

Systemic Modeling of Informal Housing Marketing in Bogotá D.C. through Systems Dynamics

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Abstract

This research establishes the behavior of marketing informal housing in Bogotá, identifying external and internal variables that affect the participation of consumer in this sector and the impact each one has on the other using the system dynamics.

The proposed model will allow realize simulations from the causal relationships between variables and support the decision-making process to mitigate the phenomenon; this is achieved, creating potential stages with variations and intentional levels to verify the general behavior of system.

Keywords: Marketing, Consumer, Variables, System Dynamics, Simulation.

INTRODUCTION

Unplanned development projects or structured formal housing as a result of multiple causes of economic, social, political, cultural or public order among other urban settlements, in several peripheral areas to Bogotá, has unleashed a series of critical problems for the city's development processes, ranging from its environmental sustainability to the cost overruns generated by their integration into public service networks and the location of educational centers, hospital services, surveillance or community support for the inhabitants who reside there. Situation is increasing and only temporary biased statistical data are known. However, until now, the levels of interrelation between variables that change constantly have been determined and explain how the phenomenon behaves in order to mitigate it or at least regulate it effectively.

This study seeks to interpret the phenomenon represented by the informal housing market as an alternative to formal housing projects, the systemic interrelation of its variables and a simulated approximation of its behavior through System Dynamics; this in order to quantify in an approximate way the effects on the preference of the final consumer towards this housing option.

METHODOLOGY

The stages defined for the development of the research are as follows:

- a) General documentation: Carry out consultation processes with entities related to urban development, housing regulation, public space administration and

consumption statistics to establish the status of informal housing in Bogotá.

- b) Define type of research and objectives: determine applicability framework and defining the scope thereof.
- c) Exploration of housing-oriented simulation models: For this purpose, reference is made to specialized publications, degree works or documents with a systemic approach applied to concepts and techniques.
- d) Identify variables: of exogenous type, through information collected in the previous stages, and endogenous type with field work, selection of the environment, definition of sample type and size, development and application of survey, determination and analysis of results.
- e) Selection of essential variables and reduction of system complexity: implement structural analysis methodology in the determination of relationships between variables.
- f) Set up Model: where it includes diagrams of causal relationships, flowchart (levels, flows and auxiliary variables), computer structuring, initial analysis of the model and simulation results.
- g) Conclusions and results: for the preparation of a final publication.

INFORMAL HOUSING

In Bogotá a considerable group of inhabitants whose poverty conditions make it difficult for them to access formal housing projects find in the informal sector a possibility to supply the need for a roof, Although it does not comply with the minimum housing conditions and, on the contrary, it increases its conditions of marginality, it is a viable option in the short term; However, when analyzing this progressive phenomenon that dates back almost 90 years, it can be identified, according to Bibiana Rodríguez Campos, who was Secretary in charge of the District Treasury in 2017, states:

“Bogotá is the city with the greatest migration or the situation of displacement of inhabitants in the country; most of the people come to the city in search of opportunities and find in it a refuge or a new home. All this population concerns mayor Enrique Peñalosa and for that reason different programs have been designed by the Administration that facilitate access to

housing and that seek to counteract the phenomenon of informal occupation of the territory; Besides, much of the territory in the city has been occupied informally by families who are victims of land-based offenders”

Under the latest monitoring of illegal occupations in Bogotá, Rodríguez Campos reported that close to one hundred thousand people live in these properties of informal origin. Ciudad Bolívar is the area with the highest number (8,598 informal housing), equivalent to 37% of the total of illegal occupations in Bogotá.

“The increase informal housing has been permanent over the years, since 2003 when the monitoring began, have increased four times, but Ciudad Bolívar the situation is extreme and is the product of excessive informal development presented in the area. Compared with the other areas, the increase presented is almost 1 to 3 ”, said Mrs. Rodríguez Campos.

She insisted, the families occupying these properties are mostly victims of illegal developers and alienators (sellers) without registration with the District Department of Habitat, who deceive citizens with false titles of ownership and without authorization to occupy these areas.

At present, there are 4,277 hectares in Bogotá identified in the monitoring polygons, a mechanism created since 2003 to determine territories at risk, occupation or already there. [1]

Next, chart 1 shows the most recent results for the areas in Bogotá. Fieldwork done by the Habitat Secretariat - Planning Department District on informal housing. Year 2017.

Chart 1. Informal housing by area until 31 august 2017

Hectares occupied illegally by area		
Area	Hectares	Total Informal Housing
Ciudad Bolívar	586	8.598
Rafael Uribe Uribe	98	2.738
Bosa	142	2.623
Usme	448	2.487
Usaquén	1.020	1.938
Kennedy	88	1.019
Suba	679	942
San Cristóbal	340	880
Santa Fe	380	818
Chapinero	270	674
Fontibón	145	158
Engativá	28	59
Tunjuelito	48	51
Barrios Unidos	3	0
Total	4.277	22.985

Reference. District Department of Habitat

As can be seen in table 1, the area with the highest number of non-legalized housing corresponds to Ciudad Bolívar, with

percentage weight equivalent to 37.4% and is the justification for part of the fieldwork to be carried out in a settlement located in this area.

KIND OF INVESTIGATION

In this case, our research will be applied and participatory, given that the problem arises within a community and the final purpose is the knowledge obtained is used in practice to apply them for the benefit of society.

OBJECTIVE OF INVESTIGATION

The final purpose of this research is to identify from the marketing point of view, being the influential endogenous and exogenous variables directly in the consumer's decision to access informal housing, systemically building the levels of incidence in each of them, to simulate and relate potential scenarios using the Dynamics of Systems.

WHY DYNAMICS OF SYSTEMS?

Because of the systemic approach where a holistic vision is defined, whose precept defends the thesis that the world forms a harmonious whole where knowledge of anything depends on being able to identify the position occupied in the whole to which it belongs, and the Organizational Cybernetics that deals with studying the systems of control and self-control in organisms as in machines, System Dynamics is born as a form or paradigm of thought that is expressed through a certain system of conventions, that is, through a particular language. [2]

Its origin is thanks to Dr. Jay W. Forrester of the Massachusetts Institute of Technology (MIT) who used it around 1961 to analyze and interpret complex problems that involve changing quantitative variables over time, making use of graphs that handle feedback and are permanently regulated; situation of social systems with systemic structures and behaviors apparently go against the logic; understanding the structural causes that cause the behavior of the system, increasing knowledge about the role of each element of the system, and see how different actions, carried out on parts of the system, accentuate or attenuate the behavioral tendencies implicit in it. [3]

The Dynamics of Systems for allowing to approach social systems, faces a series of characteristics of the system as can be seen in figure 1, where complexity, variation, volume of variables and uncertainty are combined, among other relevant aspects that demand a flexible and adaptable management of information, which characterizes this methodology and in particular its computer applications: (DYNAMO, ITHINK, POWERSIM, STELLA y VENSIM); the latter considered one of the most complete and which will be used for the development of the present investigation.

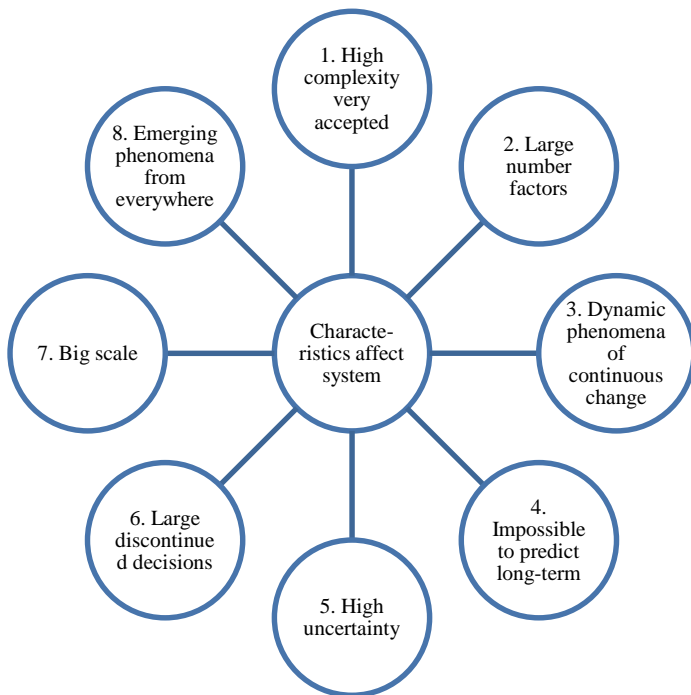
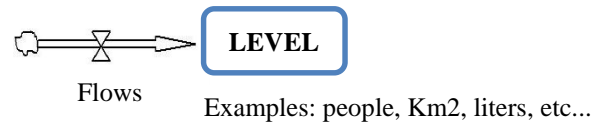
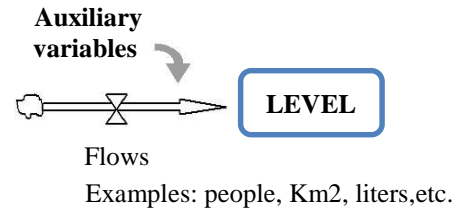


Figure 1. Characteristics affect system



The "auxiliary variables" and "constants" are parameters that allow a better visualization of the aspects that condition the behavior of the flows. [3]



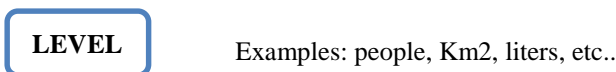
Based on the change reasons presented by the variables and internally in the software correspond to differential equations, but expressed as Dynamo language, they are processed in the computer to obtain the behavior of the system, which allows to improve the perception of the same, repeating all this process in successive occasions in what is known as simulation.

CONSTRUCTION MODEL

The methodology in this model can be done as follows: In the first way, the clear perception of the system, the essential elements and their relationships are necessary; the perception is reflected in Causal Diagram and this in turn shows the elements defined in the model and the relationships that exist between them; in this way it is said that when one element influences another there is a causal relationship and this is positive when an increase of the first produces an increase of the second or negative otherwise. The Flow Chart or Forrester shows these same elements classified in levels, flows and variables.

According to the above, the "levels" are those elements that show us at every moment the situation of the model, they present an accumulation and vary only according to other elements called "flows".

The "clouds" within the flow diagram are levels of inexhaustible content. The levels are represented by a rectangle.



The "flows" are elements that can be defined as temporary functions. They are the actions resulting from the decisions made in the system, determining the variations of the levels.

PREVIOUS STRUCTURAL ANALYSIS FOR THE SELECTION OF REPRESENTATIVE VARIABLES

The main characteristic within a social system is the high level of complexity it handles, largely to the volume of its variables; Therefore, it is necessary to implement a method that reduces its variety and allows us to select those "key variables" that exert the greatest influence on the rest, to facilitate in advance the implementation of System Dynamics by reducing the number of variables.

Within the prospective process, which investigates the key variables on which reflection about future should be based primarily; the use of structural analysis focuses on three stages:

- *Identification of Variables:* through specialized documents, interviews and surveys where direct actors or agents of change are involved, brainstorming and defining each problem as specifically as possible. In this part, market research will be used to support the process of identification and quantification of variables (endogenous and exogenous)
- *Location of relations in the structural analysis matrix:* consists of interrelating the variables in a double entry box (structural analysis matrix), according to the level of incidence that internal (endogenous) variables handle over their similar or over external (exogenous) variables, which even in the latter, develop influence over themselves.

- *Search for key variables through the MICMAC Method:* whose objective is to identify the motor and dependent variables, constructing a typology of the variables through direct, indirect and potential classifications; that allows locating them for their quantification in areas of power, conflict, autonomous problems or exit, to measure their total influence within the system and allow their management in the subsequent modeling through System Dynamics. [4]

PARTIAL RESULTS OBTAINED

The most relevant results achieved so far in the research, the following achievements stand out:

A state of the art for Bogotá of Informal Housing is established as a result of the preliminary investigation, based on whole documentation collected and interviews with public officials involved with the subject.

- a. A survey on System Dynamics was developed to support the function of marketing and a paper was prepared on this.
- b. A support group is formed for this research in the Market Engineering program, with the registration and direction of three (3) theses and the creation of a hotbed in System Dynamics (18 participants), with permanent monitoring and in the process of consolidation.
- c. A compendium of 17 analysis models related to housing and especially to informality in the sector was reviewed, from countries such as Chile, Uruguay, Argentina, Mexico and Spain where less than 30% have some simulation component, for example in the case of Chile on balance states in land use, Mexico in the approach of a regional development model and Spain for dynamics of population growth in a municipality, as potential references for the proposed model.
- d. The first exogenous variables of incidence to the model are established based on the information collected and establish its projection for updated quantification; some of these variables correspond to poverty, housing deficit, demographic density, displacement and uprooting, formal housing projects, legal framework and construction materials costs, among others.
- e. The Ciudad Bolívar area was chosen for the field work in the determination of endogenous variables corresponding to consumers, they were set and made tours of some areas within Ciudad Bolívar for selection of potential settlement.
- f. Plans were obtained from the "Cadastral Apples" where potential settlements were evidenced and the one corresponding to one called "Villa Helena" was chosen, located in an unstable area of the lower basin of the Tunjuelo River.
- g. A first approach is made with the inhabitants of informal housing for the corresponding authorization and to be able to initiate sample calculations; at the same time, the survey design to apply with consumption orientation was started to determine endogenous variables.

CONCLUSION

In spite of being a very complex investigation due to the number of variables that must be handled and the difficult conditions that fieldwork implies due to the contact with consumers who are not always willing to provide information about their situation of illegality, it is expected to build a model that greatly illustrates the behavior of the corresponding marketing system and is so flexible that it allows the inclusion and updating of new variables that arise from the dynamics of the environment or at the level of the consumer.

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