



**THE ART OF SHAPING THE**

# **METROPOLIS**

PEDRO B. ORTIZ

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Education



# **THE ART OF SHAPING THE METROPOLIS**





### ABOUT THE AUTHOR

**Pedro B. Ortiz** was Deputy Mayor in charge of strategic planning and the General Director of urban and regional planning for the City-Region of Madrid when he introduced a metropolitan growth methodology in 1996: the Metro-Matrix system. This plan was highly successful in monitoring and controlling the city's explosive growth in a sustainable manner. As a Senior Urban Planner at the World Bank, Mr. Ortiz has developed similar metropolitan-regional projects in Tunis, Mexico City, Cairo, Nairobi, Dar es Salaam, Amman, Colombo, Accra, Kingston, Barranquilla, Cartagena, Santa Marta, Bogotá, Istanbul, N'Djamena, Kampala, Baku, Monrovia, Ado-Ekiti, Kigali, Mombasa, Lekhnath, and Manila.

He is a Vice President and member of the Board of Directors of the INTA International Urban Development Association, and as such advises both planners and government officials in countries around the world on development issues. Mr. Ortiz is also a Visiting Professor at Milan Polytechnic, where he teaches "Metropolitan Management" in the Department of Architecture and Urban Studies. He was the founder of IRU Madrid, an urban planning consulting firm, and founder and Director of the Master's Program of Urban Studies at the Universidad Rey Juan Carlos, Madrid.



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Pedro B. Ortiz

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*A los que me han querido, y a los que no.  
Todos ellos son coautores de este libro.*

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## FOREWORD: A HANDBOOK FOR THE FUTURE?

The arrival of Pedro Ortiz's *The Art of Shaping the Metropolis* is an occasion for celebration. The handbook bravely focuses attention on the emerging global urbanization and proposes a new vision for the new metropolis. While making these proposals, the book also raises a series of questions. This brief introduction outlines the important questions raised by this new handbook, leaving to each reader the evaluation of the global solutions proposed, since every city is different and no application will be the same twice.

### 1. Urban Handbooks and the Dynamics of Urban History

Cities always have been dynamic, out of balance, and chaotic engines of growth and innovation. Their dynamism depends on inequality, risk and reward, collaboration, the importation of energy and food (Rees and Wackernagel 1996), a powerful working class and bourgeoisie, financial capitalism, and various safety nets. Cities have always been places of exchange and information, self-organizing systems subject to frequent collapse and re-founding, invasion, destruction, and rebuilding (Shane 2005). Cities have also acted as memory palaces, carrying cultural and symbolic meaning important to the coherence of social, commercial, and military organizations; faith; farming; and industry (Kostof 1992).

Beijing, the world's largest city for many centuries, was re-founded several times by successive

dynasties on the same site, gaining organizational capacity and stability in each iteration (Weinstock 2010). London, the next urban giant, was devastated by fire, plague, and Dutch bombardment in the mid-1600s. Then the city stabilized as a global imperial capital in the 1800s, overtaking Beijing, only to be brought to its knees by German airpower in Hitler's 1940 Blitz (Summerson 1946, Hobsbawm 1968). Now UN Habitat, the organization responsible for refugee housing after the Second World War, sees the current massive global migration to cities as a problem producing huge unmanageable inequality, instability, possibly war, and bloodshed.

Writing a handbook on urbanization in the face of such predictions requires nerves of steel while tackling an impossible task. While one-third of the urban growth globally annually so far has been in informal, self-built settlements, the UN (2003, 2008) predicts that this unregulated sector of "slums" will double in the future as poorer countries urbanize. In addition, climate change threatens many of the world's largest estuarine cities (Burk et al. 2001), endangering water and food supplies, not to mention sanitary arrangements (Gandy 2004).

### 2. Urban Handbooks in the Late Twentieth Century

Traditional modern engineering and design solutions, based on the industrial power of coal and oil, appear to be part of the long-term problem, as



the heat generated melts polar ice caps and raises water levels, altering hydraulic and climate patterns. Companies and countries that produce the energy for these industrial processes, and the consequent greenhouse gases, are richly rewarded by the global system as it stands, even as the disastrous long-term implications of their activity, powering global growth and destruction, become ever clearer (Hansen 2010, Sato 2012).

Most of the urban handbooks of the second half of the twentieth century dealt either with plans for reconstruction after the devastation of the Second World War or with the adaptation of urban form to the American invention of the mass-produced, internal combustion, gasoline-powered automobile (Buchanon 1963, Doxiadis 1963, Gruen 1964). As the imperial European metropolis with its ships and railways mutated toward the American megalopolis with its cars, planes, and containers, the scale and scope of the required urban infrastructure changed radically. Ancient Beijing had contained megablocks, such as the Forbidden City of the imperial administration, and huge streets that acted as fire-breaks but carried relatively little horse-drawn or human-powered traffic. American engineers and Le Corbusier in his “Contemporary City” of three million inhabitants of 1922 had foreseen the need for huge new highways to service automobiles, replacing railways and restructuring the city over a vast territory (Evenson 1970, Gerosa 1978).

Architects, urban designers, and planners have coupled much official urban growth and planning of the past 50 years to road infrastructure, especially in megascale blocks linked to the speed of the automobile with infrequent exits that slow down traffic (Panerai et al. 2004). The global history of new

towns from Chandigarh (1951) to Brasilia (1956), to Shenzhen or Nav Mumbai (1990s) reveals a pre-occupation with megablocks and superblocks, producing 1000-foot-wide highways inhospitable to pedestrians (Prakash 2002, Tattara 2011, Walker 1981). Kevin Lynch (1961) protested against such highways in downtown Boston, just as Jane Jacobs (1961) fought Robert Moses in New York. But in Asia, following the 1964 example of the Tokyo Olympics (Cybriwsky 1998), many countries raised these highways 60 feet above the center of old cities, following the paths of old streams or beside rivers, creating parks below. The recent removal of a raised highway and uncovering of the Cheonggyecheon (2005) stream as a park in Seoul marks a turning point, as does the global success of the Danish designer Jan Gehl, who led the team that initially pedestrianized downtown Copenhagen over 40 years ago (Shane 2005, 2011).

### **3. Handbooks and Shifting Paradigms in the Early Twenty-First Century**

Any new handbook has to confront the inevitable shift away from the highway network scale and megablock as new means of transportation emerge in response to the rising price of energy, not to mention rising sea levels and expanding deserts. In addition, this new handbook must deal with the ongoing information revolution that affects rich and poor countries alike, aiding both dispersal and centralization. Peer-to-peer self-organization, in combination with 92 percent of the areas of self-built favelas concentrated in cities of 1 to 2 million (Satterthwaite 2005), promises a new set of self-organized

armatures that will make the 1000-foot-wide highways of the late-twentieth-century planners look like dinosaurs ripe for redevelopment and downsizing. New intelligent networks of personal and mass transportation might well dissolve into small-scale networks, linked perhaps to high-density and high-speed nodes.

The fast expanding cities of Asia often include agricultural belts. These cities, as well as shrinking industrial cities in America, Europe, and Japan, the old industrial heartlands, provide a glimpse of what this future city might be like. The big-scale grid, shrunken but still surviving, provides a framework for a new urban form, multiple centralities, and a widely distributed urbanism with multiple hubs. Personal mobility on electric bikes, scooters, and cars provides local, short-distance flexibility of travel, while public transportation with an accurate information system coordinates with high-speed trains. Anyone who has traveled in the new, modern tram system of Zurich, coordinated with the Swiss Railway and airport flights, can envisage this new hybrid future that casts a much lower per capita eco footprint for transportation. Similar systems using bus rapid transit (BRT) systems can be found in Latin America as in Bogotá and throughout the developing world.

The shift in infrastructure envisioned in this scenario of energy and informational transformation takes advantage of the heritage of the large-scale automobile transport networks. This networked vision exploits the long intervals of the megablock system and its capacity to nest superblocks and regular blocks within. This giant scale allows for variety and diversity, flexibility, and patchiness within the framework of the obsolete megastructure. Ag-

ricultural villages, small factory towns, even small residential complexes, and back offices can be held within this giant framework (McGee 1971, 1991, 2007). The secondary capillary networks of the superblocks and village streets, augmented by streetcars, taxis, motorbikes, and bikes can provide a flexible alternative at a local scale to the atrophied highways and autoroutes of the past, connecting to new local nodes and regional systems that might replace the abandoned malls and highway intersections.

These new cities will not look like Hong Kong, Singapore, Shanghai, London, Paris, Madrid, or Mexico City. They may contain high-density nodes and patches responding to global pressures. But if the massive urban migration proceeds to cities of 1 to 2 million, as predicted by the UN (Satterthwaite 2005), a new urban form will undoubtedly emerge. Not every city needs to be New York, London, or Tokyo, a global hub. Networks of smaller cities linked by flexible infrastructures and new communication systems could result in many new urban forms and organizations to house people in self-built sectors, in a new hybrid, bottom-up and top-down municipal model, yielding a new form of urban social contract.

## **Conclusion: From Network to Meshwork in the Megacity/Metacity**

Pedro Ortiz's handbook provides a framework for entertaining such wide-ranging questions, with its emphasis on the power of networks as an organizing device. The book provides a basis for the contemplation of the old network paradigm of the



megalopolis into the informational meshwork of the mega- or metacity of the future. The handbook's review of the networked past is invaluable, while its projection of these networks into future plans raises very many important questions for planners, urban designers, architects, and concerned citizens alike.

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## FOREWORD: METROPOLITAN ARCHITECTURE

### **The Role of the Metropolis Is a Cultural Leap. The Reticular Matrix: A Methodological Indication for the Development of a Fast-Growing City**

Imagine being involved in the transformation of settlements, which are at the fringes of a metropolis in Africa, Asia, or Latin America, constantly changing and characterized by a variable degree of informality.

The starting point of your work comes from the necessity to define the contemporary city within its territory, and to project the metropolitan architecture as a clarification of a new scale of intervention. The framework of your project coincides therefore with the formal and structural dimensioning of the city territory.

From this point of view, you have to start your context analysis with a statement: the need for a cultural “jump” that should identify a range of elements and, in particular, new relations among elements in the metropolitan context, rather than simply upgrade the instruments of intervention and investigation. So you need a better definition of the structural pattern and backbone of this new reality, in order to show the discontinuity occurring in the urban development and in the cultural awareness of such phenomena.

Today, in fact, a syntactic transformation is happening inside cities: new relations of interdependence and coexistence (legal/illegal, formal/informal, urban fabric/urban agriculture, . . .) require

a new metropolitan structure. This is mainly because the relations between physical objects have evolved; this fact, indeed, determines the syntactic and morphological reform of the city. In other words, every urban project asks itself about the relations established within the existing historical forms and meta-historical paradigms of its typical codes (i.e., both the different settlement-habits and the diverse interpretation of the geography in each country). In fact, today, topics like “foundation” and “history” seem to have been removed in the name of a pure technological automatism, repetitive and incapable of being connected to a specific historical time. This is one of the worst effects of globalization. When we deal with large regional and local networks that become planetary models, we are ultimately going to face complex systems, related to physically increasing and self-referential models. The problem that the complexity generates is mainly an embrittlement of the settlement-syntax, which exposes it to external perturbations (mostly economical). Furthermore, its global standardization runs toward a de-complexification. At the local scale the problem is different, and twofold. On one hand, we see a struggle with the de-differentiation (neurology thinking) of local culture, which is the condition of a real spatial identity. On the other, we understand the need for a connection to the large network systems. Here we encounter the complexity, as we have no longer a problem just of instruments but of new meanings in front of us: we may talk about dialogical complexity. We deal, indeed, with systems that need both a continuous comparison among scales and dif-

ferent solutions that set new methods to actualize an identity that comes from history.

Therefore, we need a methodological indication for the development of the new metropolitan settlement. This is the concern of the Reticular Matrix methodology system. The Reticular Matrix is the study of a way for regulating growth at the metropolitan scale. It is a methodology of territorial decision making, a system of choices logically systematized: the organization of a vision inside a discipline. It is based on a project method that allows us to describe and design urban phenomena related to the change of scale, which determines the mutation of types of morphologies, of urban spaces and landscapes. Consequently, it is an investigation that we apply to the urban and architectonic disciplines (Descartes) with obstinate accuracy (Leonardo). It clarifies the precision of a way arbitrarily chosen, that is: geography, geometry, and memory (in this case its denial, as I will explain later). It is not a science; it does not study objects, but rather the relations among the objects within a new metropolitan scale of decision making. And it uses a conventional language for this study: this language deals with the relationships and not only with the quantities.

## **The Reticular Matrix Mapping: A New Way to Conceive and Represent a Metropolis. A Mental Map for the Metropolitan Architecture**

The Reticular Matrix is a system of axes: few structural geographical axes and some penetrative artificial ones, which, first, determine the develop-

ment of the center along lines and, second, define hinge points of densification. The matrix assumes its value through the definition of the logic of settlement-distribution, which makes possible the localization of interchange nodes in peripheral areas. Today, we recognize that the urban elements having an active part in urban phenomena changed, due to the new process of urbanization and following the subsequent huge spatial and temporal measures of the city. So we have to admit that the city structure, its physical and temporal relations with the citizens, is altered due to the change of its scale; the temporality of people and citizens is particularly changed. It is because of this that the way, too, of marking places and territories is changed. Today, not only the design and the representation of the architectural elements determining the growth, but also their effects on the territories—spatial, economic, social—are limited and distorted by a lack of understanding, still placed in connection with a purely functionalist and quantitative vision of the new value of the space as a built place/icon/landmark. Therefore, we assume that the built space must be considered as what determines the common sense. Consequently, it can be the subject of a participatory decision. This means that a change of the urban space from the current situation of urban sprawl implies and requires the transformation of the citizen mental map. Then, the first result of this change is a new mental map at the metropolitan scale: it is related to the transformation of the topographic space and to its space/time dimensions.

The architectural metropolitan project, therefore, is about how to give identity to the places through a figure and a robust image, but at a new dimensional scale. So we have the following essential



elements: the places could be both considered as strategic places and recognized as strategic by the new metropolitan citizenship. Nevertheless, the theme of urban quality is still too marginal an issue in urban studies, though it is in a reasonable way linked to the complexity of the functions and it is closely connected to the question of the identity and meaning of the image. In order to keep the physical issue as a focus of the design approach, the Reticular Matrix methodology produces a *metropolitan city model* through its maps/diagrams: we have before us a conceptual shape of the metropolis that allows metropolitan architecture scenarios and studies their impact on society and on legal and institutional forms.

## A Long Debate

Certainly, it can be a fatal mistake to impose a strategy on a metropolis unless its rules have been formulated in accordance with the territory.

Transport planning, in particular, suffers from a conflict between efficiency and equity. In fact, the great political powers often consider the adaptation of existing structures in the central areas more cost-effective than designing new infrastructure inside the metropolitan territory. We must consider, however, the important possibility of creating a democratic balance, which means going to an equivalence with the times of modern life within the territorial regions. The conflict, therefore, appears between the convenience and the compatibility of certain infrastructural works. We then have to set up a deep social sensitivity—that is, a culture—in order to limit the impact of economic activities and large infrastructure, which undeniably could transform the living environment of citizens.

The project, then, is a cultural project; it must be verified according to an ecological balance, which must express its sustainability according to an economic equilibrium, which must specify its feasibility according to the balance of flows, in order to clarify its efficiency. Therefore, only thanks to a powerful vision like this is it possible to build a consensus and a virtuous dynamic of interaction between public and private investors—a consensus and dynamic able to deal with the dichotomy between local and global.

We have been fascinated by Pedro Ortiz's interpretation of the organization of the metropolitan fabric in Madrid that may be defined as the model of the metropolitan city paradigm. We can define the unifying engraving of Paris as a model of urban growth; the model of Barcelona as an integral expansion; the aggregator joint or joining joint, the model of Vienna; for London, according to Grahame Shane, we could speak about enclave and armature versus net-city and archipelago, and, finally, the four pillars of the Reticular Matrix Madrid Model are: geography, history, geometry, and the denial of the historic city. Through maps it is possible to represent the concept of all these cities.

## From the Analysis of the Reality to the “Means” of Changing the Reality: Madrid Metropolitan Plan

Plan Madrid 2019 was a model for a development method for the fast-growing regional city. We consider Plan Madrid 2019, made in 1996 by the Comunidad de Madrid directed by Pedro Ortiz, the model of a discontinuous reform, born out of the interferences from the new urban road system. Plan Madrid

2019 was dealing with the instruments, first, of the plan-form and, second, of the movement-form (new linear public infrastructural system: commuter trains and highways) as a meaningful element of the plan, assuming that a new concept of territoriality, at the geographical scale, is based on the organizing principle of land as a meeting place and mobility (Lynch 1981). There are four defining elements of the plan: geography, geometry, memory, and the denial of the historic city (to change and reactivate it). The plan assumes its value through the definition of the logic of settlement-distribution, which permits the localization of interchange nodes in peripheral areas. It considers not only the inhabitants but the city-users, too, according to the concept that what matters is the existence of an exchangeable organization along the space-time networks of the commuter trains (Cercanías), highways, and airports.

Therefore, we could say that this is a discontinuous reform—the creation of the interferences inside the new metropolitan roads: a *development method*. Actually, referring to Ortiz's methodology result, rather than a *formal model* we can better talk about a *development model*, which consists of both a *series of patterns that indicate a direction of the settlements' growth* and a *series of maps or networks that suggests possible configuration and characterization of specific qualifying locations with a gradient of formality*: from the center (new metropolitan morph-types related to real estate development) to the countryside (new settlements able to involve urban agriculture). This aspect contrasts with the relative immobility of the traditional cities' order, based on a now outdated horizontal system of traffic, and leads us to propose an *integrated model* that is also based on a capillary action, on the rapidity and the multiplicity of com-

munications, which lives and spreads freely in space in any direction, reclaiming the land for nature.

That plan links to a simple square geometry. It responds to the geography of the region and the structure of the historic towns as well as historic urban evolution models. The digit of the plan is a figural landscape unit (named UDE: Unidad de Desarrollo Equilibrado, or BUD: balanced unit development) every 4.5 kilometers  $\times$  4.5 square kilometers (Thompson and Stewart 1986). This is a lattice topology, a sign of human presence in motion inside the territory. The map is not only a tool that mimics reality, representing it, but also an operational tool that must allow an experience of cognitive mapping. Geography, then, becomes the original archetypal form of Western knowledge (Febvre 1922) and should be redesigned to meet the challenges of the globalized society. The interpretation of the new "regional dimension" is achieved through geometric linear lines of gray infrastructures. The interpretation of the new "local dimension" is a topological network that determines a new portion of the *body space* (Shane 2005).

The grid tames the existing infrastructures, which become linear against circular. The new infrastructure model is conceived as an interrelated system between commuter trains and highways. Then the metropolitan architecture comes out from the location and integration of large-scale structural elements, which coalesce the metropolitan size and extend urban-style living standards to larger populations in suburban areas. Economic structures, including office buildings, factories, enterprise zones, corporate campuses, etc., along with civic structures such as full-service hospitals, universities, stadiums, etc., are designed to accommodate ex-urban



residents. Transport structures include commuter trains, high-speed trains, airports, freeways, etc. Structures that serve larger, remote populations and the systems to access them are the essential elements of metropolitan architecture.

Incorporating discontinuous infrastructure (housing, productivity, social) around the strategic nodes increases and expands their strategic importance and, as a consequence, their influence on the surrounding territory. At last, the metropolis becomes a patchwork of dynamic urban or semi-urban patches and interchange points, where people gather because of their natural attractiveness (green infrastructure) and, being crossroads (gray infrastructure), because of their convenience. Each district owns its distinctive character and it is similar, considering its structure and balance, to the infrastructure assets. These controlled territories constitute the basic structural form of the metropolis.

The design of the metropolis architecture, thus, has to arise from a spatial concept that synthesizes the strategic assets of the districts in an overall form. Once the strategic form is recognized, then the tactical location of specific projects can be effected. Each urban and architectonic project must reflect the strategic concept as tactically applied to that district: the concept takes form through the projects. This is the art of shaping the metropolis.

### **The Strategic Significance of a Geographical Interpretation for the Metropolis**

A metropolis, then, is characterized by its strategic geographical value for relationships. This power-

ful concern of the local place as a relational place, especially related to military reasons, in the Italian language of the 1500s was called *facilità della condotta*, which means “easy handling”; geographically speaking, these points are, for example, the fords, the passes, the ridges. Once upon a time, cities developed/were built close to these geographically useful places. The geography, then, that is drawn on paper, with all the consequent effort of calculating and measuring, has, as its background meanings, the need to mark these strategic value places for the relationships, which must also now let us know where we can pass from one side of the territories to another.

What can represent for us today a metropolitan city area that is in a precise geographical situation, in a place where we can find traces of its historical or archaeological past, and that, more and more today, invests uninhabited territory, or merely the countryside, which must be reconceptualized at the new urban scale? To answer that, starting from a geographical interpretation, we must recognize that every great city has a strategic role in a relationship. And then, a history made by men intervenes: it roots the metropolis to a specific geographic point.

### **An Open Metropolitan Infrastructure**

Geography, history, and myth in the past, and today a railway, a port, and an airport, for the first time tie together the points of a territory, allowing modernity to determine the specificity of its interpretation and the meaning of the reactivation of the ancient relational value of sites and places that was established over time. For this reason, rail and air

transport facilities are critical, as they are an artifact and not natural works and represent for us now what the relational value of the local point was for the ancient. Every place in the past was related to its topographical situation, and it is now determined by this either air or rail matter, which is a “more” technical issue regarding the geographic consistency and meaning of the metropolitan area.

Of course, sometimes the new infrastructure dismantles the local way of the old relationships. However, on a deeper level they always refer to the local site and place power of the relations, and this is what we mean by “easy handling.” So there is always a geographical and topographical situation that those who came before us have understood as a value of what over time was a crossroads. That matter must be strengthened and preserved. Some territorial managers call *location* the power of the place for a business project, but in that way they translate into the very light words of a business plan geography and history.

The profound criticism of the Reticular Matrix toward a vision of an only economic or ecological territorial development is especially represented by the way it addresses the matter: its empathy between metropolitan infrastructure and regional development. Within the discipline of the metropolitan project and the territorial analysis, we are often increasingly facing the implementation of the infrastructure, due to its resilience affordance, as the key to the structuring of the territory. This topic is an open wound. It has been the subject of some infrastructure works that have selectively destroyed landscapes of greatest importance for local populations. The Reticular Matrix implements a sustainable infrastructure strategy. The territory for

that strategic issue is fundamental because it is the context and the memory of the inhabitants, but, overall, because it is the framework of their experience and the space of their everyday life. Ortiz speaks about a territory and its landscape constantly changing and about infrastructure projects, which may pose a psycho-geographical knowledge of places and, therefore, the knowledge of an identity that for the territories is on process and layered in the ground, set on the traces of the history of the diverse cultures. But the past cannot always be preserved; yet conservation requires an understanding that we must achieve every day, facing the lack of means to do so.

From our perspective, the keyword to define the metropolitan strategy for a sustainable infrastructure project is conceived not only as the context of the memory but also as the context of the day-by-day experience and valuable physical space. By that, I mean we talk about a territory and its landscape constantly changing because the landscape is closely linked to the economic vocation of a territory, and is an active entity persistently rebuilt. This is not a static view.

## **The Formal Characterization of the Metropolitan City-Territory and Landscape: The Shape of the Movement as a New Settlement Code**

The renewal of urban project instruments, until now, was based on an improvement of the existing one and not on a reform. But, today, this reform is necessary indeed, due to the incommensurable



urban dimension. The size of the city urban area, then, cannot have a traditional form and will be represented by this development method, which gives value to the fixed elements, which form the backbone of its general large communications networks, in which we have to implement the time dimension and the structures where the rare urban functions are concentrated, and which become points of urban intensity and functional expression of urban organization.

In the new metropolitan landscape, then, the movement, as a new settlement code, creates the space through the environmental qualification that it determines: an infrastructure, sensitive to the territory, allowing the ground to express itself. The landscape section (the Geddes Section of the Valley) and its strategy of levels, in fact, becomes the dominant element of the project. The network mobility becomes an important and characteristic element for this purpose, which does not follow the model of the historic city, but as Gustavo Giovannoni argued (Giovannoni 1931), it is possible to preserve and develop the ancient city only if we are able to connect it to a new infrastructural network. This is an important factor, because the old urban structures, well-rooted in the territory, behave, on a regional scale, as well as structural elements of the new metropolitan reality allow it to be connected with the geography of the area, considered as a key resource at the local scale (Geddes 1909).

A strong economic attractor related to the new public infrastructure system, therefore, should foster the reversal of old abandoned cities back into a world cities network as a values symbol, and should get the spontaneous settlements back into legality, providing them with services, which could improve

the sustainable level of the entire city. For the Ortiz strategy, the attractor is a public commuter train interchange point. This is the central point of the UDE or BUD, which is the metropolitan urban digit.

Every UDE/BUD centrality within other interconnected centralities, due to a different infrastructure hierarchy, constitutes the metropolitan city fabric. It is an area that has become dense due to metropolitan functions; it is always related to the existing city and is the way to avoid urban sprawl.

### **Acting Rules for the Balance between the Two Continuous Systems: Gray and Green Infrastructures**

Hence, studying the metropolitan impact on the rural environment, the Reticular Matrix proposes a system of eco-armatures: the landscape ecological infrastructure, a balance between the green and gray infrastructure. Then, we could refer this balance methodology for intervention to Alexander's eco-morphologist patterns: defining eco-green armatures as well as immaterial network infrastructure, Ortiz discusses the question of natural resources, which cannot be planned only on the basis of the model, but also on the basis of a rule: the rule of the particular local form. According to Geddes's Valley Section that defined a link between man's work and his territory (the valley, let us say the river and the green infrastructure), Ortiz, in fact, presents some of the methodology's acting local rules for the balance between the two continuous systems: gray and green infrastructures. That is the UDE (Unidad de Desarrollo Equilibrado) or BUD, which for us is a *landscape figural*

*unit*, which means a metropolitan city unit, defined by a structure-figure that is the backbone of the landscape. So we go beyond the land use unit concept to read the territory.

## **The Compatibility between Environment and Urban Development through the Reticular Matrix Methodology**

The natural and built environment capital, then, must be integrated into the urban fabric. The flexibility of the model produced by the Reticular Matrix methodology allows the compatibility between the environment and urban development through the definition of the UDE/BUD and its centrality, which is the metropolitan architecture unit, whose size is approximately 1 kilometer  $\times$  1 kilometer. The environment prevails when the two continuous gray and green infrastructures (the only two continuous ones, whereas housing, services and industry are not, and because of this cause sprawl) overlap. The natural environments, in fact, should have continuity to allow networking and biodiversity, which have to filter through the metropolitan urban fabric to reach the heart of the metropolitan urban system.

Ortiz's method proposes the quality of the shape (*forma* in Italian) as a tool. The new scale causes another form of settlement that encompasses the engineers' soils down to the artificial soil until reaching the natural soil: each UDE/BUD, in fact, is not identified by its function, but by its geographical significance, which determines its role within

the urban system. The model identifies the quadricola of 4.5 to 4.5 kilometers as a geometric shape and a new dimension of time/scale, which allows access into the metropolitan areas and which is the surest guarantee for the establishment of new centers. It is a formal stable structure, the memory of its territory, which distributes and determines the position of the key metropolitan city elements able to structure and transform the territory, creating a new urban fabric at the metropolitan scale.

The urban fabric is opposed to a type of centripetal and centrifugal urban structure, and also rethinks the city system from the perspective of another system of connections. It is a true reform. The model, then, places the linear infrastructure networks as a characteristic feature and does not start from the historic city layer that does not interpret the new infrastructure scale well. Not proposing an addition, but a reform of the urban paradigm as a gap, Ortiz does not perform an operation to preserve the historic fabric of the city, as if it was expanded, but determines its new interferences with new urban highways and trains. These new centers at different scales must be conceived as new built form types. That is why I said before that the four pillars of Ortiz's method are: geography, geometry, history, and the denial of memory to allow a cultural leap, a metropolitan reform of a city.

## **Dynamic Strategies for Metropolitan Architecture Management**

The destruction of cities and territories, as a typical urban phenomenon in recent centuries, consists of the inconsistent detachment between geography,



the methods of urban structure projects, and its functions.

The contraction of time has neglected the value of the place. This fact led to a first rejection of the value of the ground (the *tabula rasa* of modernism) and then to the logic of the self-oriented network of infrastructure whose interfaces with the city fabric and landscapes are not often well harmonized and are built following only an economical logic. A contemporary urban design requires a clear understanding of its structure and dynamics, through an analysis at various levels of scale, able to understand the laws of its urban metabolism, to produce a dynamic and sustainable strategy to determine it and drive it. The complexity of the scales of a metropolitan architecture project involves a multidisciplinary frame, which supports a complex decision-making process driven by a strong vision.

## **The Management of the Built Cultural Heritage and Landscape in Urban Development**

Here, I think, is the heart of the matter: management of the built cultural heritage and landscape is also needed in metropolitan city development because the passages of scale have to occur without alienating the socioeconomic structure and the image of the physical structure of the city. In fact, groups of private interests rather than common public interest often develop special activities.

In the vision of Ortiz, the deep connection of the metropolitan digit, not only with the infrastructure networks but also with medium and small

cities rooted in the territory of the valley, is particularly interesting if we consider it, as we have already argued, as a profoundly critical approach against a purely economic or ecological urban development.

This kind of renewed humanism in the study of the metropolitan organism allows us, then, to fully consider metropolitan architecture as an integrated space-time system, but also leads to a reconsideration, within the urban fabric understood as a public good, of all the spaces, even those which Portugali (Portugali 2011) defines as permeated by a sense of placelessness, that is, the anonymous spaces of the “usual repeated gestures,” the abandoned and neglected ones, the space in between the infrastructures for which we have to reconceptualize a meaning and a name (now we only define them: green spaces . . .).

It is now undeniable that a more systemic perspective, like this, constitutes the basis for such a definition: the metropolitan landscape, the built environment, and the cultural heritage as a true infrastructure open to being used at different times.

## **Methodological Outlines**

Actually, in the presence of the disruption of the urban and territorial landscape, this approach promotes the appearance of a new scale of the types of settlement and their interrelations, but, above all, a substantial change in the urban/rural relation: a formality-gradient type, able to capitalize on, due to its city-center proximity, some advanced services, which are determined especially in relation to new mobility structures. Such strategic typology of settlement should also be able to communicate

with the agricultural landscape that has not only the potential to provide products for consumption and sale to local communities (urban agriculture) but also becomes an element of urban regeneration as it has always been: i.e., in the tradition of the Italian landscape as total built landscape.

For these reasons, the metropolitan projects made inside the Measure and Scale Laboratory of the School of Architecture and Society of the Politecnico di Milano followed the Reticular Matrix. Our vision, in fact, is working on the flexibility of a physical configuration: such a scheme guarantees, from one side, the connection of every settlement to the mobility system and, on the other side, integration with the surrounding periurban agriculture through a local form-typology specificity. Such an approach may envisage a sustainable relation between green and gray infrastructure, where green is intended as the hydro-geological system of the territory.

This approach has allowed us to frame the design of a metropolitan architecture, highlighting:

1. The soils, the waters, the geomorphology, the permeability of the territories to the infrastructure armatures, and the land use—especially as characters (variants and invariants) of the metropolitan context
2. The vulnerability of the soil and the water conservation, which means the capability to express an opinion on the constraints on the metropolitan project we wanted to propose

The possibility to formulate, through this method, a prior judgment through a strategic geographical

and historical analysis on the design assumptions of the interchange points between the metropolitan scale, then, also constitutes a figural index (UDE/BUD conceived as a figural landscape unit) for the project. This allows us to get a synthetic image of the entire territory: the development model allows us to determine our points of intervention, at the scale of a metropolitan architecture together with the synthetic vision of the metropolitan area.

In some cases, through an infrastructure-sensitive project, for instance, we might even get to allow a removal of the current confused image of the ground/landscape, which could be rewritten to a higher scale (through the design of a synthetic “plan of plans” at a metropolitan scale). Or we could aim for the reactivation of some old central points through a new infrastructural connection; or project the passage of a place from a neglected use, due to the fact that it is no longer working at the new bigger scale—which is a typical situation of some abandoned city centers—to a symbolic one, a sign of history and of a link with the ancient territory dimension, by looking at the scene from another point of view. This is the value of the UDE concept.

## The Task of the Metropolitan Architecture

The task of the metropolitan architecture, then, will be to build the affective scene, the new shape of the metropolis; the task of planning will be to establish a close link between planning and real estate development, aimed at a strengthening of a *feeling of adequacy* between the places and the people.



To achieve this, the metropolitan landscape must be increasingly seen as a value, also economically important, and in general must be understood as a built cultural and natural heritage, which is one of the most effective ways to understand the deep meaning of the term “public good.”

The development of a vision project is therefore essential. It starts from a methodological study that defines a new dynamic map of the territory; it recognizes the sites and their transformations through the recovery of their topography and geography; it enhances the entrepreneurship scattered on the territory, but also improves an ideal diffuse sensibility linked to the quality of the territories. Only this attitude can connect sustainable development and an integrated policy, which arise therefore from a real coordination between the actors involved, participating and united by an idea of sharing values that not only directs the system creation, but also that of the network. The metropolitan architecture project able to involve such an important number of economic investments, energy, and cultural development must become the “coat of arms” of this territorial vitality.

### **The Metropolitan Morph-Type, Such as a Gray and Green Geographical Skin of the Infrastructure**

The green infrastructure and the infrastructure of mobility (gray) obtain an urban and architectural *geographical skin* (Lévi-Strauss 1955, Varela et al. 1991) close to the nodal point interchange among the different dimensional scales. These points are

shaped by and shape the compatible form of the gray and green infrastructure, articulating the territory of the metropolis. The architecture of the metropolis (new metropolitan morph-type) inside the central megablock within its context (1 meter × 1 kilometer) inside of the UDE/BUD dimension, in short, becomes the skin of the infrastructure backbone of the metropolitan territory. It is a skin connected with the geographical structure of natural and artificial soils, as it becomes the place of the relationship with the rest of the cosmos or the metropolitan archipelago.

### **The Two Maps: Topographic and Mental**

Finally, as we said before, one the most important tools that is obtained from the application of Ortiz’s methodology is the construction of a new topographic map, which is the device capable of supporting a mental map at the metropolitan scale. It is made up of a continuous and a discontinuous system (one local space within global scale) and by layered ground. It moves from a geographical scale to a local geography. Compared to the traditional structural urban paradigm, it still wants to define the possibility of a value for a syntactic and communicative architecture (a cognitive value), through the definition of a statute of the architectural subjects, which is recognized as a tool for the construction and symbolic interpretation of the built environment but at the new scale: a landmark, as a new relay, a hinge point for the interconnections between the scales.

## The Projects

For years, when we start a new project at the Measure and Scale Laboratory of the Department of Architecture and Urban Studies of the Politecnico di Milano, we face some issues, which the Reticular Matrix could help us with. At the beginning, in fact, we must know what is peculiar to each developing city model, what size is optimal, and how to support the local people and economies within the transformation of a territory. When, for example, new energy deposits are discovered or when a new infrastructure or settlement has to be built, we have to define what we do not have to break if we do not want to destroy a kind of sustainability that the local citizens have in any case attained by themselves, or what we have to strengthen so that the inhabitants can participate and share their growth movement.

For all this, the most important thing is to find the places of the interchange among the different scales where we can introduce the new developments so that we can reach our objectives: the possibility of an evolution of the local model of urbanity, and the project for the possible and realistic growth/transformation of the regional and local models.

The Reticular Matrix methodology, then, gives us the possibility of defining the backbone of a new mapping project through a hybrid map, which, through the use of specific computational tools, can help us to build a series of topological models, describe and bring into connection the main mechanisms, and generate the physical space, simulating an ongoing reality, from which it is possible to obtain, through a critical reading of the preconfig-

ured scenarios, forecasts and models of sustainable development, characterized by a close link with the physical and cultural context.

The critical use of this methodology has helped us to define in a logical sequence:

1. The state of the art for each project area as a matter of its growth/change of scale
2. The scenario of the project, which provides criteria for the evaluation of the elements of the metropolitan context: its potential constraints and invariants

What I want to say, finally, is that a traditional sustainability model linked to quality “scientific” ratios must be respected, of course, but Ortiz’s metropolitan city model gives us the rules for the possible presence of new metropolitan quantities, and for an urban and architectonic nonstandard project. We have to try to think about a time feasible for a development in both the short and long term, for a compatible development between the two times, without having to forget one of them, and with a strong concern about the physical/cultural space that is the only real guarantee for a participatory development that is not imposed on the citizens.

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*Associate Professor, Milano Politecnico*

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*When all is said and done, it really is the commander's coup d'œil, his ability to see things simply, to identify the whole business of war completely with himself, that is the essence of good generalship. Only if the mind works in this comprehensive fashion can it achieve the freedom it needs to dominate events and not be dominated by them.*

—Carl von Clausewitz, *On War* (1832)

## INTRODUCTION

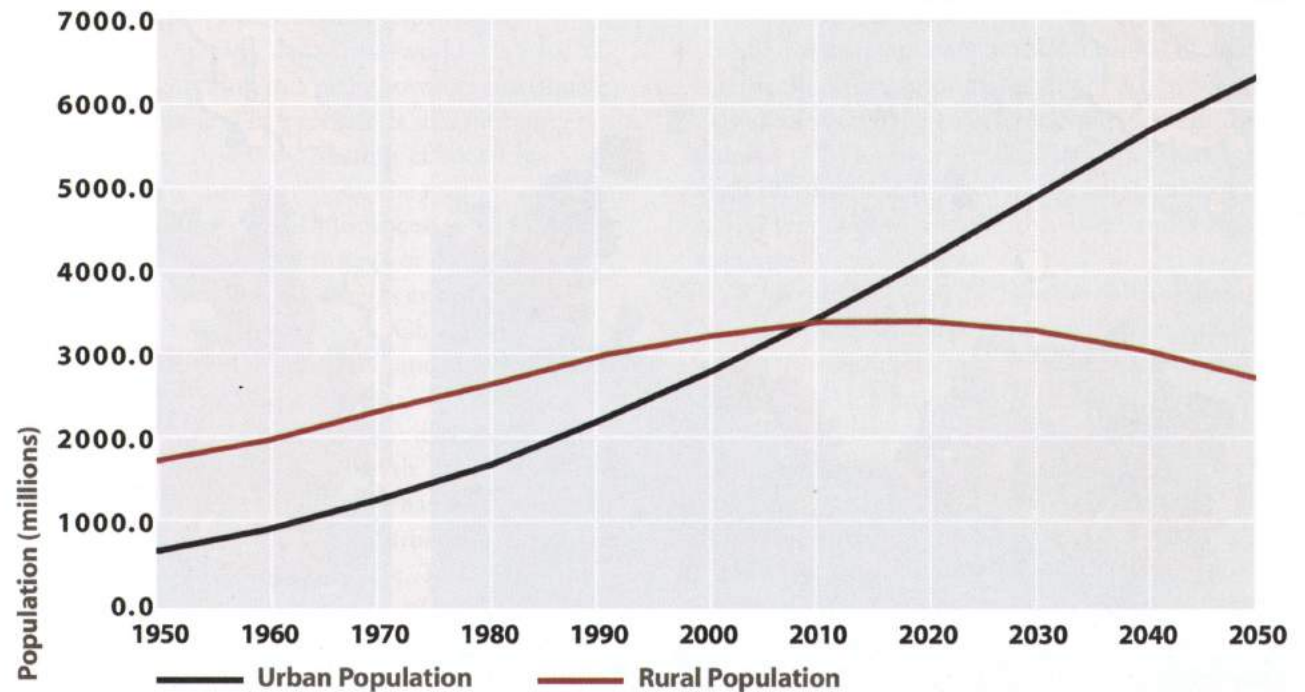
The metropolises of the world are exploding in both population and area. Many of them are growing at the rate of 5 percent or more per year. And for many, the pace is accelerating.

In June 2010, for the first time ever, half the global population was living in urban areas. There are now as many humans living in cities as there are

in rural areas. Of the 7 billion human beings on the planet, more than 3.5 billion live in cities. Within the next 25 years, up to 2035, that number will likely increase to 5.5 billion—in other words, more than 200,000 per day.

That is the trend, and it is accelerating. No voluntary planning policy of restraint is going to stop

URBAN AND RURAL POPULATION OF THE WORLD 1950–2050



■ *Urbanization trend: World urban and rural population, 1950–2050. Since 2010, at least 50 percent of world population has been living in cities. Every day, 250,000 people from rural areas move to cities, the equivalent of a new metropolis of 1.75 million people every week.*



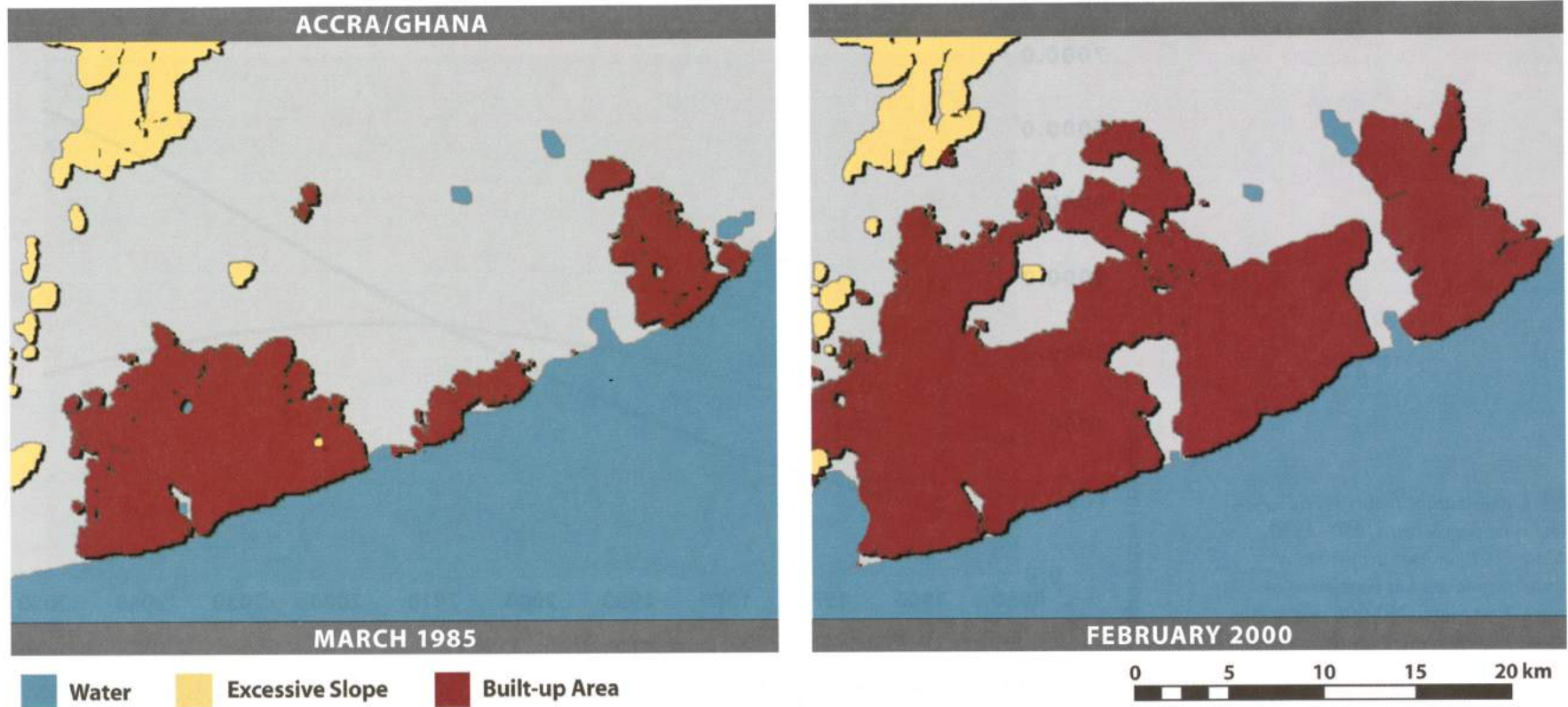
those 2 billion new urban citizens from materializing. So the challenge for us is to come up with a plan to accommodate them. The first step is to acknowledge that the way we are doing it now will fail them and their metropolises.

The cities that are currently experiencing 5 percent or higher rates of growth will expand two-fold every 14 years. Effectively, such expansion means that a city would have to rebuild itself every 14 years. That is a daunting task, made even more daunting by the fact that the two most predictable measures of expansion—population and area—do

not necessarily correspond and are dramatically affected by other factors.

For example: Between 1985 and 2000, Accra, capital of Ghana, more than doubled in area, from 133 square kilometers to 344, an average annual expansion of 6 percent. But during the same period, Accra's population grew annually by only 2.65 percent. Why did demand for land outstrip the expectations tied to population? The explanation lies in Accra's 2.21 percent annual per capita gross domestic product (GDP) growth in that time, far in excess of that of the rural areas of the country. Not only

**■ Accra metropolitan expansion:** Between 1985 and 2000, the population of Accra (Ghana) grew by 160 percent, an annual growth of 6.56 percent. Many metropolises are currently growing at about 5 percent per year, which means a doubling of population, and therefore a doubling of the urban landscape, every 14 years.



did this cause more people to migrate there, it also reflected the increasing wealth of Accra's citizens. Wealthier people use more built space for living, shopping, studying, and everything else. Wealth in itself thus causes expansion.

Wealth compounds population growth to impose a multiplier effect on the population growth figures that we normally take for granted as the essential predictors of area expansion. Thus, we must realize that even in the absence of population growth, there may still be considerable pressure for urban expansion. And even if we planners actually enjoyed the collaboration of our economist peers, we would still only be guessing at how much area to plan for actual metropolitan expansion.

The metropolises across the world are expanding—some according to a plan, however inadequate, but most without. The problem is, if a city does not respond to expansion by making effective land and urban infrastructure provisions, the result is an urban metastasis—an uncontrollable process in which urban “slum cells” spread like a fungus or cancer, destroying the structure of urban systems and life.

N'Djamena, the capital of Chad, currently is home to 1 million inhabitants, and the number is increasing by 10 percent per year. The heart of the city, Old N'Djamena, has an obvious urban structure. A look at the new growth areas, however, tells us that greater N'Djamena has grown neither naturally nor sustainably. The urban structure has disappeared, and slums dominate. The metastasis is in process. Santiago de Chile, in an expansion continuum with little more core urban structure than the basic layout inherited from the conquistadors, is spreading like an oil stain. In fact, throughout Africa and Latin America, most cities are expanding

informally, without a structure, as sprawl spreading into the countryside.

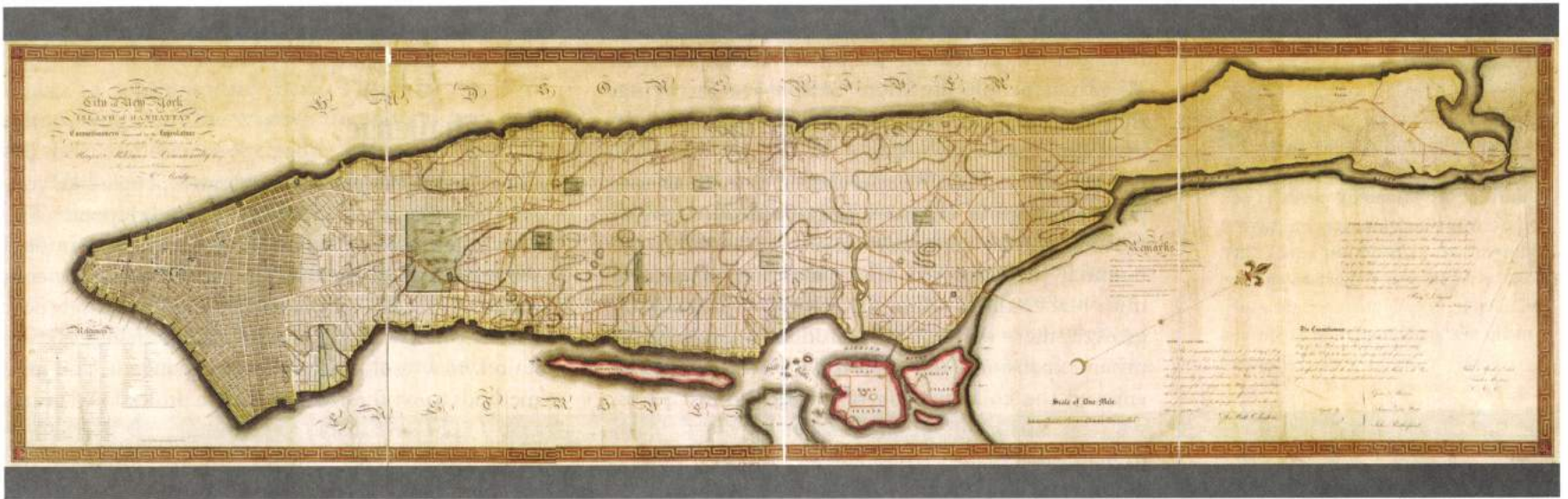
## The Challenge

How should the people in charge—people like you, who are actually reading this book—respond? The challenge exists in dimensions beyond our traditional scope of work. It outstrips the capabilities of the current tools we use to solve problems. It demands new rubrics to identify the process of growth and its evolution, new tools to monitor and gauge it, and new methods to synthesize them into a professional praxis that will be sustainable for the long term.

Cities last for centuries, and we now have the ability to develop enormous amounts of land in terrifically short amounts of time. When we make mistakes, they have large consequences and do not fade away in a few years. Instead, they metastasize with the slums. It is up to our generation of professional planners to address this issue and effect the response.

Our predecessors in history had to find their own responses to the peculiar challenges of growth in the Renaissance, the Baroque period, and the Industrial Revolution, among others. The problems of growth in those periods were proportionate to the economic, social, and technological expansion of the era—each time on a larger scale. Now, confronted with an urban population on its way to more than 5 billion souls, we must acknowledge that we have entered our own distinct historical era, the *Metropolitan Age*, and we must discover and perfect the response that is adequate both for the moment and for the coming centuries. We do not yet have that response.





Fortunately, in addition to the historical inspiration of Florence, Paris, and New York City, we can look at modern cities that are successfully confronting the challenges of the Metropolitan Age. Twenty years ago, when I was serving as deputy mayor of Madrid, my city experienced an unprecedented expansive spurt, increasing in area by 50 percent from 1975 to 1995. That figure is much lower than what the cities I just mentioned are experiencing today, yet at the time that expansion was considered a potentially dire situation, demanding an innovative response that allocated growth resources to the right places for long-term sustainability.

Madrid's growth was not a matter of choice, nor was the solution a simple matter of upscaling existing models. Without an adequate plan, economic, cultural, and political change would organically "build" the city by itself, uncontrolled, and with

the environmental destruction, transport congestion, social inequity, and economic unsustainability that almost inevitably accompany the free invasion of land. To avoid the metastasis of one of Europe's great capitals, we urgently needed a new model of expansion.

As director of the Strategic Plan for Madrid from 1989 to 1994, I was acutely aware of the challenges. Drawing on my background in architecture and urban planning, I assembled a team of dedicated professionals, who developed a plan we felt would adequately address the long-term needs of the Madrid metropolitan region. These needs included land use strategy, infrastructure, social and economic facilities, environmental protection, and housing. We were fortunate in getting broad support from political leaders across the metropolis in developing and approving it. A year later, with my team in the regional government, we went to work,

■ *New York's response to population growth in the nineteenth century: The 1811 Grid Plan. The Industrial Revolution spurred a migration to many cities in the first countries to adopt the new methods of production.*



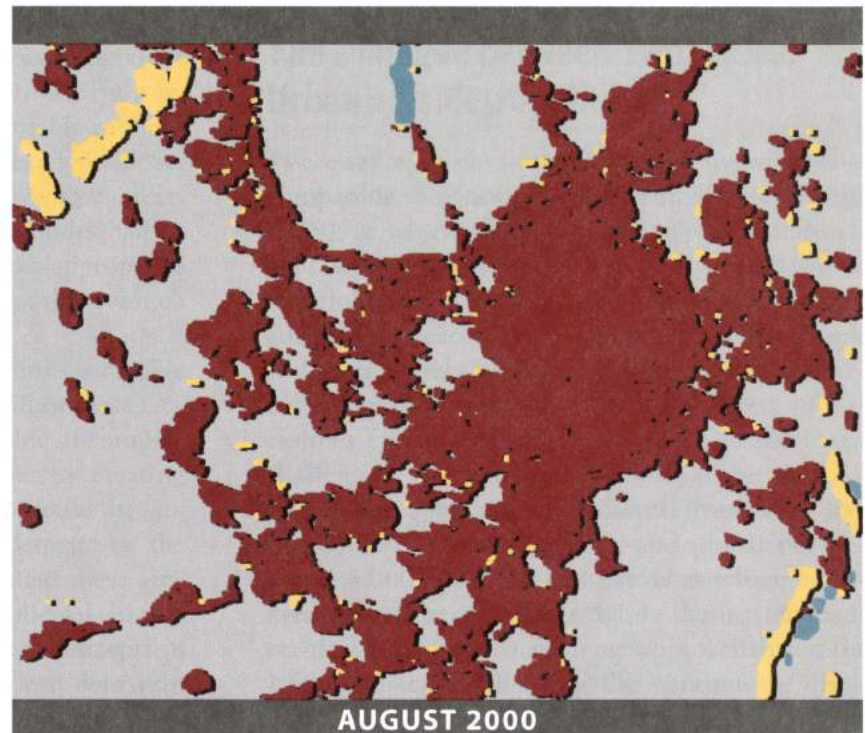
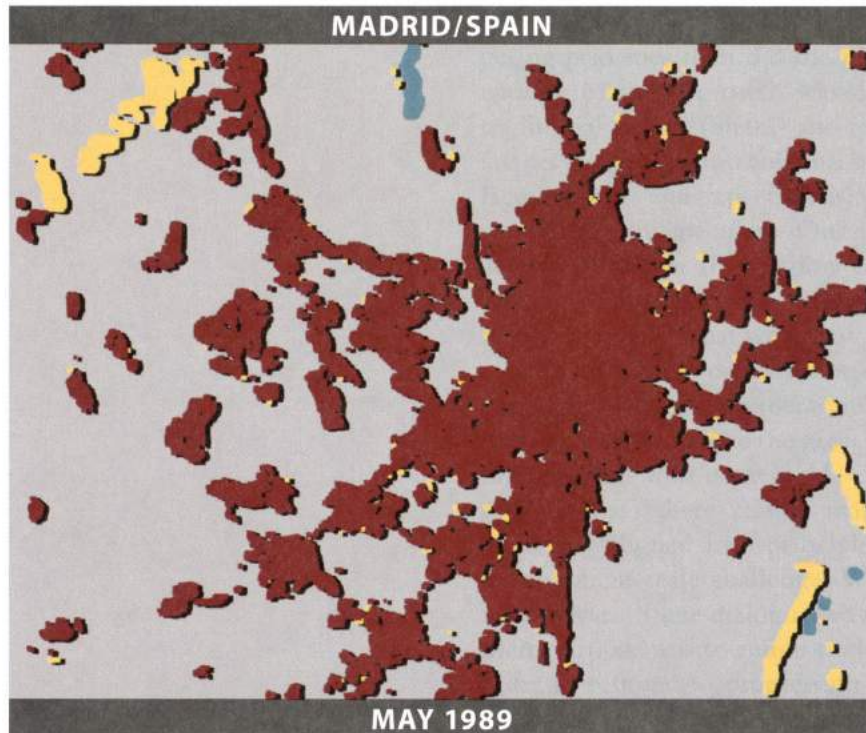
producing the Metropolitan-Regional Plan of 1996 and implementing it.

Like every previous generation of professionals who produced a unique model to address the challenges of their time and scale, we had to produce a particular model for ours, distinguished above all by its unprecedented scale and its reflection of sociological and ecological demands. Already Madrid had become much larger than a mere city, as that concept is traditionally conceived, and was subject to a much broader and disparate array of priorities. We had to accommodate those fundamental

changes and recast the entire physical concept of Madrid on a larger scale in every dimension, and with better integration within the whole. Our new scale would embody a new notion of a megaurban organism: the *metropolitan scale*.

Since then, planners and developers have successfully used the same approach in a number of other metropolitan areas. Based on the findings from Madrid and these other metropolises, we have elaborated the approach into a methodical system for addressing the crucial issues facing developers and inhabitants of twenty-first-century metropolises.

■ **Madrid metropolitan expansion:** Between 1989 and 2000, Madrid's area increased by 73 percent, or 2.62 percent per year. Since 1996, the rate has slowed but the metropolis still is expecting a 50 percent increase in built area over the next 20 years.



■ Water ■ Excessive Slope ■ Built-up Area

0 6 12 18 24 km