PATTERNS OF INSTABILITY IN THE WORLD URBAN GROWTH APPROACH

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ABSTRACT This paper will explore the subject ‘Urban Growth’ at world scale and the pattern associated with this phenomenon. Much has been written about this issue, but this research attempts to study it from a new approach, by applying Chaos Theory. The study implies how the system can disorganise and organise itself, and how this approach can be applied to a complex system, with several variables. The research hypothesis looks at cities as complex systems, composed by certain patterns. The challenge of the following study is to explore the evolution of cities through historical stages in different part of the world. At the same time, this new approach can illustrate planning failure through the analysis of these issues. To face the challenge requires the community and the authorities to be involved. Identification of such key factors will be the starting point for our examination.

A. BACKGROUND
The following paper is related to previous research carried out in conjunction with Departamento de Geociencias (The Earth Science Department) and Secretaría de Ciencia y Técnica (UNNE) (The Science and Technology Secretariat-UNNE-), and it focuses on Chaos Theory and its possible applications to urban affairs. The chosen topic concerns the increasing methodological crisis with which urban matters are being tackled.

According to previous results cities can be seen as complex systems, composed of several variables; highly unstable, with permanent exchanges of information, energy and substance. This situation makes them fluctuate between stable and unstable periods. That is to say that cities have grown between stochastic periods, shaped by great changes; and deterministic periods, in which the most significant socio-cultural development has emerged.

Further investigation has shown how a middle sized city has faced those periods and how through spontaneous mechanisms, it can stabilise itself.
Resistencia, the capital of Chaco Province, Republic of Argentina, with a population of 300,000 (Census 1991), is a good example to illustrate the evolution mechanism and demonstrate why master planning does not work. From 1920 until 1950 the city experienced continued growth, and the authorities worked to provide affordable housing and infrastructure facilities for the people. But since the 1960s, they have lost control of the situation, leading to the appearance of the first unplanned settlements. Indeed, the city is continuing to grow towards an uncontrolled and vulnerable situation. In 1982 the city faced a catastrophic flooding emergency which affected, among the other elements, its physical structure. Although the government and planning agencies intervened, nothing has been done to alleviate the problem, and the city itself has managed to shift into a new pattern of behaviour.

Before 1982, the unplanned settlements were located mainly in flood prone suburban areas. After that period, Resistencia started to grow towards higher ground directed by government agencies. Nevertheless, the city was shaped spontaneously and became different than The Master Planning and Regulations predicted and allowed. (Schneider, 1996)

These observations emerge from individualised unstability patterns: 'strong migration', which began in the 1960s when the first informal settlement was established in public, private and flood prone plots. This phenomenon has continued until the present time. These 'patterns' referred to can be visualised by non linear graphs, where every bifurcation point results in uncertainty and instability, where the systems can shift into chaos or become stable, as changes are introduced into the urban structure. (See diagram 1)

Later research attempted to discover if those patterns found in The Resistancia study could be applicable to other cities, to Latin American cities in particular, or if the observed phenomenon had been a unique response from the city to a conjunction of characteristics which compose it.

The research argued that the cities are not all equal 'Each metropolitan centre is unique', with its own social, ethnic and historical characteristics. Is it possible then that cities can react in different ways to some eventual interference? All possible impact on a certain city will depend on the nature of that impact and the self-organising capacity of that city.

There is limited knowledge about these patterns and in order to elaborate an efficient and renovated planning method a great spectrum of these indicators need to be detected. It is widely acknowledged that planning techniques are unsuitable to the expanding cities of developing regions. Planners and managers face an enormous task in the coming century.
Diagram 1: Bifurcation Experienced Over Vacant Plots In Resistencia City

The diagram shows 'bifurcations' with historical occupations of vacant land in Resistencia suburban areas started in 1961. From that period, the systems went through different stages of instabilisation. Every single point represents an 'Informal Settlement', which became more frequent after 1981 and also acute after flooding emergency in 1982.

CHAOS ROUTE...

Valeria Schneider, 1997
Source: Self production by using Final Report (1º stage).- Technical Assistance and Co-operation Agreement for urban domain study of spontaneous Settlements in Great Resistencia, Chaco Province.-1996.-Mr. Víctor Pelli, Architect.-
B. DISCUSSION

This review does not assume to find the remedy for the problems highlighted, but the findings could be useful for managers to improve the current situation of rapidly growing cities. The findings can be summarised as follows:

As a result, 'urban growth' can be seen as a general phenomenon, concerning not only developing countries; but also less developed regions in an even more acute way. The forces contributing to urban growth vary according to each country's pattern, but in general they present rules of collective regularity.

According to previous findings, Resistencia had experienced a deep transformation: the appearance of unplanned settlements, which shifted its physical structure to one totally different from that which planners had designed and pretended to control by a set of regulations.

Through the analysis of different urban growth typologies, an interesting phenomenon must be highlighted: Cities are growing and becoming bigger by joining other nearby cities. They are forming 'mega-urban-regions' containing an average of 19 million people. This phenomenon is common throughout the world and shows a new trend in urban growth.

There is also a tendency for the population in major cities to spread outward even beyond the boundaries of metropolitan areas.

It has been suggested that extended metropolitan regions can be expanded to include 'corridors' that run between them, interlocking extended metropolitan regions. The regional growth tends to sprawl along major expressways and railroad lines radiating out from the urban cores, and leapfrogs in all directions, putting down new towns, industrial states, housing projects and even golf courses in areas hitherto agricultural and rural.

Extended metropolitan development tends to produce an amorphous and amoebic-like spatial form, without set national boundaries, their radii sometimes stretching 75 to 100 Km from the urban core. The entire territory comprises the central city, the developments within the transportation corridors, satellite towns and other projects in the peri-urban fringe, and the outer zones, emerging as a single economically integrated 'mega-urban region or extended metropolitan region'. (Schneider; 1999, 2000)

As a result; urban systems grow by reproducing in themselves patterns which could draw them into chaos. The mega urban regions present a fractal structure composed of different metropolitan cores and their original components as shown in the attached figure. (See
Each city is an uncertainty point, where information feedback is detected, and this process draws the systems into a new complex model: mega urban systems. At that point systems evolve toward a new self-organising form that contains within itself, on smaller scale, all the different patterns which were dispersed before, since it contains several cities, and sometimes from different countries.

Diagram 2: Chaos Theory and its possible applications to world urban growth affairs
Each mega region contains in itself, characteristics which have originated there. Therefore, if the mega region belongs to an underdeveloped region, it will contain in its cities, patterns represented by informal slums and other associated phenomenon. Thus, these mega regions will surely be more vulnerable that those belonging to developed regions. Meanwhile, a current megalopolis constitutes a species of recapitulation of ancient cities such as Rome. The mega urban region is an 'innovative", product of system transformations.

Basically this phenomenon varies according to the country's pattern conjunction, but it is fuelled by rapid economic growth and the availability of different transportation technologies. (McGee; 1995). Productive changes and technological innovations have accelerated the evolutionary mechanisms since 1950.

Thus the world's urban system has become highly unstable. The first fluctuations caused urban growth. Cities well prepared for this change took advantage of it. Afterwards the system was able to assimilate those changes. Then, through new fluctuation, it fell into a deep transformation resulting in a new urban form, stabilised by energy, substance and information exchanges and twisted into a self-organising system.

C. CONCLUSION

In summary, the ability to manage future urban growth depends on how far the following issues are met:

Future urban plans have to consider these inflection points, by reviewing the mechanisms where urban concentrations emerged, in order to design new action plans more suitable to complex situations.

Experience demonstrates that Master Plans have not been successful because they were too rigid and inflexible and lacked the mechanisms to adapt to changing circumstances. Prigogine (1993) in his book 'Just an Illusion', suggests that city intervention must be flexible to adapt to changing circumstances and allow the planner to plan interventions as they are being implemented; in order to compensate for the inability of prediction. The prime concern is to capture those transformations. In Professor Batey's (1999) opinion, from Liverpool University, this method of planning should be integrated within a general framework, as a Strategic Plan.

Further investigation should begin by considering both the analysis of 'urban growth techniques' and the accumulated data. (Schneider, 2000)
D. FURTHER RESEARCH TO BE EXPLORED:
Key Themes for The Great Metropolitan Area of Resistencia (AMGR):

At present, the city of Resistencia has grown by adding regions of its hinterland that bring it closer to the city of Corrientes, on the other side of the Paraná river, forming as a whole, a 'mega urban region', on a smaller scale than others already mentioned, composed of approximately 600,000 inhabitants.

The evidence suggests that this mega urban nucleus functions organically and has a high potential of eventual interferences, as was demonstrated with the closing of the General Belgrano bridge, a unique physical link between the two cities, due to an acute social crisis which arose in the city of Corrientes, which has subsequently influenced the AMGR and its surrounding region.

Another pattern of uncertainty determined in AMGR is a fractal structure associated with the appearance of informal neighbourhoods, verified as well in other cities of the developing region. This situation can draw the systems into a persistent state of uncertainty which could have influence over the mega region operation.

In summary, the phenomenon mentioned before may be applicable, on a different scale, to the mega urban region composed by the cities of Resistencia and Corrientes and, in order to design a suitable plan which contains an appropriate set of policy measures, it would be necessary to have a deeper knowledge of how the mentioned phenomenon operates, the relationship between the cities, as well as the dynamics of resistance to change in the main components of this region.

BIBLIOGRAPHY

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