Five Platforms, Five Ecologies

REVIEW

Institute for Art and Architecture
Academy of Fine Arts Vienna

2008

Sustainable Systems

An Agenda for a Science of Cities

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"Man's ability to participate intelligently in the evolution of his own system is dependent on his ability to perceive the whole."[1]

Immanuel Wallerstein

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Global climate change, peak oil, depletion of natural resources, decline of the natural environment – we are daily confronted with doomsday scenarios. Yet in spite of the apparent urgency, we are unable to come to common conclusions or, worse, even start from common assumptions.

There is the argument for incremental change, the hope that based on increasingly responsible behavior of individuals or groups the situation will improve without the need for systemic change. Yet, how could this work when we find a basic imbalance of wealth at the root of the current situation, while developing countries are increasingly claiming their fair share? How much would the industrialized countries be willing to reduce their needs to balance worldwide consumption? Is not imbalance a precondition of the culture we live in rather than a short-lived aberration?

There are more radical proposals to address systemic problems by regulation, such as the excesses of global finance, with solutions ranging from treating natural resources as bankable assets of developing nations to taxing international currency trade. However, is it likely that the institutions in charge would be willing to incorporate formerly externalized costs into the logic of the market to such a degree as to really engender radical change?

Lastly, some are of the opinion that the problems we are facing are less severe than portrayed or will take care of themselves. Yet, how would we not attempt to act as moral creatures in a social system dependent on stability?

Cities are at the core of these questions as more than half of the world's population is currently living in cities[2]. And cities are the place where innovative solutions are most likely to be generated. But cities are also a direct reflection of the world system we live in. They are as much a remedy as they are the problem, as we will see shortly. As architects and urbanists, we face such questions with few tools and no overarching concepts. What seems lacking is a systemic and systematic understanding of cities: some kind of a Science of Cities[3].

Science, at its best, attempts to provide a coherent system of thought to organize and explain the phenomena around us. True to its origins in the hermetic memory systems of the Renaissance[4], it allows to assemble observed facts into coherent arguments and falsifiable hypotheses. Coherence allows a

[1] Wallerstein, Immanuel: *World Systems Analysis: An Introduction*. Durham: Duke University Press, 2004.

[2] *World Urbanization Prospects: The 2005 Revision*, Population Division, Department of Economic and Social Affairs, UN.

[3] The term Science of Cities is based on a text by Jeff Kenworthy that first made me aware of the possibility of such an agenda.

[4] Yates, Francis: *The Art of Memory*. London: Routledge, 1966.

reasonably well educated scientist to follow concepts and topics from one discipline to the other, from macroscale to microscale, from the past to projections of the future, making connections, proposing extrapolations, and verifying assumptions. Science is sufficiently stable that many people can work on a common edifice, the occasional paradigm shift as described by Thomas Kuhn[5] being just an exception confirming the overall rule.

Such a framework of thought is not available for cities. Nowhere else it seems more difficult to see the whole than when looking at the recent explosive growth of cities worldwide. A dizzying plethora of new phenomena is explored by countless writers, urbanists, or film makers. It is as if cities are too close to our own lives to be looked at objectively. Or put differently, a Science of Cities faces the same problem as disciplines such as sociology which are squarely placed in between the nomothetic "hard" sciences based on measurable evidence and the idiothetic humanist disciplines based on discursive argument.

With the waning of Modernism and its all too dogmatic approach to urban function, searching for objective truths has been discredited. Rather than the attempt to define an objective approach, we are currently witnessing an increase in specialized accounts and an explosion in the study of phenomena, a fascination with the specific rather than the generalizable.

In recent professional literature, there have been different models to describe cities: for example as popular phenomena that happen despite the architect's efforts. This notion was originally introduced by the Venturis who went to Las Vegas to look for an alternative to the highly theoretical discourse that was waged at the time in intellectual circles and magazines such as *Oppositions*. Or cities are described akin to natural phenomena. Informal architecture is studied to see how cities are developing without any imposed planning guidelines. The development of hybrid typologies in Tokyo is studied as a kind of evolution, trash heaps in Lagos as a system of self-organization. All these approaches share the underlying idea that cities are produced by "natural" processes which are out of our control, but which are basically benevolent. These processes are good as they happen "bottom-up," are self-organized and therefore legitimated both by our (still Romantic) ideal of nature, belief in the market, and trust in the action of the individual. Rarely, these accounts are concerned with a more systemic critique which is in the case of informal settlements provided by the work of Hernando de Soto[6].

Critical assessments, on the other hand, of contemporary urban development are mostly backward-looking. In *The City in History*[7], Lewis Mumford was already harshly critical of the modern metropolis. He maintained that its structure is partially responsible for many social problems seen in western society. Pessimistic in tone, Mumford argued that urban planning should emphasize an organic relationship between people and their living spaces. Mumford used the example of the medieval city as the basis for the "ideal city" and claimed that the modern city (the sprawling megalopolis) is too close to the Roman city which ended in collapse; if the modern city carries on in the same vein, says Mumford, it will meet the same fate as Rome.

New Urbanism[8] also evokes the image of the medieval city as the urban ideal. New Urbanism is less interested in the social and economic realities that underlie urban form and therefore gets easily appropriated by commercial interests. It also excludes the fact that the existence of New Urbanist commu-

[5] Kuhn, Thomas: *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press, 1962.

[6] De Soto, Hernando: *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else.* New York: Basic Books, 2000.

[7] Mumford, Lewis: *The City in History: Its Origins, Its Transformations, and Its Prospects.* Fort Washington, Pennsylvania: Harvest Books, 1968.

[8] http://www.cnu.org/charter, or: Haas, Tigran: *New Urbanism and Beyond: Designing Cities for the Future.* New York: Rizzoli, 2008.

nities is made possible by the world system around them. Medieval cities have been the precursors of the new world system we exist in (with the fake teleological conclusiveness of all evolutionary processes, of course). They were the result of mercantilism and a developing bourgeoisie, their walls a means to defend this new system (and the wealth being accumulated) against the feudal lords of a coexisting older system. Nevertheless, New Urbanism is currently still the only coherent theory of cities with an organized group of practitioners and a serious attempt made at codification[9]. And its tenets such as smart growth or transit-oriented development are a good answer to current problems.

But is it really impossible or objectionable to look for a system behind the phenomena – a kind of Third Way for urbanists in between the longing for small town values and the fascination for the corybantic megalopolis? Is it not possible to define a "New Metropolitanism" beyond nostalgia and dystopia?

Throughout the history of cities, starting with the first settlements in the Fertile Crescent near today's Anatolia and followed by the first conurbations built in Mesopotamia, cities and their population had lifecycles. Cities were not static but changed in size substantially, both growing and shrinking. Many of the once great cities have disappeared. Periods of prosperity alternated with dark ages. It was always the big centers that after a period of growth and cultural development declined, while formerly secondary cities at the periphery of the centers' sphere of influence started to prosper. While we currently experience a very long phase of expansion and unprecedented growth, there is no reason to believe that this growth will continue.

The following three theories are helpful to understand the mechanism of the expansion of urban culture:

In her book *Economy of Cities*, Jane Jacob argued that the first settlements developed on prehistoric trade routes and that over time, through the mix of ideas, the breeding of seeds, and the domestication of animals, innovations could be realized that made the first real cities possible. Settlements are the cause for innovation, not their effect, in her opinion. She also sees cities as the base units of economy – not the nation state as suggested by Adam Smith[10]. She maintains that import replacement was and still is at the root of urban growth: the ability of cities to increasingly produce themselves what they formerly used to import. The history of cities therefore was always also a history of trade and exchange. Very early on, trade routes spanned the entire world known at the time. Globalization is only the latest and most extreme instance of a phenomenon that paralleled the development of the first cities. Cities were supported by increasingly large hinterlands. The history of empires and nations may be understood as an evolution of cultural systems that organized the hinterland, that spread the footprint of a city and culture. The global culture we currently live in is based on an unprecedented spread of the hinterland and an unprecedented intertwining of centers and periphery.

To this basic account of the development of cities, Sing C. Chew[11] added the perspective of the ecosphere. He researched resource consumption and ecological degradation visible in the archeological records around ancient conurbations. Chew studied seven long historical periods: Mesopotamian and Harappan (in the Indus valley) civilizations from 3000 BC to about 1700 BC; the golden periods of Crete and Mycenaean Greece, roughly between 2000 BC and

[9] Duany, Andres et al.: *SmartCode Version 9 and Manual.* Ithaca: New Urban News Publications, 2008.

[10] Smith, Adam/Sutherland, Kathryn (eds.): *An Inquiry into the Nature and Causes of the Wealth of Nations: A Selected Edition* (Oxford World's Classics). Oxford University Press, 2008.

[11] Chew, Sing C.: *World Ecological Degradation: Accumulation, Urbanization and Deforestation 3000 BC – AD 2000.* Lanham, Maryland: Rowman & Littlefield, 2001.

1000 BC; classical Greece; Rome's Empire; Europe between 500 AD and 1800 AD; and finally the Industrial Revolution and its aftermath. For each period, Chew examines the evidence of the combination of urbanization and accumulation on forest and resources decline. He attributes the rise of civilizations to their capacity to master techniques to use organic resources to meet social and economic ends. The accumulation of resources in cities resulted in social differentiation, in the development of culture. For long periods of time, these civilizations were able to extract resources from their immediate environment and, owing to trade, war, colonization, and organizational skills, managed to tap resources from far afield. Commerce was a strong factor in enabling civilizations to prosper and raise the level of consumption of their populations, but trade over long distances had some drawbacks. It could not provide food, goods, and resources cheaply when distance expanded and organizational skills or cost of mobility were stretched to their limits.

Chew shows that most great civilizations have ended in demise. Ecological limits were attained and could not be pushed forward with the available knowledge and techniques. Chew does not say that ecological factors are the unique cause of recurring cultural declines, but that they are important contributing factors.

Immanuel Wallerstein[12] finally understands cities to be part of larger world systems. World systems describe social and economic entities that have defined borders, a particular way of "doing business," and a shared history. He argues against the division of first and third world but instead sees both as inevitable parts of one coherent world system. He bases his theory on Karl Marx's concept that the superstructure of culture rests on the base of economy, particularly its mode of production, and on Fernand Braudel's perspective of the "longue durée"[13]. Braudel saw the formation of capitalism as one long arc of development since the sixteenth century resulting in the most versatile form of accumulation of resources to date. World systems theory offers an advantage to the theory of modernization in that it allows for understanding fluctuation, decline, and dependency rather than just linear advancement and emancipation.

All three authors define cities in a relationship of core and periphery, central dominant cities and peripheral, often younger cities, the core accumulating resources and creating surplus and turning that surplus into culture and innovation (Jacobs), social differentiation (Chew), or capital (Wallerstein). The core exploits the periphery economically and ecologically but also fertilizes it by means of import replacement bestowing on it the possibility to become a core in its own right over time.

This systemic account of how cities developed can be refined by our increasing understanding of ecological processes over time. One example of the combination of historic, archaeological and ecological research resulting in the natural history of a place is Josef H. Reichholf's book *Eine kurze Naturgeschichte des letzten Jahrtausends*[14].

Wallerstein himself has consistently argued that the modern world system has reached its endpoint. He believes that the next fifty years will be a period of chaotic instability which will result in a new system, one which may be more or less egalitarian than the present one. But it might be more interesting to go beyond the framework of Marxian thought and look at change not as social emancipation, but as new forms of social, cultural and most likely urban existence in an ecological context.

[12] Wallerstein, Immanuel: *World Systems Analysis: An Introduction*. Durham: Duke University Press, 2004.

[13] Braudel, Fernand: *Civilisation matérielle, économie et capitalisme, XVe–XVIIIe siècle*. Paris: Armand Colin, 1979.

[14] Reichholf, Josef H.: *Eine kurze Naturgeschichte des letzten Jahrtausends*. Frankfurt: S. Fischer, 2007.

[15] http://www.lboro.ac.uk/gawc/

[16] Sassen, Saskia: *The Global City: New York, London, Tokyo*. Princeton: Princeton University Press, 2001.

[17] Hall, Peter / Payn, Kathryn: *The Polycentric Metropolis: Learning from Mega-City Regions in Europe*. London: Earthscan Publications Ltd., 2006.

[18] Gottmann, Jean: *Megalopolis: The Urbanized Northeastern Seaboard of the United States*. Boston: MIT Press, 1961.

The city network in our time of globalization has been more precisely analyzed by Peter Taylor at the Globalization and World Cities (GaWC) Research Network[15]. He defined a method to measure the role a city plays in its global context. In *The Global City,*[16] Saskia Sassen describes the megalopolises of London, New York, and Tokyo as the very cores of our current system. Peter Hall[17] showed that, based on the current abundant availability of transport and flow of information, also polycentric mega-city-regions (a concept originally proposed by Gottmann[18]) can act like large cores.

But cities were not only driven by ecological and socio-economic factors. In *Cities in Civilization: Culture, Technology and Urban Order,*[19] Peter Hall explores the exceptional cultural creativity which distinguished the world's great cities in their golden ages, from ancient Athens to late twentieth-century London. A contemporary equivalent, a kind of distributed golden age, is the rise of the creative class described by Richard Florida. Florida shows how the roles of cities change with the shift from industrial production to creative services. Cities are essential hubs for cultural production in a time where culture and commerce are very close by necessity: "Access to talented and creative people is to modern business what access to coal and iron ore was to steel-making [...]; it determines where companies will choose to locate and grow, and this in turn changes the way cities can compete."[20] Or in the words of Richard Lloyd and Terry Nichols Clark: "Workers in the elite sectors of the postindustrial city make 'quality of life' demands, and in their consumption practices can experience their own urban location as if tourists, emphasizing aesthetic concerns, resulting in the recent efforts to renovate and brand cities."[21]

Having defined the relationship of cities and their role in the respective world system (their ecology), a Science of Cities would need to look at what functions enable this role (their physiology):

Mobility is one of the most relevant ingredients of the equation constituting the central function of cities, the facilitation of access – access to other people, to resources, jobs, ideas, stimulation. Accessibility is determined by the combination of a number of factors: a city's organization, its density, performance, or mix of programme, as well as its urban configuration or physical shape. In fact, urban form shapes patterns of activity while on the other hand high levels of urban activity have the power to shape the form of a city over longer periods of time. Johann Heinrich von Thünen[22] and Walter Christaller[23] have focused on such relationships; von Thünen with his original market place theory, Christaller with an early analysis of city networks and his theory of central places.

More recently, Jeff Kenworthy and Felix Laube[24] researched the interplay between mobility, urban form, and efficiency (and in a recent paper first used the term Science of Cities[25]).

An unprecedented number of people enjoy an unprecedented amount of mobility. Our cities and landscapes are currently built according to the availability of cheap individual transportation which is almost exclusively based on fossil fuels. In total, it accounts for roughly one third of the energy consumption of industrialized nations.

As we know, fossil fuels have become increasingly problematic. They are one of the main causes for global climate change. Their exploitation is at the source of many international conflicts. And they are getting scarce. While there are different estimates when we will run out of oil, according to Dr. Colin Campbell[26], a former oil consultant turned peak oil activist, the peak of oil

[19] Hall, Peter: *Cities in Civilization: Culture, Technology, and Urban Order.* London, Weidenfeld & Nicolson, 1998.

[20] Florida, Richard: *The Rise of the Creative Class.* New York: Basic Books, 2002.

[21] Lloyd, Richard / Clark, Terry Nichols: *The City as an Entertainment Machine. Research in Urban Policy,* vol. 9. Greenwich: JAI Press, 2003.

[22] Von Thünen, Johann Heinrich: *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, oder Untersuchungen über den Einfluß, den die Getreidepreise, der Reichthum des Bodens und die Abgaben auf den Ackerbau ausüben.* Hamburg: Perthes, 1826.

[23] Christaller, Walter: *Die zentralen Orte in Süddeutschland. Darmstadt: Wissenschaftliche Buchgesellschaft,* 1980, 3., unveränd. Aufl., reprograf. Nachdr. d. 1. Aufl., Jena 1933.

[24] Kenworthy, Jeffrey R. / Laube, Felix B.: *An International Sourcebook of Automobile Dependence in Cities,* 1960–1990, 2nd ed. Boulder: University Press of Colorado, 2000.

[25] Kenworthy, Jeffrey R. / Laube, Felix B. / Zeibots, Michelle: "Towards a science of cities: city observation and formulation of a city theory." In conference proceedings *Siedlungsstrukturen, räumliche Mobilität und Verkehr: Auf dem Weg zur Nachhaltigkeit in Stradtregionen?* Institut für Regionalentwicklung und Strukturplanung, Berlin, 1998.

[26] Campbell, Colin J. / Laherrère, Jean H.: "The End of Cheap Oil." In: Scientific American, March 1998.

production has already been crossed. Despite the fact that there are still large oil reserves available, this means that the cost and conflict of distribution will increase when dwindling supply faces rising demand.

The degree to which cities are dependent on the automobile and hence on fossil fuel for individual transport varies widely as has been shown by Newman and Kenworthy. American cities in general are the least dense and consume the most fuel. Asian cities are the most efficient. They are dense and based on public transport to a larger degree. In the regional energy budget, transport is a pure cost. It cannot be exported. Efficiency of transport therefore directly affects a region's competitiveness.

Accessibility has also been studied on a smaller scale. Space Syntax for example is an approach to an understanding of cities which rests on the observation that spatial layout shapes human behavior which in turn has effects on the amount of activity in certain areas of the city, in passing trade, real estate value or the frequency of crimes. Space Syntax[27] is also a piece of software developed by Bill Hillier which analyzes the spatial layout of cities. The firm of the same name uses this methodology, a form of "evidence-based design," to support planners, cities, municipalities, or even shopping mall developers in developing spatial layouts which have best possible accessibility. There is also more and more demand in European planning legislation to assess the impact of proposed developments on the surrounding environment from a social, economic and environmental point of view.

A final component which is still insufficiently understood is the analysis of flows of energy and material in cities. Peter Baccini and Franz Oswald[28] developed and taught a methodology at the architectural department of the ETH in Zürich called "Netzstadt" (network city). This collaboration of an environmental chemist and an urbanist was aimed at codifying the analysis and design of city systems.

A more general approach has been developed by Mathis Wackernagel and William Rees at the University of British Columbia in Vancouver, Canada. The "Ecological Footprint"[29] is a resource management tool that measures how much land and water area a human population requires to produce the resources it consumes and to absorb its wastes under prevailing technological conditions. The average citizen on the planet needs 2.2 hectares of productive croplands, pastures, wetlands, forests, and coastal fishing grounds to get by, compared with the 1.8 hectares per head that the planet has available. Of course, the rich world is largely to blame for this imbalance. Europe's global footprint is currently 4.7 hectares per person, roughly twice its productive land area. But the footprint of Europeans looks small compared with Australians and Canadians, who require between 7 and 8 hectares each, and Americans at 9.7 hectares. At the lower end, the Chinese require around 2 hectares, and Indians 0.7 hectares. On the initiative of its former Mayor Ken Livingstone, London had its ecological footprint analyzed which turned out to be two times larger than the entire rural area of the United Kingdom. Of course, this is only possible because of London's position in the world system described before. During the times of the Empire, London's needs were covered by the colonies, as in integrated supply chains. Now these supply chains are more widely ramified and less conspicuous, but no less important.

Like any organism we consume what nature has to offer. Every action impacts the planet's ecosystems. This is of little concern as long as human use of

[27] www.spacesyntax.com

[28] Oswald, Franz/Baccini, Peter: *Netzstadt. Transdisziplinäre Methoden zum Umbau urbaner Systeme.* Zürich: vdf Hochschulverlag, 1998.

[29] Wackernagel, Mathis / Rees, William: *Our Ecological Footprint.* Gabriola: New Society Press, 1996.

resources does not exceed what the Earth can renew. But are we taking more? Sustainability was always a matter of the more or less immediate environment of a city or a system. But it is the first time that a world system (as defined by Wallerstein) is literally covering the entire world and extracts resources all over. Understanding the systemic nature of our predicament and knowing the consequences such pressures had in history, we understand that sustainability is not about averting a particular crisis, but mitigating the effects of a perpetual crisis that is at the base of our continuous development and expansion.

On the hopeful side, however, humanity has never been able to harness resources, mainly energy, from so many sources. Energy, in the form of solar, geothermal, wave, water or wind energy is abundant. And there are great potentials in increasing efficiency. We mainly face a problem of distribution and also a problem of the immense infrastructure we have built, including our cities, that directly or indirectly, is based on cheap oil or, more generally, on a highly sophisticated and energy-intense system to accumulate resources, an infrastructure we need to adapt or reuse in new ways. We have also developed entirely new kinds of infrastructures to create access and enable the exchange of ideas such as the internet, which potentially also increases the overall efficiency of the system. But the thought that we are able to rebuild our infrastructure without finding a way to address the world system we exist in might be a fallacy. It must be the aim, when the concept of sustainability is taken seriously, to engender radical change with local interventions. This is only possible when these interventions are based on an understanding of the relationships and dependencies of our world system.

Many of these larger questions are out of the hands of the architect or urbanist. But we will enter a time where we will be less concerned with the Post-modernist drive for differentiation and appeal to the market place, but rather with basic efficiency. It is for this that, I believe, a science of human infrastructure, of cities in their widest sense is indispensable.