Local alert systems, including hydrogeological events. Agencies entitled of water management and promotion are Public Bodies created by Regional and Local Authorities, with the aim of promoting the cultural and touristic development of local channels. They can be entitled of managing the touristic navigation of channels and developing policies, governance tools and development programs for the promotion and the sustainable growth of waterside areas.

6.2 A Possible Governance Mission for Water Systems in the Smart City of Milan

Efficient resource management is essential to reduce energy and water consumption and prevent waste generation, even in a modern Smart City. Milan is already included in a Smart Megalopolis from a few points of view (and it has been so for centuries, as we stated in the first paragraph of this chapter), being the first city in Italy in this sense, but it can become even smarter [60], by ensuring a more efficient water supply, wastewater management and drinking water treatment on a large scale, as key services that every Smart Megalopolis and its Municipalities should offer. The smartness concept for cities involves around 6 key factors, which are, economy, people, governance, mobility, environment, and living (*ibidem*).

From the perspective of water management, Milan is a Smart Megalopolis as it has reached some objectives in terms of environmental sustainability, mobility, participation, and economic innovation, but there is still a lot that can be done from the point of view of including the value of resources [61] in its strategies, spatializing this concept with innovative methodologies [11]. The starting point can only be a new digital consciousness, using the existing infrastructures and networks to develop a new mission for the Smart Megalopolis of the future, also in the light of the latest achievements in terms of sustainability [61], proposed by the Sustainable Development Goals.

Integrated management platforms for drinking water treatment, water distribution networks, sewer systems, and sewage treatment facilities can help monitoring the efficiency of systems in real time, ensuring a reliable supply service and efficient maintenance programs using adequate prediction models, solving issues in a fast and well-organized way. This can help saving resources, reducing consumption, and minimizing pollution and emissions [60]. For the use and reuse of waterways as transportation and communication systems, or as risk mitigation structures and energy sources, for reusing the vast network of minor mills still existing in the agricultural areas of Lombardy, the same principle is applicable. In this part of the Po valley, watering is one of the main goals to ensure, recovering modern and ancient smartness of districts and regions [11], through maps, information and data, defining correct spatial distribution rules [61] aimed at maximizing the economic sustainability of Smart Megalopolis and their resource consumption.

7 Potential Component of a Symbolic Mediators System for the Cultural Smart City of Milan Metropolitan Area

The metropolitan area analysis starts in both physical and communication ambits. Regarding the first ambit, after the exploration of constitutive physical layers, the crossing point' elements of them will be extracted as interface spaces. Such elements are in fact the contextualization of the theoretical deepening especially regarding the concepts of symbolic mediators [20], mental map [62] and Drift [63]. To precede so, the physical context is read through the hypothetic possible narrations between its constitutive layers and components. Moreover, the extracted components arranged within a comprehensive 'shape of order', based on the four layers: water system, green spaces, local industry, and cultural activities.

The apparatus is a matrix, which is meant to embrace the physical elements of the territory objectively selected on the one hand, and on the other hand, to create subjective narrations among them by a hypothetic user. In other words, the matrix, can be converted into a socio spatial temporal database capable of producing multi-directional recitations between the elements. Such narrations will make perceptible the relations between the elements by generating connective paths on the territory.

It is conceptually meant to function as a micro cosmic apparatus that reveals unlimited passages from one layer to another. In other words, the main scope of such deconstructive apparatus is to arrive as close as possible to the communication ambits in terms of cross-referential flux of information (Fig. 14).

Such deconstructive apparatus could actually help us investigate through immaterial dimensions of the territory in terms of the way we use the spaces, interact with them, and move through them. Such apparatus is a conceptual passage machine of which the logical order is based on the chaotic channels between subjective and objective presence. In an absolute condition, where geographical constraints are not of importance, would operate like what we know today as digital networks and data

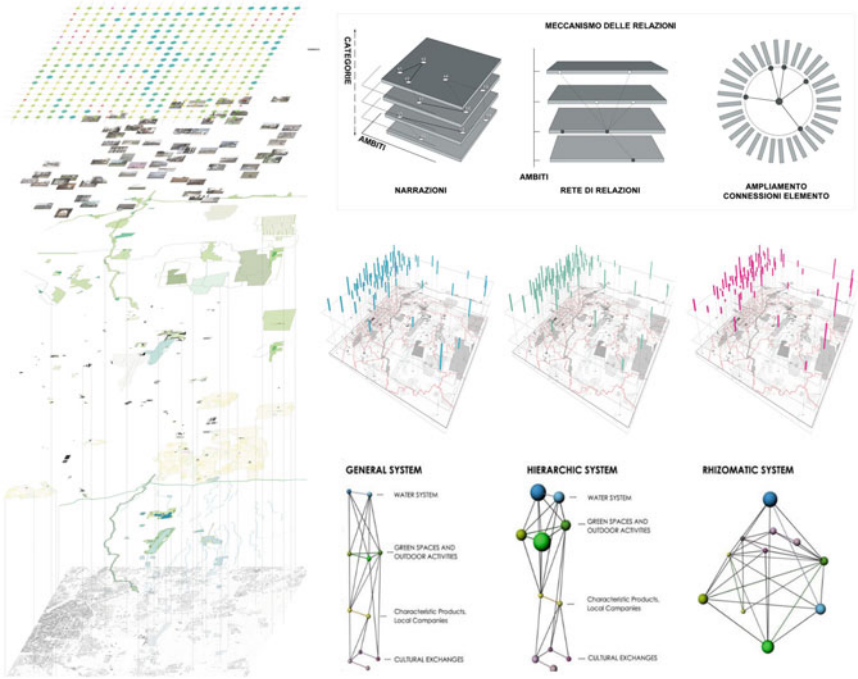

Fig. 14 Apparatus [40]

management programs: first comes the spatial organization of territory's components data in an equally-valued distribution and arboraceous structure where there is no privilege of one theme over another and so it comes with a liberty of choice like the world wide web (www) where the user is free to navigate without any linear pre-established path. Therefore, whilst the contents are categorized and differentiated, what activates them is, potentially, in chaotic and unpredictable use, movement/scroll. The second similarity is the act of movement itself through the parts positions of each component in the matrix which take the user from one stage to another, like the act of click in the cyberspace. According to the explorations of such hidden relations, we might imagine three systems of relational structure shaping the order of the apparatus:

- General System: Reflects direct and immediate relations with no privilege for one element over the other in terms of attractiveness of space;
- Hierarchic System: where places acquire greater or lesser importance depending on their public frequency potentials, location and connections they can generate with the other ones;
- Rhizomatic System: it creates preferential navigation based on the user's choice taking the territory to a polycentric condition. This later system is in fact closest one to the network-like nature of today's society, especially in the virtual world.

Up to this point, the main focus was on revealing spatial-temporal relations between physical elements of the area giving those relations a communication like shape of order. In other words, the important issue so far was to re-read the territory and moving through it by using the communication devices. The main question that rises here is: does this new 'reading' of the territory lead towards the definition of new spatial characteristic for the urban spaces, which could consequently address the projects in their physical aspects and lead to the definition of a space/scale morphology? Since in the physical context this ultimate liberty and instantly chaotic navigation is limited by geographical constrains and temporal fatigue, this kind of deconstruction of the territory in both objective and subjective ways, helps to sketch out discontinuities stand out, especially when the analysis tends towards the communication layer.

The superimposition of the physical context and tele-density layer as a component of the communication layer would result in the identification of an in-between context; a meta context where from one hand the trilateral interaction between physical context, smart device and user would be defined in a dynamic scale morphology and from the other hand the so called crossing-point elements can be re-verified as temporal symbolic mediators [11] opening theoretical interpretations regarding the psychological dimension [34] of mobile society. It is also crucial to note that the ultimate scope of these experimental analyses is not directly related to the psychological features of the communication and space but to study the mechanism of relations between those two strictly related to the space-use, urban context and urban regeneration. These parts are in fact the useful stages, which this research finds inevitable in order to comprehend the changing dimensions of the contemporary urban context.

8 The Meta-City of the Metropolitan Area of Milan for a Smart Metropolitan Communication System

Our research focuses on how Milan Metropolitan area balances both macro/micro economic factors and its spatial structure according to cultural factors: the underlying form of residential, public areas and landscapes. It discusses the relation between new settlement, activity and space and it rises from the way its culture and its activities require diverse demands on movement, new settlement of formality, gradients, and co-presence. Finally, we have to determine both the way how patterns of infrastructure and space integration influence the location of different settlements, classes and social groups in the city and how it is possible to solve the pathology of housing and public realm estates. The spatial form needs to be understood as a contributing factor in forming the patterns of sustainable urban metabolism, integration, or segregation in the city.

The starting point of this work comes out from the necessity of defining the contemporary Milan Metropolitan city within its territory, through a clarification of a new scale of intervention. The framework of the metropolitan city coincides with

the formal and structural dimensioning of the metropolitan territory. The need for a cultural jump is necessary in order to identify a range of elements and relations in the urban context, rather than simply considering that a city is Smart due to an upgrade of the technologization of its ground, and the instruments of intervention and investigation. This means a better definition of the structural pattern and spine of this reality, is needed first [32].

Still, today, it is fundamental to consider the Metropolitan Area of Milan's role as a smart city starting from some questions:

- The role of urbanity at the contemporary metropolitan scale;
- The role of technology as a tool and medium but not as goal;
- The need of keeping quality of space and man at the centre of architectural and urban design.

Considering that, according to Cedric Price (1966), the main question on the background is: Technology is the answer, but what was the question?

The Milanese area faces a quantitative dynamic, quickly accommodating the greatest number of inhabitants. This phenomenon also raises expectations of efficiency, of rapidity in the result, on the part of the owners of urban mega-projects in developing countries. The approaches of powerful developers providing design and implementation, or even part of the financing, get the decision-makers under the pressure of rapid implementation. We know that urban development is traditionally a slow process of maturation, a slowness which is rather accentuated in Western countries by the improvement of sustainable development approaches with the sophisticated and iterative interplay of good governance, consultation, segmentation of the interplay of players. The most interesting of these new city projects utopias such as Masdar's project, serve as a field of application for innovative solutions imported from Western countries: renewable energies, electric mobility, virtuous water cycles.

This somewhat disillusioned point of view must give way to an objective observation of innovation in urban design. What do new products, new technologies, innovative methods, and approaches make possible?

The urban growth of the second half of the 20th century, still plagiarized in many emerging countries, produced the shortcomings of the all carriage system, functional and social segregation, the artificialization concretization of the urban landscape, the destruction of food-producing practices. In reaction, new expectations are asserting themselves, conceptual proposals are being developed and theorised in the fields of the walking city, soft infrastructure (describing the values of the use of public spaces in the city and articulating these in an organised network), urban and peri-urban agriculture, etc. Circular economy, urban metabolism are emerging concepts which are still rather theoretical, but which should gradually become established in the design of urban projects. The Milan Metropolitan, in particular for the Expo event in 2015, started the digitalisation of the urban environment. Still, the last few years have been characterised by the digitalisation of the users, driven by the internet and mobility growth. In the last 3 years the penetration and usage of smartphones has increased substantially.

Digital technologies exploit the data and service infrastructure space, offering a way to design new experiences and contribute to fulfilling the demand. The digital experience layer is the place where city services and digital user are meeting. Citizens are interacting in the day to day living with the urban space through a variety of innovative touch points, mostly personal (smartphone, tablet, e-glasses) but also public, in the attempt of public institutions to re-qualify traditional interactions [64]. Working on innovative sensible metropolitan patterns, the focus of a Smart Metropolitan City is the use of technologies trying to enhance the accessibility of the territory at various scales and to gather proactive feedbacks as a profitable resource and legacy of the event. Setting new mental maps at the metropolitan scale of the Milan Metropolitan City Area, the meta-networking operation triggers spatial transformations and awareness. Milan so promotes the engagement of local stakeholders through different involvement policies, from formal to informal, working on public administration, associations, companies as well as on bottom-up participation and sharing-economy processes.

In an informational ecology perspective, the Milan Metropolitan Area project aims at proposing a sensitive network of reactive nodes through the definition of mapping interactive tools, thanks to the embedded technologies, fast tracking systems, augmented reality, field and immersive maps available through 2.0 smart devices. The purpose is to open possibilities for further plug-in implementations to relate the mapping experience with local economy's support and enhancement. The chapter so underlines the main theoretical premises regarding the relationships among urban space, mental maps and ICT tools and then presents a case-study focused on the west area of Milan: a critical neglected area requiring the combined effort of digital and physical design for regeneration. A Metropolitan Smart City tries to implement solutions providing services access in the framework of an integrated vision of the territory and its future, addressing therefore the following interlinked questions: Transition towards what? What do we need access for?

Alì Madanipur in his book "Whose Public Space" [65] draws four types of access regarding the socio-spatial interfaces:

Physical access: as material access to the environment;

Social (or symbolic) access: in relation to the positive or negative reception that specific social groups experience in the space;

Access to activities and discussions: particularly regarding development and use processes of the space itself;

Access to information: again, regarding development and use processes of the space itself [65].

Although from a critical point of view, such integration between social and symbolic, risks to fall into a state of generalization and simplification, since as we previously discussed, symbolic values are connected to the signs and subjective spatial connotations which do not have to be necessarily attached with social interaction in terms of interface of the masses. To avoid such theoretical error, we focus on the symbolic access since the social access is also found in the third category which is considered as real in the symbolic access is the received message as the trigger that influences and governs our actions. The third one is the access to

activities and discussion and as explained before we put the social access here-the reality is in the momentary decoding of meanings in the socio-linguistic context. For example, the traditions, the cultural behaviours of people in a specific cultural context and the fourth one is the access to information to which Madanipour assigns the ways of using the space. So, the real here lays on the spatial signals that come from the ways we interact with the space which as explained before can mute from person to person and from time to time. Overlapping the four categories, we find out that what is in common in all of them is the access to information. In fact, the fourth category is what defines qualitatively and quantitatively the access to the reality in all of the fourth categories. In other words, we see, we smell, we hear things by the information we receive with our five senses, we interpret the space, we decode the meanings of signs by the mental processing of information and our memory, we interact with the multi-dimensional information. This is what defines for us our way and quality of access to the reality and almost in every case the information comes prior to what then is considered as real. In short, we access the information as mediated reality of all kinds. Moreover, this can be the focal point: information that links them and makes them co-exist in a level above the purely objective space; a Meta level.

A state where all the substances of a society (of a city) are configured together and streamed down to the physical environment through the human-device-based conductors, can be called a Meta-city. Proceeding so, we find ourselves in front of the question: how this level converges to the physical, spatial space we inhabit? In other words, how the ways of accessing the information as Meta reality relapse on the space? To find out possible responses to these questions, requires chrono-technological stemming in the occurrence of Meta-city through different historically distinguished transitional thresholds [19].

9 Spatial Patterns of Communication Morphology

9.1 Contextualization

The phase is related to the data mapping in both digital and physical contexts and the analytical, comparative reading of both in relation to their morphology. The first step is mapping the wireless (floating) environment as an upper level of complexity above the physical urban spaces the city of Segrate where the existing private Wi-Fi environment is explored through the two steps of data capturing, and intensity contextualization processes.[2] The presence of Wi-Fi fields detected has been mapped

[2]To the research date, nearly similar experiments of mapping Wi-Fi areas were produced. Above all, the Salt Lake City Wi-Fi Map developed at Senseable City Lab, MIT. See Sevtsuk, A., Huang, S., Calabrese, F., & Ratti, C. (2008, in press). Mapping the MIT Campus in Real-time Using WiFi. In M. Foth (Ed.), Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City. IGI Global, Pennsylvania, 2008.

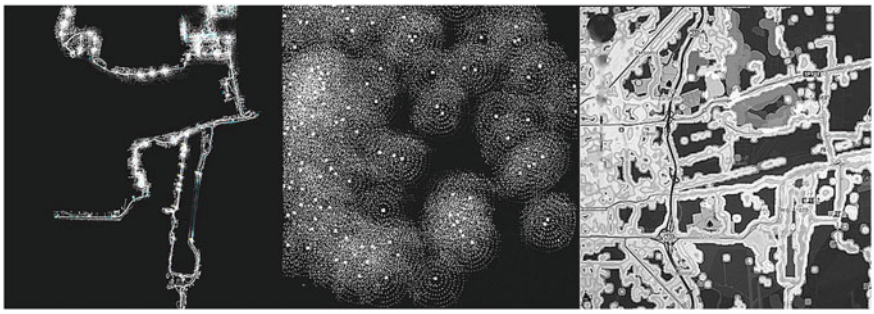

Fig. 15 Left: wi-fi pattern on the main axis [40]. Middle: cellular masts spatial distribution in the areas of Segrate and Linate. Right: coverage effective pattern in the areas of Segrate and Linate [19]

according to their locations and varying intensity. Google MyTrack is chosen as tracking program and installed on a smartphone; the measurement unit is the Wi-Fi antenna of an iPod and the covered area includes the North-West entrance to Segrate from Cascina Gobba station, towards the central and eastern parts of the city, down through the Idroscalo and finally South-Western via Forlanini [66] (Fig. 15).

9.1.1 The Hybrid Morphology

The next step of mapping is the spatial pattern of cellular masts distribution in the area of Segrate and Linate resulting from cross-referencing analyses through interactive open sources [67]. The aggregation of the cellular masts and their coverage pattern is mapped based on the coverage area of single mast while in reality coverage area results from the complex and synthetic performance of the mast. The complex pattern will be analysed in the next steps. As seen in the following image, the cell towers are mostly concentrated on the eastern edge of the examined territory. The densest areas therefore are at the borders with the city of Milan and towards the south-west near the Linate Airport. What is noticeable here is the central gap where the logistic area of the rail yard is located.

This pattern is the static condition which means that it is resulted from a manual calculation of the coverage areas. the dynamic-temporal- condition occurs through the accumulative operation of the mast in a given territory called Handover. In this regard, the following image shows the complex effective coverage pattern which alike the previous one is driven from cross-referenced data [68]. As it is noticeable in the image, the contextualization of the effective coverage areas follows mostly the physical infrastructure system in the areas with strong signal intensity (Fig. 16).

Based on this comparison, three main differences stand out: the first one is related to the spatial aggregation: in the case of physical layers, the constitutive components have a scattered distribution while those of communication infrastructure are aggregated within continuous patterns. For example, the green areas and the built fabric are both configured in separate units without spatial continuity while the cellular

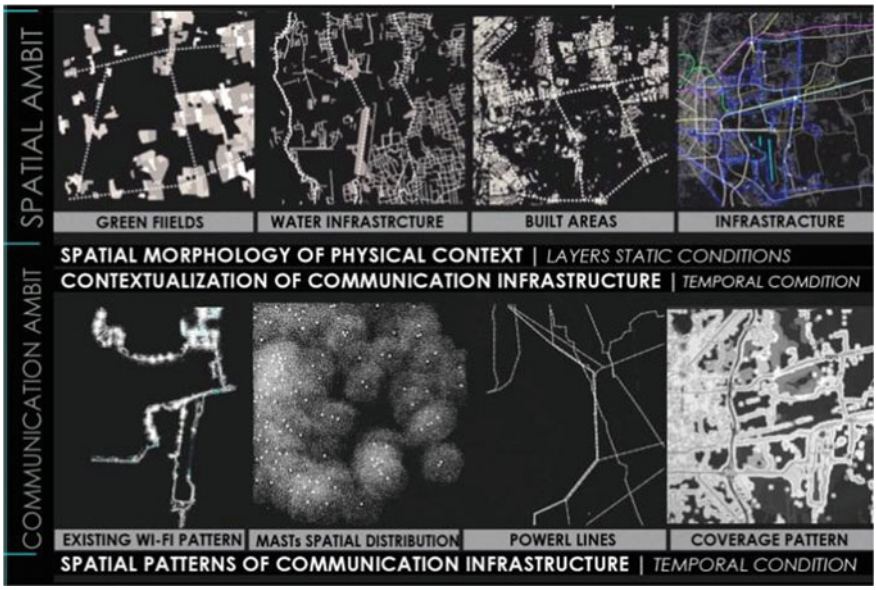

Fig. 16 Comparative contextualization of physical and communication morphology [19]

coverage results in a more or less homogeneous shape. The second difference is the connectivity between the elements: in the physical layers the elements are connected to each other by the infrastructural system that penetrates among them. The connectivity in the communication ambits is due to the spatial overlap between the component's accumulative performance. The third dissimilarity is related to the spatial direction: the built fabric, that follows a north-south direction which is mostly due to the agricultural characteristics of the area and the fact that the land is basically structured by the water system and the irrigation pattern. In the non physical ambits (the communication layers) there is no distinct direction. By overlapping the two ambits, it is more obvious that the spatial distribution and the performance pattern of the telecommunication, despite of appearing irregular, are majorly compatible with the physical infrastructure. In other words, the two infrastructural ambits have a complementary presence within the urban context. The following image illustrates the overlapping situation, and the three rectangular yellow frames are areas where the continuity of the non-physical patterns is interrupted by the physical elements, especially the infrastructural tracks (Fig. 17).

It is important to note that this examination of telecommunication pattern is however within the temporal sphere which means that while the physical attachment of the components–for example the cellular masts-is fix and stable, their performance is dynamic and alters from time to time especially due to the external variables such as weather condition or the data-traffic. Nevertheless, the total performance of such components follows quite the same pattern. What is resulted out of this set of mappings, is that the telecommunication layer has a physical and material

Fig. 17 Superimposition of cellular masts on the physical context [19]

relapse, which is affected and driven somehow, form the physical configuration of the context. It means that in spite of differences between the two ambits, both are configured together based on the physical connectivity. Such co-configuration of the two ambits is also dependent to the activities running in the urban areas. In the next part, through a set of calculations, the telecommunication pattern on the city of Segrate will be extracted.

9.2 De-Contextualization

At this point, research proceeds with the mapping of telecommunication dynamics-regardless the physical context geometry, using the big data provided by Telecom Company, which has almost 40 percent of the mobile users and telecommunication services in the Italian market [69]. Telecom's data user monitoring process is based

on the division of the territory in pixels of 223 × 223 m. To each pixel, the number of active users in every 30 min is assigned. Therefore, the resulted information is hourly dynamic maps based on different temporal threshold, which is in contrast with the static configuration of the physical territory. Such dynamic maps, besides their statistic information can in fact illustrate the changing spatio-temporal modalities of space-use and the relation of such modalities with the spatial capacities of urban spaces regarding the aggregation of people-data flux. Moreover, through the superimposition of Telecom's hourly maps with the physical territory we can identify passive and active areas in a temporal sphere of daily use which consecutively can lead towards numerous qualitative and quantitative interpretations regarding the multi-dimensional complexity of contemporary urban context. Due to the diversity of these data, three temporal thresholds are chosen based on three types of spatio-temporal user activities during the 24 h of day: January 8th at 3:30 am, January 20th at 4:30 Pm, and February 25th at 7:30 am.[3] Such selection enables us to have a comparative sight of the users-information flux and a total possible pattern of such flux 'within' the physical urban context. The geo-referenced-data mapping process in this phase is developed by using the 'Geographical Information System: GIS'.[4]

Another set of data is the statistic information of the resident population from the latest Italian official census, provided by The National Institute of Statistics (ISTAT)–2011.[5] These data are mapped first, based on the cadastral sections and then, according to the pixeled tele-data territory, in order to be able to assign to each pixel the resident population, physical density and Tele-density.

In order to examine the interpretative capacity of tele-maps, we first examine and compare them in an abstract context-without seeing the physical one and then we compare them with the spatial configuration of the physical context overlapping all together. The city of Segrate and Linate, both were once, mostly working places (industrial and agricultural) with a few fragmented residential areas and there are still a lot of industrial sites, companies, factories, workshops and cargo sites closer to the railway stations. There are places with night shift workers that are active at that time of the day. On the other side, the local residents of the city mostly work in the metropolitan areas such as the city of Milan that made the city be called 'dorm town'. So, we can assume three types of people flux here: the first two are city commuters: industrial and institutional workers in the city and people who work out of the city–like in Milan-and the third flux belongs to the airport passengers (Fig. 18).

It is now more evident that the overall pattern of the tele-data flux follows a north-south direction. The significance of this map is that the resulting pattern is an inclusive one; a synecdoche that can contain all the previous temporal thresholds independent from the different hours of the day; one of the dynamic patterns of the Meta-city; a Meta-Context. By the superimposition of the maps with the physical context, the abstract data are contextualized and enable us to look at the physical

[3]To respect the sources, the corresponding year of the data is not mentioned.

[4]The mapping process of this part is developed in the Department of Architecture and Planning (DrPAU), Politecnico di Milano in collaboration with Fabio Manfredini, 2013.

[5]Up to the date of this research, the latest census was for 2011.

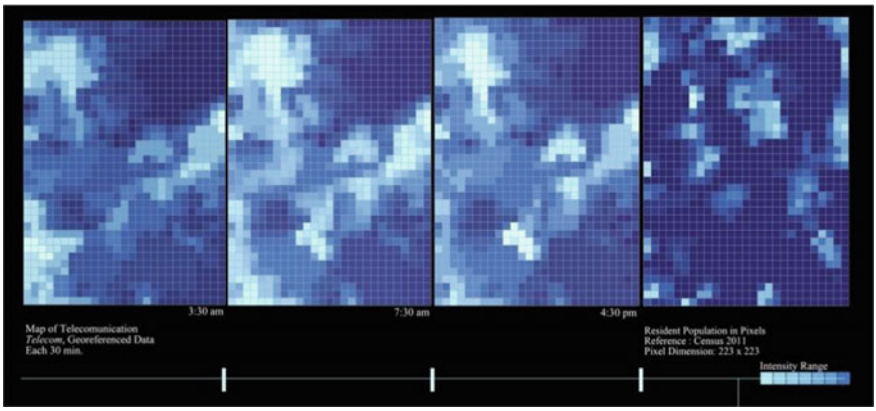

Fig. 18 Telecommunication cellular mapping in three given times [19]

infrastructure, access points, movement modality, space use and activities running in the city. In addition to the tele-maps and the physical context, in this superimposition, the physical aggregation of cellular is also overlapped with the other two which as an infrastructural layer for the communication 'hardware' can provide information regarding the permutation of the two types of infrastructure. Beside one exception which is the central city, we can observe that the major accumulation of the cellular masts is distributed within the tele-data pattern. This can be a curios ground for further interpretations as well as anticipations. In other words, can we predict sketch out the pattern of telecommunication of a physical territory without having the big data and just by extracting the physical aggregation of the cellular masts? Seemingly this theorem is not completely true due to a mismatch: the central city. As it is clear in the map, the central city in surrounded by cellular masts but is not present in any of the tele-data contextualization. There could be one possibility to eliminate the exception: analysing as many samples as possible-the different kinds of tele-data sets in different temporal thresholds to extract 'when' the central city appears as active in the pattern. Moreover, it is crucial to remind here that although the central city is not well seen in the pattern does not mean that it doesn't exist at all in the tele-maps. In other words, since visualization modality is based on colour gradient, as we can see in the first 3-pixel maps, the central city has a light colour. This means that there is a telecommunication flow in this part, but the density is such minor that in a comparative view, it may be considered as 'quasi-inactive' (Fig. 19).

9.3 Re-Contextualization

In this phase, through the superimposition of the two contexts, the research goes in deep to the urban scale and examines the changing dimensions of the physical context regarding the communication dynamics. The first set of outcomes are the extraction

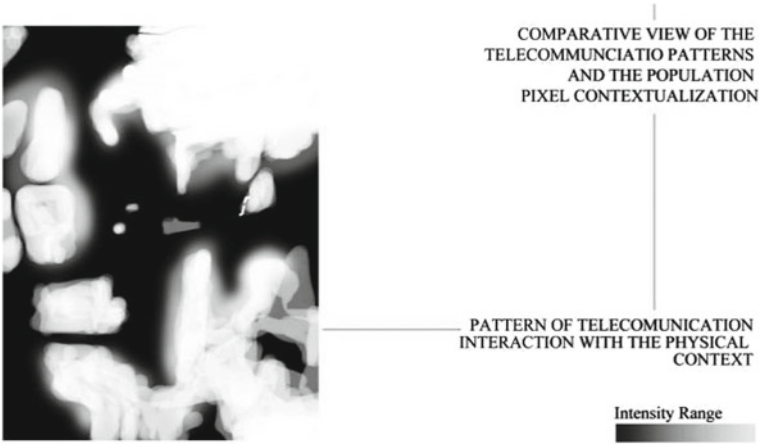

Fig. 19 Accumulative tele-pattern [19]

of areas with high telecommunication flow and low physical density: The Emerging Areas. Next, they will be quantitatively studied in a complex apparatus to calculate the Effective Areas: the surfaces that are effectively frequented; the footprint of the telecommunication in square kilometres. In other words, the recontextualization phase aims to study the two physical and telecommunication components based on their quantitative relations (Fig. 20).

9.3.1 Effective Density and Emerging Areas: Quantitative Dimensions

In this part, the recontextualization process enters to verify the effective telematic presence in the urban space scale. The objective of this part is to extract areas where the tele-density is higher than the resident population. In other words, the areas where the spatial qualities are low and so there are not noticeable characteristics for living or at least respect the densely populated areas but they fit into the daily dynamism of the city. We can assume these parts of the city as passage areas, which because of this very characteristic, have potentials to be integrated to the built fabric through urban governance and planning operations. The modality of this examination part is to cross-reference between the census and telecommunication data to areas where the number of mobile users is higher than the resident population. It is important to note that since some of these areas are completely empty not populated the mathematical assumption will be that the resident population for that area is 1. It means that we assume that there is at least one person that lives there based on the fact that most of those areas are in vicinity of ex-agricultural or ex-industrial zones and even if they are not inhabited, for the control purposes there is mostly a permanent custodian who is not counted in the census as the resident of that area. We take this assumption because for this part, the experimentation is interested in quantitative consequences

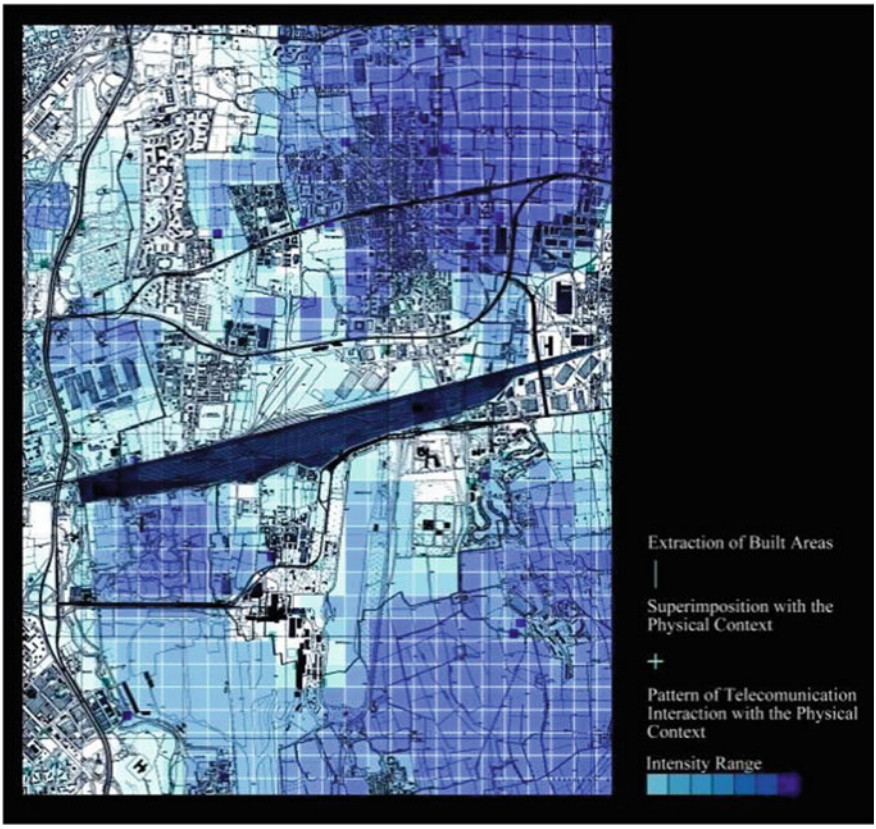

Fig. 20 Superimposition of the telecommunication pattern with the physical context [19]

of the contrast between the fix population and the changing one, therefore the cadastral statistics for the resident population integrated with the mathematical assumption mentioned above can provide us with information regarding the fix stable number of 'presences' which is in contrast with the mobile dynamic number of tele-presences. The result of this cross-referenced comparison is tele-density [70], which is interpreted as a quantitative coefficient for the effective telematic presence and will be used in the calculation of the affective areas in square kilometres. In other words, through the mathematical division of mobile users–as telematic presence and fix population as static presence we can see the capacity of the areas for further densification. Another important note is that in this process, where there is more than one area close to each other that can fit into the examination criteria tele-presence higher than fix presence they are taken altogether as one complex area which is composed of a set of data pertaining to its consisting sub-areas. The technical challenge here drives from the mismatch between the scale of applied numbers for the population and the mobile users. In other words, as we have seen in the previous parts, the

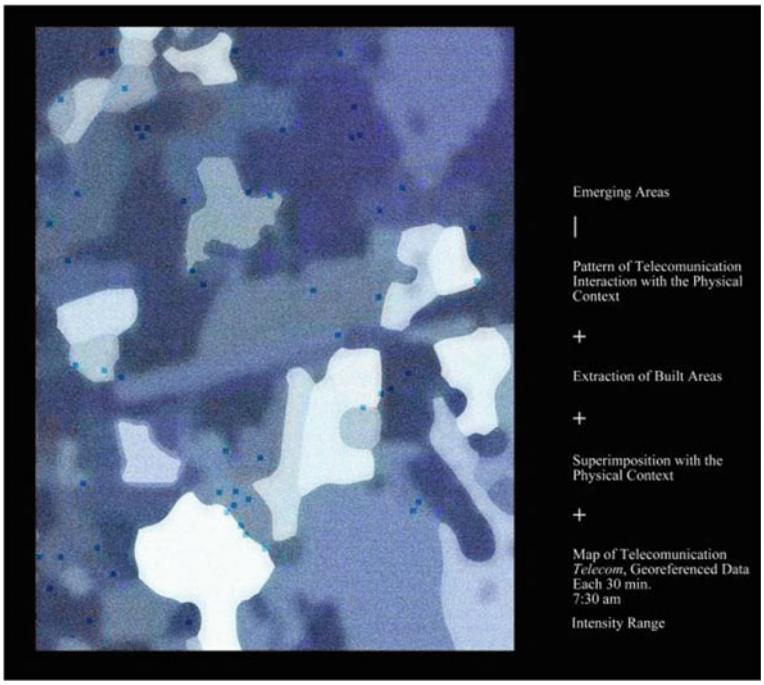

Fig. 21 Emerging areas [19]

population statistics are driven from cadastral sections while Telecom data pertains to pixels as big as 223 × 223 m. Obviously, before any mathematical operations, we have to first unify the two scale units to find the total number of mobile users for each cadastral section. This means that for each cadastral section we have to sum up the number of users belonging to its corresponding pixels and calculating the total number of users for each cadastral section (Fig. 21).

9.3.2 Effective Areas| Quantitative Indicator

In this part another quantitative indicator will be examined, which is the 'effective area' in square kilometre for each of those areas. In other words, through the mathematical relation between the effective density and the physical density in terms of the population aggregation in the area a hypothetical area is obtained which is mathematically a surface calculated in square kilometres. 'Effective area' is in fact an indicator regarding the space that is dynamically used; the area of the telematic flows. Such new data is meant to provide interpretative grounds of decision making regarding the urban densification and governance. In other words, through the comparison between effective areas of a given urban context, we can have a comprehensive sight on the potential scales and measures of the areas where future urban regeneration processes

must focus on. Although this indicator is related to the densification capacity of each area, it does not mean necessarily that all of them have potentials to be densified, since there will be cases in which the densification process must take a reverse direction to the deconstruction operation.

At this point if we substitute the physical density with the effective density, we will generate a complex formula. The remaining variable to be calculated is an area defined in square kilometres which is called the 'effective area'. Proceeding with the mentioned effective area, we can arrive to this quantitative interpretation that the areas where the number of the user-data is higher than the resident population have effective areas less than the physical ones. This reverse relation applies also on the opposite situation: where the telematics presence is lower than the fix one resident population the effective areas become bigger than the physical one. How can we explain such paradoxical situation? Is it possible that the practiced spaces become-simply speaking bigger than the existing one? As explained before, the 'effective area' is a quantitative indicator with qualitative interpretational value. It means that such indicator is a revelatory means to estimate the quantity of space that is potentially in use. Accordingly, when this indicator demonstrates an amount which is higher than the physical existing one, it means that the space under the use is overloaded-overflowed-and thus the spatial operations must take the deconstruction and/or the expansion direction.

The digital telecommunication, takes the contemporary dynamisms to a major, yet changing scales of performance, which according to Choay, is not completely compatible with the scale of practiced space [71]. Such shifting scale brings up the theoretical and practical dilemmas regarding the spatial qualities of urban spaces, especially regarding the spatial expressiveness. The dilemmas are driven from the mediating role of communication system in the environmental interactions. As mentioned in the beginning, the external manifestation of the 'convergence moment' happens in randomly resulted, anonymous temporary spaces of both physical and communication contexts with the characteristics of the two of them but without a formative and informative persistency. Such incompatibility, points to the importance of what Lynch calls "adaptive spaces" [72]. The adaptiveness of spaces, itself is dependent to the adaptiveness of different scales of spatio-communicational interactions. The performativity of the adaptation process depends to the variables which, are mainly the changing velocity, time and modalities of space-use. As it is explained at the beginning of this part, the calculation of the effective areas can be a comparative yet interpretational method to have a comprehensive sight on the quantitative spatial frequency of the temporal dynamics. This research aims to provide a method to extract the qualitatively neglected but quantitatively frequented areas and reveal their potentials for further developments.

10 Po River Valley Megapolis and Milan Metropolitan Area Eco-Centrality. A Metropolitan Architecture Project Proposal

The Milan Metropolitan area is no longer just an urban agglomeration, but a polycentric Metropolis that works within the Po River Valley Megalopolis with high environmental quality: sets of interactive Metropolises [73].

They constitute a third city capable of breaking the social and economic hierarchies between centre and suburbs, between urban and rural, as well as encouraging the coexistence of different cultures. An important aspect concerns the intention to find the right form to organize what already exists by adopting recovery strategies, to transform and invest in new meanings that are available. It is essential to develop the tools to implement the metropolitan vision that can consolidate its Megalopolitan identity through the new definition of regional boundaries and the planning of spaces among municipalities. The megalopolitan vision needs a multiscale interaction: the grey/green series. The construction of a set of landscapes is the primary element to determine a gradient of formality, which preserves the agricultural origin of the landscape despite the presence of intermodal nodes. It is a Green-Grey infrastructure understood as a sustainable in fill: porous infrastructural texture, remarkable points and reinforcements bifurcating towards the two directions and the respective landscapes. The objective is the metabolic reactivation of the territory: thematization and re-invention of degraded areas through ad hoc regeneration projects, for the areas of overlapping indicators on relevant ridges. It is a porous, permeable city, based on an ecological structure of wetlands and three types of spaces defined by high speed (cars), medium speed (public transport), low speed (pedestrian and cycle paths) that radically change the mobility of the metropolitan area. Reduced distances, sustainable travel times and accessibility to services for all are essential parameters of intervention. In this way, a strong perceptual and programmatic link is established between specific sites, the entire city, and the vast territory of the urban region, in its different values: identity/social, productive/economic, recreational/tourism, connective/infrastructural, regenerating and consolidating the entire network of actors involved, from the public to private, from local to the global scale. In this context, a structural role is played by the connection with the agricultural park, the South Park and the Adda Park.

MSLab the unit of research of the DASTU at Politecnico di Milano, within the Segrate Municipality made a proposal for the concept of a new pattern for a Megalopolis Eco-Centrality. Segrate Municipality is located in the Milan Metropolitan East Area in the center between two ring roads. Very lively municipalities compose its regional context whose growth dynamics have reached the threshold of territorial densification, which require a first degree of integration and supra-municipal and metropolitan articulation in order to support complex degrees of development. A "leap in scale" was envisaged starting from the supra-municipal dimension and the need for the relative infrastructural and functional urban support articulation.

In this context, it is necessary to encourage municipalities to become aware that they are part of a linear supra-metropolitan city, which is an element of recalibration of the city of Milan towards the East. The Linear City East of the Metropolitan Milan Area (Lem_City) has a robust infrastructural structure. However, the leap in scale needs, in order to be conceptualized, a centrality defined at the regional city scale. It could be a Centrality that connects the green and grey infrastructure, through the green corridor project, which reunifies the urban farming fragments left over from the infrastructure, renaming them by linking to new functions. It is necessary, then, not to bind these areas to private use, but to subject them to a central public use, which is fed by service functions and partly by residences on the edges, respecting a gradient of formality capable of modulating the grain (or density) from the edges to the center-left unbuilt. Being the seat of large industrial realities from a supra-metropolitan point of view, Lem-City could be the driving force behind this articulating and aggregating structural reform in metabolic terms, also through advanced forms of technological research and production, renewed in its potential to future generations. The quality of the differences of its agricultural territory compared to the North-West area must become a relevant factor of identity and enhancement of the context, a potential matrix that contributes to generating significant and widespread collective benefits. The East Linear City is the gateways to the South Agricultural Park, one of the strategic places in the Megalopolis area. Here it is possible to enjoy the advanced systems of the city and a unique Lombard landscape.

The role of the new centrality is the development in its territory of knowledge, competence and training related to the green deal. Nevertheless, for this, it is necessary to be aware of the fields that stimulate the improvement of competitiveness in terms of sustainability of the Po River Valley Megalopolis system. It is necessary, so, to move through a civil awakening of a city that not only had to refund territorial planning culturally but that, above all, had to rethink the reasons for its landscape degradation deeply. That is, to face the annulment of its symbolic power. Thus, even before talking about decisions and strategies for planning and governing interventions, the Po River Valley Megalopolis within Milan metropolitan Area outline a vision of the common good, which is the basis for a discussion on the evaluation of attractiveness. The East Linear City has its strengths in the Linate airport, in the new shopping center (its construction is stopped now due to the Covid19 crisis), in the Idroscalo, and the TAV gate station. However, we must reiterate that growth must find the points of articulation with the landscape and the entire territory of the East Linear City understood as events that create synergy.

Po River Valley Megalopolis is moving towards a model of an extended city. A balanced and sustainable region, connected and interconnected, a city of consumption and services, with a rationalized and efficient construction, densified and expanding blocked, attractive towards tourism and interesting historically and culturally). The East Linear City must become a new Eco-Centrality and the urban agricultural armature along the Lambro river a place of balance of full and empty green spaces and historical memories of the Lombardy area. Urban Design and New Technologies together could make it possible to define a network of paths to be followed in a final or spontaneous way (User Generated Content) to experience the territory as a unique

place: the water system (fountains line), the historical heritage, the leisure (Villa Invernizzi and Idroscalo).

10.1 Sustainability of the Agricultural Area to the New Metropolitan Centres

The new model of the Megalopolis incorporates agriculture in its relationship (wet/dry) including new functions and a new idea of public space. The East of Milan Metropolitan area must be increased in order to safeguard the South Park and the Lodigiano area by creating a mega-form where the Linate airport is located. Growth needs a discontinuity in its structuring, which regulates the logic of decommissioning structures that are no longer sustainable. However, against heritage dissipation, the sustainability concept must be perfected so that the transformation of this area can be sustainable.

The identity dimension of habitability must be re-conceptualized through a synergic relationship with the urban structures. The field conditions in the Megalopolitan area affected by the dynamics of infrastructural transformation of its agricultural and former industrial parts must determine a porous plot, searching for sensitive territories by reactivating parts in degradation as new care of the landscape. The architectural project must determine a place of exchange not only for consumption (part-time life), where it is possible to exchange beauty.

Today, the agriculture deals with a city's need for alternative energy linked to small waters and the local context. Based on the water as an energy-industrial resource, the industry built the Lombardy landscape and constituted a way of sustainability that was consumption, but also care. Today we are talking about agriculture for Park reasons, and therefore we have to disengage the farmstead from the field because, since the new vocations of the area, new formal properties require the definition of new functions.

The agricultural area is fundamental for the consolidation of the Megalopolis and its values. However, it is currently in a state of stagnation. The agricultural field must be re-conceptualized, as a consolidation of what is the citizens' leisure. Starting from the study carried out on intangible value indicators, expressly requested by the European Community, we read this part as an emerging and highly qualified area to become a cornerstone of the linear centrality at the upper scale of the Megalopolis. That is essential for the development of a polarity, naming the new entity, called the East Linear City. Vice versa, however, it is affected by degradation phenomena due to the abandonment of the agricultural function.

10.2 Strategy

MSLab has identified some actions needed to realize this vision for the metropolitan city:

(1) Consolidating identity: it is essential to think about the relationship between Compact city, infrastructural continuity, and the advanced systems of the Milan capital city;
(2) Multiscale interaction: from metropolitan to interstitial. New relations between the agricultural origin of the landscape and intermodal nodes;
(3) Creation of Eco-Centrality by strengthening a sustainable in-fill: porous connections/areas with low accessibility as a strategic tool;
(4) Metabolic reactivation: re-monetizing sensitive/neglected/vulnerable areas of the landscape through the method of urban sensitivity indicators.

11 The Indian Scenario

Urbanization is the megatrend of the century. The metropolitan areas in India are constantly growing as more and more people are migrating from rural to urban areas because of several factors such as growing economic activities, education and health-care, availability of higher order facilities etc. According to the 2011 census, there were 53 million plus cities in India & a total of 12 cities near the 3 million mark. These cities are bound to expand and grow over the coming years. Given the size and population of Mumbai, Chennai, Kolkata, one can understand that these are not cities, they are Metropolises. As Indian Metropolises are at a stage of massive trans-formation, the population growth in them indicates that unplanned spatial expansion in fringe areas and the development of satellite towns around the inner cities is inevitable in the future. The Metropolises are not a mere aggregation of the urban units. They are a comprehensive region that includes urban, peri-urban, rurban and the rural areas, surrounding a city core. In Indian context, the rural areas surrounding to the urban areas are on the verge of getting urbanized. The unplanned approach of managing this growth will not only affect the urban rural linkage but also hamper the sustainability of Metropolis comprehensively.

The conventional planning process in India males the rural-urban linkage and the Metropolises, present major planning challenges to planners especially about the territorial intelligence and regional balance. The general trend in India where the people migrate from rural areas to the cities, prefer to settle in its outskirts and the villages on the boundary of the city. There are several factors behind this that include affordability in housing, the cheaper land rates and the lower rental values. This results into massive infill in these villages, where the residing population and its demands are urban, but the supply and context is rural. The administration and governance of such areas and the demands of population becomes difficult as the powers of Grampanchayat are limited. Hence, it gives rise to violation of land use

rules, exploitation of water bodies and wetlands due to construction activities. This has a direct impact on the health of the city and its residents. Hence it becomes vital to introduce a new form of governance, the metropolitan discipline in India to increase their efficiency, to nourish the desakota regions, the rural linkages and the territorial intelligence.

To equip the Metropolises for fulfilling this gap, there is a need to think of governance at a metropolitan scale rather than the urban scale as the urban scale of planning is different than the metropolitan scale. Since metropolitan planning is a dynamic and evolving process in which population movements, economic variations, demographic and social dynamism play an important role, this paper tries to highlight how the obstacles in provision of affordable housing can be removed by introducing the Metropolitan Discipline [73] in the planning process in India to attain the desired precision and delivery.

Urbanization has caused rapid migration to cities and forced them to expand beyond their own administrative borders, resulting in creation of large metropolitan territories. Metropolises are engines of growth and development which have significant impact on national and global economies. However, this scale of urbanization has caused tremendous stress on housing and infrastructure. This transformational growth requires different scale and level of planning altogether as the Metropolises are fundamentally different, more complex and larger than the cities. Metropolitan Discipline in the process of planning is a new phenomenon that has appeared in the 20th century along with the thought that Metropolises require a different management mode than cities. The Metropolises are of an intermediate scale between the cities and the states in Indian context. The migration of people residing in the rural areas towards the urban, in quest of higher order facilities, better quality of life, employment opportunities, adequate physical as well as social infrastructure, is causing stress on availability of resources and basic infrastructure associated with the housing present in cities. According to census 2011, almost 20.5 million people migrated from rural areas to urban areas whereas 14.3 million people migrated from urban areas to the other urban areas. These numbers depict the extent of migration in India. As the growth in migration is directly proportional to the housing demand, the necessity to increase housing stock grows.

The recent trend of the promotion of smart city concept in India gave birth to the smart cities mission of India which aims to enhance the sustainable growth of cities by integrating the planning with ICT modules. However, given the character and historical evolution of Indian cities, the responsible usage of technology to enhance quality of life and the urban rural linkages is vital. The technology and ICT interventions shall be used in such a way that they comprehensively ensure the solution of governance and planning at a metropolitan level. The smart city concept in India has been perceived as an exaggerated usage of technology at an urban design level. Whereas there is a need to integrate these efforts at the metropolitan level.

The Blue Infrastructure present across the territories, that is the water bodies such as rivers and canals serve the rural areas as well as the urban areas. They flow through the rural-urban linkage as well. Hence, it is important to understand the governance of these water bodies has to be done from a territorial scale or the metropolitan scale.

This will enable the streamlined water management for agricultural activities that are there in rural areas and the industrial activities that are present in urban areas. Administration and governance of the water at the urban level leads to the exploitation of water bodies. The construction activities in peri-urban areas that block natural-rural water channels and take place in low lying areas cause massive water clogging and flooding. This flooding exposes the short-sighted planning and governance behind water management. To deal with such complex issues, usage of technology and ICT solutions has to be more of a territorial phenomenon than compacting it into a Smart City.

The study aims to understand the various patterns and linkages between two major Metropolises of India, the Chennai and Kolkata. We present the relationship between Open data and Smart city that recovers the concept of Desakota territory as an eminent of the territorial intelligence of the Metropolis and Megalopolis of the Far East through two projects developed in the Indian context (Kolkata and Chennai). One of the tools used in the study is MIDA–Metropolitan Impacts & Drivers Assessment which is a tool to gather, process and visualize data crucial for current metropolitan issues. MIDA seeks to enhance the understanding of the impacts and drivers of urban settlements from the territory to the alleys, through the use of multi-scalar mapping (Fig. 22).

Through the examples of two Indian Metropolises, we interpreted the interaction between Smart City (ICT/Technology) and Open data that covers the concept of Desakota territory as the fundamental part of the territorial intelligence of the

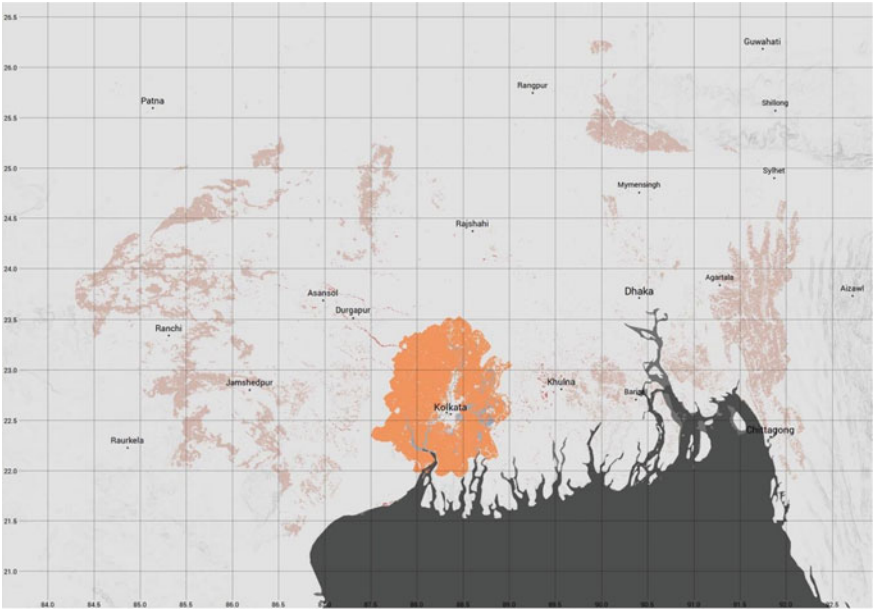

Fig. 22 The ecological footprint _ Kolkata. *Source* MSLab_. *Credit* I. Neri

Chennai and Kolkata Megalopolis. These two projects developed in the Indian context (Kolkata and Chennai), are presented as an asset-based approach to model, represent and manage the sustainability and resilience initiatives in the metropolitan architecture systems. The creation of a geospatial data ecosystem is done for fusing the secondary data, which is an open data of the government with the automated spatial-temporal analysis of remotely sensed imagery. For the comprehension of site-specific phenomena, undetectable through the simple use of statistics indicators the call for spatialization that is becoming more and more necessary because both these aspects are interlinked and attached to the territories and geoinformatics.

11.1 Chennai Metropolitan Region

The 400 year old coastal city of Chennai, formerly known as Madras, is the 31st largest metropolitan area in the world. Although this established global port city has gained Economical recognition being a part of international corridors like Mekong India economic corridor and also East India corridor, concurrently it has been ecologically vulnerable making headlines as a disaster capital with floods, droughts and cyclones, the reasons being severe alteration of coastline and unconscious urban sprawl that lead to the loss of green cover which has almost doubled during the recent years.

The Asian Urbanization has entered a new phase that differs significantly from the patterns of the city growth experienced in other developing and the developed nations. This existence and evolution of new and different kinds of settlements providing evidence of settlement transition is observed in Asia as Desakota Regions coined by T.G. McGee in 1991 (Figs. 23 and 24).

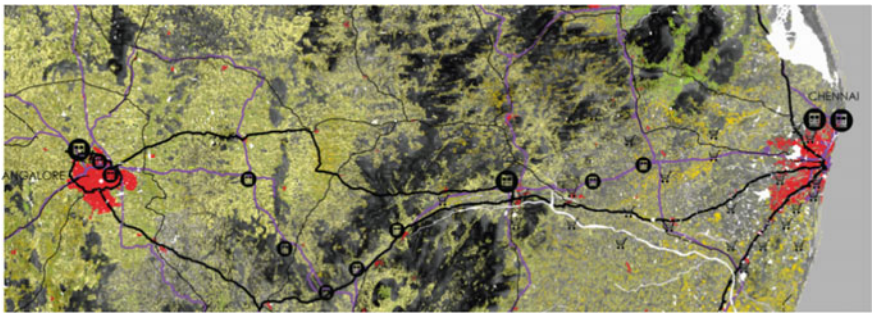

Fig. 23 Zones of intensive economic interaction between rural and urban activities are emerging. These zones are new form of socioeconomic organization that is neither urban nor rural but preserves essential ingredients of each. The landscapes in these metropolitan zones have changed little over decades. Most people live in villages, and almost all the land is under cultivation, however, most income now comes from non-agricultural sources [74]

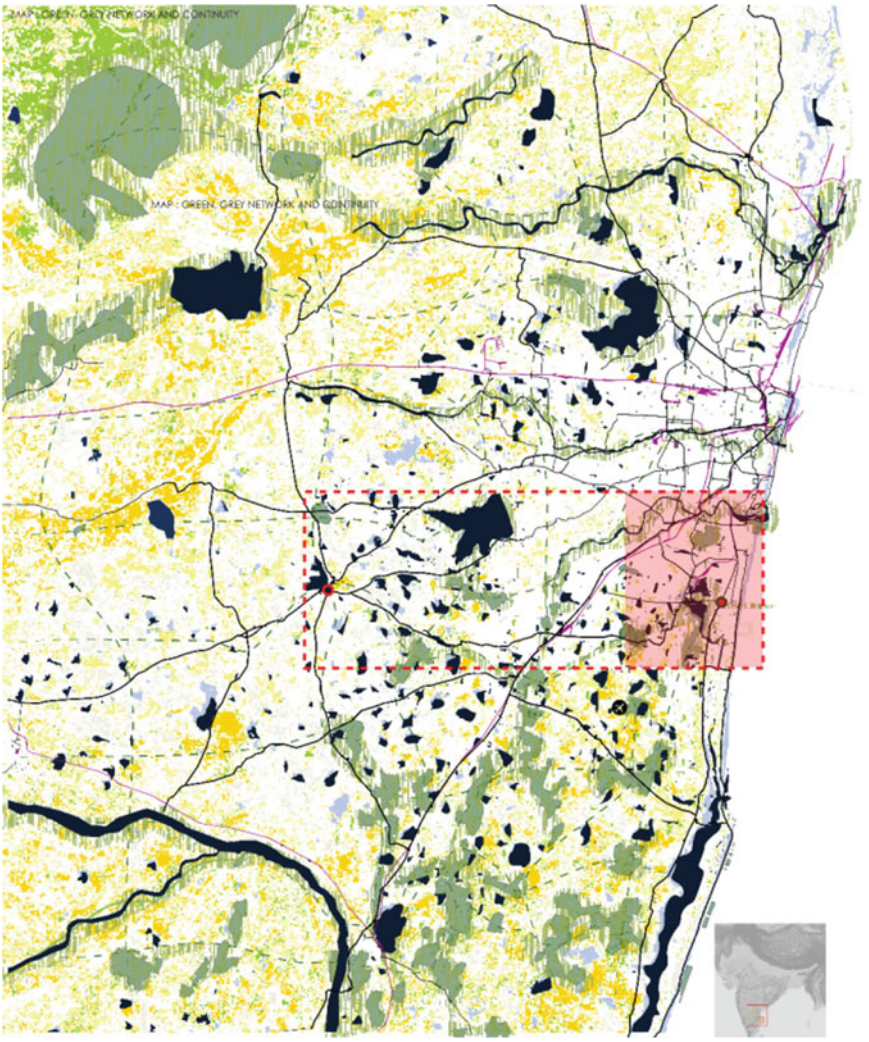

Fig. 24 A powerful civilization can begin to act on their total environment at a significant scale: how to form the total scene so that is easy for the human observer to identify its parts and to structure the whole,-total environment made visible-[…] A clear image enables us to move easily and quickly, and it is able to furnish the raw material for the symbols and collective memories of group communication. We need to pin images (the memorable ones) through landmarks to the ground to be able to see the hidden forms in the vast sprawl of our city. So that, we need a coherent order,–such as an antecedent form–ordering this complex environment [74]

These distinctive areas of agricultural and non-agricultural activity are emerging adjacent to and between urban cores, which are a direct response to pre-existing conditions, time-space collapse, economic change, technological developments, and labour force change occurring in a different manner and mix from the operation of these factors in western industrialized countries.

The project focused to acknowledge metropolitan landscape that deals with 4 main points: Territorial intelligence, Desakota system, Regeneration, Urban rural interface. Thus scaling down to the adverse effects of this human interference that saturated the urban cores, aiming to regenerate the last remaining marshland of Chennai city, the Pallikaranai marshland, a unique ecosystem of its kind, that has been reduced to one-third of its original extent due to encroachments.

11.2 Kolkata Metropolitan Region

Water has always been an important element in Indian city planning, and has been employed to created micro-climates; wells, tanks, areas for washing, recreation and ritual, which dotting the landscapes of the urban, peri-urban and the desakota as in the case study of Kolkata, where the intelligence of the site was once very comprehensively utilized. Located on the Hooghly River, one of the main distributaries of the Ganges delta, Kolkata is unremittingly exposed to water as some scholars say that its very name is delivered from 'khol'–canals and 'kata'–to cut meaning cut opening the shores.

The region frequented by floods during the times of the monsoon and faces tropical cyclones from the Bay of Bengal, at times bringing devastation and death to the area. With unfolding climate change, the city is ever more feeling the need to respond urbanistically to new dangers and challenges. Being located at an altitude just barely above sea-level, any increase in flooding or rise of the water level poses fundamental risks to the city. Due to this urgency, Kolkata finds itself in a strategic position with urbanistic responses to climate change necessarily having to be developed, tested out and implemented in the nearest future.

Today exposed to a steady influx of rural-urban migrants, combined with natural growth, adding almost 400,000 people to the urban population every year, in the future it might find itself in the center of massive movements of climate refugees. Understanding through the realm of metropolitan landscape is an attempt to answer how a city copes with these elementary conditions of climate change while simultaneously experiencing rapid growth. Does it expand steadily or grow in stages with phases of stagnation, reinventing itself over time, or holding on to an identity of the past.

The typical 'Bengal landscape' of the Kolkata metropolitan area is one of its strongest assets. The diversity of landscapes, the inter-linkage of land and water-the ponds or 'Pukur' & canals or 'khal', countryside and cities and cultural heritage with ecological values are of great importance. With an efficient water management system which can be classified as traditional knowledge system. It shows how water

is closely linked to the everyday lives of the people and thus has been an important tool in the settlement patterns. Over the years as the city is expanding and engulfing its periphery not only is there loss of traditional knowledge, agricultural land and deforestation resulting in climate change affects but also the city suffers due to change in social structure and living conditions. The mutual relationship existing between the city and suburb is at a stake and of the most is its water body-the ponds and wetlands, which play a crucial role in maintaining the temperature, sewage treatment, drainage etc. In the metropolitan landscape of Kolkata water again has an important role to play in the planning of the city.

The diagram is a hybrid model of the unit of our peri-urban area inspired by Grahame Shane's Desakota Megablock diagram may be the most appropriate solution to the issues related to our site. The study tried to identify this landscape of flux, since we cannot define the dimension of the desakota which is huge and spread very organically. So, from the desakota system we recognize the pattern and identify the elements and putting them together theoretically to form an endless network. By connecting the blue green-grey infrastructure between these settlements and creating new centralities we provide a better way of life to the existing communities living around it. Here, along with preserving and conserving the wetland practices we also define a strong mode which provides an alternative way of sustainable development. The attempt tried to gain another layer of existing pattern over its existing layers, strengthening its network of systems promoted on a global level (Fig. 25).

12 Metropolitan Urbanity Toward the Desakota Strategy and Pattern

In both the 2030 Agenda for Sustainable Development and the New Urban Agenda, Member States agreed to normative policies supporting integrated urban and territorial planning and development, calling for new, inclusive approaches and enhanced synergies between urban and rural communities and spaces [75]. Governments at all levels, who are the primary agents of transformation, must move from recognition of climate change, and food scarcity challenges to coordinated actions to strengthen urban-rural linkages and implement integrated territorial development. Urban-rural linkages are understood to include all flows between urban and rural spaces in the world, including people, goods, and services.

In the Western Megapolis, the green infrastructure is the regional network of environment parks that go from the higher level of national parks to the lower level of urban parks, until the city garden. They are all interlinked to provide for the fluency of the biodiversity. Moreover, each of them takes a different function depending on the role it has to play concerning rank and proximity. In Europe, the peri-urban parks well assume the role of urban agriculture. Conceptually, this fact is crucial. For that, concerning the far east cities, we start to discuss the desakota mixed-use patches model of management of the city. It is an open model that namely conceives

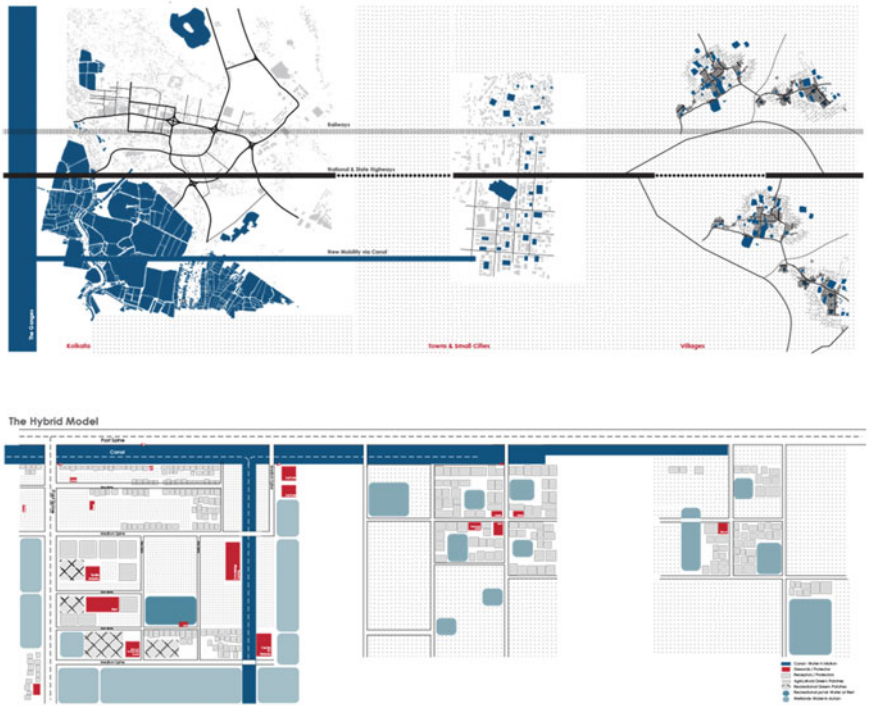

Fig. 25 Reinforcing the network between city-town-Desakota shown through the hybrid model [74]

the metropolis as something in between the town and the village with a continuum countryside territory among the urbanized points. Indeed, a green parks system able to be efficient in order to produce a balance with its bio-potential power (ecological footprint) is very strategic. Through this system, therefore, it is possible to determine a new condensation of agricultural land use in the between of the patches and the interchange node becomes the centre of almost two of them.

Because the park, the relations among the different functions and their positions are not so regular as in a dense city and the movements inside are free: lanes and channels which constitute a second range armature. It could be reinterpreted as a new pattern for the new dimension of the city, that have to determine new projects, policies, governance strategy, and tools. That is also the scope of the Practice of the Metropolitan Discipline [76].

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authored together paragraph 6. Sravya Lutukurthi, Ravali Sathiwada, Kushal Kumar, and Piyush Girgaonkar wrote paragraph 11.

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