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“Geospatial analysis and living urban geometry”

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Abstract: *This essay outlines how to incorporate morphological rules within the exigencies of our technological age. We propose using the current evolution of GIS (Geographical Information Systems) technologies beyond their original representational domain, towards predictive and dynamic spatial models that help in constructing the new discipline of “urban seeding”. We condemn the high-rise tower block as an unsuitable typology for a living city, and propose to re-establish human-scale urban fabric that resembles the traditional city. Pedestrian presence, density, and movement all reveal that open space between modernist buildings is not urban at all, but neither is the open space found in today’s sprawling suburbs. True urban space contains and encourages pedestrian interactions, and has to be designed and built according to specific rules. The opposition between traditional self-organized versus modernist planned cities challenges the very core of the urban planning discipline. Planning has to be re-framed from being a tool creating a fixed future to become a visionary adaptive tool of dynamic states in evolution.*

1. Introduction.

It is easy to understand what determines optimal urban morphology. By means of recently derived geometrical rules (Alexander, 2001-2005; Krier, 1998; Salingaros, 2005; Salingaros *et. al.*, 2006; Steil *et. al.*, 2008), we know what can be done to fix the inhuman urban form found both in today’s suburban sprawl, and in dysfunctional housing projects. These rules are contained, in part, in traditional urbanist knowledge (Caniggia & Maffei, 2001; Krier, 1998; Marzot, 2002), but that is now unfortunately considered “out of fashion”. Most importantly, minimal interventions are possible in order to recover a large part of failed projects. Whereas the form of some structures is indeed so inhuman that demolition is necessary, many cases could be significantly improved by much cheaper interventions on the existing urban fabric (Steil *et. al.*, 2008).

Prominent politicians declare an interest in building for low-income residents, yet blocks of public housing by famous architects actually resulted in inhuman living environments (Porta, 2006). We believe that solutions offered up until now have been, for the most part, unsuccessful (Salingaros *et. al.*, 2006). In particular, the usual modernist urban planning typologies do not go anywhere near towards understanding the urban geometry needed for resident satisfaction. Politicians and architects now declare that we must demolish existing structures and reconstruct new quarters for social housing. This admirable sentiment does not take into account, however, that the present generation of architects connected to the political system could likely create yet another failed urban experiment. An ever-increasing number of high-profile urban projects directed by “star” architects are designed according to the same criteria as before, only that the buildings look more “sparkling” externally.

We are not speaking about the failure of a set of theories, or even single or a group of architects and planners: it is the failure of an entire discipline, which originated at the end of the nineteenth century around ideas of top-down control. Urban phenomena have now been recognized as enormously complex and therefore inherently uncontrollable from the top down. We do not just need better architects and planners: we actually need architects and planners of an entirely different kind, who take the challenge of self-organization in cities seriously enough to investigate new forms of description, prediction, and intervention. Especially, we need a broader awareness that all this has nothing to do with *style* and everything to do with *structure*. The process of spatial evolution in traditional cities has always been unplanned, and so it must be in part for good future cities. Planners have to focus on the structural drivers of such evolution in order to manage the seeds of change, and not try to control its final state.

2. Networks of urban space in a living city.

We (together with many other authors) have now developed sufficient information and tools to be able to design new cities with the correct human-scale geometry, whose purpose is to enhance urban life. This characteristic ribbon geometry of urban pedestrian space follows very simple rules (Salingaros, 2005):

1. A city's life is the direct result of pedestrians using its public urban spaces.
2. Urban space is an open container for crisscrossing footpaths, protected from, but at the same time connected to all other forms of transportation.
3. Urban space also provides the setting for the crucial human contact with nature.
4. The function of building fronts is to enhance the enclosure and informational properties of urban space.
5. All urban space is connected in a pedestrian network: sidewalks simply widen out into plazas.
6. A street is urban space that allows itself to be traversed by vehicular traffic, sacrificing pedestrian space locally in exchange for connecting pedestrian space globally.
7. Where the pedestrian network crosses another transport network, pedestrians must be protected by the physical structure itself.

8. When a city doesn't provide living urban space, private developers will do so, but then it is disconnected from the urban fabric.

Networks are flows defined by movements of people, vehicles, goods, information, etc. Any physical flow imposes linearization on a city, thus city flows tend to be linear. That does not necessarily mean a rectangular grid, although an initial rectangular grid does help to establish a good linear flow after the built environment has developed. In older settlements, we see a more organic urban fabric that has been linearized afterwards so that flow can occur, sometimes by cutting roads into older urban fabric. Both these methods are entirely valid.

There is also a third very relevant model: cities founded formally that later evolve an organic urban fabric. Those morphologies originated from a formal top-down plan (mostly grid layout) that then developed historically into an organic settlement through time. A very common pattern of so many medieval towns in Italy and elsewhere in the former Roman Empire is their origin as roman military camps with a regular grid, and then their evolution into "organic" cities because of endless bottom-up changes and modifications (Bertuglia & Staricco, 2000). The ensuing organic growth is contingent upon relaxation of the initially rigid geometry, in these cases due to drastic changes in society.

The main misunderstanding with today's urban form is that planners mistakenly believe that priority must be given to the fastest automotive traffic (Hall, 2008). This error in thinking precludes planning for all the myriad small-scale movements and slow flows necessary for a living city. Another casualty of this approach is that, as a general principle, flows are made to erase stationary places such as plazas and parks that combine tangential pedestrian flow with pedestrian nodes. Those spaces must be protected from street traffic (Salingaros, 2005).

Modernist planning is by its very nature devoted to separation. That practice draws back upon outdated scientific thinking (from which modernism claimed its roots), which in fact cannot deal with complex systems (Porta, 1999). Cities, like organisms, are the prime examples of complex systems. Separation is nevertheless the gospel in every aspect of modernist theories on cities; therefore, separation of urban space users is just an application of this attitude to over-regulating urban life. One example of this, in addition to squares and parks, is the boulevard. Boulevards successfully combine rapid mechanical flows, slow mechanical flows, pedestrian flows, pedestrian stationary nodes, etc. (Jacobs *et. al.*, 2003). Boulevards were legally banned at the beginning of the 20th century because they were complex spaces that gave place to different kinds of networks altogether.

A healthy mix of social classes and uses is obtained first of all by having an urban design that allows such a mix to occur. There exist distinct approaches, all converging towards a type of urban form that brings us back to the great historical city tradition. We prioritize establishing living urban fabric, before getting into any specific architectural style. Once the first-order problems of urban morphology have been resolved, then the city can support any architectural mix that contributes to the richness and variety of its urban environment.

Adaptive urbanism is not a stylistic problem, and is not tied exclusively to architecture, but rather to the complexity of the city as a whole. The disasters of today's periphery are not only degraded buildings, but also the inhuman quality of its urban environment. We believe that good urbanism can support some ugly buildings, whereas poor urbanism with even a few good buildings is not repairable. For this reason, traditional urbanism represents a genuine novelty in its global vision, similar in scope to that of the modernists but opposite in its aims, in which the street becomes the ordering element, and a block is no longer a lot with a building in its center. The street and street fronts should be reconstructed so as to guarantee a strong and viable pedestrian realm.

Any city that looks too regular or that exists only on the large scale must be treated with suspicion: it may be alive, but there are primary reasons to warrant checking if human activity and movement are indeed taking place on all scales. A living geometry encourages movement and the utilization of space (not to be confused with people putting up with a hostile geometry because they have no other choice). If that is not happening, then the city is dead. Although hundreds of millions of persons have been forced to live in dead urban regions, that does not make those places any more alive in an essential sense. Those dead regions actually look very neat and ordered from the air.

There are some who say that since society has changed, it is necessary that the city must also adapt by changing its form radically. Others believe instead that urban values remain valid because human biology has not changed. Those timeless urban values, however, are no longer resident in our consciousness, since they belong to the lost part of our collective intelligence. They now have to be rediscovered as a proper "discipline" that architects, urbanists, and historians must study and carefully apply, adapting it to the times. Since we boast of living in a mature and evolved society, we can make an intelligent effort of recovering rules that have determined beautiful and functional cities. We can then apply them to our present situation. The question is not if these rules are old but only that they are valid.

3. Geospatial analysis and "Urban Seeding".

At the heart of our thesis is the distinction between living and dead urban fabric. There appears to be a strict relation between the *quality* of city spaces (i.e. living or dead) and the kind of process that lies behind their formation and evolution. That is, whether the processes are self-organized at the small scale from the bottom up, or planned at the large scale from the top down. What we are depicting here is the failure of a discipline that for the entire span of the last century has brought an anti-human realization wherever it acted on the ground, to the extent that it was allowed to by other external forces equally at work. In order to inject the positive quality that Christopher Alexander named "wholeness" (Alexander, 2001-2005; Alexander *et. al.*, 1987), which can only emerge and cannot be designed in cities, we need new practices for the description, prediction, and transformation of urban spaces of an entirely different genre. This different approach, which we term "urban seeding" instead of "urban planning", should be characterized by the following processes:

1 — A distinction about what is *structural* (common to entire macro-cultural regions and changing at a slower pace of time) and what is *super-structural* (specific of every micro-cultural enclave and changing at a faster pace in time).

2 — An awareness that while the super-structural dimension should be left to mainly self-organized processes of change and therefore does not regards planners at all, the structural dimension can and should be managed by formal processes of control, which in turn should be led by a mainly participative organizational rule.

3 — An enhanced understanding of the structural dynamics of change that characterize the evolution of self-organized urban settlements, according to which proper policies can be put into place for targeting achievements that are shared by urban communities.

It is at this latter level that GIS technologies can help enormously. GIS is itself evolving from a set of computer-based technologies for describing spatially-related entities, into a very diverse set of procedures that increasingly have to do with modeling and predicting spatially-related dynamics. While embedding time variation in GIS applications and in network spatial analysis is still a matter of vision and research (Batty, 2002; 2008), GIS scientists are increasingly working with interdisciplinary approaches that are at the heart of self-organization in spatial structures. GIS technologies are now intersecting studies in self-organized flows by means of cellular automata (Wagner, 1997); fractal geometry and emerging urban form (Batty & Longley, 1994); *e*-government, ubiquitous computing and the Internet as means for electronically-mediated public participation in decision-making (Carver, 2001); community envisioning and urban design (Thwaites & Simkins, 2007); information management for sustainable development (Campagna, 2005); Virtual Reality and community involvement (Faust, 1995); remote sensing (Donnay, 2001); pedestrian behavior and public life (Golicnik, 2007); the physics of complex networks (Boccaletti *et. al.*, 2006); spatial networks, not limited to street networks, as affecting crucial urban dynamics such as land-use, community building, and crime (Jiang & Claramunt, 2002; Porta *et. al.*, 2006).

In short, GIS helps to develop a much deeper understanding of key factors that rule the emerging spatial order at the structural level of city evolution. Up until very recently, this extremely important factor has been elusive because of our limited methods of measurement. Gathering and processing data on human behavior in the past required very costly video cameras set up for weeks in a particular spot (Whyte, 1988). Now, we can display an enormous amount of data in visual form, processed in various ways that reference geographical locations in space by means of remote sensing techniques associated with GIS (Senseable City Lab, 2006). Discovered patterns of use that confirm earlier theoretical results can be used as the basis for a radical re-organization of urban use and government policy. Where strong connections are concentrated only into a few channels, and if those channels are exclusively long-distance, then the urban morphology must clearly change to encourage shorter connections.

A basic topic of investigation that we cannot pursue in depth here is the analogy with Finite-Element Methods of analysis, a technique developed in Mathematics and Engineering. A dynamic complex system is decomposed into components that have distinct time variations. As a first approximation, those elements that vary more slowly

are treated one way, whereas those that vary more rapidly are treated in another. The methods used for analysis are thus related to our model of city-as-computer mentioned later: *structural* features correspond to hardware, while *super-structural* features correspond to software. Continuously varying urban processes are decomposed and studied in the appropriate time frame. The finite-element analysis analogy underlines that even the structural features are evolving with time, only that this is happening on a different time scale (Harris, 2008).

4. Useful and useless urban space.

The two principal typologies generating dead contemporary left-over urban space are: the unenclosed open plazas between modernist tower blocks, and the green space between isolated suburban houses whose garage doors face each other across the street. GIS analysis confirms our predictions that the vast concrete plazas between residential tower blocks, and the exterior space in the sprawling suburb, are characteristic of very low people utilization. Both are in fact purely decorative elements, hence from their very inception, wasted space. Some open plazas between office blocks may be used during working hours, but are usually empty in the evening. There has been a tremendous confusion on these points, for two separate reasons.

First, as far as dead modernist urban space is concerned, architects, urbanists, and politicians have believed modernist design dogma, which claimed that the city of the future needed those vast unenclosed spaces, the products of formalist design. A lot of political baggage was tied to formal abstract geometries, with attractive promises such as “freedom”, “individual liberty”, “political breathing space”, etc. None of these slogans ever took into account the scientific nature of city form, nor paid attention to actual people use. The iconic power of modernist images guaranteed their continued application, a regrettable practice that continues to this day because those wasteful urban typologies have been legalized into the planning system.

Second, the vast open space found in the sprawling suburb has escaped intelligent analysis because it looks so good in a photo. Or rather, only when there are no cars parked in the street, which is usually how the ideal suburb is photographed. In reality, the strip of green defined by road and open suburban front lawns is next to useless because it is too exposed (Salingaros, 2005). Lawn and trees in front yards simply do not define useful urban space because of the fundamentally irresolvable conflicts about their open/enclosed and private/public qualities (Alexander *et. al.*, 1977). The urban character of this typology, now occupying the majority of surface area in suburbia, was never properly thought out. The urban space of suburbia is primarily occupied with what amounts to a giant parking lot (curbside parking on the excessively wide road, and on driveways in front of the house garages, because those are now full of consumer junk so the cars don’t fit inside).

American suburbanites accepted the burden of buying and maintaining a front lawn that they themselves never use, and which is meant strictly for the visual promotion of the suburban icon for private development companies. The front lawn is a fiercely private realm that cannot be used by others. As a result, no one uses this wasted space on any regular basis. In Europe, the same wasteful philosophy, replacing natural connections by

formal, visual typologies, has led to the useless garden. Bearing no relation to older gardens that give pleasure to pedestrians, we see in Europe pieces of green that are inaccessible, isolated, and usually constrained by an unnatural formalistic geometry (both in their overall shape, and in the shape of their physical built supports such as planters).

People are so thoroughly confused about urban space after decades of seductive modernist images in the media that they no longer have any certainty of their own innate spatial feelings. Those educated in a Western-influenced system cannot distinguish between useful and useless open space, nor between what should be private and what should be public open space. Residents of the developing world, who are forced to rely upon their basic intuitions, usually can, however. Added to this confusion, we have a legislated set of post-war regulations that usually forbid one to enclose any legally owned space so as to make it useful.

As we accumulate data on pedestrian presence and movement, we can pick out and classify those urban regions where people can be found. Then, we can follow movement to plot frequency and length of pedestrian trips. For example, the front entrance to a suburban house is rarely used, remaining an expensive and stubbornly decorative architectural element. On the other hand, traditional urban space in historic cities, and open spaces in owner-built informal settlements (favelas) both attract an incredibly high density of human presence. Studies establish correlations between human presence and the shape of urban space (Salingaros, 2005). Those spaces are alive, providing paradigmatic urban environments of a living city. There is a growing interest in technologies for the remote sensing of people in urban spaces and for tracking the movement of persons in sectors of cities. There is more experience for small groups of people in small places. These conclusions raise the question of whether post-war planners created the “city of the future” deliberately to keep people confined inside buildings (Oliva-i-Casas, 2001).

Architects routinely engage in deception (or just wishful thinking) by showing unrealized projects with pedestrians all over their dead open spaces. It’s very easy to draw figures in the open space of projects in a presentation, but those attractive (and deceptively realistic) images usually bear no relation to the eventual use of the spaces they show. In more cases than not, those spaces are useless because people will simply not go there; there is no reason to do so. If pedestrians ever wander out into that space accidentally, they feel insecurity, anxiety, a feeling of being unanchored to the place, disoriented, or a feeling of being lost. This reaction is the sensation one experiences when walking in a giant parking lot. People will therefore avoid such a space, and will get out of it as fast as possible.

Poor urbanism continues to be practiced, enthusiastically supported by the universities, because both private developers and city governments refuse to accept the scientific basis of good urbanism. They continue to listen to academic experts who dismiss human-scale solutions so as to promote their own ideologically-based mechanistic fantasies. Geographical Information Systems can finally resolve some old questions and establish the knowledge basis for urban regeneration. Nowhere is this drastic revision more desperately needed than in housing for the poor.

5. Urban complexity and modular decomposition.

The underlying concept in creating a living city lies in accepting its hierarchical complexity (Salingaros, 2005). A city must be made up of interconnected components, each of which functions in as complete a manner as possible. For example, a person's house or apartment should be as self-sufficient as possible, according to its urban geometry, whereas house clusters and apartment buildings should try to be self-sufficient and not depend for every minimal function on the rest of the city. These smaller units should then fit coherently into the larger units, thus defining a hierarchy of scales of increasing urban complexity. This is the idea of modular decomposition, the opposite of the idea of functional segregation. Its application to cities suffers from serious misunderstandings about the complexity of each module (Salingaros, 2005: Chapter 7).

The problem is that modernist planners, in ignoring the network structure of living cities, defined simplistic geometric modules that tried to eliminate complexity. As a consequence, modularization of urban elements led to cutting the essential connections that drive a living city to function. Hardware and software modularization (and its analogies in countless biological cases), by contrast, works by containing a maximum of complexity within each module. There is a correct and a wrong way to define modules in a complex system. These results have been known for decades in the scientific literature, but are still ignored today by most architects and urbanists (Salingaros, 2005: Chapter 4).

Modernist housing blocks represent the worst sort of wrong-headed modularization of urban components. They are really industrial structures for storing people (and their lives), treating those people like machines. Housing blocks follow the typologies of early industrialization, with their visually mechanical (and inhuman) rectangular block form. The urbanist elements here consist of "standards" and "services", used in a purely quantitative mechanical vision of the city. This conception concentrates mechanical operations and then distributes them to the different urban quarters according to some technical measurements, ignoring the rules necessary for generating the network of social and connective relations of the living city. This logic can never create the street and spatial hierarchies that characterize traditional urban planning.

Buildings are then dropped into urban quarters without any possibility of ever becoming attractive nodes in the urban fabric. There is no trace of continuous street fronts created from buildings in direct relationship with the street itself, nor of residences placed side by side (and obviously not isolated). A *horizontal* social relation in the neighborhood is no longer possible. The planned elimination of social urban space is then substituted with a fictitious *vertical* relation on a useless and exaggerated scale, introducing "condominium common spaces" dedicated to the lost social ties, but capable only of creating indifference, fear, alienation, and conflicts. Public buildings (and their services) no longer succeed in becoming objects of collective concern, deprived as they are of every shared symbolic or aesthetic quality, because they are based solely on "needs" established by a power base.

6. Three different metaphors for a city.

Three useful analogies for a city are the “city-as-organism” (Lynch, 1981; and earlier authors since Plato), the “city-as-machine”, and finally the “city-as-computer” (Salingaros, 2005). City-as-organism supposes that a living city works much like an animal (and specifically, human) body, with separate circulation systems (nerves, blood, lungs), body structure (skeleton, tissues, organs), central control (heart, brain), peripheries, etc. This analogy seems to fit the great cities of traditional urbanism (i.e. pre-twentieth century urban fabric). It has proved a useful metaphor, but one easily twisted into an inhuman environment that only superficially copies structural complexity. The point is that we must build urban fabric according to its own structural laws and not by copying visual complexity from another system. Architects and planners fall into this trap by thinking artistically instead of scientifically.

The second analogy, the city-as-machine, is often proposed as the opposite model for a city: the city as a working machine, not biological but entirely artificial. Contrasting the two opposites, the city can range from being more like an organism (good) or more like a machine (bad). Describing the city in these terms is useful, and gives some practical insight into urban structure and function. Nevertheless, every city is necessarily an artificial construction, hence by definition a machine, though a very sophisticated one. It would be more accurate to describe a city as a combined biological/mechanical system.

The city-as-machine is a rudimentary instrument because it lacks diffused hierarchical connections. Placing a formal simplistic plan side by side with the plan of a historical city center, one cannot help but perceive the poverty of the former and the spontaneous beauty of the latter (unless you happen to have gone through architectural training). In urban design, the true difficulty lies in reproducing, or trying to approach as closely as possible, the level of complexity of an organism. The city-as-organism is something more than a metaphor. A city constituted from overlapping, interacting networks approaches the structure of an organism more substantially (and less and less metaphorically) because it increases its degree of useful complexity.

The third analogy, the “city-as-computer”, distinguishes the two parts of any computing system into hardware and software (Salingaros, 2005: Chapter 7). A computer is clearly separated into its physical components (as built), and its software (which is strictly informational): each relies upon the other to work together. In a city, hardware is built into solid structures (buildings, roads, infrastructure, etc.) whereas software consists of the moving elements (people, cars, goods, energy, etc.). A city provides the solid framework upon which movement of information (the analogy to software) can take place.

A functioning information-exchange system requires a level of complexity (Salingaros, 2005: Chapter 7). Below a certain threshold of complexity, the system is either inefficient, or dysfunctional for its purpose. Therefore, we can find two types of computer systems (and many others that fall in-between). At one end, the hardware contains the requisite complexity in terms of hard-wired computational capability, while the software is relatively simple. At the other end, the hardware is simplified by modularization, thus shifting the requisite complexity into the software. In the latter case, the software has to assume the burden of complexity and becomes more prone to breakdown (i.e., less stable). Either way seems to work. The point is that the total complexity (hardware plus

software complexity) is an invariant according to the computational task to be accomplished.

Let us now draw the analogy with urban systems. Traditional urban fabric mimics hardware complexity in that the built structures are highly complex, showing connective components and structures on all different scales (as for example in the historic city center and in the self-built favela). These complex structures help people to interconnect and to enrich their information exchange experience; more important, they exhibit a high capacity to accompany social and economic change, again at all scales, through the continuous adaptation of the overall city fabric through time. Such changes take place by means of countless initiatives outside any central control.

By contrast, the modernist city has simplified its hardware to either of two typologies: simplistic isolated high-rise blocks, and isolated suburban houses, with a series of buildings that carry out collective functions arranged randomly. It is still possible for people to achieve complex information exchange while living in these simplistic environments, but they have to pay the price: which is an extremely complex “software” consisting of cars, public transport, electronic communication, etc. Those connections turn out to be socially exclusive, in that they are not available to all individuals. Moreover, modernist urban environments are extremely rigid. They completely exclude continuous processes of bottom-up change because of the prevalence of large-scale developers (no matter whether private or public) and spatial units of development, coupled in all developing countries with patterns of “instant growth”.

The metaphor of city-as-computer reveals the restrictions of simplistic modernist urban typologies. Whereas relatively wealthy and healthy adults can engage in complex movements in order to act out their lives as complex software, the poor, the young, the old, and the infirm cannot: they have no urban life at all. They are dependent upon precarious or non-existent connective systems to lead anything resembling an emotionally fulfilling life. Often, they simply exist as urban prisoners. All the efforts of city governments to provide the complex connectivity needed by those marginalized groups of individuals can never duplicate the effortless connective capabilities of complex “hardware” already present in the complex connective urban fabric of traditional city structure.

Let us not forget that the wealthy living in dead urban environments (say, a luxurious condominium in a tower isolated in a park, or a palatial house in remote suburbia) pay a lot of money to vacation in a European capital city in order to “re-charge” their urban information deficit. Ordinary suburban residents, and those living in monofunctional residential blocks on a city’s periphery, pay transportation costs to experience urban life in a private commercial center or shopping mall. City life has, in many cases around the world, been transferred to private interests by governments who became convinced that the contemporary city doesn’t need to encourage it.

7. Do we wish to connect to our neighbor?

It is neither useless nor utopian to demand the restoration of relations today with our neighbors. Maybe we have nothing in common with our house neighbor, and in fact,

most of our social and professional conversations could be via the internet. One small store under our apartment or near our house, reached comfortably on foot, could have a poor selection of goods and limited choice, and we certainly prefer to go by car on a highway to a shopping center or “big-box” store. In the same way, we take the car to reach the hospital, the school, the concert hall, and the soccer game. Urban life today offers a variety of choices, privileging the excellent ones via the mechanism of market competition. If the best is not next-door, then we have access to it wherever it is located. At least, until we have a catastrophic energy crisis.

That is not the whole point, however. As described accurately by Hillel Schocken in his essay “Intimate Anonymity” (Schocken, 2003), human beings have a craving for community, and it could just as well be a community of strangers. Seeing other people up close has a biologically beneficial effect on our organism (Kellert *et. al.*, 2008). This is one aspect of biophilia: we crave intimate contact with plants, natural environments, other animals, and other human beings. We cannot satisfy this need for contact with only our close friends, thus the traditional urban environment of non-threatening strangers turns out to be a key factor in an emotionally-nourishing city (Oliva-i-Casas, 2001).

Scientists point out the importance of weak links between networks that are strongly connected internally (Granovetter, 1973). Those weak links tie distinct networks together into a larger network. We interpret this mechanism in the urban context as follows. People have a strongly-connected network supporting their everyday life. Strong connections do not necessarily mean nearby ones, however (a drastic reversal from village life). We could be telecommuting, working for a company in another city, or driving our children to a good school far from home. Those distant links are the strong ones. The weak links in this case could be the persons and urban nodes close to one’s own residence or workplace. Opening up the possibilities for casual contact and pleasurable direct experience outside one’s normal routine is what makes the city alive.

Unlike in the modernist planning philosophy, where behavior is strictly imposed on the population, we are referring to creating situations that make individual choice possible. We wish to facilitate the random exposure and contact with other human beings, which in a properly designed urban environment is not chaotic. Gathering of people as well as spatial changes at the micro-scale of the urban structure are not pre-determined by anyone else, but they are *influenced* by urban geometry and spatial morphology. Nobody should be forced to meet other people, or to merge two adjacent lots, or to change the land use of part of her/his property, but all must have these possibilities. We (planners) must guarantee this degree of freedom to everyone. These provide the social environment for developing weak links. The possibility of establishing such weak links has driven urbanization ever since the earliest city.

Even mono-functionality is allowed, but should never be imposed. For example, small shops of the same kind do cluster under the appropriate circumstances. The spontaneous clustering of similar small retail commercial premises to form homogeneous commercial areas is a timeless pattern: we can find it anywhere, at anytime in history. This counters the idea that shops should be located at a convenient distance from each other in order to avoid the overlapping of market catchment areas, which stands behind many artificial models of regional and urban planning. The rationale underpinning the clustering pattern is exactly that small shops simply cannot offer, as single trading units, a sufficient range

of goods to potential customers, whereas they can when taken altogether. What develops is the self-organized bazaar neighborhood. This argument supports the idea that retail commerce must be conceived in clustered areas characterized by spatial proximity, in order to allow such win-win dynamics to emerge.

Generally, given two adjacent urban quarters, there is a single road that joins them and another road perpendicular to the connecting one, which divides them. This gives rise to the following double problem. Movement between one zone and the other is obligatory, and we have traffic jams on the sole connector road. To go from one urban quarter to another, a pedestrian must cross a traffic artery that has no urban qualities, and thus usually abandons the idea of doing so. The weak links (those on the pedestrian scale) necessary for including the two urban quarters into a larger encompassing network are missing.

8. Respecting and re-creating complex urban fabric.

Representing the type of living city people prefer is not very difficult. We have examples in the historical city centers of thousands of cities and villages. The difficult task is not to see the city-as-organism and to represent it, but to reproduce it anew every time someone writes up a master plan, divides open territory into building lots, or even designs a single room. Why it is so difficult to reproduce something that we believe (and claim) to know so well? And why does it seem that in the past (but apparently not nowadays) it was so easy to “invent” an organic urban fabric?

The reason is that nothing was ever invented at the large scale in the ordinary urban fabric of the city. People just built such fabrics by following their “collective intelligence”, which itself derived from a more closed and thus less complex society than today’s. People building traditional settlements followed rules that are in harmony with nature, or better said, in harmony with the geography. Those rules satisfied a society’s basic requirements first of all (i.e. defense, presence of water, the availability of long-distance connecting roads, an agricultural hinterland, etc.). After those priorities, citizens tried to satisfy higher-level needs and urban requirements (i.e. commerce, political organization, religious life, etc.). Cities have a strong conceptual identity. There was a strong sense of belonging to a city, and having a house in the city was necessary to become a citizen of that city.

The modernist city doesn’t work because human beings are not a product that can be commanded to move in a great metallic machine, like bottles in a bottling plant, without losing their humanity. Human beings are made up of feelings and instincts. They require the freedom to choose. In the city-as-machine the apparent choices are many, but the actual ones very few. In order to go from one place to another you have efficient roads of fast flow, but you are forced to take the car and submit to traffic stress. In Europe, you don’t dare try to find an old acquaintance’s house without using a satellite navigator in your car since you risk remaining blocked in disorienting dead-end roads from which you don’t know how to exit. In order to meet other persons you have no other choice than to pay in order to enter specialized premises, or to go spend your money in a shopping mall or big-box hypermarket.

You do not have the freedom to leave your children play by themselves in front of the house, unless you possess a private garden (preferably enclosed); you do not have the freedom to send small children off to school by themselves; you do not have the freedom to go out in the summer evenings to eat an ice cream in the middle of other people without being forced to take the car, unless you live in the city's (historical) center, or you resign yourself to an ice-cream cone consumed while driving along a squalid road full of cars.

The city-as-machine anticipates only programmed mechanical movements, and has few degrees of freedom because there is little choice among alternative flows. This holds true not only for the paths themselves, but also for the means of transportation along those paths. A city has to guarantee the mutual coexistence of pedestrians, cars, bicycles, etc., without any particular bias or specialization, except for special needs in very limited regions. Living cities are invariably those that are highly connected by internal networks (Salingaros, 2005) and which show a fractal geometry. There exists complex structure at every scale of magnification, from the size of the entire city, to the size of a neighborhood, to a cluster of buildings, to a single building, down to the urban spaces, and further down to the scale of sidewalks, trees, and street furniture. Living urban structure reproduces, in abstract form, complex natural and biological structures, which exhibit fractal scaling.

The living city is understood from an appreciation of its networks, and many solutions to problems of urban planning follow from network thinking. Urban permeability is obvious from the point of view of vehicular traffic, but also has a major impact on personal and social relations, and thus on the general functioning of the city with its innumerable activities. A city has to guarantee the largest number of degrees of freedom to each citizen. The city-as-machine is the exact opposite of this choice.

We know of urban plazas in historic cities, where the success of the urban space is entirely independent of the architectural (but not geometrical) qualities of the surrounding buildings. Those might not exhibit any particular architectural interest, sometimes the façades are degraded, badly restored after interventions or war damage, and were not necessarily elegant even before historical wear and tear. The space, however, is articulated because it was established, connected, and reinforced during successive times. Such central spaces of the city have a great advantage by being extremely lively, used by many pedestrians, often containing markets of some sort, and have remained popular, even contributing to connect the historic center to the periphery. The point is that the urban space, by being alive, has rejuvenated the surrounding buildings. By adapting to the pedestrian uses of the urban space they enclose, the buildings have adapted typologically to the rest of the living urban fabric. Curiously, they have often evolved to look more like the older buildings in the historic center than the post-war buildings in the periphery.

9. The problem of designing the city's periphery.

Governments struggle with problems of new housing. In Europe, the population pressure tends to result in high-rise dormitories on the city's edge; whereas in the USA the same pressures are responsible for the sprawling (and unsustainable) dormitory

suburbs constituted of isolated single-family houses. Both typologies are monofunctional, hence do not and cannot give birth to living urban fabric. A living city, by definition, has to combine functions in as close an intermixing as possible without any one function harming the others (Salingaros, 2005).

An immense body of planning laws and regulations behind architects and urbanists determines the basic choices of future residents. Those regulations obstinately follow a modernist city model based on a building centered on its lot: they deny the need of the street acting as both ordering and connecting element, and totally neglect to relate a new building with the rest of the city. Streets are designed for fast vehicular movement, taking no account even of the existence of pedestrians (Hall, 2008). Building norms that have imposed limitations of every kind were set up on the principle of giving people a roof, but not a home that is contained organically in a city. Those norms certainly have as their project's objective a faceless population of proletarians with the most basic mechanical needs rather than human beings with feelings.

The true responsibility for the dissolution of cities lies with the modernist regulating plan. People who would otherwise walk or bicycle to a local market in some central location, crossing the smaller streets of the historic center and running into friends and acquaintances, are now exiled to a no-man's-land. People are sent to live in the periphery where streets are no longer streets because they are not bounded by building façades. Houses or apartment buildings are rigorously separated 10 meters from each other, and set back from the street line. This creates useless pieces of lawn, garden, and open space. Streets thus become asphalt ribbon conduits that serve only the car. The trip to the center, deprived of stores and the possibility of encounters, is classed simply as "urban mobility".

Choosing to erect anonymous blocks without the slightest reference to the essential properties of a house, projects are then executed with pseudoscientific accuracy. Their architect painstakingly verifies the surface area of every single space based on a "predetermined need" as set into law by an elite that has decided for everybody else. Living quarters whose inhabitants cannot recognize as familiar places with which to identify have nothing in common with the traditional city as it was known for so many generations. Such new constructions exist on the same conceptual level as the periphery destroyed by speculative building: they have been planned, exalted, advertised, and studied in all the universities. Those projects have been taught as positive examples to students, by architects who have transformed a vision they originally declared to be "ethical" into an "aesthetic" dimension, which ended up as a mix of mechanization and political ideology.

Lest readers think we are exaggerating, we recall several gross failures of social housing in our times. The Pruitt-Igoe high-rises in Saint Louis, Missouri were dynamited by the government after they became so degraded and crime-ridden that they were an embarrassment to the city. In the USA, this failed project is now used as a case study of inhuman urbanism. The situation is different in Europe. Four examples of public housing built in Italy: Monte Amiata in Milan, Corviale in Rome, Scampia in Naples, and Zen in Palermo, were condemned by European urbanists in 1991 as being total and abysmal failures. Nevertheless, 15 years later, those very projects were spotlighted in an exhibition of innovative Italian architecture, which toured the major Italian universities

(Porta, 2006). These examples, wherein similar cases gave rise to opposite lessons, underline that the discipline itself stubbornly sticks to a failed ideology.

There exists a fundamental principle that is indifferent to the iconic and stylistic preferences of any individual (especially an architectural or planning “expert”): architecture has a civic value because it belongs to everybody. The city is a common and collective good. Since the city is not private, citizens have the right to choose the environment in which to live, to move, to work, to enjoy their recreation, to love, to study, to travel in, etc. How can we make it possible for citizens to choose their environment directly? A good starting point is for administrators to stop following self-referential planning and building regulations, and realize that every written rule has an immediate consequence on projects. Those rules are typically not written to oppress the citizen, but instead to obtain a narrow typological and morphological result.

Today everything from the past is disowned, and this may be a good thing in part because it is necessary to look ahead; but without a truly intelligent review of the causes of the urban disasters in the periphery, we risk making the very same mistake under a different disguise. We call attention to three dangerous contemporary trends.

1. Many people call for the figure of an “appointed” architect to fight all of society’s ills, discharging all the present and past political mistakes, but who necessarily draws from the ideology of the generation of architects after the events in Paris of May nineteen sixty-eight.

2. Urban models completely unrelated to those of our historical cities continue to be implemented, with plans indistinguishable in substance from those that are now targets for demolition. Those new proposals are apparently ennobled by an architecture slightly more “in fashion”. Nevertheless, in the next “season” they will also become out of style. Today’s urban projects are enriched by new symbols, for example the skyscraper, which every self-respecting mayor fervently desires, using the ideological cover of the new urbanistically-correct catchword “sustainability”. Sustainability thus becomes the generating element of the project, in a way that everything completely instrumental becomes substantially false. For example, we see the glass skyscraper presented as a sustainable typology, whereas it is the exact contrary.

3. Even the social mix often talked about seems oriented more to a totalitarian operation of social engineering (on an ethical level, to be sure) than to an organic idea supported by city design. Only human-scale urban planning can render the goal of social mix effectively possible, driven by the mechanism that borrows from the geometry achieved in the traditional city.

This is neither a stylistic issue, nor any romantic nostalgia for the past, as those architects who pretend to be passionate about modernity would have us believe. Negative slogans referring to “obsolete forms of social life” and “historically superseded public space” continue to support dead urban typologies that prevent the emergence of living urban fabric. Their ideological followers perpetuate dogmatic images of an idealized modernity, blind to the damage those wreak on the living city. Their goal is simply to relegate supporters of a humanistic approach to the city (and the appropriate architecture for accomplishing this) to the margins of the cultural debate, and above all to exclude the humanist architects/urbanists from professional and university jobs.

It is not only the fault of architects. Politicians, mayors, and administrators who have no generative urbanist ideas mask this insufficiency by copying fashionable architecture. When city officials look through an architectural magazine that illustrates all the marvels of the latest “star” architecture, they dream of a single coup that will resolve their problems: building something that will make them famous. For precisely this reason, a mayor will hire a celebrity architect (not even an urbanist) to design a new region of the city. An irresponsible game of urban planning has given origin to entire quarters that are today recognized as being places of urban degradation, of the lowest architectonic quality and quality of social cohabitation. The political choice of assuring a house at low cost, either to rent or to purchase, for those who do not have housing, follows the choice of a particular architectural and urban planning typology. To reverse the failures of the periphery, we first need to understand the failure of social housing.

10. Spatio-temporal scale jumps and their implications.

The dramatic consequences of housing billions of people loom ahead for humanity. Such a problem can be sized up only if the magnitude of the processes of urbanization in developing countries is taken into account. It is literally billions of new urbanities, most of them poor, which are expected to be sheltered in some way in global cities in the next few decades. Nothing “strange” is happening, but the administrative answer to that massive pressure is, and will be, given in orthodox modernistic fashion, which will ultimately lead to environmental and social failures of historical relevance for the planet as a whole.

The reasons for which our current practices are increasingly negative towards the creation of human space are of course rooted in attitudes of contemporary society. To cite the most structural ones, we have witnessed a collapse of processes in both space and time, a collapse that takes the form of huge jumps in scale. Formal urban development is now led by extremely large interventions of extremely powerful public/private subjects, resulting in a jump in the spatial scale. Moreover, the urbanization process now occurs in an extremely short pace of time, which is a jump in the temporal scale. The combined effect of these two collapses makes it impossible for us to hope for a restoration of the traditional mechanisms of city evolution for the contemporary city, while at the same time setting the agenda of an entirely new role for city planning. City planning is therefore called to a profound renovation of its conceptual/technical toolbox; this renovation might be so radical that a new discipline will emerge. Because the characteristics of such a discipline must be to recognize and put into place structural *drivers of urban self-organization* instead of structural and super-structural *programs of urban organization*, we might well call it “urban seeding” instead of “urban planning”.

It should be pointed out that modernist planners, after all, simply followed the visual modernist vocabulary, which, in wishing to disown traditional architectural and urban forms, insisted precisely upon unnatural scale jumps. This is the “anti-fractal” philosophy that turned into a complete design ideology. The tight relation between political ideology and the ideology of the architect’s professional world cannot be denied. Regardless of any design ideology, human beings are endowed with sensory mechanisms that recognize unnatural scale jumps (Kellert *et. al.*, 2008). Therefore, as pointed out elsewhere, the

elimination of architectural ornament does indeed have major and unsuspected consequences for the dehumanization of cities on the urban scale (Salingaros & Masden, 2008).

11. Spontaneous settlements: what we can learn from them.

Looking at any image of obviously spontaneous settlements, as in a favela, we are able to observe that the basic urban fabric works far better than that planned by architects. Apart from its social problems, a favela makes understandable urbanism in a very simple way. It is not visually simple, unlike social housing or entire quarters of private buildings planned by architects and cited in books and architectural reviews. Those turn out to be too simple to contain human complexity. Certainly, the houses in a favela are often poorly made and there is a total lack of buildings for collective and public functions. Most serious is the absence of even minimal services. All of these are essential to define a city. Nevertheless, this is normal because we are not in the presence of an autonomous society, but instead a collection of marginalized citizens trying to survive outside an organized and structured society.

The collective intelligence responsible for informal settlements is no longer present in more technologically advanced and richer societies. Making a great simplification, we believe that the growth of individual freedom has triggered the increasing autonomy of individuals from their social group, with the unavoidable loss of some key values. Generally this is a positive transformation for society, but one of its negative consequences is the end of the type of city founded upon a shared collective vision. People replaced their intuitive sense of connecting to each other and to a common built environment, with an exclusively individual conception of the world. They detached themselves and manipulated the form of the built environment to enhance their isolation.

The overwhelming majority of people (architects aside) are not satisfied with the contemporary city. Does this tell us something? If historical centers have the highest real estate values, this gives us a motivation to do something. Connections and the relationship to our environment are really personal and physical relations, of which human beings have a basic need. It is not possible to substitute such connections with contacts from the web, which becomes rather an additional resource, one more way to meet and know other people in a different manner. The web is not an alternative to physical and sexual contact that human beings need and cannot do without. Today's young people chat and blog on the internet, exchanging their feelings and sentiments, but in the end, they meet each other in physical places, both old and new.

Our study on social housing (Salingaros *et. al.*, 2006) reveals an incessant battle between people trying to create their own living environment, and government agencies determined to impose their own "geometry of power". That geometry is indeed tied to the modernist ideology of industrial power, and which we now know precludes living urban fabric. And yet, governments of all political persuasions are obsessed with images of that formalistic geometry. They are insistent upon stamping out self-built human-scale urbanism, because that encourages the non-mechanical qualities of human beings who have not yet lost their humanity.

Countless examples of government-built social housing as residential towers have failed miserably. Either the people refused to leave their owner-built shanties (and the rich social networks of the favela), or they were forced to move to the new towers after their shacks were bulldozed. In the latter case, the residents eventually ended up destroying the towers as much as they physically could, expressing their hatred at this prison-like typology. The only success — but one that is denied by most governments and agencies — is the gradual upgrading of the favela, accomplished by the residents themselves with materials and infrastructure provided by the government or other agency.

It is nowadays rare to find the insertion of the appropriate urban structures on every human scale that we know to be necessary for encouraging and containing urban life. The aim and visions of modernist architects with respect to the form and substance of buildings leads to the imposition of an “originality” that is alien to human beings. Even early post-war housing settlements tried to use the high-tech materials of their day, and encouraged (instead of trying to tame) the intrinsic gigantism of such structures. Within the urban context (in contrast to, say, a petrochemical plant), the modernist claim that it is necessary to abandon traditional forms and structures falls apart. In reality, the search for novel architectural forms in most cases turns in on itself, and tends to ignore and condemn its context. It thus becomes a purely promotional exercise for the designer, where the architect becomes the end instead of the means.

It seems that what has driven social housing is less consumer demand than vested commercial interests that live on images, and above all a discipline that has lost any contact with reality. It ignores the reality of people who really wish to live in traditional cities and buildings, and that ask precisely for such environments for the past 60 years. People don’t ask for a degraded and alienating industrial environment. That part of the discipline that is exquisitely technical, which is concerned with easy to determine standards, necessarily focuses on simplistic geometries for necessary city components. It neglects the basis of past experience, and avoids taking that older knowledge forward into difficult forecasts in a society in constant change. Urbanism now has to make a qualitative jump, and, like a genetic mutation, the correct technical analysis must now become the generating criterion of the project.

In the great historical cities this picture is surely more dramatic than elsewhere. Some urbanists point their finger at “the dinosaurs of popular housing blocks”, which have failed because of the concentration of people and weak or non-existent services, forcing social homogenization upon the resident population. Politicians now speak of creating a true social mix: proposing the elimination of single use and single destination in new buildings, in order to make it possible to mix social functions such as work, residences, offices, light industry, handicrafts, students, etc. Despite all these nice phrases pointing out the social failure of the modernist city model while promising change, the action for remedy is caught up in politics and ideology. The reason for lack of progress is an entrenched formalist thinking that is still being taught in our universities, and legislated into current planning regulations. If politicians wish to generate living cities, then their first priority is to scrap all the modernist planning laws that prevent the construction of living urban fabric. The second priority is to learn from the spontaneous geometry of informal settlements (Salingaros *et. al.*, 2006).

We come back to the metaphor of the city-as-organism. A city behaves as an organism, or it behaves according to a plan, authoritarian in its very nature, in which someone decides for everyone else and assigns functions, tasks, and roles. The most totalitarian power an institution can wield over people is to tell them exactly where they should live, where they can or cannot walk, exactly how large (or small) a space they are allowed to inhabit, etc. Governments propose a “new great synthesis”, without admitting that human-scale solutions can already be found within the traditional city. Meanwhile, the city-as-machine continues to grow more inhuman and to proliferate around the globe. The most popular urban model today, constructed in the best of cases with all of its pieces put in their proper place, as computed from the modernist conception of a city, still doesn’t function.

12. Conclusion.

We have inherited a rich variety of invariant patterns for urban structures. These have changed very little from what we see in traditional settlements, so we can apply those typologies to generate *living urban structure* today, i.e., a type of urban fabric that fosters the informal human exchanges which generate “life between buildings” (Gehl, 1996). Living urban fabric evolves with time through countless unplanned and unpredictable grass-roots contributions by citizens and social actors at all scales. The problem is that most architects and planners, influenced by decades of anti-traditionalist practices, have forgotten the morphology of such living urban structure. In fact, the discipline of architecture and urban planning itself as we know it needs to be substantially re-framed in a new “urban seeding” approach, so as to embrace the idea of self-organization as a key feature of successful urban spaces. Lacking those insights, whenever arrogant modernist and “star” architects try to design urban fabric today, it turns out to be dead. Those who argue most fanatically against the use of traditional forms are ironically the same persons who defend the deadening sameness of the sterile modernist forms they wish to apply for every case and for every locality. The diversity and adaptivity of traditional typologies is our guarantee against homogenization. There exist common bases, biological and perceptual, for any architecture and urbanism, and every human being can verify if those are adaptable to our living environment. We change the forms, following changing cultural traditions and needs, in which the common rules of behavior are manifested. What remains invariant, however, is the biological perception common to all people.

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