The City of 7 Billion: An Index

The apotheosis of urban development is the state of crisis. The "The City of 7 Billion" dissolves borders between cities and re-invents the world as a single urban entity—the ultimate city. It gives agency to the architect to confront the global crisis of urban growth. The following index to "The City of 7 Billion" is a primer on the basic terms, techniques, and concepts necessary for architecture to reframe the world as one city and consider a global design strategy. It offers an introductory reference guide to global urbanization and development.

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7 BILLION... AND COUNTING

Population growth that surpasses expectations has prevailed as a constant force of global development throughout history. Last year, a global milestone was reached: the 7 billion-problem, or opportunity, of human population. Global urbanization statistics currently predict that 69%, or 6.3 billion, of the world's projected 9.3 billion people will live in urban areas by 2050. This crisis of growth will be concentrated in new and expanding megacities of the developing world, where industrialization, modernization, and significant growth are still burgeoning forces that have yet to mete out their full impact. The 2008 tipping point of a global urban majority is a mere precursor to an accelerating phenomenon of relentless and rapid urban population growth.[1]

LIMITS AND THE CITY

The built environment is one product of this unprecedented population growth, the sum contribution of humanity to the physical realm. From the rise of the industrial city and the modern metropolis, to the proliferation of regional conurbations, urban and suburban agglomerations, and the rising count of megacities, the scale and scope of post-industrial urbanization has tested, enlarged, transgressed, and ultimately dissolved traditional limits and boundaries of cities.[2] As the footprints of contemporary cities far exceed their physical and administrative limits, identifying boundaries or defining ideal case studies has become all too problematic.

Scale is further compounded by speed. The birth, growth, and collapse of an entire city in a half-lifespan have become a common occurrence, fueled by global markets, post-war development, and a mobile interconnected age of

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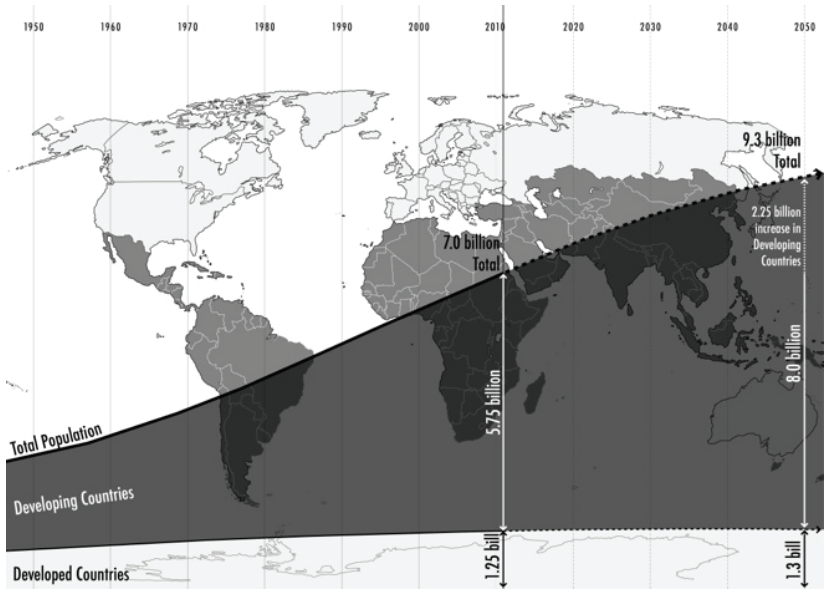

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interdependent resources. The complex networks and intricate supply and production structures of the post-industrial city can no longer be contained within, nor defined by discrete limits of space and time.

FROM URBAN AREAS TO AN URBAN SPHERE

This dissolution and usurpation of the "city" by the "urban," heralded four decades ago by Henri Lefebvre,[3] has been ushered by a litany of semantic attempts to invent terms, categories, and definitions for urbanization, from Patrick Geddes' 'conurbation' (1915) and Jean Gottmann's 'megalopolis' (1961) to Saskia Sassen's 'global city', The Urban Age Project's 'Endless City' (2007) and Neil Brenner's 'Planetary Urbanisation.'[4] Continued urban growth is inevitable and, barring an apocalypse, newly defined terms, categories, and boundaries will also be outgrown.

Like the plethora of terms, the clichéd urban–rural dichotomy also has little meaning, as statistical definitions of 'urban areas' are not only variable by municipality, region, o country,[5] they disregard the network and flows of required resources. Every corner of the earth is arguably urban, beholden to cultivation, industrialization, drilling, clearing, transportation, and pollution.

In an age of increasing connectivity, the instability of the future presents a collective dilemma. It demands a confrontation of the exigencies of growth that reconfigure the global terrain. The impact of population growth and resource consumption on the built and natural environment requires an approach that confronts the scale and scope of the entire world.Rather than distinguishing between arbitrary and futile dichotomies of urban and rural, land and water, or developed and natural, a holistic global strategy for the urban sphere is required. "The City of 7 Billion" erases divisions and

Figure 1: Prototype of urban population density

Figure 2: : World population growth chart based on United Nations projections in 2011

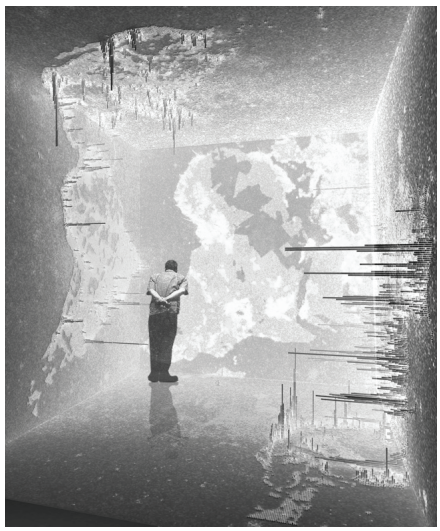

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Figure 3: "The City of 7 Billion," a design approach for global urbanization

differences, removing all boundaries of ownership, politics, and responsibility. It projects an understanding of the collective population and global development as one unified urban entity without boundaries. An antidote to the fragmentation of global development, "The City of 7 Billion" demands a shift in interest from city infrastructures to global infrastructures. Design strategies must reframe the scope and scale of global urbanization to re-engage speculative approaches that define the world as one single urban entity.

A global holistic view is not without ideological precedent as an architectural project, redolent of the vibrant paradigms and praxis of the 1960s and 1970s, from Doxiadis' Ecumenopolis and Eames's Powers of Ten to Buckminster Fuller's Dymaxion Map and Superstudio's, The Continuous Monument: An Architectural Model for Total Urbanization.

What was previously purely paradigmatic and speculative, however, can now be critically enabled and robustly supported by new spatial technologies and information sourcing. While neither a new nor unprecedented intention, this global approach has yet to be seriously undertaken and fully accepted as a definitive identity for developing organizational strategies.[6]

THE INDEX

What follows is an incomplete catalogue of the city of 7 billion through its history, actors, culture, maps, land, numbers, and data. The complete urbanization of the world is difficult to understand, but most easily accessed through an inventory of its interrelationships and a classification of its characteristics. In its simplest form, an index is a list. A list can be instrumental in decoding a complex and heterogeneous system such as the urban sphere.

This index offers an essential reference to the phenomenon of global urbanization. It is purposefully promiscuous, embracing a voluminous array of timelines, catalogues, data sets, lists, matrices, maps, and spreadsheets to illuminate the interdisciplinary and intricate processes contributing to the rapid rate of urbanization and its patterns of growth. Time plays an important role, capturing the tension between the past, present, and future while enabling the comparison of multiple states.

Included topics are: development chronology, institutions of power, national indexes, development metrics, projection systems, geographic data, land use, urban epicenters, growth rates, and continuous urbanism.

DEVELOPMENT CHRONOLOGY

In 1951, the United Nations Population Division began producing official estimates and projections of global population. The world's population was 2.5 billion, nearly one-third the current population. A chronology of the significant events, trends, policies, innovations, and construction of the past 60 years chronicles the global narrative of massive urbanization and population growth. It traces the intricate interplay and complex linkages between people and resources across time.

The history of urbanization is a history of cause and effect. A timeline of post-war development through formal and informal construction, natural

and manmade crises, the products of human culture, and the agencies and protocols of control, deconstructs history and distills the ingredients of global urbanization.

Rebuilding dominated the international agenda of global development following the large-scale destruction of the Second World War. The pressing need for housing was met with a global proliferation of top-down western planning approach in both western and non-western nations, the effectiveness of which was challenged in following decades. An ever-increasing developing world population led to the growth of informal settlements in the 1960s. This growth of the developing-world population was intrinsically connected with the creation of new nations and capital cities, as countries gained independence through decolonization.[7]

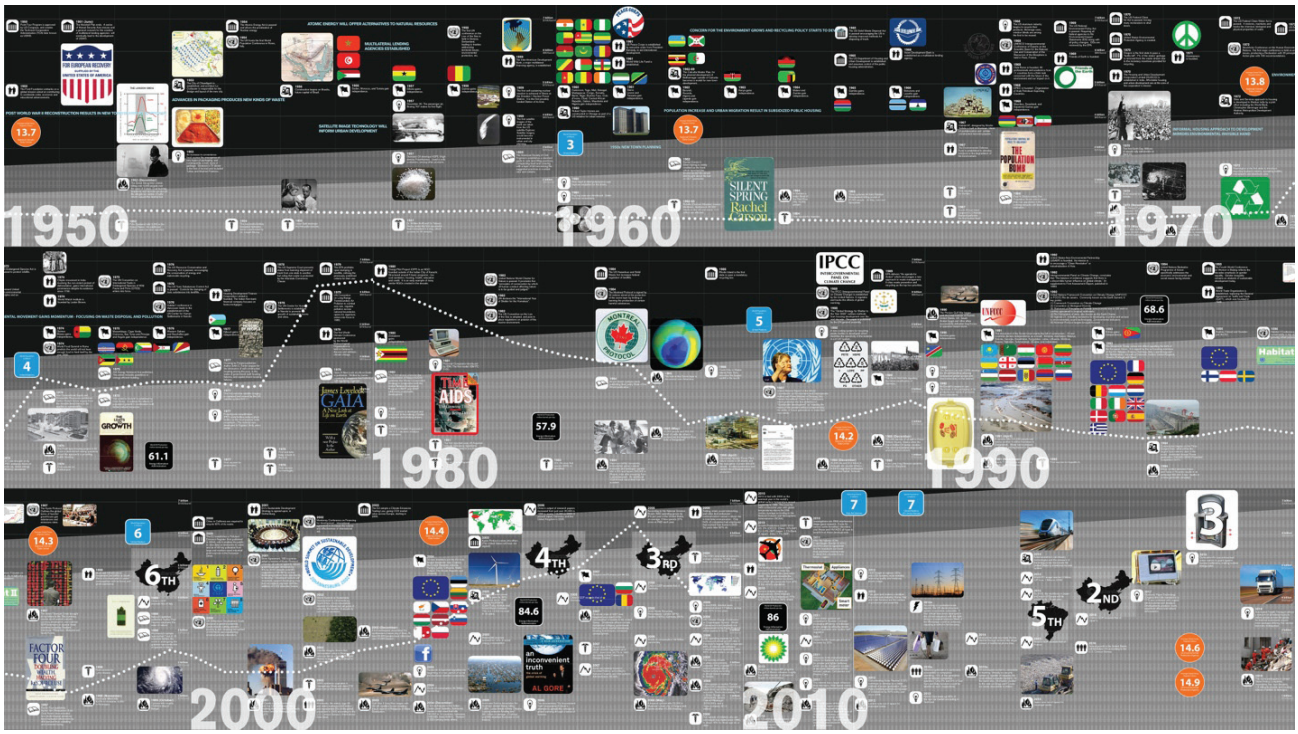
Crises are often the results of an unsustainable equilibrium of resources, testing the limits of their mobilization and prompting collapse. The history of urbanization can be traced through these points of failure, both natural (floods, cyclones, droughts) and man-made (energy crises, nuclear fallout, and trade shocks).

The oil and energy crises of the 1970s illuminated the global dependency on energy and its repercussions on the financial markets, leading to the stagnation of economies worldwide. On the heels of the increasing realization of a global scope, the confluence of the Bhopal gas leak in 1984, the detection of the hole in the ozone layer in 1985, and Chernobyl nuclear power plant failure in 1986 resulted in an immediate need to address the pressing issues of global development, transcending the conventional norms of national boundaries or regional affiliations. These disasters, coupled with the impending repercussions of long term crises, such as the population explosion, and the further possibility of mass starvation forecasted in *The Population Bomb* by Paul Elrich in 1968, set the stage for the urgency in assessing human development. The impact of human action was no longer local or regional, but global as well, and its scale was unprecedented. Publications like *Limits to Growth* (1972), commissioned by the Club of Rome, similarly capitalized on the global disaster scenario. Modeling the impact of population growth, pollution, and industrialization on resource depletion, *Limits to Growth* projected a scenario where the carrying capacity of the Earth is eventually undermined, leading to a cataclysmic global collapse. In critiquing unlimited and unrestrained growth in a world of finite resources, the publication proved both influential and controversial.

Today, doomsday predictions are neither shocking nor influential, but rather have become accepted norms. The end-state scenario has become the perpetual reality.

INSTITUTIONS OF POWER

The codification of global institutions of power through time illuminates the sequential emergence and interest in social, economic, and most recently, environmental issues. The growing number and proliferation of inter- and non-governmental agencies, coupled with the multitude of economic allegiances, such as the G7, G7+5, G8, G15, G20 and G77, further mirror the shifting and competing agendas of politics and power over the last century.



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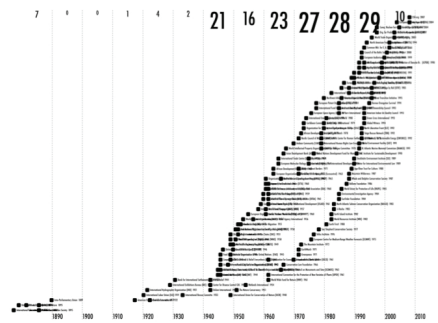

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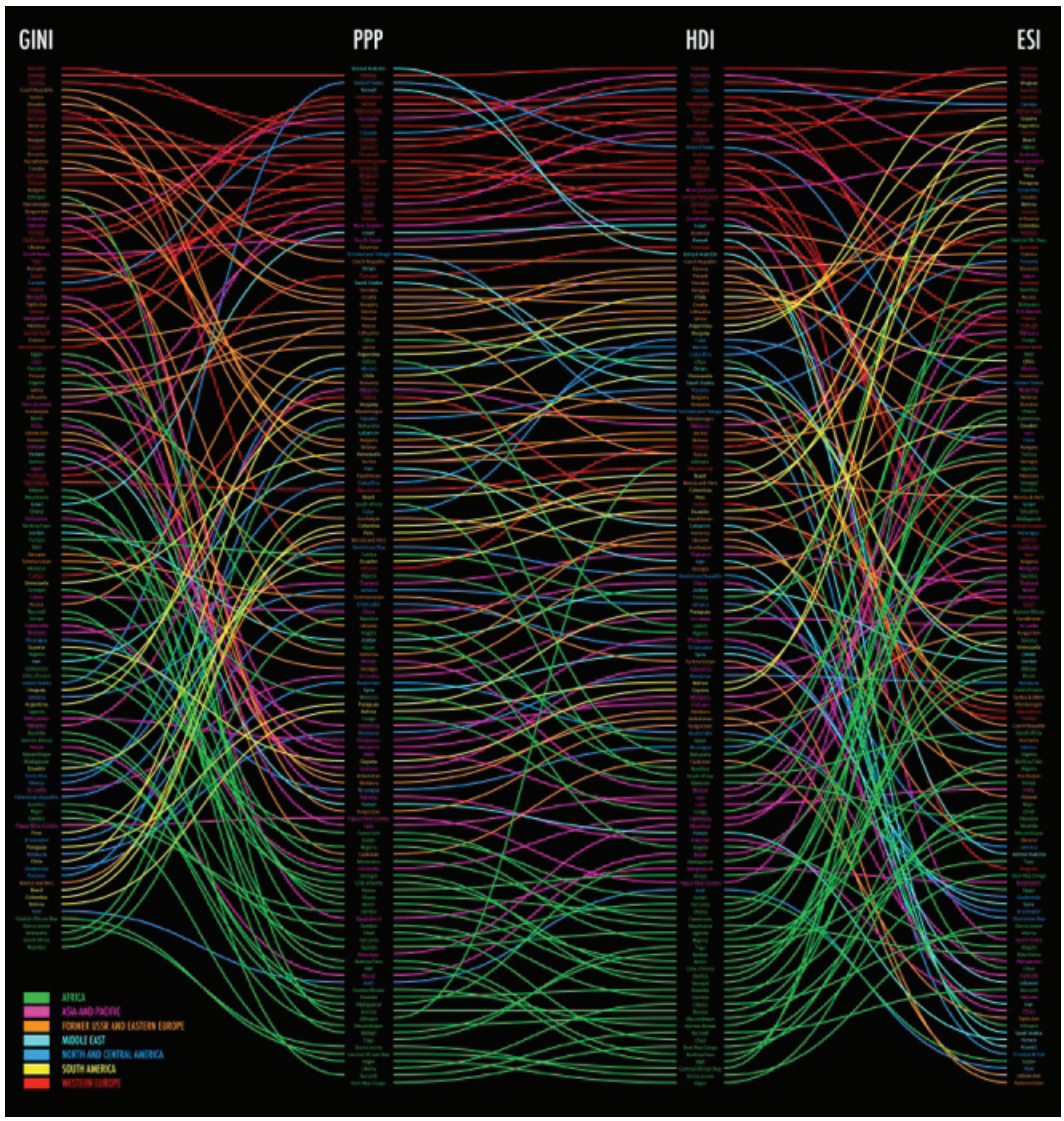
Figure 4: Comprehensive chronology of global development tracking key trends, statistics, movements, cultural production, physical construction, crises, events, and movements

Figure 5: Graph of the emergence and proliferation of global development organizations through time

The challenge of reconstruction and economic and social development dominated the international agenda following the large-scale destruction of the Second World War and the subsequent nation building of newly independent countries. Rebuilding efforts directed new attention toward issues of human settlement, provision of basic needs, improvement in quality of life, and humane living conditions. Concern for the environment as a discrete objective only gained global attention and momentum in the 1960s and early 1970s.[8] As the ideals of a unified global vision are continually confounded by impasse and deadlock within this expanded network, the future of urbanization is ultimately contingent on statecraft and negotiation between protagonists across multiple disciplines. The laborious mechanism of consensus building is increasingly subject to a series of international conferences, conventions and summits, yielding a relentless arsenal of reports, agendas, goals, plans, strategies, recommendations, resolutions, regulations, and protocols across this ever expanding field of participants. The blossoming of a truly globalized political network has simultaneously left fragmented authorship and a crisis of responsibility in its wake.

NATIONAL INDEXES

In positioning urbanization at the global scale, the need to evaluate how individual countries perform collectively and relative to each other are of critical import. Existing national scale indexes such as the Gini Coefficient, Purchasing Power Parity, the Human Development Index, and the Environmental Sustainability Index attempt to quantify abstract issues of equity, economy, development and environment, respectively, and serve as



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effective instruments of evaluating a country's performance. Comparison across these national scale indexes highlights regional disparities and fluctuations in performance according to their relative measures. The comparison illuminates not only how countries stack relative to each other, but also reveals the relative instability of almost every country as its performance varies across competing demands of equity, economy, development, and environment.

DEVELOPMENT METRICS

The proliferation of agencies and institutions monitoring and controlling human development, each driven by a need to numericize development qualities, has led to an exponential increase of indicators and measures that track urbanization and its effects. Indicators are meant to simplify, refine, synthesize, and calibrate a breadth of information into exact and comparable measures. According to the United Nation's *Sustainable Development:*

Figure 6: Diagram comparing the relative ranking of nations across national indexes of equity (GINI), wealth (PPP), society (HDI), and environment (ESI), color-coded by region

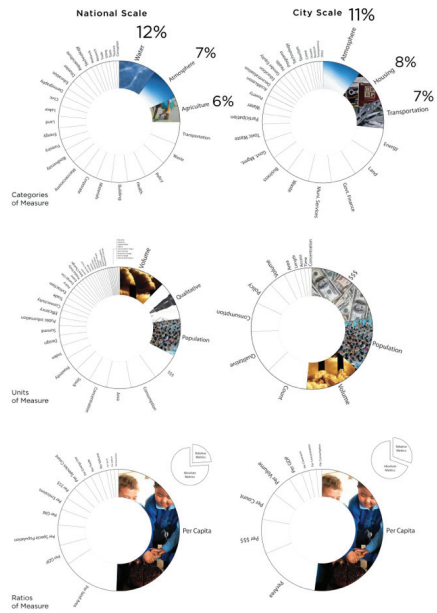

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Figure 7: Types of measures for selected sample of development indexes

Figure 8: "Invented" world map projection that privileges re-configurability and the accuracy and continuity of equal land area by hybridizing the Goode-Homolosine, Dymaxion and cubic projection systems

Guidelines and Methodologies, indicators help entities make informed decisions concerning sustainable development and perform multiple functions, including the identification of issues and trends, compilation and clarification of information for planning and decision-making, communication of ideas for policies and resource allocation, and utilization of early-warning systems.[9] The various scales, composition, groupings, and units of measure reveal differences in visions and strategies to numerically assess the performance of urbanization. Whether per capita or per population, ratio or rate based, the multitude of metrics at the national, regional, and city scales point to the relativity of each indicator and the impossibility of a singular denominator. The prevalence of financial and per capita ratios and a scarcity of ecological and resource capacity metrics privileges the demand side of human need, rather than the supply side of global resources.

MAP PROJECTION SYSTEMS

A world map is, by default, a master plan for the City of 7 Billion. The diverse array of existing world maps embodies the cartographic challenge of representing the three-dimensionality of the Earth's surface on a two-dimensional surface. Projection systems for mapping the world are inherently distorted. They must compromise between oppositional properties of area and shape, direction and bearing, distance and scale, agendas and biases. World maps are as much cartographic as they are deliberate cultural and political statements of intent.

GEOGRAPHIC DATA

The mapping of data builds on the wealth of information and tools offered by satellite imagery and geographic information systems that have changed the course of global development. By synthesizing development data in geographic space with evolving methodologies of mapping, a hybrid model offers a new three-dimensional cartography to assess the impact of urbanization.

Since antiquity, the grid has served as an effective mechanism to administer control. It was codified through systems of surveying, such as the Roman "centuration," to demarcate the extents of the city and its surrounding landscape.[10] By using modern technology, the grid can be further instrumentalized as a platform to integrate multiple systems of information on land use intensity and population density for the entire surface of the earth. While the grid is systemically disassociated from literal boundaries, the shape and figuration of conventional boundaries are still identifiable as a low-resolution figure. The resolution of a grid can be varied by increasing or decreasing the size of the pixel or cell that corresponds to a parcel of land. It is as much a cartographic chart as it is a geographic spreadsheet, where each cell is coded with data. This data field provides the informational parameters for three-dimensionalization using geographic information systems such as GIS, coupled with digital processing, scripting, parametric and modeling tools.

By translating absolute values into 'per space' metrics, indicators can be integrated and geospatially located relative to development and

co-related across cities. Indicators acquire spatial efficacy through their cartographic visualization, translating data into new organizational and design intelligence.

LAND USE

As the limits of urbanization extend beyond simplistic definitions of cities and metropolitan areas, a comprehensive analysis of land use across the entirety of the Earth's surface becomes the only true measure of its impact. Normative definitions of city boundaries and urban limits are increasingly called into question as urban footprints encompass a much wider network of resources and ecological flows. The ecological footprint of London alone is estimated at 293 times its geographical area.[11] Urban development is increasingly the locus of resource consumption worldwide; globally, cities are not only responsible for approximately 75% of all the energy used, they also account for 60% of all water consumption and 80% of all greenhouse gases produced.[12] Urban areas simultaneously account for a disproportionate percentage of a country's national output. In the United States, cities contain 83% of the nation's residents, 85% of its jobs, and generate 90% of its economic production and federal tax revenue. The White House Office of Urban Affairs states that the 363 metropolitan areas of the United States create and produce the bulk of the country's assets and human capital. A national urban policy further describes cities as the "critical engines of the economy, the locus of national assets, and the vehicle by which we solve the most pressing national issues of our time."[13] Traditional dichotomies of rural versus urban, developed versus undeveloped, and natural versus built are increasingly rendered obsolete within this system of global exchange.

URBAN EPICENTERS

Rather than a simplistic focus on total populations of cities, the analysis of densification emerges as a meaningful model for examining patterns of urbanization and land use. The relative densities of a broad constellation of cities and their larger metropolitan regions across the world provide a basis for comparison, analysis, and speculation. Disassociating these urban epicenters from their administrative boundaries, and comparing them by an equal and much larger catchment area offers an alternative means of understanding urban type. The vast difference in the scale and distribution of population in developing cities becomes evident in this alternate catalogue of urbanization. The extended metropolitan regions of Dhaka, Manila, Bangkok, Beijing, Delhi, and Shanghai dwarf their western counter parts. While the sheer density of developing cities in the absence of sufficient infrastructure can lead to collapse, they also provide hope for the future as arguments to supersize cities for sustainable development have resurfaced. Calculations that larger, denser urban centers consume less per capita than smaller suburban ones have led to conclusions that a sustainable society will require big and dense cities to get even bigger and denser, as they benefit from increasing economies of scale. [14]

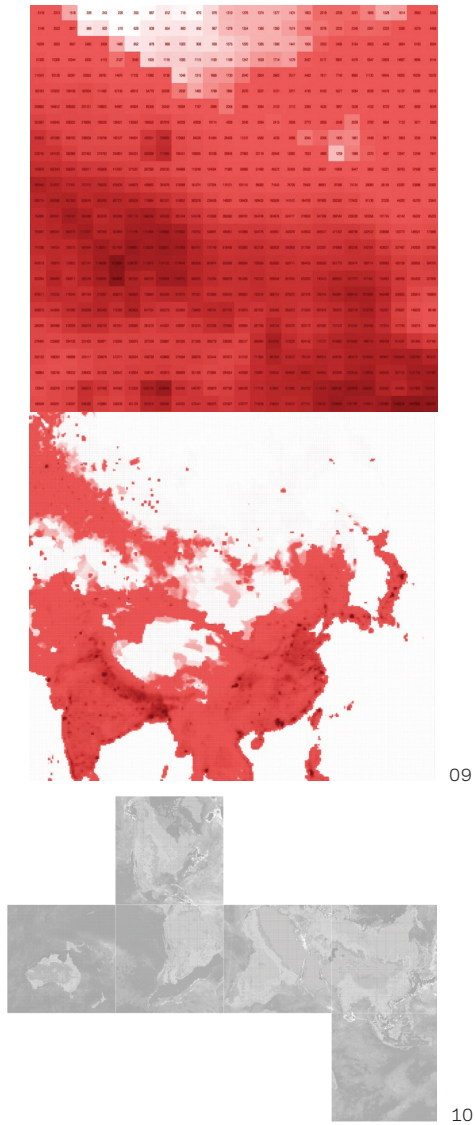

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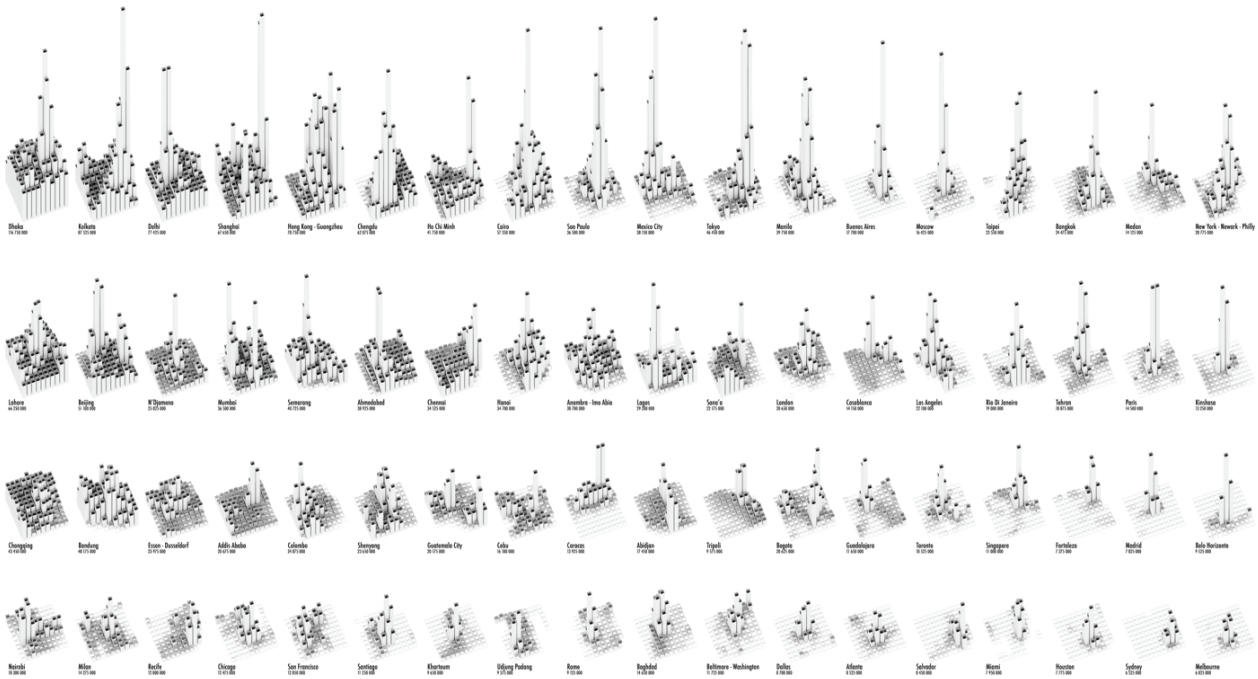
Figure 9: World data map spreadsheet of population by land area, detail (upper) of Asia (lower). Each cell is positioned geographically to represent a 25km x 25km area, tabulates population, and is color-coded according to value.

Figure 10: World data map of land use and human impact. This map unfolds and subdivides the entirety of the earth's surface into 540,000 pixels. Each pixel maps and keys the intensity of human use of land resources and human impact to marine ecosystems for each specific 25km x 25km plot.



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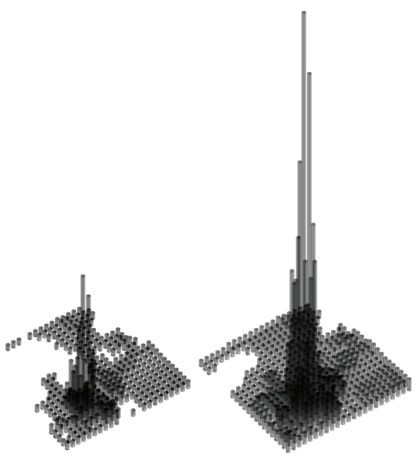

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GROWTH RATES

The scale of urbanization is further compounded by its speed. Urban centers in the developing world, such as Dhaka in Bangladesh, Lagos in Nigeria and Karachi in Pakistan, test new thresholds for density as their populations double and quadruple in the span of a few years, while their systems of infrastructure, urban protocols, and master plans struggle to keep up. Dhaka, whose population has increased fourfold over the last 25 years, is one of the fastest growing urban centers in the world. It is simultaneously one of the densest cities in the world, and one of the cities with the lowest per capita income, posing development challenges at an unprecedented scale and speed.[15] The tracking and analysis of population growth through time provides a basis to evaluate, analyze, and test future scenarios of development against dominant trends. By projecting alternative scenarios and their possible impact, urbanization can be understood through time as a static or active condition of growth or decline.

CONTINUOUS URBANISM

The variation in population density reveals a diverse range of development patterns at the regional scale, from the episodically distributed urban centers of North and South America to the vast scale of contiguous growth that spans across East and South Asia.

The scale and speed of unprecedented population growth in the developing world has yielded a new and continuous form of urbanism that is unique to the modern era. Urban epicenters, such as Shanghai, Shenzhen, Hong Kong, Dhaka, Kolkata, Delhi, Lagos and Mexico City appear as a range of multiple peaks within a continuously undulating topography of extremely dense urbanization. Only the oceans, increasingly subject to landfill and

development, break and separate the relentless fused growth of the ever-expanding megalopolises of the world.

The inevitability of this hyper urbanism is the dissolution of cities and their variegated administrative, political, and geographic boundaries. As urban regions coalesce together, the singular global city emerges as the new paradigm and prototype of urbanization.

CONCLUSION

Defining the world as an agglomeration of fragmentary components, whether built or natural, is insufficient. A global problem demands a global approach that analyzes and addresses the scope of the entire world as a single urban entity. The field of architecture is best equipped to comprehensively coordinate the competing and complex issues confronting urbanization.

Absolute distinctions between land and water, urban and rural are dissolved in favor of a continuous graduated topography, indexing population density, land and water use to spatialize the continuing crisis of growth. With each modeling system, future scenarios can be evaluated against baseline conditions. Indexing systems can not only analyze and track, but also forecast and project development. Predictive models can identify areas that could be subject to development pressures, such as overpopulation, energy and infrastructure constraints that lead to collapse. Visualizing the spatial dependence and distribution of development constraints as they play out over time and space aid in evaluating future impacts and directing planning and policy measures at multiple scales and dimensions.

All too often, the architectural profession relegates issues of this scale and complexity to other areas of expertise, such as geography, geology, economics, politics, and policy. Yet, the architect is ideally suited to analyze and understand urbanization as a holistic issue, able to draw from and integrate multiple disciplines, and apply architectural thinking and methods to an inherently spatial problem. ◆

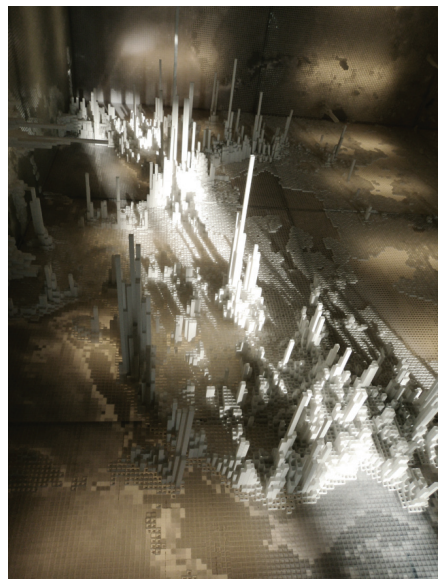

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Figure 11: Comparative matrix of population for a 250km x 250km area around urban epicenters

Figure 12: Expanding and shrinking cities: a comparison between Dhaka (top row) and Frankfurt (bottom row) of the change in population over 25 years, in 1990 (left column) and 2015 (right column)

Figure 13: Continuous urbanism of East and South Asia

ENDNOTES

1 United Nations–Habitat, *State of the World's Cities 2008/2009* (London: Earthscan, 2008), 11. Also refer to: United Nations Department of Economic and Social Affairs Population Division, *World Population Prospects: The 2010 Revision, Highlights and Advance Tables* (Working Paper No. ESA/P/WP.220, 2011). United Nations Department of Economic and Social Affairs, Population Division, *World Urbanization Prospects: The 2009 Revision*, *Press Release* (March 25, 2010) states: "Globally, the level of urbanization is expected to rise from 50.5 per cent in 2010 to 69 per cent in 2050. In more developed regions, urbanization is expected to increase from 75 per cent to 86 per cent, while it is projected to rise from 45 per cent to 66 per cent in the less developed regions between 2010 and 2050."

2 Lewis Mumford, *The City in History: Its Origins, Its Transformations and Its Prospects* (New York: Harcourt, Brace & World, 1961), 410. Mumford describes the growth of the city as "new forces [favoring] expansion and dispersal in every direction, from overseas colonization to the building up of new industries, whose technological improvements simply canceled out all medieval restrictions. The demolition of their urban walls was both practical and symbolic."

3 Henri Lefebvre, *La Révolution Urbaine* (Paris: Editions Gallimard, 1970).

4 P.J. Taylor and R.E. Lang "The Shock of the New: 100 concepts describing recent urban change," *Environment and Planning A* vol. 36 (2004): 951-958. Taylor and Lang discuss the proliferation of terminology to describe urbanization.

5 Urban areas are defined in different ways by each country, regional authority, or municipality. Each entity applies different density and total population standards that varies from 200 people per square kilometer to more than double up to 400 or 500 people per square kilometer. For example, Australia's minimum definition of an urban area would be considered rural in India or China.

6 'Comprehensive' projects or analyses have been limited by means and methods—using selected case studies as a means of formulating representative typologies. The Urban Age Project, by the London School of Economics and Political Science, with Deutsche Bank's Alfred Herrhausen Society, for example, while acknowledging the entirety of the world, and the "endless city" relies upon a series of selected case studies to make its case.

7 Development efforts following the war focused on provision and adequacy of housing, resulting in slum-clearance projects, urban renewal initiatives, and public housing proposals funded by the World Bank and newly formed regional banks. Bernard Rudofsky's MoMA exhibition and book *Architecture Without Architects* reflected a shift in favor of informal or spontaneous approaches toward human settlement. By the 1970s self-generating and self-regulating systems were argued for. In *Housing by People,* John Turner's investigation in Peru led to the conclusion that informal approaches to housing were not only viable but in fact necessary, while James Lovelock, in *GAIA,* posited that the global environment was a self-regulating and self-correcting system. The growing world population and significant housing shortage of the 1970s culminated in Habitat, the first UN conference on Human Settlements in Vancouver in 1976, demonstrating the organization's recognition of the pressing nature of the issue. Bernard Rudofsky, *Architecture Without Architects: An Introduction to Non-pedigreed Architecture* (New York: Museum of Modern Art, 1964). John Turner, *Housing by People: Towards Autonomy in Building Environments* (New York: Pantheon Books, 1974). James Lovelock, *GAIA: A New Look at Life on Earth* (Oxford: Oxford University Press, 1979).

8 Published in 1962, *Silent Spring* is often cited as the beginning of the environment movement widely publicizing the environmental consequences of pesticide use. Rachel, Carson, *Silent Spring* (Greenwich: Fawcett Publications, 1962). Within a decade, the environmental movement gained recognition on a global scale and was codified as international policy. The first Earth Day in 1970 was followed two years later by the UN's first conference on environmental issues. The Stockholm Conference brought together 113 countries and an even larger body of inter- and non-governmental organizations, and led to a declaration with 26 principles and 109 recommendations and the establishment of the UN Environment Program. For a list of detailed events, refer to: United Nations Department of Economic and Social Affairs, Division for Sustainable Development 2010, "Milestones," accessed November 10, 2010, http://www.un.org/esa/dsd/dsd/dsd_milestones.shtml.

9 United Nations Department of Economic and Social Affairs, "Indicators of Sustainable Development: Guidelines and Methodologies," (New York: United Nations, 2007) 40-42. Ulrike Weiland, "Sustainability Indicators and Urban Development," *Global Change Urbanization and Health* (Beijing: China Meteorological Press, 2006), 241-250.

10 Oswald Dilke, "Roman Large Scale Mapping in the Early Empire," *The History of Cartography*, edited by J.B. Harley and David Woodward, Volume 1, (Chicago: University of Chicago Press, 1987), 212.

11 Chartered Institution of Wastes Management Environmental Body, "City Limits, A Resource Flow and Ecological Footprint Analysis of Greater London," (Best Foot Forward Ltd., September 12, 2002) 27.

12 References to consumption percentages by cities are plentiful according to frequently quoted figures, ranging from the United Nations to climate agencies and officials. See B. Williams, "Climate Change," (statement delivered at the United Nations Commission on Sustainable Development, United Nations Human Settlements Programme, 15th Session, New York, 2007). Also refer to: Siemens, 'Sustainable Cities,' (2010), accessed August 2010, http://www.usa.siemens.com/sustainablecities/.

13 The White House (2011), "The Office of Urban Affairs Principles," accessed January 20, 2011, http://www.whitehouse.gov/administration/eop/oua/about/principles.

14 Luis Bettencourt et al., "Growth, Innovation, Scaling, and the Pace of Life in Cities," *Proceedings of the National Academy of Sciences* vol 104. No. 17 (2007): 7301-2.

15 United Nations Department of Economic and Social Affairs Population Division, *World Urbanization Prospects: The 2011 Revision*, *Highlights* (March 2012) 7-10.