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Saint Mathew Law and Bonini Paradox in Textual Theory of Complex Models

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Abstract The mathematical models of the complex reality are texts belonging to a certain literature that is written in a semi-formal language, denominated $L(M_T)$ by the authors whose laws linguistic mathematics have been previously defined. This text possesses linguistic entropy that is the reflection of the physical entropy of the processes of real world that said text describes. Through the temperature of information defined by Mandelbrot, the authors begin a text-reality thermodynamic theory that drives to the existence of information attractors, or highly structured point, settling down a heterogeneity of the space text, the same one that of ontologic space, completing the well-known law of Saint Mathew, of the General Theory of Systems and formulated by Margalef saying: “To the one that has more he will be given, and to the one that doesn't have he will even be removed it little that it possesses."

Keywords: *complex models, entropy, grammar, information, temperature of information, Zipf’s Law*

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1. Introduction

In previous papers (Sastre-Vazquez et al., 1999[a,b], 2000[a,b]; Usó-Doménech et al., 1997, 1999, 2000, 2001[a,b]; Usó-Doménech and Villacampa, 2001; Usó-Doménech and Sastre-Vazquez, 2002; Usó-Doménech, Vives Maciá and Mateu, 2006[a,b]; Villacampa & Usó-Doménech, 1999; Villacampa et al., 1999[a,b]), have been defined the syntactic and semantic characteristics of a semi-formal language for building complex models. The deductive-inductive modeling processes the authors use to deal with complex reality, is based on the following assumptions:

1. The construction of a causal model based on previous theories of reality to study. In term, it can be divided into the following phases:

Choose relevant objects or variables related to the proposed objectives. Scientific theories would be the theoretical base of this phase. However, subjective components (intuition, brainstorming, etc.) play an important role.

Identify the cause-and-effect relationship between the considered elements.

Give a functional representation to the detected relations; that is to say; write them as state equations. The mathematical meta-language gives the laws for this.

2. Experimentation for obtain data of variables (measurable attributes or primitive symbol).

3. Creation of flow equations or words though experimental data.

4. Integration of the system of the ordinary differential equations (state equations or sentence) through numeric methods.

Point 3, or construction of flow equation is made up of the following processes:

Each independent primitive symbol that intervenes in the flow equations is an initial symbol of a vocabulary, formed by $\frac{m^{n+1}-1}{m-1}$ transformed functions (symbols), where n is the order of the symbol and m the number of first order symbol ones, prefixed by the Subject.

b) The symbols of an order ≥ 2, are constructed by means of recursive processes. The greater order of symbol functions, more extensive vocabulary will be. That in term is prefixed by Subject agent. There will be as many vocabularies as there are primitives. The union of vocabularies constitutes the lexicon. Each of the elements of that lexicon (transformed functions) is called a symbol.

c) With the symbols of the Lexicon the sentence is built (flow equation), which is connected together by means of an operator $\otimes$ i.e., $\otimes = \{+,-,x,:\}$. The length l of the sentence will be l ≥ p, where p is the number of primitive symbols of the lexicon.

d) Once the words are constructed, whose number, say q, will depend on the biggest order of the symbol on the Subject and on the experimental data, a process of recognition is generated where only a number of words say w, will be left, that is, those that are “correct”. The rest (q – w) are considered “incorrect”. The “correction” criteria will be determined according to different criteria of recognosibility.

e) With the "correct" words, state equations will be constructed $\frac{dy_j}{dt} = A_j = \sum_{i=1}^{n} \Psi_{ij}; j = 1, 2, ..., n$, where Aj are the flow function or sentences.

f) The procedure of numeric integration of ordinary differential equations, will be determined by the Subject according to the needed precision, and in turn depending on the model disaggregation, the economy of calculation, etc., and finally on the preference of the Subject.

An *associative field of a measurable attribute w* and denominated Φ_w, the set constituted by all possible symbols of said measurable attribute: $\Phi_w = \left\{\varphi_w^0, \left\{\varphi_w^1\right\}, \left\{\varphi_w^2\right\} .... \left\{\varphi_w^n\right\}, ...\right\}$

The set Φ_w will be a denumerable set. In the practical tool, it will be a requisite to define one subset $V_w \subset \Phi_w$ whose cardinal will be an integer number. The associative field of a measurable attribute w will be called *First Order Vocabulary* (FOV) or Vocabulary of order one and will be denoted by V_w^1. The elements of V_w^1 will be called t-symbols and will be denoted by $\varphi^j{}_i$, where i represents an index of the symbol and j denotes the order of transformation. The measurable attributes are a particular case of the t-symbols.

The set X formed by a FOV generated by the set of measurable attributes $W = \{w_1, w_2, ...w_n\}$ will be called *Primary Lexicon* (PL) or *alphabet of the n-order monads*, $X = \left\{V_{w_1}^1, V_{w_2}^1, ..., V_{w_n}^1\right\}$

Primitive monad or *alphabet* A is formed by a set W of characters used to express measurable attributes $W = \left\{w_1, w_2, ..., w_{n,...}\right\}$, a set D of differential functions in relation to time $D = \left\{\frac{d}{dt}\right\}$ and a set Φ of n-order monads $\Phi = \left\{\left\{\varphi^1\right\}, \left\{\varphi^2\right\}, ..., \left\{\varphi^n\right\}\right\}$. The W set is formed by the input and state variables, and $A = W \cup D \cup \Phi$. The *textual alphabet* A_t is jointly built with the alphabet A and the set R of real numbers (model parameters) $R = \{r / r \in \Re\}$.

Simple Lexical Units (SLUN) are constituted by the elements of the set A-D.

Operating Lexical Units or operator-LUN (op-LUN) are the mathematical signs +, -.The *Ordenating Lexical Units* or Ordenating-LUN (or-LUN) are the signs =, <, >.

Special Lexical Unit (SpLUN) is the sign d/dt, which belongs to the alphabet A and defines the beginning of a phrase (state equation).

Differential vocabulary or d-vocabulary of a measurable attribute w, V_w^{∂}, is the set formed by all partial derivatives of any order of w with respect to any other measurable attribute and the time t.

Primary differential vocabulary, $V_w^{1\partial}$, is the set formed by all partial derivatives of order 1 of w with respect to any other measurable attribute and the time t. $V_w^{1\partial} = \left\{\frac{\partial w}{\partial t}, \frac{\partial w}{\partial y}, ...\right\}$. Secondary higher order differential vocabularies may also be defined and will be denoted by $V_w^{n\partial}$, $n \geq 1$.

For ease of calculation in practical complex system modeling, we define a subset of $V_w^{1\partial}$ called *dimensional primary differential vocabulary*, ${}^{XYZt}V_w^{1\partial}$, consisting of all partial first order derivatives of the measurable attribute w with respect to the three spatial dimensions X, Y, Z and time t,

$${}^{XYZt}V_w^{1\partial} = \left\{\frac{\partial w}{\partial X}, \frac{\partial w}{\partial Y}, \frac{\partial w}{\partial Z}, \frac{\partial w}{\partial t}\right\}.$$

To implement the models of the System Dynamics, a subset of cardinal 1, ${}^{t}V_w^{1\partial}$, and whose only element is the partial derivative of the p-symbol with respect to the time, will be used.

Let $w_1, w_2, ..., w_n$ be a set of measurable attributes. The *differential Lexicon*, d-L, is the set formed by the d-vocabularies generated by the measurable attributes,

$$d - L = \left\{V_{w_1}^{1\partial}, V_{w_2}^{2\partial}, ..., V_{w_2}^{n\partial}; V_{w_2}^{1\partial}, V_{w_2}^{2\partial}, ..., V_{w_2}^{n\partial}; ...; V_{w_n}^{1\partial}, ..., V_{w_n}^{n\partial}\right\}.$$

The elements of d-L will be called *d-symbols.* The characters (,), {, }, [,], are simply signs since they lack of meaning and they are the equivalent to the signs ?, !, ; (,) in the natural languages.

Separating of Lexical Units (s-LUN) are the signs * and /.

Composed Lexical Units (CLUN) are the strings of a SLUN separated by a s-LUN. The *Syllables* or composed lexical units (CLUN) are constituted by a SLUN, or a chain of them, separated by an op-LUN or a or-LUN.

Words are the SLUN or CLUN The symbols [·] preceding the other symbols + or – are word separations.

Opsep vocabulary V^S is the one formed by operating and separating LUNs. $\otimes \in V^S; \otimes = \{+, -, *, :\}$ *a*nd it will be written a element of *VS* by $\otimes$. A *simple sentence* is a flow variable. It is built by a CLUN or a combination of CLUNs. *Vocabulary of order n* $V_{w_1 w_2 ... w_n}^n$ is formed by simple sentences

$$V_{w_1 w_2 ... w_n}^n = \left\{\varphi_i \otimes \varphi_j \otimes ... \otimes \varphi_\omega; \varphi_i \in V_{w_1}^1, \varphi_j \in V_{w_2}^1, ..., \varphi_\omega \in V_{w_n}^1\right\} = \left\{\Psi_{w_1 ... w_n}^n / \Psi_{w_1 ... w_n}^n = \varphi_i \otimes \varphi_j \otimes ... \otimes \varphi_\omega; \varphi_i\right\}$$

A short notation would be $\phi_{w_1, w_2, .., w_n}^n = \varphi_{i_1} \otimes .... \otimes \varphi_{i_n}$. The set of all vocabularies of any order is called *t-Lexicon* t-L, and it is formed by the FOV and simple sentence vocabularies.

$$\text{t} - \text{L} = \left\{V_{w_1}^1, V_{w_2}^1, ..., V_{w_n}^1, V_{w_1 w_2}^2, V_{w_2 w_3}^2, ..., V_{w_1 w_n}^2, V_{w_2 w_3}^2, ..., V_{w_{n-1} w_n}^2, V_{w_1 w_2 ... w_n}^n\right\}$$

$$\left\{V_{x_1}^1, V_{x_2}^1, ..., V_{x_n}^1, V_{x_1}^2, V_{x_2}^2, ..., V_{x_n}^2, ..., V_{x_1}^n, V_{x_2}^n, ..., V_{x_n}^n\right\}$$

The set Φ will be a subset of t-L.

Let $\{\phi_n\}_{i=1,...,n} \in V^1_{i=1,...,n}$. We say that $\phi_1, \phi_2, ..., \phi_n$ are related linguistically in a *n-order relationship* and we call it $(\phi_1, \phi_2, ..., \phi_n) \in r_n$ if and only if $(\exists \otimes \in V^S) \vee (\exists V^n_{12...n}) \vee (\exists \Psi^n_{12...n} \in V^n_{12...n})$ and $\Psi^n_{12...n} = \phi_1 \otimes .... \otimes \phi_n$. We will call R_L the whole of all linguistic relationships $r_L; L = 1, 2, ..., n$. Let $V^n_{12...n}, V^m_{12...m}, ..., V^l_{12...l}$ be vocabularies of *n, m,...,l* orders, respectively. We say that $V^n_{12...n}, V^m_{12...m}, ..., V^l_{12...l}$ are *related linguistically* and we will call it $(V^n_{12...n}, V^m_{12...m}, ..., V^l_{12...l}) \in r_V$ if and only if $V^h_{12...h} / h = n + m + ... + l$ vocabulary exists so that

$$(\exists \Psi^n_i \in V^n_{12...n}) \wedge (\exists \Psi^m_j \in V^m_{12...m}) \wedge ... \wedge (\exists \Psi^l_k \in V^l_{12...l}) \wedge (\exists \oplus \in V^S) \wedge (\exists A^h_{ij...k} \in V^h_{12...h})$$

where $A^h_{ij...k} = \Psi^n_i \oplus \Psi^m_j \oplus ... \oplus \Psi^l_k$.

A *complex sentence* is each ordinary differential equation (ODE) or state equation, which is built by linear combination of simple sentences $A^h_{ij...k} = \Psi^n_i \oplus \Psi^m_j \oplus ... \oplus \Psi^l_k$. A *text* T = (L, A) is the concatenation of complex sentences, determined by the argument A of the text or semantic links between these complex sentences. The *Lexicon L of a text* is the union between the t-Lexicon and the differential Lexicon, $L = t - L \cup d - L$. We can say that the text is written in a formal language, and we call it as $L(M_T)$.

Mathematical modeling of complex structural systems (Nescolarde-Selva and Usó-Doménech, 2013[b]) is the process of producing texts of mathematical relations with the rules defined by the syntax of the $L(M_T)$ with a homomorphism in respect to a conceptual semiotic system and/or ontological reality.

2. Thermodynamic Characteristics of Text

Consider the lexicon L. Consider a sign system S, representing a set of texts $\{T\}$ on the lexicon L and $S = \{T\}$ (Nescolarde-Selva and Usó-Doménech, 2013[a]). By definition, the sign system S consists of all texts generated by the argument A. being A $\rightarrow hypothesis + objective$. It is defined a *textual space* T = < A, S>. For signs of lexicon L, $\delta \in L$ there is defined a number function $E(\delta)$, which is interpreted as the *complexity of the generation of the sign* δ in the argument A. With each text $T \in S$ there is associated a *complexity of generation* E(T), equal to the sum of the complexities appearing in the sign text

$$E(T) = \sum_{\delta \in T} E(\delta) = \sum_{\delta \in V} f_\delta E(\delta) \tag{1}$$

being f_δ the number of distinct appearances of the sign δ in the text t or frequency of δ. Obviously, $\sum f_\delta = \Lambda$ or length of the text (number of equal or different signs). By thermodynamic analogy, E(T) will be the energetic cost or *energy of generation* of the text T.

Mandelbrot (1954, 1961), propose for the Zipf's Law (1949) the following:

$$f(r) = P\Lambda(r+\rho)^{-\beta} \tag{2}$$

being ρ, β two parameters depending of the text T and $\beta > 0$, and P is determined by

$$P^{-1} = (1+\rho)^{-\beta} + (2+\rho)^{-\beta} + ... + (\nu+\rho)^{-\beta} \tag{3}$$

being ν the number of different signs of the text T. the formula (2) can be written in probabilistic form as

$$p_r = P\Lambda(r+\rho)^{-\beta} \tag{4}$$

The parameter β is the inverse of *temperature of information* of the text T, $\Theta = \frac{1}{\beta}$. The entropy H of the text, will be determinate by Shannon's formula $H = -\sum p_r \log p_r$. $\frac{\partial H}{\partial \beta} < 0, \frac{\partial H}{\partial \Theta} > 0$. H continuously growths from 0 to $\log \Lambda$ when Θ goes from 0 to $+\infty$. H determines Θ for a given Λ. The Mandelbrot's criteria consists on transforming in 0 the variation free of $A = E(\delta) - \Theta H$, that is to say, the energy excess if the energy for symbol in the formula of Shannon was $\frac{1}{\Theta}$. A it will be the *usable energy of Helmholtz*, that is to say, the available energy for the dissipation, being $E(\delta)$ the enthalpy or *heating content of information*. Therefore it can assimilate Λ as a *text volume*, and Λ, Θ as state variables. The existence of a hypothetical text volume will make suppose the existence of a "recipient" where the components of this text exercise a hypothetical *pressure of information* P. The entropy H measures how much information lacks to understand that structure has a system that is disordered for the observer of this system. From (2)

$$\Lambda = f_r P^{-1}(r+\rho)^{\frac{1}{\Theta}} \tag{5}$$

1. The entropy H is a growing magnitude that goes of 0 to $+\infty$. Therefore the information I will go of 0 to $-\infty$.
2. If $\Theta = 0 \Rightarrow \Lambda = \infty$ and $H = 0$, that which is logical since the signs of very high range add very little to H or to $E(\delta)$. The information I will be 0. An infinite text is equal to an infinite volume, formed by infinite signs with a structure infinitely rigid without any movement (appearance) of the signs. Then we will be before the *absolute zero of information*. The absolute zero of information will correspond to the maximum of information.
3. If $0 < \beta \le 1 \Rightarrow 1 \le \Theta < \infty \Rightarrow \Lambda \to \infty$ therefore $H \to 0$ and the information will spread to be zero. The system will spread to be more and more structured.
4. If $\Theta = \infty \Rightarrow \Lambda = f_r P^{-1} = 0$, then therefore the information will be $I = -\infty$. The structure is zero. An empty volume corresponds to the *empty text* $T = \varnothing$.

5. To take information means to make the most complex, stronger structure and logically to go bringing near the temperature of information from the system to the absolute zero of information. Contrarily, to give information means to make the weakest structure and to bring near the temperature of information to the infinite.

6. A system is *informatively colder* regarding other, when its temperature of information is more near the absolute zero of information that the other system that will be considered informatively hotter.

7. If a system informatively cold contacts another informatively hotter, the first one will cool down more, at the same time that the second system warms, increasing its temperature of information.

8. A system takes information of other when it makes more complex its structure and therefore it diminishes its temperature of information

From the information point of view, we define *heat of information* Q, as information in traffic, being the form like the information is transmitted from a system to another as a result of a difference of temperature of information. We will establish the concept of *heating capacity of information* C, like the property that, multiplied by the variation of temperature of information, it gives the quantity of information that it has taken or given the system when it contacts another that has a different temperature. If the temperature of the system diminishes of Θ_1 to Θ_2 (it increases of structure and consequently of information) when taking a quantity of heat of information Q, then the heating capacity of information C of the system will come given for

$$Q = C\left(\Theta_1 - \Theta_2\right) \tag{6}$$

therefore

$$C = \frac{Q}{\Theta_1 - \Theta_2} \tag{7}$$

The value of C, will always be negative when increasing the system's complexity. If the variation of temperature of information $\Theta_1 - \Theta_2$ is represented for $\Delta\Theta < 0$, the *heating capacity of true information,* will come given by the expression

$$C = \lim_{\Theta_2 \to \Theta_1} \frac{Q}{\Delta\Theta} \tag{8}$$

If we consider constant the text pressure P then $\frac{\partial H}{\partial \Theta}$ can be considered as $\left(\frac{\partial H}{\partial \Theta}\right) = \frac{C}{\Theta}$, then

$$C = \Theta\left(\frac{\partial H}{\partial \Theta}\right) \tag{9}$$

therefore the result can be expressed in the following way

$$dH = \frac{C}{\Theta} d\Theta = Cd\log\Theta \tag{10}$$

and integrating

$$\left(H - H_0\right) = H = \int_{\Theta}^{0} \frac{C}{\Theta} d\Theta = \int_{\Theta}^{0} Cd\log\Theta \tag{11}$$

being H_0 the hypothetical value of entropy in the absolute zero of information being the same pressure of information P in each case, that like we have seen previously it will be 0. For the entropy variation that accompanies to a change of of temperature of Θ_1 to $\Theta_2, \Theta_2 < \Theta_1$, is obtained

$$\left(H_2 - H_1\right) = \int_{\Theta_1}^{\Theta_2} \frac{C}{\Theta} d\Theta = \int_{\Theta_1}^{\Theta_2} Cd\log\Theta \tag{12}$$

3. Saint Mathew Law and Bonini Paradox

Consider a textual space S_T = <A, S > = <A, $\varnothing, T_1, T_2, ..., T_n, ..T_{Su}$ >. As the volume of the text becomes bigger, the temperature of information becomes smaller, that is to say $\Theta_S = \{-\infty, \Theta_1, \Theta_2, ..., \Theta_n, ..., 0\}$. We suppose the existence of a *supreme text* of infinite volume (Villacampa and Usó-Doménech, 1999; Usó-Doménech et al., 2000[a]) and therefore $cardL = \aleph_0$, being their temperature of information the absolute zero of information

The existence of this supreme text means that in him all the LUNS corresponding to all the possible behaviors and all the propositions that can be formed starting from them exist. That is to say, complex text is as complex as reality is complex. Their information will be 0, that is to say the knowledge of the supreme text supposes the knowledge of the same reality, but not its understanding. We can reformulate then the *paradox of Bonini*[1] in the following way: *The existence of a supreme text of infinite volume supposes knowing the reality, that is to say information 0, and therefore so much understanding of the text on the part of the observer like the same reality.*

On the other hand, Margalef (1980), formulates the one that he denominates Saint Mathew Law: "when two systems are in interaction, the information increases relatively more in the one that was more complicated that seems to feed of the simplest and it can assimilate it". We can reformulate, in our case, this principle in the following way: For oneself argument A, all built text starting from other previous, their complexity will increase taking the information of him by means of a heating capacity of negative information that spreads $-\infty$, and bringing near its temperature of information to the absolute zero of information as it comes closer to the supreme text whose volume Λ is infinite.

It supposes the existence of an asymmetry in the exchange of information, asymmetry that is consequence of the second principle of the thermodynamic one, increases of the global entropy and unidirectional of the time's arrow. The information has convergent character toward the portions of the structured textual space, being

[1] Models or simulations that explain the workings of complex systems are seemingly impossible to construct: As a model of a complex system becomes more complete, it becomes less understandable; for it to be more understandable it must be less complete and therefore less accurate. When the model becomes accurate, it is just as difficult to understand as the real-world processes it represents (Bonini, 1963).

able to speak of an *attractor of information* that will coincide with the supreme text, ideal expression of the same Reality in the case of the textual space.

References

[1] Bonini, Ch. P. 1963. *Simulation of information and decision systems in the firm*, Englewood Cliffs, N. J.: Prentice-Hall

[2] Mandelbrot, B. 1954. Structure formelle des textes et communication. Deux études. *Word*, 10. 1-27.

[3] Mandelbrot, B. 1961. Word frequencies and Markovian models of discourse. In: *Structure of Language and its Mathematical Aspects*, Proceedings of Symposia in Applied Mathematics, 12. American Mathematical Society, Providence, Rhode Island, 190-219.

[4] Margalef, R. *La Biosfera, entre la Termodinámica y el juego.* Ediciones Omega, S.A. Barcelona. (In Spanish).

[5] Nescolarde-Selva, J. and Usó-Doménech, J. L. 2013a. An introduction to Alysidal Algebra V: Phenomenological components. *Kybernetes.* Vol. 42 (8). pp. 1248 – 1264.

[6] Nescolarde-Selva, J. and Usó-Doménech, J. L 2013b. Topological Structures of Complex Belief Systems (II): Textual Materialization. *Complexity*. Vol. 19, 2. 50-62

[7] Sastre-Vazquez., P., J.L. Usó-Doménech, Y. Villacampa, J. Mateu and P. Salvador. 1999a. Statistical Linguistic Laws in Ecological Models. *Cybernetics and Systems: An International Journal*. Vol 30. 8. 697-724.

[8] Sastre-Vazquez, P., Usó-Doménech, J.L. and Mateu, J. 2000b. Adaptation of linguistics laws to ecological models. *Kybernetes*.. 29 (9/10). 1306-1323.

[9] Usó-Doménech, J. L., Mateu, J and J.A. Lopez. 1997. Mathematical and Statistical formulation of an ecological model with applications. *Ecological Modelling*. 101, 27-40.

[10] Usó-Doménech, J.L., Villacampa, Y., Mateu, J., and Sastre-Vazquez, P. 2000a. A proposal of Uncertainty and Complementary Principles in Flow Equations of Ecological Models. *Cybernetics and Systems: An International Journal*. 31 (2), p 137-160.

[11] Usó-Doménech, J.L., Villacampa, Y. 2001. Semantics of complex Structural Systems: Presentation and Representation. A synchronic vision of language L (MT). *Int. Journal of General Systems.* 30 (4). 479-501.

[12] Usó-Doménech, J.L, P. Sastre-Vazquez, J. Mateu. 2001b. Syntax and First Entropic Approximation of L (MT): A Language for Ecological Modelling. *Kybernetes*. 30 (9/10). 1304-1318.

[13] Usó-Doménech, J.L, Sastre-Vazquez, P. 2002. Semantics of L(MT): A Language for Ecological Modelling. *Kybernetes*. 31 (3/4), 561-576.

[14] Usó-Doménech, J.L, Vives Maciá, F. And Mateu. J.. 2006a. *Regular grammars of L (MT): a language for ecological systems modelling (I) –part I. Kybernetes*. 35 nº6, 837-850.

[15] Usó-Doménech, J.L, Vives Maciá, F. And Mateu. J.. 2006b. Regular grammars of L(MT): a language for ecological systems modelling (II) –part II. *Kybernetes* 35 (9/10), 1137-1150.

[16] Villacampa, Y., Usó-Doménech, J.L., Mateu, J. Vives, F. and Sastre, P. 1999a. Generative and Recognoscitive Grammars in Ecological Models. *Ecological Modelling*. 117, 315-332.

[17] Villacampa-Esteve, Y., Usó-Doménech, J.L., Castro-Lopez-M, A. and P. Sastre-Vazquez. 1999b. A Text Theory of Ecological Models. *Cybernetics and Systems: An International Journal*. Vol 30, 7. 587-607.

[18] Villacampa, Y. and Usó-Doménech, J.L. 1999. Mathematical Models of Complex Structural systems. A Linguistic Vision. *Int. Journal of General Systems* Vo. l 28, no. 1, 37-52..

[19] Zipf, G.K. 1949. *Human Behavior and the Principle of Least Effort.* Cambridge, Mass.