

Antonio Leone Carmela Gargiulo
Editors

Environmental and territorial modelling for planning and design



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INFORMAL SETTLEMENTS, COMPLEXITY AND URBAN MODELS

IS THERE ANY ORDER IN AUTOPOIETIC URBAN
SYSTEMS?

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ABSTRACT

In 1961, Jane Jacobs depicted the city as a problem of organized complexity, endowed of inner unpredictability. Urban planning tools are expected to reflect this nature of the city, what is not that obvious. The sunset of the golden age of urban modelling, based on a rational comprehensive approach, has revealed the difficulties in pursuing such purpose according to a deterministic logic, thus opening the way to a stochastic approach, under the idea that unpredictable elements and random variables deeply affect the city functioning. In this broad framework, the configurational analysis of urban space, first pioneered by Bill Hillier, has gained momentum, assuming the urban grid as the primary element in the phenomena that occur within the city and in the urban dynamics as well. In so doing, it has brought to light key underlying structures in the city, showing that also autopoietic urban systems seem to materialize the equilibrium between environmental, economic and socio-cultural forces. Informal settlements appear an ideal testing field of the configurational approach. Fostering the idea that informal communities actually drive the evolution of such settlements, this paper aims at using the configurational analysis to make their hidden order to emerge, in order to face the matter of the upgrading of these "forgotten places", overtaking the idea of an impossible removal. The Baseco Compound, in the center of the mega-city of Metro-Manila, hosting no less than 90,000 people in an area of about 0.6 square kilometers and doubled in size over the last 15 years, appears an ideal case study to implement the configurational techniques in order to reveal and identify an order and a spatial logic where order and logic are supposed not to be.

KEYWORDS

People with Autism; Quality of Urban Life; Urban Capabilities

1 INTRODUCTION: OR, RATHER, THE UNDERLYING ORDER OF AUTOPOIETIC URBAN SYSTEMS

Informal settlements represent one of the most widespread and critical urban issues in the present global scenario. The Habitat agency of United Nations defines informal settlements as residential areas where inhabitants have no security of tenure dwellings they inhabit, with modalities ranging from squatting to informal rental housing, the neighbourhoods usually lack, or are segregated from, basic services and city infrastructure and the housing do not comply with current planning and building regulations. Furthermore, informal settlements are often situated in geographically and environmentally hazardous areas and, as a consequence of their intrinsic socio-economic features, their inhabitants are constantly exposed to eviction, disease and violence (UN-Habitat, 2015). Such a definition involves a perimeter that, as a matter of fact, currently includes more than 25% world population, having increased around 213 million people in the last 25 years (UN-Habitat, 2013). As is clear, it represents anything but a small geographic area, since its features can be widely recognized within a large part of Africa, in Asia, Latin America, and in some cases in the developed countries and in Italy as well. Due to their specific features, it is not easy to ascribe the layout of informal settlements to schemes, patterns or formal archetypes; and it is also hard to use methods for supporting the management of urban parts that seem to refuse any management and planning rule. The absence of pattern, the intrinsic incoherence of forms, the lacking of infrastructures, the uncertain definition of public and private spaces, the precariousness of the located activities and the vagueness in land use: all this makes the analysis tools blunt instruments, which can hardly be used in a labile field, where housing and activities location have been increasing in a total absence of rules. A different analysis approach is therefore required, so as to focus on the actual spatial forms, and to recognize within them the (social, cultural, functional) elements that have determined their genesis; the elements that presently remain implicitly embodied within the spatial organization of the settlements and are their intrinsic founding principles as well as their vital sense. The idea is that a subtle, intrinsic order exist in urban areas that are apparently devoid of order; an invisible order, hidden behind the casual arrangement of buildings and the chaotic texture they form; an order that is the result of a autopoietic process, carried out by the community in order to adapt their spatial behaviour (their movement, their activities location, their housing, their inner geography of their neighbourhoods) to their cultural roots and social and cultural organization; an order, whose features cannot be found in the material appearances of the neighborhoods, in the shape of blocks, buildings, streets and squares, but in the relational state of the urban grid. This is what makes the configurational techniques, which are expressly based on the role of the urban grid as the primary element of the phenomena that occur within its paths, a powerful toolbox for identifying such order, making it to emerge and defining its features. It will be argued that the use of a configurational approach can allow detecting the self-organization processes that govern the bottom-up dynamics which materialize into the informal settlements. It will also provide considerations for policies and strategies aimed at upgrading those areas and improving their environmental condition.

2 BACKGROUND: INFORMAL COMPLEXITY AND CONFIGURATIONAL ANALYSIS

A city, although in some cases apparently ordered, as characterized by a recognizable geometric form or pattern, is undoubtedly a complex system. Behind a physical structure, materially made up of buildings, blocks, streets and squares - or more generally of free access places - an intricate system of reciprocally

connected phenomena takes place in the city: what induces to make an actual duality to arise: on one side, a large collection of buildings connected by space; on the other one, a rich set of activities linked by interactions (Vaughan, 2007). The long-lasting debate on whether these two dimensions are connected is the foundation of the configurational approach of Space Syntax, since the relationship between physical and social layer in the city symbolize the link between structural and functional spatial features (Hillier, 2012). In the aim of developing a "unique" theory of the city as a whole, Space Syntax approach assumes that the urban space is "the common ground for physical and societal cities" (Vaughan, 2007). The freely accessible space of the city, as the place where urban phenomena happen, is considered to be a spatial configuration, or rather a set of "relations between all various spaces of a system" (Vaughan, 2007). A network of interconnected open spaces could hence represent the urban layout. It is what we call an urban grid, whose elements contribute to the functioning of the city. The grid configuration in itself generates and affects movement rates. The theory of the so-called natural movement - that is the portion of movement that does not depend on the located activities, but only in the grid configuration (Hillier et al., 1993) - assigns the space a generative role on urban phenomena, as primarily influenced by the whole grid. Space Syntax assumes that activities located on the grid can amplify the movement rate induced by the spatial configuration, acting as movement's multipliers. We call them configurational attractors. As opposite, non-configurational attractors generate movement rates regardless of the grid, as it is the case of monopolistic urban activities. Following the so-called "movement economy" process (Hillier et al., 1993), both kind of attractors contribute to define the movement rates underlying city functioning: the space, directly influencing movement, generates human interaction bringing social and cultural pattern into the urban layout. Form and function of urban space are related by a non-casual connection, due to the strong influence of urban layout on space potential (Hillier 1996; Vaughan 2007). Space Syntax theorizes that spatial configuration, depending on the purely topological structure of the urban grid, is fully expressed by the dual graph that is gotten by switching the edge of the urban network into the nodes of the graph and, conversely, nodes in edges. In this manner, several measures of centrality can be identified on the urban graph. The Space Syntax techniques, in fact, provide each element of a spatial grid with a full set of numeric values that correspond to several configurational parameters; yet the notion of centrality – appraised in terms of attractiveness for activities - is actually pivoted around two measures known as "choice" and "integration". The first one (betweenness in graph theory) expresses how many chances has a node to intercept flows on the graph. The second one (closeness in graph theory) expresses how close a node is to all the others on the graph.

According to Freeman (1978), betweenness measure C_B for a point P_i is concretely obtained comparing the number of geodesic paths between P_j and P_k containing P_i ($g_{jk}(P_i)$, where $i \neq j, \neq k; j < k$) with the total number of geodesic paths linking P_j and P_k (g_{jk}) (Freeman, 1978; Hillier & Iida, 2005). Defining n the total number of nodes in a graph, choice index can be obtained as

$$C_B(P_i) = \sum_j^n \sum_k^n \frac{g_{jk}(P_i)}{g_{jk}}$$

Several researches so far have certified choice value as a reliable index in the estimation of movements rates in the city, especially when applied to determine the distribution of vehicular movement flows. According to Sabidussi (1966), the closeness measure C_C of a point P_i can be obtained considering the inverse of the total

number of edges in the geodesic path between the points P_i and P_j ($d(P_i, P_j)$) (Freeman, 1978; Hillier & Iida, 2005; Sabidussi, 1966):

$$C_C(P_i) = \left[\sum_T d(P_i, P_j) \right]^{-1}$$

Integration value is the most important measure in configurational analysis, assuring a reliable correlation with the distribution of movement flows, mainly pedestrian, and the density of located activities; the parts of the urban grid that results provided with higher integration values is acknowledged as its integration core. Integration is able to make the urban structure to arise. The process of network generation, as previously introduced, allows to give a spatial meaning to the topological measures of centrality, so that we can easily switch from nodes of the graph to lines in the space, characterizing space with the topological properties of the associated urban graph. The results of network analysis could hence be pushed onto reality. Configurational indexes express different properties of the city depending on the scale of analysis. At local scale, restricting the analysis to a defined number of nodes/lines around a given node/line, they reflect the way humans cognize the spatial reality; at global scale, analyzing the system as a whole, they give a non-discursive description of the urban structure. Several studies so far proved the existence of a direct and narrow relationship between configurational indexes and movement rate, making the configurational approach a reliable tool for investigating the working of urban environments and making hidden properties of a settlement to arise. Such an approach could be effectively used to investigate whether – and to which extent – informal and autopoietic urban structures are actually provided with an inner order, which remains intrinsically materialized within its grid and cannot be identified by means of a traditional geometric approach. It operates, in fact, basing on the topology a spatial settlement expresses instead of the geometry it shows, changing the meaning of "structure" in itself. While recognizing that some geometrical structures show an intuitive relation to specific topological configurations – Hippodamian structures in particular, considered paradigmatic in movement efficiency since ancient times – it is not obvious that apparently (that is, geometrically) ordered settlements work better than others appearing twisted, less harmonious, or anyway lacking an easily recognizable order, pattern or design. This is the case of informal settlements, whose layout, by definition, generally does not correspond to geometrical schemes, formal patterns or morphologic archetypes.

3 CASE STUDIES: DOES INFORMALITY CONCERN ALSO EUROPE?

This paper presents a research that is based on an inductive approach. It won't investigate the theoretic mechanism of self-organization processes that determines the making of autopoietic settlements. Nor, it won't discuss the specific (geometrical, functional, socio-economical) features of such settlements, which are clearly very different from one case to another, due to their physiological lacking of pattern or regulatory rules. The research will rather focus on the configurational properties, if any, that appear shared by radically different urban cases, which undoubtedly only share their informal settlement, resulting from a self-organized genesis. According to this criterion, our case studies have been selected and drawn out of different geographic contexts, in the so-called developing countries and in the developed ones as well: a comparison of their respective results will only regard their configurational state, setting aside all the differences that distinguish them. Autopoietic settlements are widely spreading throughout the world, especially in areas where strong population growth dynamics induces a wide urban expansion. Often, this type of settlements assumes the characteristics of "informality", generally intended as the extreme form of

anarchy in the occupation of urban land and in the hoarding of public services. Are developed countries immune to these forms of urban environment? Urban science has no direct and unambiguous answer to this question. While it is difficult to bump into a real informal settlement, there are many densely populated areas where the rules and forms of urbanization actually assume ambiguous characters, even in Asia (Karimi & Parham, 2012) and in the heart of the old continent as well. Focusing on the first case of the informal settlement of the Baseco Compound, in the city center of Manila, the research aims at recognizing similarities with some autopoietic settlements in Europe. Manila is the political and economic center of the Philippines and is one of the major metropolitan regions in Asia-Pacific. The metropolis is the 18th largest urban agglomeration in the world in terms of population size, and according to the World Health Organization, about 35 percent of the capital region's 14 million population live in slums. On the edge of the port of Manila, by the banks of Pasig river, is located an Engineer's Island established in the mid-1950s and informally known as the Baseco Compound. The area has an extension of about 0.6 Km. sq. and a population estimated in more than 70.000 inhabitants (Philippine Statistic Authority, 2017). The lack of a reliable registry makes difficult, if not impossible, to know the actual number of inhabitants, which unofficial reconstructions consider exceeding one hundred thousand units. The territorial and urban morphology of Baseco have largely changed in the last decade, and, due to an uncontrolled building activity, the island is now almost completely occupied (Fig. 1). The result is a very fragmented area, which has few properly structured public spaces and many common spaces, where the boundary of private property is very labile. This obviously reverberates on the conformation of the urban network of the settlement, which in fact show a high average density of lines (about 48,000 lines per Km sq.).

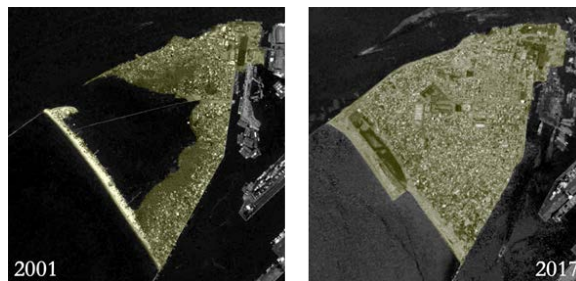


Fig. 1 The evolution of Baseco Compound (2001 – 2017). The emerged land is highlighted in yellow

The configurational analysis of the settlement unveils a strong polarization of the global integration and choice indexes. Both their values are very high in the lines that represent, within urban network, the few existing paved roads (Fig. 2). This highlights the lacking of a real urban center, in favour of an infrastructural framework, mainly devoted to pedestrian and vehicular movement and to the activities directly connected as well (some shops and few services - mainly schools and places of worship), which holds together and connects a large array of highly autonomous local centralities. Their presence is confirmed by the analysis with limited metric radius – the so-called "local analysis" - which highlights a very high fragmentation of the area. Baseco stands out as constituted by many groups of highly autonomous lines (high index of local integration) and small magnitude (less than 200 meters). Such result is clearly shown in the so-called "background patchwork analysis" (Al Sayed et al., 2014), which is a bi-dimensional graph whose lower peaks on the y-axis indicate how many local centralities there are, and the distance of the same peaks along the x-axis stands for their mean mutual distance (Fig. 3).

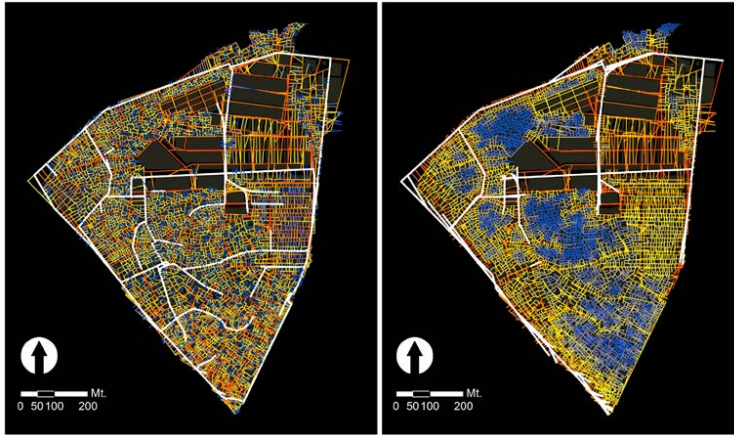


Fig. 2 Configurational analysis of the Baseco Compound: global choice (left) and global integration (right). White lines have higher values

This anomalous urban structure reflects the particular social structure of Baseco, in which life takes place in a community way for small proximal groups, as the evidence in the use of space seems to confirm (Cutini & Di Pinto, 2018). The case of Baseco, although summarily introduced, highlights the close relationship between urban space and local communities: if usually social needs tend to shape the space, in particular conditions the constraints imposed on urban development seem to prevail, determining the adaptation of the community to the existing or possible urban scenario. The balance between these instances determines the actual working of a settlement and leaves a clear trace in its topological framework. Thus, a configurational analysis appears an indispensable tool for revealing the presence and actual working of such a mechanism of mutual adaptation of space and local communities. A case in which a self-organization process clearly prevails and which is no stranger to Europe and to the entire western world, where some considerable examples could be found. Albeit with different forms and with mitigated outcomes, if compared to the informal settlements in developing countries, also the European scenario presents, in fact, autopoietic adaptations of space and urban communities. A paradigmatic case, for the issues it poses and the international echo it holds, is the Vesuvian coastal strip. This area, which has been experiencing an uninterrupted growth process since the 1950s, has undergone a transition that in just a few decades has transformed it from a nuclear urban settlement into an urban continuum that houses about 400,000 people in a strip of land at south of Naples, narrowed between the sea and one of the most dangerous active volcanoes on the planet. As elsewhere described (Cutini & Di Pinto, 2015), the result of this transition is the lowering of the average density of the built space compared to that of the individual pre-existing nuclei, with a consequent increase in the risk of isolation of one or more parts of the urban system and an increase in traffic levels on few critical roads; what also affect the normal functioning of A3 motorway (Di Pinto, 2018). All this translates into an increase of the vulnerability of the Vesuvian coastal settlement to volcanic hazard, as the comparison between the synthetic indexes in synchronic and diachronic scenarios clearly expresses (Fig. 4). The case of the Vesuvius does well reveal the pitfalls that the urban autopoiesis can conceal and, at the same time, highlights the need to consider appropriate approaches, tools, strategies in order to identify, recognize and manage them.

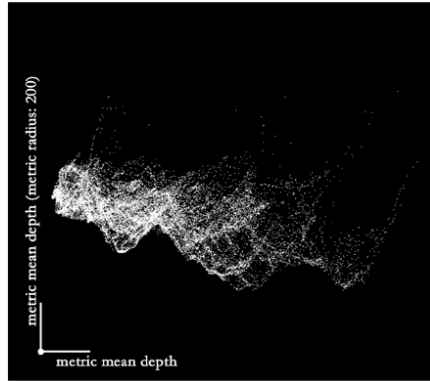


Fig. 3 Configurational analysis of the Baseco Compound: Background Patchwork Analysis (BPA) – local metric radius: 200

5 CONCLUSIONS AND FUTURE DEVELOPMENTS

The findings of the case studies that were briefly presented above can be summarized in the following results. First, radically different informal settlements seem to share some constants configurational properties, which can hence be assumed as clear hints of a recurring order, whose features are not readable in the stones of the material city but embedded within the spatial relationships of its grid. Moreover, despite all the evident differences that distinguish them, still the inner geography of the observed settlements is narrowly connected to the behavioral pattern of the located communities, so as to be recognizable as the output of a process of mutual adaptation of social and material city. Furthermore, not necessarily an autopoietic growth dynamics is suitable for intrinsically assuring a settlement high levels of robustness and resilience; on the contrary, self-organization processes may well involve an increased vulnerability of the system. The configurational analysis of the settlement can reveal such effects; and they can also orient the guidelines for activating regeneration processes, aimed at upgrading the degraded areas and improving their environmental condition. What is not a trivial result, but rather a promising starting point. On such bases, developments can be expected from further researches on the mechanisms of urban addition and growth governed by self-organization processes.

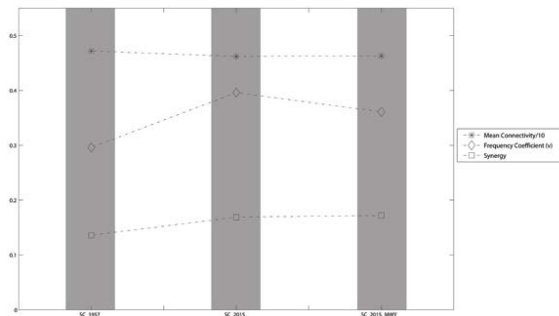


Fig. 4 A comparison among resilience indexes calculated for the Vesuvian area at 1957 and 2015, also considering the motorway A3 (SC_2015_MWY) (Cutini & Di Pinto, 2015)

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Valerio Cutini is Professor of Town Planning in the University of Pisa; since 1996 he teaches Urban Planning at the School of Engineering of the University of Pisa. His main interests and studies are in the areas of the analysis of urban settlements, aimed at focusing on their development and the diachronic transformation of their morphology and functional consistency, investigating the way the design of the built environment affects the patterns of social and economic behaviour of individuals and communities.

Valerio Dipinto is an architect and a Ph.D. in Urban planning. Since 2010, he teaches and carries out research at University of Naples "Federico II". His main interests are focused on the analysis of urban space as well on the quantitative analysis of landscape. His studies look at extending quantitative methodology to the comprehension of human behavior in urban space and to the analysis of the relationship between local communities and their environment, into the aim of provide new knowledge to urban planning.

Antonio Leone is full professor of Environmental and Territorial Engineering at the Tuscia University. Degree in Civil Engineering. Member of the Teaching College PhD "Land and Urban Planning" at Politecnico di Bari and "Environment and landscape design and planning" at Sapienza University of Rome. Participant and responsible in several projects financed by the European Union within 5th Framework Programme, Interreg IIIB Research Program, COST-actions, LIFE programme and other national and regional research programs (e.g. Nature 2000 sites). Member of Scientific International Committee for Metropolitan Strategic Master Plan "Terra di Bari". Author of about 150 papers and scientific articles on the main international journals related to the management of the environment and landscape and to the engineering of the territory, for the most part of which he also carries out the activity of an anonymous reviewer.

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