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SPATIALIZING THE SOCIAL: COMPUTATIONAL STRATEGIES FOR INTERVENTION IN INFORMAL SETTLEMENTS

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ABSTRACT

Traditional design and planning tools seem everyday less adequate to deal with the complexity of contemporary cities. Istanbul is a striking example of these contradictions [1]: indeed, the recent urban developments are eroding the informal settlements, commonly called Gecekondu, that during the last century shaped large part of the city. The development of neoliberal policies is threatening the future of these lively communities, while at the same time encouraging an increase in phenomena of social segregation and urban fragmentation [2].
This paper wants to propose an alternative method for the intervention in these areas, based on the application of computational techniques to understand, foresee and drive the growth of more sustainable and integrated settlements. The method is articulated in four phases: analysis, model creation, scenario planning and implementation.
The analytical phase allows both for the understanding of the relational rules of the urban form of these areas and of the social and economical mechanisms that led to this kind of urban structure. This will inform the creation of a model, allowing in this way to create the background and keep the study linked to the current area, while at the same time allowing for a generalization of the assumptions [3]. The set of rules extracted in this way can be encoded successively in a complex computational model, where a set of generic algorithms of urban development [4] is coupled with the structural relationship of the neighbourhood analysed. The model is developed by interlinking different rules of urban development with social and economical simulation processes, allowing for the simulation of complex dynamics of change.

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The model built allows then for the creation of different scenarios of development, based on a combination of bottom-up processed driven by citizens decisions and top-down policies implemented by the municipalities. The scenarios can be tested and evaluated, allowing for the definition of alternative policies of intervention. The implementation phase can then be carried out in different ways, but, by maintaining a continuous process of feedback with the computational model and the reality of change, maintain a degree of control without imposing a rigid development.

Key words: Informal Settlements, Interactive Planning, Participative Urbanism, Urban Simulation, Neoliberal Policies.

Introduction

Traditional design and planning tools seem everyday less adequate to deal with the complexity of contemporary cities. '[...] The globalization of market forces, the deregulation of financial institutions, the privatization of public services' are creating strong inequalities in the social and urban fabric of cities, and the planning powers are unable to pose a limit to this [5].

This paper is proposing a new kind of approach to the study and intervention in informal settlements, based on the use of computational design tools to understand, foresee and drive the necessary transformations in these areas, everyday more threatened by the growth of neoliberal urban policies.

The contemporary approach towards the research and the operation in the complex environment of informal urban settlements is in many ways still based on a modernist view, where the informality is seen as a negative aspect that needs to be in some ways solved or, more often, completely erased [6]. This approach couples well with the neoliberal policies of most of developing countries (where a major part of these settlements is located), since it allows to open large parts of land, once occupied by self-built urbanities, to speculation and investments from private companies [1].

At the same time, it appears anyway necessary to take distances from some of the contemporary 'alternative' approaches towards the study and intervention in slum areas, where these areas become easily romanticised as some sort of 'primitive' self-sufficient communities, with a strong social identity and a balanced relationship with the environment. This kind of view point fails in understanding the criticality and the real needs of these types of settlements, while at the same time leading to a sort of stasis, where these neighbourhoods are seen as perfect models, without need for integration.

The main aim of this proposal is to find strategies to build a 'common ground' between the top-down level of state and municipalities planning procedures and the forces and needs of citizens that are self-building the city in where they live.

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Istanbul and the Gecekondus

Istanbul is a striking example of these contradictions: Turkey's second city, it is situated between two continents and with its own 14 million inhabitants expands for 110 kilometres along Marmara Sea. The city is divided to 39 municipalities, acting under the control of the Great Municipality of Istanbul.

Till 20th century Turkish economy was based on agriculture and just 20% of the country was urbanized. From 1923, after declaration of the Turkish Republic, the governmental policies shifted towards industrial sectors and pushed towards a rapid modernization of the whole economical system. As these new modernization policies were based on rapid urbanization, cities need for labour market increased rapidly, even if urban fabric was not ready to house this strong increase of population [7, 8].

So this immigrant population started to claim less valuable lands in city's periphery and built their houses. From this time the expression 'Gecekondu' entered Turkish urban vocabulary. Commonly referring to a good or a product that has been built badly, in the urban context is used to define an accommodation, which has been built quickly on illegally occupied land. According to old Islamic mandate, if a person built a structurally sounded accommodation on public land, the Authority would not be allowed to demolish it. Partially relying on this legal breakdown, government tolerated these settlements mainly for two reasons: first, with the modernization policies they had to deal with a complex conflict with the extreme religious parties, often really powerful in the informal sectors, and second these settlements were considered as transition phase which would prepare rural people for urban life, while at the same time offering a quick and inexpensive way to host them in the urban areas. Due to their low wages and their rural background, inhabitants started practising agriculture inside the city in order to produce part of their food. To overcome water supply problem, inhabitants installed water storage tanks and created underground systems to store sewage.

In the mid sixties three new laws radically affected the development of informal settlements. The first one increased the power of district council on making local changes. The second law provided some funds for improving houses in Gecekondu and the last one enabled these small detached houses to be transformed into 4-5 storeys blocks, while at the same time allowing for the purchase of land rights [9]. Unfortunately these end up imposing the economical power of new private development companies on these areas. This changed Gecekondu house owner's social class. Most of them built apartment block with the help of developers and invested their capital, while at the same time building other houses and renting them to newcomers [10].

Whilst neoliberal policies and planning timing pushed upper classes to start building illegally too. With their tendency to settle in north of the city, the forests, water basins and other natural resources became endangered. Government tried to moderate land price with the creation of the Land Office, while newly born TOKI (Turkish Mass Housing Organization) was created with the aim of providing housing for low income citizens [1].

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Today Turkish economy is shifting from heavy industry towards service sector and tourism. Turkish Government considers the so-called 'global city' scenario for the future of Istanbul to survive as a financial centre [11]. With this in mind, the city has developed a non-sustainable survival strategy based on construction sector that is replacing residential areas with retail, offices and leisure facilities. Several urban transformation projects backed by political power continuously opened up new land for real estate development. The result of this sort of urban transformation projects is the emergence of phenomena of gentrification, social segregation and spatial fragmentation, which had already affected historical inner city areas as well as some Gecekondu neighbourhoods.

Method

The approach to the topic of analysis and intervention in these areas have been based on the coupling of two complementary approaches: from one side, the exploration of computational algorithms for urban simulation, including the study and evaluation of precedent project that applied these methods in various ways, and from the other side, a deep and continuous field study on the spatial, social and economical structure underlying the growth and development of informal settlements within the realm of Istanbul. The two strands have not been developed separately, but they have been researched in parallel, continuously feeding the result of one in the other and vice versa, in order to build a systematic and coherent method.
The resulting method uses a series of computational techniques to build a set of complex relational models of urban simulation, where the different socio-economic factors are dynamically related to the spatial form of the urban fabric. This model allows for an attempt to define a method of operation to understand, foresee and drive the growth of more sustainable and integrated settlements. The method is articulated in four phases: analysis, model creation, scenario planning and implementation.

Analysis

The analytical phase allows both for the understanding of the relational rules of the urban form of these areas and of the social and economical mechanisms that led to this kind of urban structure. This informs the creation of a model, allowing to identify a shared background and keep the study linked to the current area, while at the same time allowing for a generalization of the assumptions [3].
The analysis of the growth and of the patterns of urban tissues revealed two mechanisms as the most relevant for the growth of Istanbul; both of them are valuable for some aspects, while at the same time neglecting other facets. The first one, that has been defined as 'top-down urbanism', includes the most traditional strategies of urban planning, based on functional zoning of the city. These processes over the years have came to be dominated by the market economy and the rise of neoliberal practices [5], resulting in plans devoted exclusively at the maximization of profit and of control over the growth of the city, excluding any flexibility and any attention to citizens

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needs and wills. The direct consequences of these approaches have been the waves of eviction that are changing drastically the face of contemporary Istanbul [12], together with a deep increase of phenomena of social and spatial segregation.
On the other hand the second mechanism, defined as 'bottom-up urbanism', consists in processes developed independently by citizens, which are building in response to direct housing needs. This process, even if it allows for the growth of coherent neighbourhoods and strong communities, at the same it ends up in creating high-density areas lacking the most basic infrastructure and services. Citizens struggle for their basic needs such as clean water, electricity, sewage and rubbish collection as well as transport system, schools, hospitals and shopping facilities. In many cases citizens create local services to overcome their needs such as street vendors, collective taxis and agriculture. High density and narrow, irregular streets make it very difficult for council and service providers to meet citizens needs.
Our research poses the need for searching a meeting point between the two approaches, a meeting point where the positive elements of each could empower the whole system, allowing for the complex and integrated growth determined by bottom-up processes, while at the same time allowing for the introduction of a certain degree of control on the development of urban form, opening up possibilities for the betterment of life quality in these neighbourhoods.

Model Definition

Once the main mechanisms underlying urban growth in the settlements have been defined, the subsequent step have been the definition of a computational model of the processes operating in the analysed areas.
The approach to computational simulation have been firstly informed by the articulated research carried out by the Centre of Advanced Spatial Analysis at the UCL Bartlett, and this addressed us towards the use of Cellular Automata based algorithms [4]. The advantage lying in these is based on the fact that the evolution of the model is never based on global decisions, but always on the simple interactions that happen at the unit level and between the unit and its own direct neighbourhood. The downside of this is the fact that it creates systems in continuous state of transition, that hardly ever reach stable formations. In order to introduce some sort of stability, typical of the built environment, a graph structure have been introduced, in order to consolidate the interconnections between different units at street level [13].
The overall structure of the simulation have been created mirroring the duality between bottom-up and top-down urbanism, allowing for the integration of both systems in the same algorithm. Specifically, the bottom-up processes have a parallel in the cellular structure of the simulation, while top-down decisions can be imposed by the manipulation of the overall parameters of growth.
The algorithm have been developed additively, creating new rules and introducing them one on top of another, testing at each level the result of the simulation and the changes introduced by the new rules. This has given the great advantage of building a relatively flexible simulation, where different rules can be switched on or off

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according to the need and the characteristics of the tested neighbourhood. All the rules define a spatial relationship between the elements of the simulation, including the relationship between roads and building position and orientation, between the topography and the size of the units, between units and their relative plots. The most relevant step have been the introduction of a simple economical model in the simulation, that allowed for the representation of the complex interrelations that emerge between built form, garden size (that allows for an increase of the income through urban farming) and the composition of the families inhabiting the unit.
After some tests on an existing road network, the simulation have been expanded by the introduction of a multi-agents system to define the growth of a new urban network as the starting point of the simulation. Two families of autonomous agents have been distributed on the topographical surface of the area, one always searching for the highest slope of the terrain and the second one searching for the lowest one. The two groups defined in this way a hierarchical network of connections, where the 'high-slope' agents' trails created the road armature of the area, while the 'low-slope' agents defined the secondary connections between the main network.
The resulting simulation shows a wide variety of behaviours in response to different economical parameters and different topographical determinations. More than that, the additive logic of the algorithm seems to allow a great adaptability of the model to other contexts rather than Istanbul.

FIG 1. Layers of the simulation on Sarigol: income, gardens, social groups.

In order to extract data and test the simulation, two neighbourhood in Istanbul have been chosen as case study for this phase of research. The first one is Sarigol, in the Gaziomanpasa municipality, a neighbourhood developed between the '50 and the '80, as result of a wave of evictions in the central areas of the city. The advantages of working on this area come from the fact that is has a relatively clear structure, and, by having a really variegate topography and building typology, it allows to extract rules regarding the relationships between these two elements, rules that can be fed into the simulation to start structuring and tuning the algorithm. More than this, the study of Sarigol demonstrated for the first time the need to implement local development rules, customized for any different neighbourhood analysed.

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The second neighbourhood analysed has been Derbent, in the Sariyer municipality. This neighbourhood, which is today threatened by a new masterplan that decided its complete demolition and substitution with a middle-class gated settlement, is built on a group of hills and, due to that, it has a really incoherent and fragmentary structure. The work carried out on Sarigol became here extremely valuable, since it allowed to introduce and define a coherent set of rules, that was not clearly visible form the spatial structure of the Derbent itself. The biggest shifts in the algorithm applied in this case have been the introduction of the 3rd dimension, that allowed to define sizes and deformation of the housing units based on height and slope configurations, and the removal of the grid system on which the Sarigol simulation was based, allowing for a more natural and articulated simulation of real urban form.

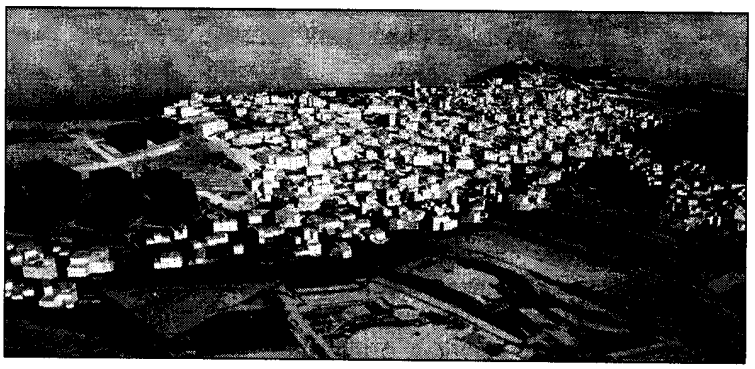

FIG 2. Output of the simulation on Derbent.

Both tests showed the ability of the simulation to produce complex urban patterns with similarities both in terms of relational structure and built form with the real neighbourhoods. This allowed for the confirmation of the validity of the developed model for the use in the subsequent phases of study.

Scenario Planning

The developed algorithms, coupled with the testing carried out in the two neighbourhoods of Sarigol and Derbent, suggests the possibility to use this kind of simulation techniques to build a new approach towards the understanding and the intervention in informal areas of urban contexts.

First of all, the simulation allows to build a deeper understanding of the mechanisms embedded in the urban fabric; indeed, if a 'traditional' analysis could be able to find regularities and deduce possible rules of development, the use of an algorithm that unfolds these hypothetical rules over time, allows for verification of the result of these rules and helps to distinguish between apparent regularities and real dynamics at work in the area. This becomes even more clear with the introduction of a simple economical model, and by doing this creating an environment for the study of the

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consequences of the invisible economical and social forces that are shaping the urban environment.
The exploration of the complex and differentiated interrelations between neighbourhood rules, growth parameters and economical changes leads to the definition of possible scenarios of growth for the settlement, where the influence of each of the elements of the simulation can be evaluated in response to different requested standards of urban structure and economical performance. This opens up to the possibility of using the algorithm as a tool for the evaluation and optimization of proposed designs for the area prior to the implementation, allowing for the consideration of hidden effects and relationships between different urban phenomena and parameters.

Implementation

Beyond the construction and evaluation of possible scenarios of development, the approach based on the use of computational simulations can give relevant advantages also during the implementation of the necessary changes in the urban fabric of informal settlements.
The creation of a platform able to integrate top-down planning decisions and bottom-up developments driven by citizens could lead to the definition of an innovative method of planning and management of city parts, where the possibility of independent growth produced by citizens is maintained, but it is inserted in a complex system of feedbacks with the planning Authorities, which become able to drive the unstable and irregular growth of these areas, introducing integrated strategies of management, without the need for massive evictions and demolition plans.
On the architectural side, this would allow for the definition of a new process for the construction of the city, based on a logic of 'kit of parts', where the inhabitant is empowered with the access to a modular construction system, that can be set in place autonomously. This would allow to maintain the same logic that allowed for the creation of the strong community sense, based on the 'self-construction' of the city by its own inhabitants [14], while at the same time introducing a complex and flexible technological system able to upgrade the existing housing quality in these areas.

Conclusion

The approach discussed in this paper, made possible by the integration of digital modelling techniques in the realm of social, economical and urban decision making, show the great potential that lies in the use of computational tools as a way to understand, drive and act urban changes. It shows clearly how these potentials emerge in the exact moment in which the digital tools stop to be seen simply as a new formal vocabulary, but rather as powerful systems of information processing, modelling and, in many extents, thinking.
It poses itself as a step further in the definition of a new set of methodologies for urban intervention, where the informational nature of the computational medium

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becomes the starting point for an opening of the urban planning procedures, both towards the citizen, that should become more integrated and be able to actually 'interact' with the proposed plan, and also between professionals, where the constitution of an open platform of simulation, decision-making and discussion would allow for the emergence of a more integrated and contextual practice of urban and architectural design.
The resulting strategy of intervention will hopefully offer new possibilities both to the citizens and to the professionals in charge of the planning procedures, enabling to create a more efficient system, both on the economical, social and environmental level.

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